2021 / volume 33 / number 1

ORTHOPAEDIC PHYSICAL THERAPY PRACTICE

The publication of the Academy of Orthopaedic Physical Therapy, APTA

FEATURE:
Functional Disability, Catastrophizing, and the Stage of Change in Veterans with Chronic Pain

APTA
American Physical Therapy Association

ORTHOPAEDIC PHYSICAL THERAPY PRACTICE

The publication of the Academy of Orthopaedic Physical Therapy, APTA

In this issue

Regular features

OPTP Mission

To serve as an advocate and resource for the practice of Orthopaedic Physical Therapy by fostering quality patient/client care and promoting professional growth.

Publication Staff

Managing Editor & Advertising
Sharon Klinski
Academy of Orthopaedic Physical Therapy
2920 East Ave So, Suite 200
La Crosse, Wisconsin 54601
800-444-3982 x 2020
608-788-3965 FAX
Email: sklinski@orthopt.org

Editor
John Heick, PT, DPT, PhD, OCS, SCS, NCS

Associate Editor
Rita Shapiro, PT, MA, DPT

Publication Title: *Orthopaedic Physical Therapy Practice* Statement of Frequency: Quarterly; January, April, July, and October
Authorized Organization's Name and Address: Academy of Orthopaedic Physical Therapy, 2920 East Avenue South, Suite 200, La Crosse, WI 54601-7202

Orthopaedic Physical Therapy Practice (ISSN 1532-0871) is the official publication of the Academy of Orthopaedic Physical Therapy, APTA, Inc.

Online Only for $50.00 per year or Print and Online for $75 per year/International Online Only for $75 pear year or Print and Online $100 per year (4 issues per year).

Orthopaedic Physical Therapy Practice is indexed by Cumulative Index to Nursing & Allied Health Literature (CINAHL).

ACADEMY OF ORTHOPAEDIC PHYSICAL THERAPY

DIRECTORY

2020 / volume 32 / number 4

BOARD OF DIRECTORS

President:
Joseph M Donnelly, PT, DHSc
800-444-3982 • jdonnelly@orthopt.org
1st Term: 2019-2022

Vice President:
Lori Michener, PT, PhD, SCS, ATC, FAPTA
804-828-0234 • lmichener@orthopt.org
1st Term: 2020-2023

Treasurer:
Kimberly Wellborn, PT, MBA
615-465-7145 • kwellborn@orthopt.org
2nd Term: 2018-2021

Director 1:
Aimee Klein, PT, DPT, DSc, OCS
813-974-6202 • aklein@orthopt.org
2nd Term: 2018-2021

Director 2:
Tara Jo Manal, PT, DPT, OCS, SCS, FAPTA
302-831-8893 • tmanal@orthopt.org
1st Term: 2019-2022

Director 3:
Janet L. Konecne, PT, DPT, OCS, CSCS
714-478-5601 • jkonecne@orthopt.org
1st Term: 2020-2023

EDUCATION
Nancy Bloom, PT, DPT, MSOT
314-286-1400 • nbloom@orthopt.org
2nd Term: 2019-2022

PRACTICE
James Spencer, PT, DPT
jspencer@orthopt.org
1st Term: 2020-2023

RESEARCH
Dan White, PT, ScD, MSc, NCS
302-831-7607 • dwhite@orthopt.org
2nd Term: 2019-2022

Office Personnel

(608) 788-3982 or (800) 444-3982

Terri DeFlorian, Executive Director
x2040.....tdeflorian@orthopt.org
Tara Fredrickson, Assistant Executive Director
x2030..... tfred@orthopt.org
Sharon Klinski, OP & ISC Managing Editor
x2020.....sklinski@orthopt.org
Aaron Czappa, CPG Managing Editor
x2130.....aczappa@orthopt.org
Nichole Walleen, Acct Exec/Exec Asst
x2070..... nwalleen@orthopt.org
Joyce Brueggeman, Bookkeeper
x2090.....jbrueggeman@orthopt.org
Melissa Greco, Administrative Assistant
x2150..... mgreco@orthopt.org

COMMITTEE CHAIRS

MEMBERSHIP CHAIR
Megan Poll, PT, DPT, OCS
908-208-2321 • meganpoll@gmail.com
1st Term: 2018-2021

VICE CHAIR
Christine B. Mansfield, PT, DPT, OCS, ATC
1st Term: 2019-2022
Members: *Molly Baker O'Rourke, Kelsey Smith (student)*

EDUCATION CHAIR
Nancy Bloom, PT, DPT, MSOT
(see Board of Directors)

VICE CHAIR
Emmanuel "Manny" Yung, PT, MA, DPT, OCS
2nd Term: 2019-2021
Members: *Brian Eckenrode, Eric Folkins, Gretchen Seif, Valerie Spees, Kate Spencer*

AOM DIRECTOR
Keelan Enseki, PT, OCS, SCS
Term: 2019-2021

INDEPENDENT STUDY COURSE (ISC) EDITOR
Guy Simoneau, PT, PhD, FAPTA
guysimoneau@marquette.edu
Term: 2020-2023

ISC ASSOCIATE EDITOR
Gordon Riddle, PT, DPT, ATC, OCS, SCS
gordoncriddle@hotmail.com
2nd Term: 2020-2021

ORTHOPAEDIC PRACTICE (OP) EDITOR
John Heick, PT, DPT, PhD, OCS, SCS, NCS
480-440-9272 • John.heick@nau.edu
1st Term: 2019-2022

OP ASSOCIATE EDITOR
Rita Shapiro, PT, MA, DPT
Shapiro.rb@gmail.com
2nd Term: 2020-2023

PUBLIC RELATIONS CHAIR
AOPT Office

Members: *Salvador B. Abiera IV, Derek Charles, Tyler Schultz (Historian), Kyle Stapleton (student), Will Stokes*

RESEARCH CHAIR
Dan White, PT, ScD, MSc, NCS
(see Board of Directors)

VICE CHAIR
Amee Seitz PT, PhD, DPT, OCS
2nd Term: 2019-2023
Members: *Alison Chang, Matthew Ithurburn, Phillip Malloy, Edward Mulligan, Louise Thoma, Arie Van Duijn*

ORTHOPAEDIC SPECIALTY COUNCIL
Hilary Greenberger, PT, PhD, OCS
greenber@ithaca.edu
Term: Expires 2021
Members: *Judy Gelber, Pamela Kikillus, Peter Sprague*

PRACTICE CHAIR
James Spencer, PT, DPT
(see Board of Directors)

Members: *Jim Dauber, Kathleen Geist, Gretchen Johnson, Molly Malloy, Marcia Spoto, Emma Williams White*

FINANCE CHAIR
Kimberly Wellborn, PT, MBA
(See Board of Directors)
Members: *Doug Bardugon, Matthew Lazinski, Theresa Marko, Penny Schulken*

AWARDS CHAIR
Marie Corkery, PT, DPT, MHS
617-373-5354 • m.corkery@northeastern.edu
1st Term: 2019-2022
Members: *Lisa Hoglund, Murray Maitland, Amy McDevitt, Michael Ross*

NOMINATIONS CHAIR
Michael Bade, PT, DPT, PhD
michael.bade@ucdenver.edu
1st Term: 2020-2023
Members: *Stephanie Di Stasi, Annette Karim*

JOSPT
Clare L. Arden, PT, PhD
clare.arden@liu.se

EXECUTIVE DIRECTOR/PUBLISHER
Edith Holmes
877-766-3450 • edithholmes@jospt.org

APTA BOARD LIAISON
Deirdre Daley, PT, DPT, MSHPE

2021 HOUSE OF DELEGATES REPRESENTATIVE
Gretchen Seifi, PT, DPT

ICF-BASED CPG EDITORS
Christine McDonough, PT, PhD
cmm295@pitt.edu
3rd Term: 2019-2022

RobRoy Martin, PT, PhD
martinr280@duq.edu
1st Term: 2018-2021

Guy Simoneau, PT, PhD, FAPTA
guy.simoneau@marquette.edu
2nd Term: 2020-2023

Special Interest Groups

OCCUPATIONAL HEALTH SIG
Rick Wickstrom, PT, DPT, CPE
513-772-1026 • rwickstrom@orthopt.org
1st Term: 2019-2022

FOOT AND ANKLE SIG
Christopher Neville, PT, PhD
315-464-6888 • cneville@orthopt.org
2nd Term: 2019-2022

PERFORMING ARTS SIG
Laurel Abbruzzese, PT, EdD
212-305-3916 • labbruzzese@orthopt.org
1st Term: 2020-2023

PAIN SIG
Nancy Durban, PT, MS, DPT
ndurban@orthopt.org
1st Term: 2020-2023

IMAGING SIG
Charles Hazle, PT, PhD
606-439-3557 • chazle@orthopt.org
2nd Term: 2019-2022

ORTHOPAEDIC RESIDENCY/FELLOWSHIP SIG
Matthew Haberl, PT, DPT, OCS, ATC, FAAOMPT
608-406-6335 • mhaberl@orthopt.org
1st Term: 2018-2021

ANIMAL PHYSICAL THERAPY SIG
Francisco Maia, PT, DPT, CCRT
fmaia@orthopt.org
1st Term: 2020 - 2022

Education Interest Groups

PTA
Jason Oliver, PTA
lsu73lsu73@yahoo.com

President's Corner

Adaptability and Flexibility "The Strength of Our Profession"

Joseph M. Donnelly, PT, DHSc, FAPTA

As I write this President's Corner, COVID -19 continues to rage across the United States and it is hard to believe that we have been dealing with this situation for 9 months and now 11 months as you read this message. The holidays have come and gone and for all of us they were as unprecedented as 2020 was. I want to take this opportunity to wish everyone a Happy New Year! I believe 2021 will be the year for healing and getting all of our lives back on track. I would like to remind the AOPT membership about a letter that Dr. Sharon Dunn, APTA President sent in March 2020. These two sentences are still very relevant:

On March 20, 2020, APTA President, Sharon Dunn wrote, *"I hope that this uncertain time brings us together — as a nation, as a community, as an association — by showing us how connected we are, and how much we depend on each other. And I hope that our profession will do what it does best: help our society move on from a period of suffering, by restoring function, independence, and dignity to survivors."* A call to action to make sure we did not lose sight of who we are for society.

I would predict as we get out of the COVID-19 pandemic there will be many people that will need our services due to the amount of time spent in static postures leading to changes in body structure and function and impairments in the movement system. This is our opportunity to demonstrate to society that we are the practitioner of choice to address their post-COVID-19 aches and pains and movement impairments.

The AOPT is committed to Practice, Research, Education, and Advocacy for continued growth and progress for both orthopaedic physical therapy practice and the profession. The AOPT leadership has worked very hard this past year to bring together a new Strategic Framework that brings all the special interest groups and committees in alignment with the organization's strategic framework to develop an effective and cohesive leadership team. The strategic framework is bold and moves us into areas we have not explicitly engaged in previously. Our strategic framework is presented below:

Vision Statement: The Academy of Orthopaedic Physical Therapy will be a World leader in providing services to optimize movement and musculoskeletal health.

Mission Statement: The Academy of Orthopaedic Physical Therapy empowers members to excel in orthopaedic physical therapy.

The AOPT leadership team has developed actionable items for 2021 and we will need member engagement to accomplish these goals in 2021. This year is our year to recover and accelerate our profession to the next level. Our attention to our CORE values of Professionalism will be essential as we battle the psychological impact of COVID-19 on all of us and society. My hope is that post pandemic we are a kinder, gentler society that has empathy and cares for those who are suffering. I strongly believe as a profession we need to be as flexible and adaptable as possible to get through this together. Continued advocacy for telehealth services and payment for this delivery of care will be necessary. The Art and Science of Physical Therapy must prevail, and we must continue to fight against any cuts in payment for our valuable services.

I look forward to seeing everyone at the virtual CSM and all of the AOPT live events.

Value and Payment	***• Enhance payment for services by demonstrating the value of physical therapy***
Positioning and Public Awareness	***• Position members as experts in managing movement and functional performance impairments***
Diversity, Equity, and Inclusion	***• Increase the diversity of members and leaders and engage in efforts to make AOPT a more inclusive organization***
Evidence to Best Practice	***• Promote the development and implementation of evidence to best practice***

Editor's Note

Honoring our Centennial 1921-2021: Military Physical Therapists Editorial

(Note-This editorial is edited since earlier drafts from https://www.apta.org/your-practice/practice-models-and-settings/primary-care/exploring-roles-of-pts-in-primary-care with the Editor as one of the authors.)

As you know, 2021 is our Centennial year, a year of celebrations to honor our profession. I am so GLAD to close the door on 2020 and to look forward! This year, as *OPTP* Editor, I would like to honor our 100-year history by starting with our military. Our profession started in the military with our first physical therapists, known as reconstruction aides. The reconstruction aides were employed by the United States Army during World War I and they rehabilitated our soldiers after injury.

Army physical therapists have served in every major military conflict since World War II.[1-4] During the Vietnam conflict, the roles and responsibilities of some Army physical therapists were expanded to allow those physical therapists to become physician extenders.[3,4] The U.S. Army physical therapists were the first military physical therapists to perform primary care with direct access for evaluation and treatment of patients with neuromusculoskeletal conditions. In addition to the standard privileges in the scope of physical therapist practice, expanded privileges were deemed mandatory if military physical therapists were to safely perform the primary care role. These expanded privileges included the ability to:

(1) refer patients for radiographic/imaging studies and lab studies,
(2) restrict patients to quarters for up to 72 hours,
(3) place patients on restricted duties for up to 30 days,
(4) refer patients to medical specialty clinics, and
(5) prescribe certain analgesic and nonsteroidal anti-inflammatory medications.

Non-military physical therapists later followed the U.S. Army model for evaluating and treating patients with neuromuscular conditions in their primary care, direct access role.

The use of military physical therapists as primary care providers for patients with neuromusculoskeletal conditions has been an overwhelming success in both peace and wartime conditions.[1,2,4] In our next 100 years, will these expanded privileges be extended to all physical therapists? Where will we go as a profession? What will we achieve? I am hopeful for our future as a profession and I look forward to what is in store for us!!

Respectfully submitted,

John Heick, PT, PhD, DPT
Board certified in Orthopaedics, Sports, and Neurology

(The Editor would like to sincerely thank Dan Rhon, DPT, DSc, OCS, FAAOMPT, and Brian Young, PT, DSc, OCS, FAAOMPT, for their service and for being willing to share these pictures.)

REFERENCES

1. Greathouse DG, Schreck RC, Benson CJ. The United States Army physical therapy experience: evaluation and treatment of patients with neuromusculoskeletal disorders. *J Orthop Sports Phys Ther*. 1994;19(5):261-266. doi:10.2519/jospt.1994.19.5.261.
2. Murphy BP, Greathouse D, Matsui I. Primary care physical therapy practice models. *J Orthop Sports Phys Ther.* 2005;35(11):699-707. doi:10.2519/jospt.2005.35.11.699.
3. Moore JH, Goffar SL, Teyhen DS, Pendergrass TL, Childs JD, Ficke JR. The role of U.S. military physical therapists during recent combat campaigns. *Phys Ther*. 2013;93(9):1268-1275. doi:10.2522/ptj.20120136.
4. Shaffer SW, Moore JH. US Army Physical Therapist Roles and Contributions in Operations Enduring Freedom and Iraqi Freedom. *US Army Med Dep J*. 2016;(2-16):52-57.

Functional Disability, Catastrophizing, and the Stage of Change in Veterans with Chronic Pain

Estey Evans, PT, DPT, ISPI
Therapeutic Pain Specialist[1]
Joel Bialosky, PT, PhD, FAAOMPT, OCS[2]
Ann Barry, PT, DPT, CHT, ISPI
Therapeutic Pain Specialist[3]

[1]*James A. Haley Veterans' Hospital, Department of Veteran Affairs, Tampa, FL*
[2]*Clinical Associate Professor, Department of Physical Therapy, University of Florida, Gainesville, FL*
[3]*Greenville Community Based Outpatient Clinic within the Columbia Veterans Administration Health Care System, Department of Veteran Affairs, Greenville, SC*

ABSTRACT

Background/Purpose: A biopsychosocial approach for the treatment of veterans with chronic pain is warranted. Veterans are more likely to report severe pain than nonveterans and reports suggest that the prevalence of pain complaints among veterans is growing steadily with each passing year. In addition, veterans also have a high prevalence of psychological comorbidities that can play an important role in the development and maintenance of chronic pain. The purpose of this study was to explore the relationship between the stages of change, psychological distress, pain catastrophizing, and disability in veterans with chronic pain referred to outpatient physical therapy. **Methods:** Distress, function, and pain catastrophizing were examined according to the stages of change and regression models were developed to account for variance. **Findings:** There was a significant difference found for pain catastrophizing but not for distress or function based on the stage of change. The stages of change explained a significant amount of variance of function and catastrophizing, when controlling for age and sex. **Conclusion:** The stage of change adds significant value to the prediction of function and catastrophizing. **Clinical Relevance:** To maximize treatment outcomes and to influence behavior change, physical therapists must monitor a veteran's readiness to change and align our interventions accordingly.

Key Words: biopsychosocial, motivation, self-management, Transtheoretical Model

INTRODUCTION

Chronic pain is a substantial problem in the United States affecting approximately one-third of Americans.[1] However, this epidemic becomes even more prevalent when looking at veterans. For example, chronic pain among previously deployed soldiers and veterans is estimated as high as 60%.[2] In addition, veterans have 1.5 times the odds of having severe pain than nonveterans, while younger veterans aged 18 to 39 are at even greater risk: with the odds increasing to 3:1.[3] The wars in Afghanistan and Iraq have resulted in a unique group of younger veterans, who are more likely to report severe pain and psychological distress than their age-matched nonveterans.[4] Pain is the costliest of all disorders for veterans treated in the Veterans Health Administration facilities and reports suggest that the prevalence of pain complaints among veterans is growing steadily with each passing year.[1,5] Collectively, these findings suggest an urgent need to develop effective treatment approaches in order to decrease the burden of chronic pain for veterans, given that they are disproportionately affected by the current chronic pain epidemic in the United States.

Psychological factors play an important role in the development and maintenance of chronic pain.[6] Motivation is a complex psychological process that is the driving force behind goal-oriented behavior such as the self-management of chronic pain, which is directly linked to pain treatment outcomes.[7] Developing healthy coping behaviors and maintaining these changes is challenging and unlikely to occur without enough motivation.[7] In contrast, pain catastrophizing is the tendency to exaggerate, ruminate on, and feel helpless about the experience of pain.[8] Feelings of helplessness may prevent veterans from feeling motivated to self-manage their pain, leading to poor coping skills.[9] Pain catastrophizing is a mediator of physical and mental health status[10] as well as functional outcomes[11,12] in patients with chronic pain. Veterans suffering from chronic pain have diverse, often complex psychological co-morbidities. For example, veterans in pain being treated at a Veteran Affairs (VA) orthopedic spine surgery clinic had psychological distress rates twice as high as non-VA patients.[13] Furthermore, lifetime prevalence of post-traumatic stress disorder (PTSD) alone in Vietnam veterans is approximately three times higher than non-veterans.[4] Veterans with co-morbid chronic musculoskeletal pain and PTSD experience higher pain severity, greater pain-related disability, higher affective distress, and more maladaptive pain cognitions such as pain catastrophizing than those with chronic pain alone.[4] Collectively, these findings support the influence of psychological factors on the pain experience. This, as well as the high prevalence of psychological co-morbidities in veterans with chronic pain necessitates a biopsychosocial approach to treatment.[14]

There is emerging evidence that adopting motivational-based interventions is effective for reducing pain intensity, increasing exercise and physical activity, promoting treatment adherence, and improving physical functioning in people with chronic pain.[15] The combination of motivational interviewing and physical exercise demonstrated improvements in pain intensity, pain self-efficacy, physical mobility, and psychological well-being.[16] Such an approach demands consideration of individual differences in motivation and readiness to adopt self-management strategies.[2] An effective intervention approach for increasing motivation and behavior change is motivational interviewing.[15] Motivational interviewing is a patient-focused approach that aims to resolve ambivalence about behavior change by strengthening their own motivation and commitment to change.[17] In clinical settings, motivational interviewing frequently draws upon the transtheoretical model (TTM) of behavior change. This model describes how and why individuals make health-related behavioral changes in terms of their "readiness" or how motivated they are to make a behavioral change.[18] Four distinct stages of this model (Table 1) have been validated.[19]

The stages of change as defined by the TTM predict both engagement in self-management therapies and outcomes in patients with chronic pain.[23-26] Furthermore, the stages of change may help direct treatment.

Table 1. Stages of Chronic Pain Management[20-22]

Precontemplation	Preparation	Action	Maintenance (after 6 months of action)
Avoidance behavior, passive coping skills, lack of motivation, belief medical provider is responsible for pain relief. Self-management considered irrelevant.	Continues to pursue biomedical model, begins to consider self-management strategies. Medical treatment has limits; self-management may be beneficial.	Beginning of self-management, actively involved in learning coping techniques; increased self-efficacy.	Health care provider acts as coach and mentor to prevent relapse. Committed to self-management and a lifestyle with a range of self-management strategies.
Each stage has specific behavioral attributes and the time spent in each phase is variable. It is possible to regress as well as to progress to another stage of change.			

For example, cognitive-behavioral treatment designed to promote beliefs of a self-management approach were most effective in veterans who scored high on the precontemplation scale. Resistance to an intervention may be indications that the provider is assuming greater readiness to change than is the case, and it is a cue that the motivational strategies need to be modified.[17] Progression through the stages is associated with improved outcomes in patients with chronic pain as compared to those who regress or remain stagnant.[26] Progression from the precontemplation stage to the more motivated stages of action and maintenance is associated with decreased pain, disability, and psychological distress.[23] Using motivational interviewing enables patients to achieve an optimal stage of change to promote treatment adherence and ultimately efficacy. Subsequently, the stages of change as defined by the TTM may be an important consideration in managing patients with chronic pain conditions in order to provide more individualized treatment, monitor treatment progress, and facilitate better outcomes.

The purpose of this study was to explore the relationship between the stage of change, psychological distress, pain catastrophizing, and disability in veterans with chronic pain referred to outpatient physical therapy. We hypothesized veterans in the less motivated stages of change would have a greater prevalence of psychological distress, higher levels of pain catastrophizing, and higher levels of disability. Furthermore, we hypothesized the stage of change would account for a significant amount of variance in disability and pain catastrophizing.

PARTICIPANTS

This study was approved by the Columbia Veterans Administration Health Care System Institutional Review Board. Data were extracted from the electronic medical records of veterans evaluated by one physical therapy provider in the Greenville Community Based Outpatient Clinic. Inclusion criteria were: referral to physical therapy from a primary care physician between February 2017 and July 2017, complaints of musculoskeletal pain persisting for at least 3 months, fluency in English (reading and speaking), full completion of a functional outcome measure, completion of the Pain Catastrophizing Scale (PCS), and completion of the Freiburg Questionnaire- Stages of Chronic Pain Management (FQ-STAPM). Exclusion criteria included no shows or treatment refusal, patients attending for braces or assistive devices exclusively, conditions requiring immediate referral back to the primary care provider such as hypertension, hypoglycemia, or syncope; systemic conditions including cancer pain, chronic obstructive pulmonary disease, chronic kidney disease, cardiac dysfunction, or peripheral neuropathy; complaints other than chronic pain including stiffness, acute pain, no pain, or the presence of active substance abuse.

MEASURES

Participating patients completed the following questionnaires during their initial physical therapy session. Each patient completed 3 self-report questionnaires including a region-specific outcome measure, the PCS, and the FQ-STAPM.

Physical Functioning

Region-specific measures of physical functioning were collected as recommended in chronic pain clinical trials.[27] For veterans with neck pain, the Neck Disability Index (NDI) was used. This questionnaire consists of 10 items that have 6 response categories (range 0–5, total score range 0–50). The total score is doubled resulting in a percentage with higher scores indicating higher perceived disability. The NDI has been found to be valid and responsive for individuals with neck pain.[28]

For veterans with shoulder pain we used the Shoulder Pain and Disability Index (SPADI). The SPADI is a standardized 13-item questionnaire. It has a pain scale (5 items) and a disability scale (8 items) that range from 0-10 and can be combined for a total score. The SPADI scores range from 0 to 130 that can be converted to a percentage, with higher scores reflecting worse shoulder pain and function. This questionnaire has been found to be valid, reliable, and responsive to change for patients with shoulder pain.[29]

For individuals with low back pain, the Oswestry Disability Index (ODI) was used. The ODI consists of 10 items rated on a 6-point scale (0–5); a higher score indicates a higher level of disability related to low back pain. The ODI has been found to be valid, reliable, and responsive for patients with low back pain.[30]

The Lower Extremity Functional Scale (LEFS) was used for veterans with any lower-extremity orthopedic condition. The LEFS is a 20-item questionnaire with each question rated on a 5-point scale, from 0 (extreme difficulty/unable to perform activity) to 4 (no difficulty). The total possible score of 80 indicates a high functional level. In order to remain consistent with the other outcome measures, we took the inverse LEFS score so that the higher scores would indicate a lower level of function. The LEFS has been found to be a reliable and valid measure for patients with lower extremity musculoskeletal dysfunction.[31]

Pain Catastrophizing

The Pain Catastrophizing Scale (PCS) is a 13-item questionnaire scored on a 5-point scale with 0 being "not at all" and 4 being "all the time". Raw scores range from 0-52 where higher scores indicate more catastrophizing thoughts. The PCS has good psychometric properties[32] and has been widely used in patients with chronic pain.

Stages of Change

Patients were administered the FQ-STAPM. This 17-item questionnaire scores each item on a 5-point scale with 1 being "strongly disagree" to 5 being "strongly agree". Five items are specific to the precontemplation stage, 4 are specific to the preparation stage, 4 items are specific to the action stage, and 4 items are specific to the maintenance stage. The raw scores for each stage are transformed to a mean. The patient is then classified as being in one of 4 stages of change (precontemplation, preparation, action, and maintenance) based on the highest mean score. Individuals are placed in the higher stage in the case of a tie. All stages have been found to have sufficient reliability and discriminant validity.[19] The 4-factor-structure has been confirmed and used repeatedly in the literature and previous analyses found internal consistencies with Cronbach's α = .68 for precontemplation (5 items), .57 for preparation (4 items), .82 for action (4 items), and .73 for maintenance (4 items), respectively.[33]

Psychological Distress

We operationally defined psychological distress as having PTSD, depression, or anxiety. Patients were classified as having psychological distress if any of these conditions were listed as a formal active diagnosis in the patients' problem list in their medical record. Severity and chronicity were not determined and psychological distress was classified on a yes/no basis.

Demographics

Age and sex were also recorded as secondary variables. A total of 69 males and 19 females met the inclusion criteria for a total of 88 veterans.

ANALYSIS

For descriptive purposes, frequencies were determined for categorical variables and means and standard deviations for continuous variables. Functional outcome measures were converted to Z-scores for comparison. Chi-Square analysis was used to determine the frequency of psychological distress across the stages of change. Separate analysis of variance considered differences in disability and pain catastrophizing across the stages of change. Separate multiple linear regression models were developed to account for the variance in disability and catastrophizing. First, age and sex were entered into the model followed by the stages of change dummy coded with precontemplation as the reference.

RESULTS

Three hundred and ten medical records were reviewed that represented the total number of referrals to the physical therapist during the 6 months chosen for chart review. Eighty-eight records satisfied the inclusion criteria and were included in the analysis (Figure 1).

Descriptive statistics for all variables are listed in Table 2. Seventy-eight percent of patients were male and 68% of the sample had a diagnosis of psychological distress with a mean age of 53 ± 13 years old. The largest percentage of patients (47%) were in the preparation stage of change and the least (7%) were found in the maintenance stage.

The frequency of psychological distress was not different across the stages of change (p=.239). We also found no significant difference between the functional outcome measure score based on the stage of change (p=.091). However, a significant difference

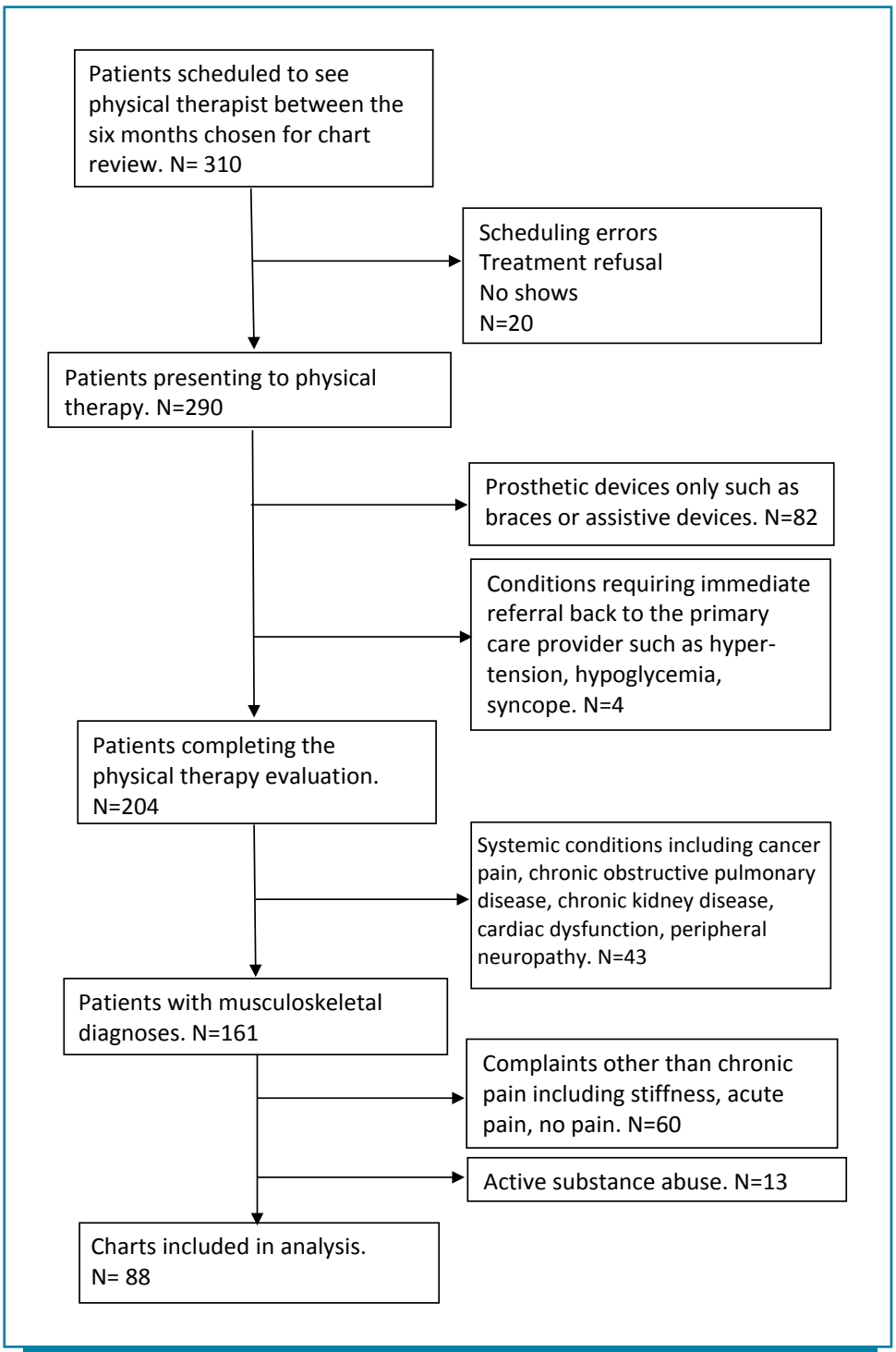


Figure 1. Flow chart of study inclusion.

Table 2. Descriptive Statistics of the Variables Including Age, Gender, Psychological Distress (Anxiety, PTSD, or Depression), Pain Catastrophizing Scale, and Functional Outcome Measure Based on the Patients' Pain Complaint Were Included for Each Stage of Change

	Precontemplation (n=21)	Preparation (n=41)	Action (n=20)	Maintenance (n=6)	Total (n=88)
Age (mean years)	M=52 SD=2.77	M=57 SD=1.78	M=46 SD=3.23	M=51 SD=7.09	M=53 SD=1.41
Gender-Male	17	35	14	3	69
Distress (yes)	17	29	11	3	60
PCS	M=33.38 SD=12.00	M=25.20 SD=14.28	M=22.60 SD=10.02	M=10.50 SD=9.93	M=25.56 SD=13.67
Neck	1	5	1	0	7
Shoulder	0	0	1	2	3
Low Back	13	30	12	0	55
Lower Extremity	7	6	6	4	23

Abbreviations: M, mean; SD, standard deviation; PCS, Pain Catastrophizing Scale

was found for the PCS scores based on the stage of change (p=.001) with participants in the action stage (p=.047) and maintenance stage (p=.001) presenting with significantly lower PCS scores than those in the precontemplation stage (Table 2).

When controlling for age and sex, the stages of change accounts for 16% (p=0.03) of the variance of function (Table 3) and 24% (p< 0.01) of the variance in catastrophizing (Table 4).

DISCUSSION

This study investigated the relationship between the stages of change, psychological distress, pain catastrophizing, and functional disability in veterans with chronic pain. We found a significant difference in pain catastrophizing based on the stage of change; however, the frequency of psychological distress and functional outcome measure scores did not vary significantly across the stages of change. The stage of change explained 16% (p=0.03) of the variance of function and 24% (p<0.01) of the variance in catastrophizing, when controlling for age and sex.

Sixty eight percent of our population had a formal diagnosis of psychological distress. This is greater than what previous work has found in a civilian population with 22% indicating psychological distress.[34] The rate of psychological distress found in our study also varies considerably from the 36% and 43% found in veteran populations.[13,34] Brooks[34] and Patton[13] defined psychological distress as measured by the Distress and Risk Assessment Method, a validated survey consisting of the Zung Depression Scale and the Modified Somatic Perception Questionnaire. Although we did not use this questionnaire, we operationally defined psychological distress based on a formal diagnosis of these subscales and with the inclusion of PTSD. The inclusion of PTSD may contribute to our increased incidence compared to other veteran populations. Interestingly, we observed no differences in psychological distress across the 4 stages of change. Our findings differ from others in nonveteran specific samples.[6,35-37] For example, Zenker[35] and Maurischat[36] found individuals in the maintenance stage to have the lowest rates of psychological distress. Both of these studies used the Hospital Anxiety and Depression Scale to define psychological distress. Our findings add to this body of literature by suggesting rates of psychological distress, when accounting for PTSD, do not differ for veterans across the stages of change.

We found that function did not differ based on the stage of change with the stages of change accounting for 16% of the variance in function when controlling for age and sex. This is inconsistent with Zenker[35] as they found that patients in the maintenance stage had the lowest levels of disability. In contrast, Keefe[38] found individuals in the precontemplation and action stages tended to have the lowest levels of disability. Current findings indicate that the association between readiness to self-manage pain and patient functioning is neither clear nor consistent.[39] Our findings suggest that contrary to what has been observed in nonveteran samples, function may not differ across the stages of change in veterans. Using the stages of change may assist in individualizing interventions for veterans independent of their baseline level of function.

We observed the highest levels of pain catastrophizing in the precontemplation stage with the stages of change accounting for 24% of the variance in catastrophizing when controlling for age and sex in a veteran population. Individuals in the precontemplation stage are less motivated to adopt behavioral change and our findings of higher levels of catastrophizing in this stage is consistent with the literature in nonveteran samples.[38-40] Increased levels of pain catastrophizing may be attributed to the precontemplation stage being associated with higher levels of helplessness, lower perceived control, and less ability to cope actively with pain.[36] High pain catastrophizing alone is a poor prognostic factor for chronic pain[41] and may have further negative implications on chronic pain treatment success when a veteran presents in a less motivated stage.

Limitations of this study include a skewed distribution that limited our ability to use non-parametric analysis while maintaining separation of all stages of change. Lastly, no follow-up was completed on these participants and therefore the data represents

Table 3. Multiple Regression Analysis

Model	R Square		Significance F Change
1	.061	.98044254	.069
2	.161	.94370774	.026

Model 1: Age and sex alone accounting for variance in disability. Model 2: The addition of the stage of change prediction of function when controlling for age and sex. Stage of change dummy coded using precontemplation stage as the reference.

Table 4. Multiple Regression Analysis

Model	R Square	Standard Error	Significance F Change
1	.049	13.48828	.116
2	.242	12.26236	.000

Model 1: Age and sex alone accounting for variance in the Pain Catastrophizing Scale. Model 2: The addition of the stage of change prediction of Pain Catastrophizing Scale when controlling for age and sex. Stage of change dummy coded using precontemplation stage as the reference.

an initial point in time of evaluation only. This limits our ability to extrapolate and determine causation.

CONCLUSION

Motivation to change behavior as measured by the stage of change is an important variable to assess for health care professionals as it can impact chronic pain treatment success.[33,39] We determined that the evaluation of a veteran's stage of change adds significant value to the prediction of function and catastrophizing and that levels of catastrophizing differ across the stages. Further research into developing interventions that facilitate progression to a more motivated stage and determining whether these interventions contribute to improved patient outcomes is warranted.

Clinical Application

In veterans with chronic pain, poor motivation to maintain self-management activities has been identified as a key barrier to engagement in, and adherence to interventions.[42] Low motivation for self-management of chronic pain is consistent with low engagement, as in the precontemplation and preparation stages of change. The success with which an individual engages in behavior change to self-manage chronic pain plays a key role in treatment outcomes.[7,40-42] An essential characteristic of motivational interviewing is monitoring the patient's degree of readiness to change, and ensuring that resistance is not generated by jumping ahead of the patient.[17] Matching interventions to the stage of change emphasizes patient autonomy while drawing out individual thoughts about change rather than imposing provider ideas. To maximize treatment outcomes and to truly influence behavior change, we must monitor an individual's readiness to change and align our interventions accordingly.

ACKNOWLEDGEMENTS

This material is the result of work supported with resources and the use of facilities at the Columbia Veterans Administration Health Care System. The contents do not represent the views of the U.S. Department of Veterans Affairs or the United States Government.

REFERENCES

1. Kerns RD, Philip EJ, Lee AW, Rosenberger PH. Implementation of the veterans health administration national pain management strategy. *Transl Behav Med*. 2011;1(4):635-643. doi:10.1007/s13142-011-0094-3.
2. Johnson SS, Levesque DA, Broderick LE, Bailey DG, Kerns RD. Pain self-management for veterans: development and pilot test of a stage-based mobile-optimized intervention. *JMIR Med Informs*. 2017;5(4):e40. doi:10.2196/medinform.7117.
3. Nahin RL. Severe pain in veterans: the effect of age and sex, and comparisons with the general population. *J Pain*. 2017;18(3):247-254. doi:10.1016/j.jpain.2016.10.021.
4. Outcalt SD, Ang DC, Wu J, Sargent C, Yu Z, Bair MJ. Pain experience of Iraq and Afghanistan Veterans with comorbid chronic pain and posttraumatic stress. *J Rehabil Res Develop*. 2014;51(4):559-570. doi:10.1682/jrrd.2013.06.0134.
5. Haskell SG, Ning Y, Krebs E, et al. Prevalence of painful musculoskeletal conditions in female and male veterans in 7 years after return from deployment in Operation Enduring Freedom/Operation Iraqi Freedom. *Clin J Pain*. 2012;28(2):163-167. doi:10.1097/ajp.0b013e318223d951.
6. Keefe F. Psychological aspects of persistent pain: current state of the science. *J Pain*. 2004;5(4):195-211. doi:10.1016/s1526-5900(04)00665-0.
7. Jensen MP, Nielson WR, Kerns RD. Toward the development of a motivational model of pain self-management. *J Pain*. 2003;4(9):477-492. doi:10.1016/s1526-5900(03)00779-x.
8. Quartana PJ, Campbell CM, Edwards RR. Pain catastrophizing: a critical review. *Expert Rev Neurother*. 2009;9(5):745-758. doi:10.1586/ern.09.34.
9. Bair MJ, Matthias MS, Nyland KA, et al. Barriers and facilitators to chronic pain self-management: a qualitative study of primary care patients with comorbid musculoskeletal pain and depression. *Pain Med*. 2009;10(7):1280-1290. doi:10.1111/j.1526-4637.2009.00707.x.
10. Suso-Ribera C, García-Palacios A, Botella C, Ribera-Canudas MV. Pain catastrophizing and its relationship with health outcomes: does pain intensity matter? *Pain Res Manag*. 2017;2017:9762864. doi:10.1155/2017/9762864.
11. Besen E, Gaines B, Linton SJ, Shaw WS. The role of pain catastrophizing as a mediator in the work disability process following acute low back pain. *J Appl Biobehav Res*. 2017;22(1). doi:10.1111/jabr.12085.
12. Kovacs FM, Seco J, Royuela A, Peña A, Muriel A. The correlation between pain, catastrophizing, and disability in subacute and chronic low back pain.

Spine. 2011;36(4):339-345. doi:10.1097/brs.0b013e3181cfba29.
13. Patton CM, Hung M, Lawrence BD, et al. Psychological distress in a Department of Veterans Affairs spine patient population. *Spine J*. 2012;12(9):798-803. doi:10.1016/j.spinee.2011.10.008.
14. Asmundson GJ, Coons MJ, Taylor S, Katz J. PTSD and the experience of pain: research and clinical implications of shared vulnerability and mutual maintenance models. *Can J Psychiatry*. 2002;47(10):930-937. doi:10.1177/070674370204701004.
15. Cheing G, Vong S, Chan F, Ditchman N, Brooks J, Chan C. Testing a path-analytic mediation model of how motivational enhancement physiotherapy improves physical functioning in pain patients. *J Occup Rehabil*. 2014;24(4):798-805. doi:10.1007/s10926-014-9515-8.
16. Habib S, Morrissey S, Helmes E. Preparing for pain management: a pilot study to enhance engagement. *J Pain*. 2005;6:48-54.
17. Miller WR, Rollnick S. *Motivational Interviewing: Helping People Change*. New York, NY: Guilford Press; 2012.
18. Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. *Am J Health Promot*. 1997;12(1):38-48. doi:10.4278/0890-1171-12.1.38.
19. Maurischat C, Härter M, Auclair P, Kerns RD, Bengel J. Preliminary validation of a German version of pain stages of change questionnaire. *Eur J Pain*. 2002;6(1):43-48. doi:10.1053/eujp.2001.0271.
20. Hadjistavropoulos H, Shymkiw J. Predicting readiness to self-manage pain. *Clin J Pain*. 2007;23(3):259-266. doi:10.1097/ajp.0b013e31802f67f3.
21. Dijkstra A. The validity of the stages of change model in the adoption of the self-management approach in chronic pain. *Clin J Pain*. 2005;21(1):27-37. doi:10.1097/00002508-200501000-00004.
22. Kerns RD, Rosenberg R, Jamison RN, Caudill MA, Haythornthwaite J. Readiness to adopt a self-management approach to chronic pain: the Pain Stages of Change Questionnaire (PSOCQ). *Pain*. 1997;72(1-2):227-234. doi:10.1016/s0304-3959(97)00038-9.
23. Kerns RD, Rosenberg R. Predicting responses to self-management treatments for chronic pain: application of the pain stages of change model. *Pain*. 2000;84(1):49-55. doi:10.1016/s0304-3959(99)00184-0.
24. Carr JL, Moffett JAK, Sharp DM, Haines DR. Is the Pain Stages of Change Questionnaire (PSOCQ) a useful tool for predicting participation in a self-management programme? Further evidence of validity, on a sample of UK pain clinic patients. *BMC Musculoskelet Disord*. 2006;7:101. doi:10.1186/1471-2474-7-101.
25. Biller N, Arnstein P, Caudill MA, Federman CW, Guberman C. Predicting completion of a cognitive-behavioral pain management program by initial measures of a chronic pain patients readiness for change. *Clin J Pain*. 2000;16(4):352-359. doi:10.1097/00002508-200012000-00013.
26. Gersh E, Arnold C, Gibson SJ. The relationship between the readiness for change and clinical outcomes in response to multidisciplinary pain management. *Pain Med*. 2011;12(1):165-172. doi:10.1111/j.1526-4637.2010.01030.x.
27. Dworkin RH, Turk DC, Farrar JT, et al. Core outcome measures for chronic pain clinical trials: IMMPACT recommendations. *Pain*. 2005;113(1):9-19.
28. Schellingerhout JM, Verhagen AP, Heymans MW, Koes BW, Vet HC, Terwee CB. Measurement properties of disease-specific questionnaires in patients with neck pain: a systematic review. *Quality Life Res*. 2011;21(4):659-670. doi:10.1007/s11136-011-9965-9.
29. Bicer A, Ankarali A. Shoulder Pain and Disability Index: A validation study in Turkish women. *Singapore Med J*. 2010;51(11):865-870.
30. Vianin M. Psychometric properties and clinical usefulness of the Oswestry Disability Index. *J Chiropr Med*. 2008;7(4):161-163. doi:10.1016/j.jcm.2008.07.001.
31. Binkley JM, Stratford PW, Lott SA, Riddle DL. The Lower Extremity Functional Scale (LEFS): scale development, measurement properties, and clinical application. *Phys Ther*. 1999;79(4):371-383. doi:10.1093/ptj/79.4.371.
32. Sullivan MJL, Bishop SR, Pivik J. Pain Catastrophizing Scale. *Psychol Assess*. 1995;7(4):524-532. doi:http://dx.doi.org/10.1037/1040-3590.7.4.524.
33. Heider J, Köck K, Sehlbrede M, Schröder A. Readiness to change as a moderator of therapy outcome in patients with somatoform disorders. *Psychother Res*. 2017;28(5):722-733. doi:10.1080/10503307.2016.1265686.
34. Brooks DE, Agochukwu UF, Arrington ED, Mok JM. Psychological distress in the active duty military spine patient. *Mil Med*. 2013;178(10):1059-1064. doi:10.7205/milmed-d-13-00162.
35. Zenker S, Petraschka M, Schenk M, et al. Adjustment to chronic pain in back pain patients classified according to the motivational stages of chronic pain management. *J Pain*. 2006;7(6):417-427. doi:10.1016/j.jpain.2006.01.446.
36. Maurischat C, Härter M, Kerns RD, Bengel J. Further support for the pain stages of change model: Suggestions for improved measurement. *Eur J Pain*. 2006;10(1):41-41. doi:10.1016/j.ejpain.2005.01.006.
37. Krampe H, Salz A-L, Kerper LF, et al. Readiness to change and therapy outcomes of an innovative psychotherapy program for surgical patients: results from a randomized controlled trial. *BMC Psychiatry*. 2017;17(1). doi:10.1186/s12888-017-1579-5.
38. Keefe FJ, Lefebvre JC, Kerns RD, et al. Understanding the adoption of arthritis self-management: stages of change profiles among arthritis patients. *Pain*. 2000;87(3):303-313. doi:10.1016/s0304-3959(00)00294-3.
39. Jensen MP, Nielson WR, Turner JA, Romano JM, Hill ML. Readiness to self-manage pain is associated with coping and with psychological and physical functioning among patients with chronic pain. *Pain*. 2003;104(3):529-537. doi:10.1016/s0304-3959(03)00092-7.
40. Guite JW, Kim S, Chen C-P, et al. Pain beliefs and readiness to change among adolescents with chronic musculoskeletal pain and their parents before an initial pain clinic evaluation. *Clin J Pain*. 2014;30(1):27-35. doi:10.1097/ajp.0b013e31828518e9.
41. Martinez-Calderon J, Jensen MP, Morales-Asencio JM, Luque-Suarez A. Pain catastrophizing and function in individuals with chronic musculoskeletal pain. *Clin J Pain*. 2019;35(3):279-293. doi:10.1097/ajp.0000000000000676.
42. Matthias MS, Kukla M, Mcguire AB, Damush TM, Gill N, Bair MJ. Facilitators and barriers to participation in a peer support intervention for veterans with chronic pain. *Clin J Pain.* 2016;32(6):534-540. doi:10.1097/ajp.0000000000000297.

The Use of a Direction Tolerance System for Patients with Low Back Pain: Intra-Rater Reliability and Outcome

Martin Lambert, PT, PhD, OCS, FAAOMPT, FAFS[1]
M. Samuel Cheng, PT, MS, ScD[2]
Jennifer Bogulski, PT, DPT, OCS[3]

[1]*Buffalo Rehab Group Physical Therapy, Hamburg, NY*
[2]*Nova Southeastern University, Fort Lauderdale, FL*
[3]*Daemen College, Amherst, NY*

ABSTRACT

Background and Purpose: In recent years, the approach to treating patients with low back pain (LBP) has evolved to establishing patient diagnosis based upon common clinical characteristics. Several classification systems exist in the current literature; however, the current systems lack examination of tolerance to movement exclusively in the standing position. The Direction Tolerance System (DTS) provides the clinician an examination and treatment tool that observes patient movement through all planes of motion in standing. The purpose of this study was to evaluate the intra-rater reliability of the DTS assessment in patients with LBP, investigate patient success outcomes using the DTS treatment protocol, and determine if an association exists between patient clinical characteristics and outcomes achieved using the DTS. **Methods:** Five physical therapists (2-26 years of experience) performed the testing and treatment in the study. Sixty subjects, ages 18-80 years (mean = 52 ± 16.0), with LBP were examined and treated using the DTS protocol. The Direction Tolerance Index (DTI), Numeric Pain Rating Scale (NPRS), Oswestry Disability Questionnaire (ODQ), and Fear-Avoidance Beliefs Questionnaire – Physical Activity Subscale (FABQ-PA) were collected for inclusion criteria and to evaluate outcomes. **Findings:** Intra-rater ICC was 0.80 (95% Confidence Interval 0.68-0.88) indicating good reliability ($p<0.001$). Of the 60 subjects that completed the study, 75% achieved a positive outcome with 62% (37/60) classified as success and 13% (8/60) classified as improved. **Clinical Relevance:** As treatment classification systems become more prominent in clinical use, the DTS may provide clinicians across all levels of experience a reliable tool that requires minimal training and is easy to administer a way to successfully examine and treat patients with LBP. **Conclusion:** The results of this study preliminarily suggest that the DTS is a reliable and effective tool for the examination and treatment of patients with LBP using functional testing and treatment positions.

Key Words: classification, direction tolerance, low back pain

BACKGROUND AND PURPOSE

The traditional approach to the diagnosis and treatment of low back pain (LBP) was historically based on determination of pathology and the assumption that LBP arises from a deviation of the lumbopelvic complex from a normal anatomical and physiological state.[1] For a pathology-based classification system to be effective, one must first identify a structural fault that can be treated and corrected for signs and symptoms of LBP to dissipate.[2] The pathology-based classification system, used for the purpose of diagnosis and subsequent treatment of LBP, is no longer supported by the literature due to its inability to identify structural pathology in the vast majority of patients.[3,4] Authors now suggest that patients with non-specific LBP be classified based on common clinical characteristics.[5-7] This type of classification may be used for diagnostic purposes and to guide the subsequent treatment plan to improve clinical decision making in the management of patients with LBP.[8]

Several existing classification systems for LBP cited in the literature include the Mechanical Diagnosis and Therapy (MDT),[5] Treatment Based Classification (TBC),[9] and Movement System Impairment (MSI).[10] A common theme across all of these systems are that the system uses response to end range spinal motion as a guide to diagnosis and management of patients with LBP in differing ways.[4,8,11,12] Each of these systems use patient symptoms combined with response to movement to diagnose and treat. However, development of a classification system that integrates the concepts of all three models may provide a useful alternative or adjunct to the existing systems currently used in the clinic. Patients seek treatment to not only reduce pain, but improve tolerance to upright functional activities. An examination and treatment system that uses repeated spinal motion in functional standing positions combined with upper extremity movement to determine direction tolerance may provide outcomes similar or better than existing systems. This new system may also guide treatment by treating impairments at the hips and trunk while activating the core to reduce strain to the lumbar spine.

Inspired by Mechanical Diagnosis and Therapy as well as the Treatment Based Classification Models, the Direction Tolerance System uses the concept of repeated movement testing to establish all directions of tolerance to guide intervention decision-making. Additionally, the DTS is modeled after the Movement System Impairment lumbar examination using the concept of assessing movement in the standing position. By combining the concepts of repeated movements in functional upright positioning, the DTS offers clinicians a brief examination tool to assess response to repeated movement and guide clinical decision-making with intervention. The DTS is performed exclusively in the standing position and investigates patient tolerance to 6 integrated limb and spinal repeated active motion tests: right and left rotation, right and left side-bending, and forward and backward bending. Each motion is graded as either aggravating or non-aggravating. Aggravating factors are defined as any motion that causes symptoms to peripheralize and/or increase in intensity when peripheralization does not occur. Non-aggravating motions are defined as any motion that does not cause symptoms to peripheralize and/or intensify when peripheralization does not occur. Direction Tolerance System treatment consists of a scripted flexibility and core activation exercise program based on non-aggravating motions.

The purpose of this study was to determine the intra-rater reliability of the DTS

assessment in patients with LBP, investigate patient success outcomes using the DTS treatment protocol, determine if an association exists between patient clinical characteristics and outcomes achieved using the DTS, and if there is an association, determine the clinical characteristics that predict successful patient outcomes using the DTS for individuals with LBP.

METHODS

Subjects

In this pre-post experimental design, individuals between the ages of 18 and 80 years seeking physical therapy treatment for complaints LBP at 1 of 5 outpatient orthopedic clinics across Western New York were recruited. Participants were required to currently have complaints of LBP with or without the presence of lower extremity symptoms. Exclusion criteria included previous spinal fusion surgery; LBP attributable to current pregnancy; acute fracture, tumor, or infection; or the presence of two or more signs of nerve root compression defined as diminished lower extremity strength, sensation, and/or reflexes. Participants were also excluded if they were unable to physically perform any of the 6 test positions used in the DTS on visit one and/or two. A power analysis was conducted to determine the appropriate sample size for this study. Written informed consent was obtained from each participant prior to the start of the study. The protocol was approved by the Institutional Review Board of Nova Southeastern University.

Examiners

Five physical therapists in New York were trained in the DTS system. Each therapist received written instructions and psychomotor training on the examination and treatment protocol procedures. All physical therapists completed a written and psychomotor examination prior to the start of the study to demonstrate an acceptable level of knowledge regarding subject recruitment, examination procedures, and exercise progression using the DTS.

Initial Testing

All subjects were examined by the treating physical therapist on visit 1. The examination consisted of gathering participant subjective information, self-report outcome measures, and physical examination. Visit 1 subjective information included duration of symptoms (days since onset) and location of current symptoms. Self-report outcome measures used include the modified Oswestry Disability Questionnaire (ODQ), the Numeric Pain Rating Scale (NPRS), and the Fear-Avoidance Beliefs Questionnaire Physical Activity subscale (FABQ-PA). The clinometric properties of the ODQ,[13-19] NPRS,[20,21] and FABQ-PA[22-26] are well established in the literature. The physical examination consisted of a standard neurologic screen examination inclusive of lower extremity myotomes, sensation, and reflexes, for possible exclusion, and the DTS examination.

DTS Testing

The DTS was assessed in the standing position where the patient performs 6 different repeated limb and spine active motions: right and left rotation, right and left side-bending, and forward and backward bending (see Figure 1-3). Each motion was performed a total of 10 repetitions; however, the test may be terminated after 5 repetitions if the participant experienced peripheralization of symptoms or an increase in the intensity of baseline symptoms (ie, pain) resulting in a score of 0 on the Direction Tolerance Index (DTI). Completion of 10 repetitions successfully (centralization of symptoms or no change) was assigned a score of 1 on the DTI. Testing was performed at the start of each visit to determine the treatment progression for each session.

Right rotation was assessed with the participant standing with arms extended at shoulder height and hands together. Pivoting on the right leg, the left heel comes off the floor with straight knees while the head, arms, trunk, and pelvis rotate right and return to the start position. This procedure was repeated for rotation left (see Figure 1).

Side-bending right was performed with the participant standing with feet shoulder width apart, hands together overhead and arms extended. Keeping the knees straight, participants glide the hips to the left and allow the head, arms, and trunk to tip to the right and return to the start position. This procedure was repeated for side-bending left (see Figure 2).

Sagittal plane forward bending (FB) and backward bending (BB) begin with the participant standing with feet shoulder width apart, arms extended, hands together, and back to the wall. Distance from heel to wall was determined by the participant's ability to touch the wall during FB or BB with knees extended and good form. During FB, the pelvis glides backward to touch the wall while the upper body reaches forward at the hip height and return to the start position (see Figure 3A). For BB, the pelvis glides forward while reaching with both arms up and overhead to touch the wall and return to the start position (see Figure 3B).

DTS Scoring

Each motion was assessed as non-aggravating or aggravating. Non-aggravating motion was defined as any motion that does not cause symptoms to peripheralize and/or increase the intensity of baseline symptoms. Aggravating motion was defined as any motion that causes peripheralization and/or increase of baseline symptoms. The DTI has a composite score of 6 points allowing scores to range from 0-6/6.

DTS Intervention

Interventions included patient education of the DTS principles, flexibility exercises, and core activation exercises prescribed based on the non-aggravating motions at each session. Flexibility exercises required participants to use a doorframe and stable chair with positioning of the lower extremities in stride and varied upper extremity positioning to bias the sagittal, frontal, and transverse planes (Figure 4). Core activation exercises consist of the integrated pelvic and upper extremity motions performed during testing using the non-aggravating positions (directions of tolerance) identified at the start of each visit (see Figures 1-3). Each flexibility and/or core stability exercise was performed for 10 repetitions, once per day as a home exercise program. Each participant received a total of 8 treatments (2 visits per week for 4 weeks).

Outcome Assessment

Participants were tested at visit one for the location and duration of symptoms, DTI, NPRS, ODQ, and FABQ-PA. The NPRS was administered at each session to establish pain scores for comparison between visits and over the course of treatment. The DTI was reassessed each session and all measures were reassessed on visit 8.

On visit 1, participants completed DTS testing protocol (DTI 0-6/6) with no treatment administered this session. Participants were reassessed on the DTS at visit 2 and results were recorded. Treatment began using DTS results on visit two. The DTI scores for visit 1 and 2 were used to determine intra-rater reliability. No greater than 2 days lapsed between visits 1 and 2. Intra-rater reliability was determined using the Intra-class Correlation Coefficient (ICC) model.[1,3]

The correlation between the outcome

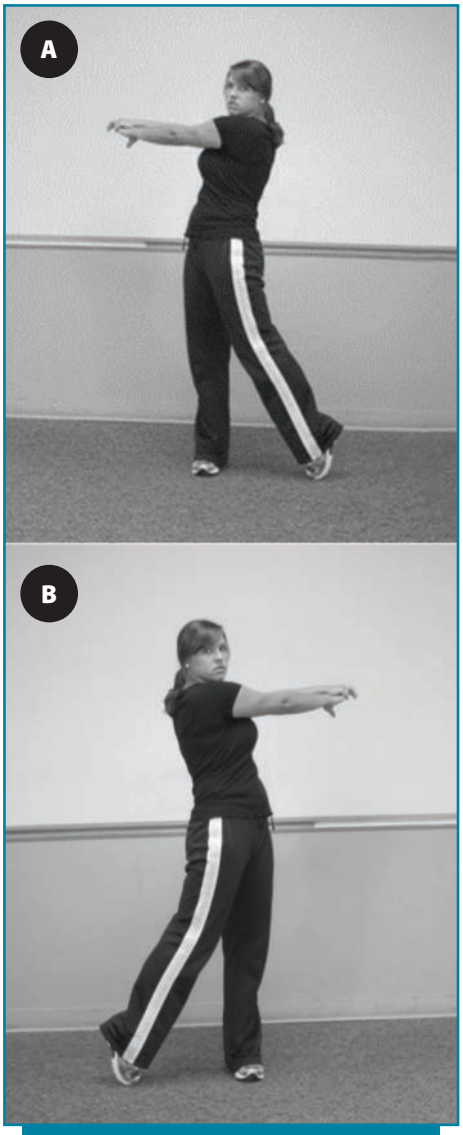


Figure 1. Transverse plane Direction Tolerance System testing and core stabilization. A, Right rotation. B, Left rotation.

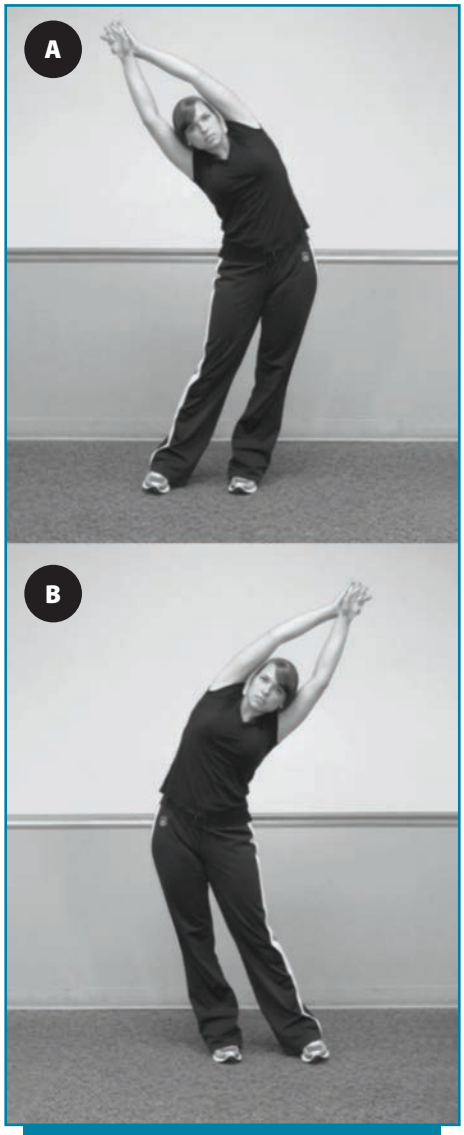


Figure 2. Frontal plane Direction Tolerance System testing and core stabilization. A, Side-bend right. B, Side-bend left.

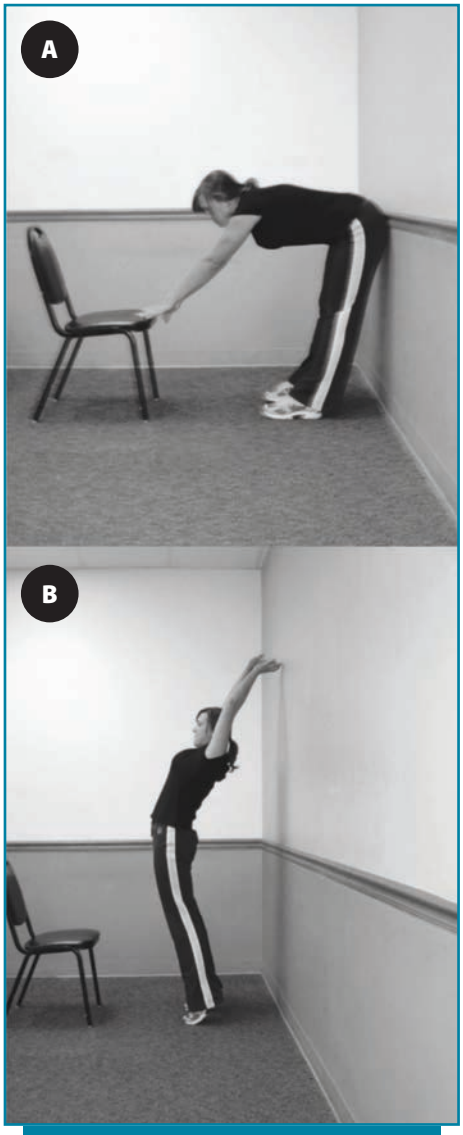


Figure 3. Sagittal plane Direction Tolerance System testing and core stabilization. A, Forward bending. B, Backward bending.

variables (DTI, ODQ, NPRS, FABQ-PA) and baseline demographic and clinical characteristics was analyzed using Spearman's Rank Correlation Coefficient. The change scores between visits 1 and 8 were analyzed using the Wilcoxon Signed Ranks Test. A logistic regression was performed to determine if baseline demographic and outcome variables could be used as a predictor of success when using the DTS to examine and treat patients with LBP. Success for treatment was defined as ≥ 50% improvement in ODQ scores. If 50% improvement was not reported, a 6-point change in ODQ score was deemed improved.[18]

The α criterion was set at 0.05 for all analyses. IBM Statistics 18.0 (SPSS Inc., Chicago, IL) software was used for analyses.

FINDINGS

Sixty-eight participants were recruited to participate in the study. Eight participants were excluded upon initial examination (2 presented with 2 or more neurologic signs, 6 had a DTI score of 0/6). A total of 60 participants met the inclusion criteria and all subjects completed the study. Baseline demographics (age and gender) and clinical characteristics (location and duration) are presented in Table 1.

Change Scores: DTI, ODQ, NPRS, FABQ-PA

Median scores for the 4 outcome variables measured (DTI, ODQ, NPRS, and FABQ-PA) were compared using the Wilcoxon Signed Ranks Test. Median values on all 4 measures indicate improvement for all outcomes ($p < 0.001$) as illustrated in Table 2.

Intra-rater Reliability

The DTI scores from visit one and two were used to assess intra-rater reliability. The ICC using absolute agreement yielded a reliability of 0.80 with an acceptable range of 0.45 to 1.0 (95% CI: 0.68 - 0.88) indicating good intra-rater reliability ($p < 0.001$).[27]

Treatment Success

Of the 60 subjects that completed the study, 75% achieved a positive outcome with 62% (37/60) classified as success and 13% (8/60) classified as improved. Twenty-five (15/60) were classified as treatment non-success after the comple-

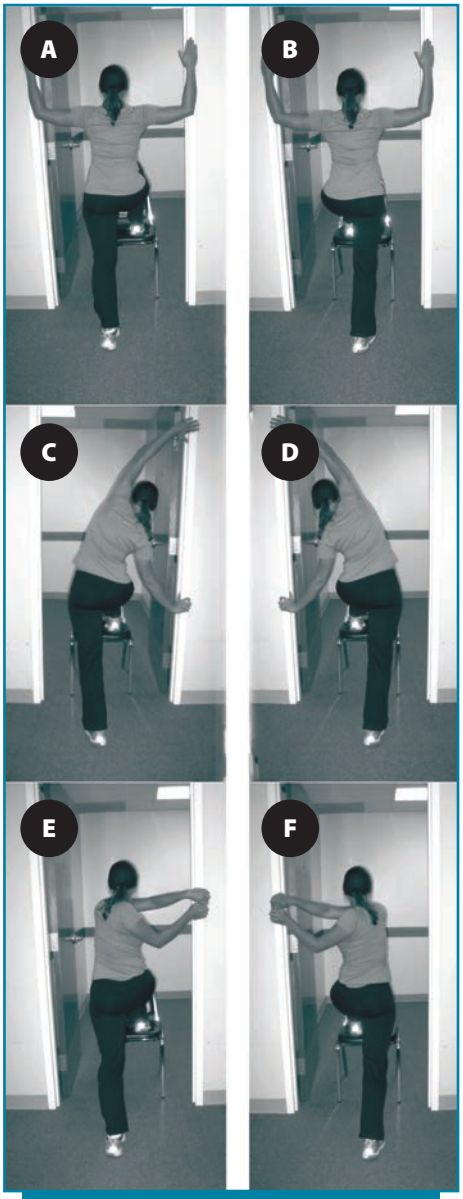


Figure 4. Flexibility protocol. A, Sagittal plane neutral with right foot up. B, Sagittal plane neutral with left foot up. C, Frontal plane side-bending right. D, Frontal plane side-bending left. E, Transverse plane right rotation right foot up. F: Transverse plane left rotation left foot up.

tion of 8 visits for not meeting the minimum criteria for change.

Correlation between Demographic Variables and Successful Outcome

Spearman's Rank Correlation Coefficient revealed no association between baseline demographics and a successful outcome. Additionally, the lack of association between these variables precluded a logistic regression from being conducted.

DISCUSSION

Overall, the DTS demonstrated good intra-rater reliability (ICC 0.80, 95% CI: 0.68-0.88, $p < 0.001$). The clinical experience of the physical therapist ranged from 2 to 26 years with one who had advanced specialist certification. Four of the 5 physical therapists demonstrated moderate to excellent reliability with ICC values ranging from 0.60 - 1.0 (95% CI: 0.68-0.88, $p < 0.001$), while the fifth therapist had an ICC of 0.45 (95% CI: 0.68-0.88, $p = 0.09$). The PI had a reliability of 1.0; however, this physical therapist had the most years of experience and was the developer of the DTS, which may contribute to this value. All other physical therapists had an entry level DPT degree with no advanced specialist certification. Establishment of intra-rater reliability is essential to demonstrate consistent application of the scoring criteria[27]; however, there is potential for rater bias when serial measures are taken by the same individual. The intra-rater reliability shown in this study suggests the DTS may be an effective examination tool for clinicians of all skill levels to implement. Interrater reliability was not established for this study, but should be investigated to further compare the agreement in scoring of the DTS across practitioners of all levels of experience. Lower ICC values for some of the therapists may have resulted from the training comprised of only patient simulation. Training with live patients who have pathology would provide therapists with the ability to see how a patient would respond to the movements and how to interpret the testing results. For clinicians with fewer years of experience, a patient simulation does not provide the same learning experience as a more complicated live patient case. Future study of the DTS should include training with live patients and blinding of scoring results between visits to protect against rater bias and improve grading criteria classification for consistency.[27]

The DTS demonstrated a success rate of 62% as defined by the ODQ for the treatment of patients with LBP over the course of a 4-week treatment period. Upon examination of success rates by the therapist, there appears to be variability across clinicians (Table 3). This difference may be due to several factors. First, the therapists with higher intra-rater reliability scores during DTS testing appear to have outcome success rates greater than 50%. This difference may be accountable to the training process, lack of accurate interpretation of the examination findings, especially by less experienced clinicians and the potential for bias as the examining physical therapist was also the treating clinician. Due to the fact that the DTS was inspired by evaluation systems like McKenzie and MSI, clinicians with training or exposure to these methods of examination may have increased accuracy with evaluation of patient response during testing.[28-32] Second, the therapeutic alliance between the clinician and patient may have contributed to success rates. Ferreira et al reported a positive therapeutic alliance correlated to improved outcome measures in patients with chronic LBP as measured by the Working Alliance Inventory.[33] This study did not measure the therapeutic alliance, but the potential influence in the success rates of subjects with chronic LBP should be considered in future research. The variability of success across physical therapists in this study may also be due to the difference in baseline measure scores of patients between clinicians. The physical therapists with lower success rates had patients with lower initial DTI scores and higher ODQ scores. This patient presentation with greater disability at baseline, as measured by the ODQ, may have contributed to the lack of success demonstrated at the end of 8 visits (Table 4). Potentially, a longer duration treatment may have shown greater success for these subjects.[34-36]

The DTS success rate should be compared to other classification systems using the same definition of success. When compared to the TBC, Fritz et al in 2003 compared the effectiveness of the TBC to therapy based on clinical practice guidelines in 78 subjects with LBP and achieved an overall 50% success rate.[37] The subjects in the 2003 study were all classified as acute LBP and had a mean ODQ score of 42.9 and NPRS of 6.5.[37] Fritz et al treated 243 subjects, where 75% had acute LBP, in 2009 using the TBC and achieved an overall success rate of 45%.[37] These subjects had a mean ODQ of 41.7 and NPRS of 5.6.[37] In this study, 38% of subjects were classified with acute LBP with mean baseline scores on the ODQ and NPRS of 33.4 and 4.7, respectively. Overall treatment success was achieved in 70% (16/23) of subjects with acute pain and 57% (21/37) of subjects with chronic pain. The value of 70% success in subjects with acute pain is significantly higher than the Fritz studies on the surface.[19,37] The high success may also be attributed to the baseline ODQ and NPRS scores of the subjects in this study being lower than previous investigations or to the concept of spontaneous recovery with acute LBP. Spontaneous recovery of acute LBP has been observed in the literature and there is

general agreement that once LBP becomes chronic the rate of spontaneous recovery rapidly diminishes from 80% to 90% to 33% to 41% of patients.[34,35,39] The rate of success using the DTS, specifically in patients with chronic LBP, may be attributed to the DTS intervention rather than spontaneous recovery. Alternatively, the baseline scores on the ODQ and NPRS being lower in this subject population may suggest that to meet the standard for improvement may not have required as much change as the subjects in the Fritz studies in 2003 and 2009.[19,37]

Baseline variables in this study did not show any statistically significant association to successful outcome. Hicks et al examined the use of a table-based stabilization program for the treatment of LBP.[40] Similarly, this study used the ODQ and FABQ-PA as outcome measures; however, Hicks identified 4 factors most predictive of success included: age less than 40 years, average straight leg raise greater than 91°, aberrant movements during sagittal plane lumbar range of motion, and a positive prone instability test.[40] Further investigation is warranted to see if these objective variables predict success for patients with LBP using the DTS.

Previous research examined the effect of stabilization exercises on LBP with biweekly visits for 8 weeks and 10 weeks.[40-42] The DTS study was conducted for 4 weeks; therefore, it is possible that longer duration treatment may improve success rates.

The DTS intervention was designed to have the patient perform 10 repetitions in all planar motions that are scored as tolerated beginning day one. In its current form, DTS does not delineate between direction tolerance and direction preference.[4,43-45] The DTS may have a greater treatment outcome if initial treatment used the direction of preference followed by integration of all tolerated directions over the course of intervention modeling MDT principles. For example, if a patient tolerated backward bending and right and left rotation during initial testing, but BB reduced or centralized symptoms, the therapist would initiate treatment using only BB on day one. At the next session, the clinician would then begin integrating the transverse plane motions.

While the DTS shows promise as an examination and intervention tool for clinicians, the study did exhibit limitations that should be investigated with further research. Continued exploration of the reliability and validity of the DTS as an examination and treatment tool should be investigated using clinicians across multiple levels of experience and advanced certification or credential. Other baseline characteristics and measured variables should be incorporated to determine if any association may be found with a successful outcome, such as tolerated plane of motion on visit one with outcome success. Additionally, using DTS intervention over a longer treatment duration, incorporating direction of preference first followed by direction tolerance, and comparing DTS

Table 1. Baseline Demographics of Participants (n=60)

Variable	Number
Participants	60 (100%)
Age	52 ± 16.00
Males	21 (35%)
Females	39 (65%)
Low Back Pain Only	20 (33%)
Symptoms Distal to Low Back	40 (67%)
Symptoms < 90 days	23 (38%)
Symptoms ≥ 90 days	37 (62%)

Values represent mean ± standard deviation or n (%)

Table 2. Median (Interquartile Range) Outcomes for Visits 1 and 8

Measure	Visit 1	Visit 8	Change
DTI	3 (2)	5 (2)	+2
ODQ	33.40 ± 15.22	18.42 ± 15.60	-14.98 (-44.85%)
NPRS	4.66 ± 1.95	2.49 ± 1.98	-2.17
FABQ-PA	15.95 ± 5.20	6.65 ± 6.61	-9.30

Note: $p < 0.001$ for all comparisons

Abbreviations: DTI, Direction Tolerance Index; ODQ, Oswestry Disability Questionnaire; NPRS, Numeric Pain Rating Scale; FABQ-PA, Fear-Avoidance Beliefs Questionnaire – Physical Activity Subscale

Table 3. Oswestry Disability Questionnaire Outcome by Therapist (N=5) and Group (N=60)

Therapist	Years in Outpatient Practice	N	Success*	Improved*	Non-Success*
PT1	26	14	14 (100%)	0 (0%)	0 (0%)
PT2	9	12	5 (42%)	2 (17%)	5 (42%)
PT3	2	12	8 (67%)	1 (8%)	3 (25%)
PT4	2	10	4 (40%)	2 (20%)	4 (40%)
PT5	5	12	6 (50%)	3 (25%)	3 (25%)
Group		60	37 (62%)	8 (13%)	15 (25%)

*Values n and (%)

Abbreviation: PT, physical therapist

Table 4. Direction Tolerance Index Score Visit 1 and Treatment Outcome

DTI Score	N	Success	Improved	Non-Success
1	9	5	1	3
2	20	14	4	2
3	12	7	2	3
4	11	7	0	4
5	6	4	0	2
6	2	0	1	1
Total	**60**	**37**	**8**	**15**

Abbreviation: DTI, Direction Tolerance Index

to other classification and treatment systems should be examined.

CONCLUSION

For patients with LBP, the DTS may be a useful tool for examination and treatment. Patients with chronic LBP treated using the DTS demonstrated good tolerance to this system as preliminarily compared to similar treatment models. The DTS is a reliable tool that is easy to administer and requires minimal training for successful examination and treatment of patients with LBP. Future research may look to expand the DTS to identify and treat using the patient direction of preference prior to implementation of direction tolerance and compare DTS to other classification systems for patients with LBP.

REFERENCES

1. Waddell G. A new clinical model for the treatment of low back pain. *Spine*. 1987;12:632-644.
2. Engel GL. The need for a new medical model: a challenge for biomedicine. *Science*. 1977;196:129-136.
3. Abenhaim L, Rossignol M, Gobeille D, Bonvalot Y, Fines P, Scott S. The prognostic consequences in the making of the initial medical diagnosis of work-related back injuries. *Spine*. 1995;20:791-795.
4. Bouter LM, van Tulder MW, Koes BW. Methodologic issues in low back pain research in primary care. *Spine*. 1998;23:2014-2020.
5. McKenzie R, May S. *The Lumbar Spine: Mechanical Diagnosis &Therapy*. Minneapolis, MN: Orthopedic Physical Therapy Products; 2003.
6. Spitzer WO. Approach to the problem. *Spine*. 1987;12(Suppl):9-11.
7. Von Korff M. Studying the natural history of back pain. *Spine*. 1994;19(Suppl):S2041-2046.
8. Delitto A, Erhard RE, Bowling RW. A treatment based classification approach to low back syndrome: identifying and staging patients for conservative treatment. *Phys Ther*. 1995;75:470-489.
9. Stanton TR, Fritz JM, Hancock MJ, et al. Evaluation of a treatment-based classification algorithm for low back pain: a cross-sectional study. *Phys Ther*. 2011;91:496-509. doi: 10.2522/ptj.20100272. Epub 2011 Feb 17.
10. Sahrmann S. *Diagnosis and Treatment of Movement Impairment Syndromes*. St. Louis, MO: Mosby Inc; 2002.
11. Sullivan PE, Markos P. *Clinical Decision Making in Therapeutic Exercise*. Norwalk, CT: Appleton & Lange; 1995.
12. Minick KI, Kiesel KB, Burton L, Taylor A, Plinsky P, Butler RJ. Interrater reliability of the functional movement screen. *J Strength Cond Res*. 2010;24(2):479-486. doi: 10.1519/JSC.0b013e3181c09c04.
13. Fritz JM, Irrgang JJ. A comparison of a modified Oswestry Low Back Pain Disability Questionnaire and the Quebec Back Pain Disability Scale. *Phys Ther*. 2001;81:776-788.
14. Davidson M, Keating JL. A comparison of five low back disability questionnaires: reliability and responsiveness. *Phys Ther*. 2002;82:8-24.
15. Fritz J. Invited Commentary: Disentangling classification systems from their individual categories and the category-specific criteria: an essential consideration to evaluate clinical utility. *J Man Manip Ther*. 2010;18:205-208. doi: 10.1179/106698110X12804993427162.
16. Fairbank JC, Couper J, Davies JB, O'Brien JP. The Oswestry Low Back Pain Disability Questionnaire. *Physiotherapy*. 1980;66:271–273.
17. Hudson-Cook N, Tomes-Nicholson K, Breen A. A revised Oswestry disability questionnaire. In: Roland MO, Jenner JR, eds. *Back Pain: New Approaches to Rehabilitation and Education*. New York, NY: Manchester University Press; 1989:187–204.
18. Deyo RA, Battie M, Beurskens AJ, et al. Outcome measures for low back pain research: a proposal for standardized use. *Spine*. 1998;23:2003–2013.
19. Fritz JM, Hebert J, Koppenhaver S, Parent E. Beyond minimally important change: defining a successful outcome of physical therapy for patients with low back pain. *Spine (Phila Pa 1976)*. 2009;34(25):2803-2809. doi: 10.1097/BRS.0b013e3181ae2bd4.
20. Childs JD, Piva SR, Fritz JM. Responsiveness of the numeric pain rating scale in patients with low back pain. *Spine (Phila Pa 1976)*. 2005;30:1331–1334. doi: 10.1097/01.brs.0000164099.92112.29.
21. Jensen MP, Turner JA, Romano JM, Fisher LD. Comparative reliability and validity of chronic pain intensity measures. *Pain*. 1999;83:157-162.
22. Hart DL, Werneke MW, George SZ, et al. Screening for elevated levels of fear-avoidance beliefs regarding work or physical activities in people receiving outpatient therapy. *Phys Ther*. 2009;89:770-785. doi: 10.2522/ptj.20080227. Epub 2009 Jun 18.
23. Hart DL, Werneke MW, Deutscher D, et al. Effect of fear-avoidance beliefs on physical activities on a model that predicts risk-adjusted functional status outcomes in patients treated for a lumbar dysfunction. *J Orthop Sports Phys Ther*. 2011;41:336-345. doi: 10.2519/jospt.2011.3534. Epub 2011 Apr 6.
24. George SZ, Fritz JM, Childs JD. Investigation of elevated fear-avoidance beliefs for patients with low back pain: a secondary analysis involving patients enrolled in physical therapy clinical trials. *J Orthop Sports Phys Ther*. 2008;38:50-58. doi:

10.2519/jospt.2008.2647. Epub 2008 Jan 22.
25. Fritz JM, George SZ, Delitto A. The role of fear-avoidance beliefs in acute low back pain: relationships with current and future disability and work status. *Pain*. 2001;94:7-15. doi: 10.1016/s0304-3959(01)00333-5.
26. George SZ, Fritz JM, Erhard RE. A comparison of fear-avoidance beliefs in patients with lumbar spine pain and cervical spine pain. *Spine (Phila Pa 1976)*. 2001;26:2139-2145. doi: 10.1097/00007632-200110010-00019.
27. Portney LG, Watkins MP. *Foundations of Clinical Research: Applications to Practice*. Upper Saddle River, NJ: Pearson Prentice Hall; 2009.
28. Harris-Hayes M, Van Dillen LR. The inter-tester reliability of physical therapists classifying low back pain problems based on the movement system impairment classification system. *PM R*. 2009;1(2):117-126. doi: 10.1016/j.pmrj.2008.08.001. Epub 2008 Dec 27.
29. Clare HA, Adams R, Maher CG. Reliability of McKenzie classification of patients with cervical or lumbar pain. *J Manipulative Physiol Ther*. 2005;28:122-127. doi: 10.1016/j.jmpt.2005.01.003.
30. Kilpikoski S, Airaksinen O, Kankaanpaa M, Leminen P, Videman T, Alen M. Interexaminer reliability of low back pain assessment using the McKenzie method. *Spine (Phila Pa 1976)*. 2002;27:E207-214. doi: 10.1097/00007632-200204150-00016.
31. Kilby J, Stigant M, Roberts A. The reliability of back pain assessment by physiotherapists, using a 'McKenzie algorithm'. *Physiotherapy*. 1990;76:579-583.
32. Fritz JM, Delitto A, Vignovic M, Busse RG. Interrater reliability of judgments of the centralization phenomenon and status change during movement testing in patients with low back pain. *Arch Phys Med Rehabil*. 2000;81:57-61. doi: 10.1016/s0003-9993(00)90222-3.
33. Ferreira PH, Ferreira ML, et al. The therapeutic alliance between clinicians and patients predicts outcome in chronic low back pain. *Phys Ther*. 2013,93:470-478. doi: 10.2522/ptj.20120137. Epub 2012 Nov 8.
34. Gurcay E, Bal E, Hasturk AE, et al. Acute low back pain: clinical course and prognostic factors. *Disabil Rehabil*. 2009;31(10):840-845. doi: 10.1080/09638280802355163.
35. Costa LdCM, Maher CG, et al. The prognosis of acute and persistent low back pain: a meta-analysis. *CMAJ*. 2012;184(11):E613-E624. doi: 10.1503/cmaj.111271. Epub 2012 May 14.
36. Fritz JM, George S. The use of a classification approach to identify subgroups of patients with acute low back pain. Interrater reliability and short-term treatment outcomes. *Spine (Phila Pa 1976)*. 2000;25:106-114. doi: 10.1097/00007632-200001010-00018.
37. Fritz JM, Delitto A, Erhard RE. Comparison of classification-based physical therapy with therapy based on clinical practice guidelines for patients with acute low back pain: a randomized clinical trial. *Spine (Phila Pa 1976)*. 2003;28:1363-1371; discussion 1372. doi: 10.1097/01.BRS.0000067115.61673.FF.
38. Stanton TR, Fritz JM, Hancock MJ, et al. Evaluation of a treatment-based classification algorithm for low back pain: a cross-sectional study. *Phys Ther*. 2011;91:496-509. doi: 10.2522/ptj.20100272. Epub 2011 Feb 17.
39. Coste J, Delecoeuillerie G, Cohen LA, et al. Clinical course and prognostic factors in acute low back pain: an inception cohort study in primary care practice. *BMJ*. 1994;308(6928):577.
40. Hicks GE, Fritz JM, Delitto A, McGill SM. Preliminary development of a clinical prediction rule for determining which patients with low back pain will respond to a stabilization exercise program. *Arch Phys Med Rehabil*. 2005;86(9):1753-1762. doi: 10.1016/j.apmr.2005.03.033.
41. McGill SM. Low back stability: from formal description to issues for performance and rehabilitation. *Man Ther*. 2002;7(4):183-192. doi: 10.1054/math.2002.0478.
42. O'Sullivan PB, Phyty GD, Twomey LT, Allison GT. Evaluation of specific stabilizing exercises in the treatment of chronic low back pain with radiologic diagnosis of spondylosis or spondylolis-thesis. *Spine (Phila Pa 1976)*. 1997;22:2959-2967.
43. Long, A, May S, Fung T. The comparative prognostic value of directional preference and centralization: a useful tool for front line clinicians. *J Man Manip Ther*. 2008;16:248-254. doi: 10.1179/106698108790818332.
44. Werneke MW, Hart DL, Resnik L, Stratford PW, Reyes A. Centralization: prevalence and effect on treatment outcomes using a standardized operational definition and measurement method. *J Orthop Sports Phys Ther*. 2008;38:116-125. doi: 10.2519/jospt.2008.2596.
45. Hefford C. McKenzie classification of mechanical spinal pain: Profile of syndromes and directions of preference. *Man Ther*. 2008;13:75-81. doi: 10.1016/j.math.2006.08.005. Epub 2006 Dec 22.

Follow Your Pathway to Success

Discover Barral Manual Therapies

Online Learning Workshops:

Check website for your local time zone.

Visceral Manipulation: Abdomen 1; Virtual Component (VM1-VC)

– Feb 13 - 14, 2021
– Apr 10 - 11, 2021
– May 22 - 23, 2021
– Jul 31 - Aug 1, 2021

In-Person Workshops:

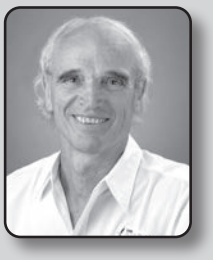
**This is a Lab Class. Pre-requisite is a 2-Day VM1-VC (Visceral Manipulation 1: Lecture Content; Distance Instruction).*

Visceral Manipulation; The Abdomen (VM1)

Albuquerque, NM*	Feb 19 - 21, 2021
San Diego, CA*	Feb 19 - 21, 2021
Ottawa, ON*	Mar 12 - 14, 2021
Salt Lake City, UT*	Mar 19 - 21, 2021
Hartford, CT*	Mar 26 - 28, 2021
Chicago, IL*	Apr 23 - 25, 2021
Baltimore, MD*	Apr 30 - May 1, 2021

Neural Manipulation 1; Neuromeningeal Manipulation: An Integrative Approach to Trauma (NM1)

Phoenix, AZ	Feb 19 - 21, 2021
Calgary, AB	Mar 12 - 14, 2021
Vancouver, BC	Mar 26 - 28, 2021
Denver, CO	Mar 26 - 28, 2021
Minneapolis, MN	May 7 - 9, 2021
Portland, OR	May 14 - 16, 2021



Jean-Pierre Barral
DO, MRO(F), RPT
Developer

Additional dates & locations:
CALL
866-522-7725, Ext. 2
CLICK
Barralinstitute.com

THE BARRAL INSTITUTE
Putting Health In Your Hands

Inquire about our Core-Pak Training and Certification Package
SAVE MORE THAN 30%
SATISFACTION GUARANTEED!

APPROVED PROVIDER for Continuing Education

$100 PER MONTH

All classes subject to change. For updates due to COVID-19, please check our website for the most updated information.

Discover the Complete D'Ambrogio Curriculum

In-Person Workshops:

Total Body Balancing 1 (TBB1)

Portland, OR	May 13 - 16, 2021
St. Louis, MO	Oct 28 - 31, 2021
Orange County, CA	Nov 4 - 7, 2021
Calgary, AB	Nov 18 - 21, 2021

Lymphatic Balancing; Upper Quadrant (LBUQ)

San Francisco, CA	May 6 - 9, 2021
San Diego, CA	Nov 11 - 14, 2021

Lymphatic Balancing; Lower Quadrant (LBLQ)

Phoenix, AZ	Oct 14 - 17, 2021

Energetic Balancing 1; Musculoskeletal System (EB1-MS)

Palm Beach, FL	May 13 - 16, 2021

Kerry D'Ambrogio
DOM, AP, PT, DO-MTP
Developer

Additional dates & locations:
CALL
800-311-9204, Ext. 2
CLICK
DAmbrogioInstitute.com

DAI D'AMBROGIO Institute

Ask about DVD Home Study & Core-Pak Special Pricing

Win a FREE Entry-Level Workshop at DAmbrogioInstitute.com/win

Barral & D'Ambrogio Institutes are endorsed by the International Alliance of Healthcare Educators.

Clinical Reasoning in the Maitland-Australian Approach Resulting in Treatment Directed at the Cervical Spine for a Patient with Temporomandibular Disorder: A Case Study

Jeffrey Deguire, PT, COMT, FAAOMPT[1]
Clare Jones, PT, OCS, COMT, CFMT, FAAOMPT[2]
Chris Showalter, PT, DPT, OCS, FAAOMPT[3]

[1]Mountain Land Physical Therapy, Billings, MT
[2]Bellingham Physical Therapy, Bellingham, WA
[3]Program Director, MAPS Accredited Fellowship in Orthopedic Manual Therapy, Cutchogue, NY

ABSTRACT

Background and Purpose: A correlation between temporomandibular disorder (TMD) and cervical spine dysfunction has been reported in the literature. However, there are a lack of studies that look at the use of manual therapy directed at the cervical spine in the treatment of TMD. This case study describes a patient that was initially referred to physical therapy for TMD but through the use of a thorough assessment and clinical reasoning it was determined that her cervical spine was the primary source of the symptoms. Treatment was therefore conducted towards the cervical spine instead of the temporomandibular joint (TMJ). The purpose of this case study is to demonstrate the importance of a thorough examination and the use of effective clinical reasoning in the treatment of TMD. **Methods:** Evaluation of the TMJ as well as the cervical spine was completed using the Maitland approach. The main focus of the treatment was to the cervical spine. **Findings:** Improved outcome scores on both the NDI and TMD Disability Index Questionnaire as well as a decrease in reported symptoms are reported in this case report. **Clinical Relevance:** Clinical reasoning is an important aspect of the physical therapy evaluation and treatment of all patients. Temporomandibular disorder is a multifactorial disorder and presents with pain that can be referred from other structures. **Conclusion:** Cervical spine mobilizations may be useful when treating TMD. Further studies are needed to investigate this correlation and effect of interventions directed toward the cervical spine for patients with TMD.

Key Words: craniomandibular disorder, spinal mobilizations, TMJ

INTRODUCTION

Temporomandibular disorder (TMD), also called craniomandibular disorder, is a term used to describe pain in and around the jaw. It refers to the stomatognathic system that is made up of the temporomandibular joint, the masticatory systems, and the related organs and tissues within this region.[1] Temporomandibular disorder is a multifactorial disorder that, when treating, the clinician needs to consider all regions that could potentially be the cause of the pain including imbalance among occlusal, anatomical, psychological, and neuromuscular factors that can promote neck and head structural dysfunction.[2] According to Rakesh et al,[3] evidence suggests that 50% to 75% of the general population exhibit at least one sign of TMD while 25% manifest symptoms. They reported that women are more affected than men, especially women over the age of 55 years.[4]

The majority of evidence only reports on possible correlations between cervical dysfunction and the temporomandibular joint (TMJ).[5-7] A study by De Laat et al[8] indicated a correlation between cervical segmental limitations, especially at C0-3, was more common in patients with reported TMJ pain than in controls. Another study found a direct relationship between postural head position and amount of available range of opening of the jaw.[9] In their study, Rakesh et al[3] suggested that head and body posture can be related to initial onset, development, and perpetuation of TMD. Minimal research has been conducted looking at the effects of manual therapy to the cervical spine in the management of TMD. The authors of the current study are aware of only one study that examined the effect of treatment solely directed at the cervical spine upon TMJ pain.[10] The study was successful in showing that manual therapy directed solely at the cervical spine was helpful in decreasing pain in the TMJ. Interestingly, the patient in this case would have been excluded from the above study based on the exclusion criteria that included the diagnosis of fibromyalgia and using a night guard within 3 months of joining the study.

The TMJ evaluation used in this case study followed the process described in Maitland's Peripheral Manipulation text.[11] The Maitland-Australian approach is a patient centric evaluation that uses patient's signs and symptoms coupled with a hands-on evaluation using active physiological movements, passive physiological movements, and passive accessory movements to find the patient's comparable sign that relates to their main complaint. Maitland defines the comparable sign as a "joint or neural sign that is any combination of pain, stiffness, and spasm that the clinician finds during examination and considers comparable with the patient's symptoms."[12]

Jones and Rivett,[13] in their text *Clinical Reasoning for Manual Therapists*, define clinical reasoning as "the process in which the therapist, interacting with the patient and significant others (eg, family and other healthcare team members), structures meaning, goals and health management strategies based on clinical data, client choices and professional judgement and knowledge." It is multidimensional, hypothesis oriented, collaborative, and reflective.[13] The purpose of this case study is to demonstrate the importance of a thorough examination and the use of effective clinical reasoning in the treatment of TMD.

CASE DESCRIPTION

History

The patient was a 25-year-old female who presented to physical therapy for right sided jaw pain. She reported that initial symptoms began after having her wisdom teeth removed

10 years prior where she had pain with eating and talking. She also reported intermittent flare ups resulting in intense pain and the inability to open her jaw at all for a duration of up to 7 days at which time she was only able to eat soft foods. Her physician had prescribed muscle relaxants in the past; however, they were ineffective in reducing her symptoms. She also had a history of grinding her teeth at night and was given a night guard by her dentist that helped with the pain despite intermittent usage. The patient had a habit of biting her finger nails and holding pens in her mouth when at work and reported intermittent pain to both sides of her nose when chewing. Other pertinent history reported included a diagnosis of fibromyalgia 7 years ago with symptoms starting in her neck bilaterally. She had been seen by another physical therapist approximately 5 years ago for her neck and low back pain when she experienced clicking and popping in the left side of her jaw. She experienced the clicking in her jaw when she opened her mouth to talk. No other pertinent dental history was reported. Current medications and supplements taken include Cyclobenzaprine as a muscle relaxant, Levothyroxine for hypothyroidism, Nexplanon for birth control, Lorazepam for anxiety, asthma inhalers, curcumin, probiotics, and allergy medications.

The patient reported experiencing tightness in her neck with pressure in both ears (R > L) and eyes (R > L). She also reported that she suffers from headaches, 3 to 4 times per week, that manifest in the right side of her head. She was employed at the local newspaper that included writing articles and prolonged periods of sitting at her computer. Though she reported actively trying to maintain good posture throughout her work day, she stated that she continued to experience increased pain as the day progressed. She reported feeling that her life is busy and that she experiences high levels of stress most days. Her other history included 3 automobile accidents (2008, 2014, and 2017), with the last one resulting in a minor concussion. She also suffered from mild seizures for which she is under the care of a neurologist. The patient had tried chiropractic care and massage therapy for her neck, low back, and jaw pain with little relief of her symptoms.

Patient Examination

During the initial visit, the patient was thoroughly examined using the TMJ evaluation outlined in Maitland's Peripheral Manipulation text.[11] Results from the physical evaluation are recorded in Table 1.

Table 1. Examination Findings During Initial Physical Therapy Visit

Examination Test	Result
Posture:	Slight tilt of head to the left
Prominence of facial and neck muscles:	Prominent right masseter muscle
Clenching behaviors visible?	No
Parafunctional behaviors:	History of grinding teeth, nail biting, and holding pen in mouth
Intraoral Environment:	No issues found
Active ROM – Completed in Sitting	
Mandibular Depression:	52 mm Deviations: none Pain: positive Sounds: clicking in mid-range of movement 3 knuckles in mouth? Able to insert 4 knuckles into mouth
Lateral Deviations:	Right: 18 mm Left: 16 mm Sounds: none Pain: none
Protrusion:	8 mm Sounds: none Pain: none
C-Spine: ROM with OP:	
Flexion:	37°, pain in mid-thoracic spine
Extension:	70°, pull in anterior neck muscles
Rotation: Right:	60°, pain-free
Left:	55°, pain-free
Side bending: Right:	35°, pain-free
Left:	30° with pain in upper cervical spine
Passive Accessories:	Comparable sign at C3 with right UPA C3-4 and CPA on C3 spinous process
Palpation:	
Head/Neck/TMJ/Masticatory Muscles:	Spasm noted in cervical paraspinals bilaterally, right masseter and bilateral SCM
TM Joint Assessment	
Joint Play: Assessment Inferior, lateral/medial, anterior and caudal-anterior-medial glide	All passive accessory joint assessments were pain-free. Patient had a difficult time allowing jaw to fully relax during passive assessment
Special Tests:	
Beighton scale:[1]	7/9
Cervical flexion-rotation test:[22]	Positive to the right @ 40° of rotation

Abbreviations: ROM, range of motion; OP, overpressure; UPA, unilateral postero-anterior; CPA, central postero-anterior; TMJ, temporomandibular joint; SCM, sternocleidomastoid

Based on current literature showing a strong correlation between TMJ and the cervical spine, the examination focused not only on the jaw, but further explored the cervical spine as a contributing factor. The patient's reports of right sided headaches led to the completion of an upper cervical differentiation test in order to determine if her headaches were cervicogenic in nature which would have indicated a cervical spine dysfunction. It was concluded that the patient's headaches were likely cervicogenic headaches due to the reproduction of the patient's right sided head pain, cervical spine pain, and right sided jaw pain with right unilateral posteroanterior (UPA) pressure on the facet joint of C3-4 with the spine in neutral. Only active jaw opening resulted in clicking and pain; however, she felt it was negligible compared to the symptom reproduction from the cervical spine. A stainless-steel ruler marked in millimeters was used for the range of motion (ROM) measurements of the TMJ. The interrater reliability of measuring TMJ motions with a ruler has been shown to be good to excellent (0.90 – 1.0) in the literature.[14] A universal goniometer was used for cervical spine ROM measurements that has also been shown in the literature to have good intratester reliability.[15] Based on the findings of the evaluation, it was determined that the patient's comparable sign, as defined earlier, was a UPA on the right C3-4 facet joint.

Outcome Measures

Two patient-reported outcome measures were administered upon initial visit, the Neck Disability Index[16,17] (NDI) and a modified version of the TMD Disability Index Questionnaire.[18] Research studies have reported the validity of the NDI as an outcome measure.[17,19] There do not appear to be any studies that have evaluated the validity or reliability of the TMD Disability Index Questionnaire; however, it is the most widely used questionnaire in research and in the clinical setting for this population.[18,20] In fact, there appear to be no fully validated TMJ specific questionnaires. The initial and final results from the outcome measures are recorded in Table 2.

Table 2. Patient-reported Outcome Measures

Outcome Measure	Result	
	Initial Visit	Final Visit
Neck Disability Index – MDC 10%	12/50 = 24%	5/50 = 10%
TMD Disability Index Questionnaire	6/36 = 16.7% Initial visit	0/36 = 0%

Abbreviation: MDC, minimal detectable change; TMD, temporomandibular dysfunction

TREATMENT

Based on the results of the examination, the patient's initial treatment was focused on her cervical spine. Her comparable sign was found at C3-4 facet joint on the right. She was initially treated in prone using a central posteroanterior (CPA) mobilization at spinous process of C3 Grade III 2 x 2-minute bouts and a right unilateral posteroanterior mobilization C3-4 facet joint Grade III- 3 x 2-minute bouts. Maitland grades of movement[21] were used to describe the joint mobilizations conducted. She was also educated on the resting position of the jaw (teeth slightly open with the anterior third of the tongue resting on the roof of the mouth directly behind the upper teeth), avoiding oral habits such as chewing on her pens at work, as well as the potential benefits of using her night guard regularly. Through the first half of her physical therapy sessions, the majority of the treatment was focused at C3 as this was deemed the most comparable sign; however, other joint signs[21] throughout the cervical and thoracic spine were found. These were also treated as deemed appropriate by the therapist. Therefore, each session consisted of an assessment of joint mobility through cervical to mid-thoracic spine and treatment based on the findings.

Table 3 describes all treatments administered to the patient during her physical therapy visits. The patient was seen for a total of 14 visits over the course of 14 weeks on an average of 1-2x/week when able. Travel for work was a limiting factor for her regular attendance. Due to the patient's co-morbidities, she presented with other complaints throughout her body at subsequent visits. Treatment for these complaints was provided to these other areas as well. These treatments are also reported in Table 3.

RESULTS

The patient showed positive outcomes on both the NDI and TMD Disability Index Questionnaire. Both tests showed improved scores across the time she was attending Physical Therapy as reported in Table 2. The patient's score on the TMD Disability Index Questionnaire was 0% by visit #11; this equals a change in score of 16.7%. Her score on the NDI recorded at the final visit was 5/50 (10%), which equals a change in score of 14%. This is clinically significant as the minimal detectable change (MDC) for the questionnaire is 5 to 10 points out of 50. This equals 10% to 20%.[9]

The patient regularly reported a decrease in jaw pain throughout and at the end of her course of treatment. Each visit she reported feeling that the treatment to her neck was helpful for maintaining and improving her active ROM, as well as keeping her headaches from recurring as often or as intensely.

The patient reported decreased frequency of headaches to one time every other week with a decrease in the intensity and duration. She demonstrated improved active ROM of cervical flexion to 55°, an increase of 18°, without pain, and bilateral rotation to 80°, an increase of 20° to the right and 25° to the left. There were no reports of pain with any cervical movements. The cervical flexion-rotation test was negative for pain, with 55° of motion to each side, which was an increase of 15° to the right. She maintained the TMJ active ROM that she originally presented with; however, she reported complete resolution of pain and clicking with all movements. She also reported minimal muscle spasm in cervical paraspinals and facial muscles. The only symptom that she continued to report posttreatment was the "pulling" pain that she felt through the anterior soft tissue of her neck with end range cervical extension.

A 3-month follow-up phone call with the patient indicated that she continued to feel relief from her original jaw pain and clicking, continued decreased frequency of headaches to at most 1x/week depending on her work load, and overall less cervical spine pain including while sitting at the computer for work. She reported 3/10 pain level at worst while sitting for periods > 2 hours at the computer. It was suggested to the patient that she continue with further treatment to address the ongoing symptoms in her neck but she decided to stop treatment as she felt the remaining symptoms were manageable.

DISCUSSION

This case study describes the treatment of a 25-year-old female that presented to the clinic specifically for TMJ pain and clicking.

Table 3. Treatment Applied During Each Physical Therapy Visit

Visit #	OMT Intervention Relating to TMD	Other OMT Interventions	Other Interventions
1	CPA C3 Grade III- and R UPA C3-4 Grade III- 3 x 2 min bouts each	---	Patient education regarding resting position of jaw, diet modification, and the need to stop putting pens in her mouth
2	CPA C2 Grade III- and R UPA C3-4 Grade III- 3 x 2 min bouts each	R UPA T4 Grade III 3 x 2 min bouts	Postural education for work with sitting at computer including proper monitor positioning and sitting posture
3	CPA C2 Grade III- and R U11PA C3-4 Grade III- 3 x 2 min bouts each	R UPA T4 Grade III 3 x 2 min bouts	Pectoralis and thoracic spine stretching over foam roll
4*	R UPA C4-5 in sidelying and supine Grade III with end range MWM into R rotation 3 x 2 min bouts each	---	Seated eccentric shoulder flexion, R eccentric shoulder abduction x 20 each using 4# cables with sustained R cervical rotation
5	CPA C3 Grade IV 2 x 3 min bouts	CPA T5-6 Grade IV+ 2 x 2 min bouts	HEP review
6	CPA C3 Grade IV 2 x 3 min bouts	CPA T5-6 Grade IV+ 2 x 2 min bouts and STM to mid-thoracic paraspinals	Prone on elbows active cervical extension and rotation 1 x 20 each
7	CPA C3 Grade IV 2 x 3 min bouts and STM sub-occipital release R > L and manual cervical traction x 5 min hold	---	---
8	R UPA C3 Grade IV 3 x 3 min bouts	R UPA T4-5 Grade IV+ 3 x 3 min bouts and STM to L mid-thoracic paraspinals	---
9	CPA C5 Grade IV--, 2 x 2 min bouts, CPA C2 Grade IV- 2 x 2 min bouts and R UPA C1 Grade IV- 2 x 1 min bouts	---	---
10	---	Right UPA L5-S1 Grade IV- 3 x 3 min bouts	HEP review, Ankle 4-way exercises with medium exercise band for LE strengthening and balance
11	R UPA C2 Grade IV- 3 x 2 min bouts	CPA C7-T1 Grade IV- x 2 bouts and STM to upper/mid thoracic paraspinals	---
12	Bilateral C1 transverse mobilizations in supine Grade IV 3 x 1 min bouts each direction	---	---
13	R transverse mobilizations on C1 Grade IV 3 x 2 min bouts and R UPA C6-7 Grade IV- 3 x 2 min bouts	---	---
14	---	Right UPA L5-S1 Grade IV 3 x 3 min bouts, CPA T4-5 Grade IV—3 x 2 min bouts and STM to R mid-thoracic paraspinals	---

*Visit number 4 was conducted by another physical therapist due to primary physical therapist being out of town
Abbreviations: OMT, orthopedic manual therapy; TMD, temporomandibular disorder; CPA, central postero-anterior; R, right; UPA, unilateral postero-anterior; min, minute; MWM, mobilization with movement; STM, soft tissue mobilization; HEP, home exercise program; L, left; LE, lower extremity

Following a thorough examination, it was hypothesized that her cervical spine was likely the leading factor in her symptoms due to the reproduction of her TMJ pain with palpation to the cervical spine. No reproduction of pain symptoms was found with passive assessment of her TMJ. Manual therapy was then focused on her cervical spine for the purpose of reducing her TMJ symptoms. Direct correlations between the TMJ and cervical spine are supported in the literature. Therefore, using the previously discussed studies and taking into consideration the patient's presentation and comparable sign, her cervical spine became the focus of manual treatment. As a result of the treatment, she began reporting a decrease in pain and clicking in her TMJ with activity. As treatment progressed, other joint signs were found throughout her cervical and thoracic spines and were also addressed. Over the course of the treatment, she noted an improvement in her headache intensity and frequency as well as decreased neck pain and improved ROM. By treating throughout the cervical and thoracic spines, she was able to achieve full neck flexion without feeling pain in the upper thoracic spine. The patient reported decreased neck pain and headache frequency while sitting at her desk at work.

The patient was seen for 14 visits over a span of 3.5 months due to inconsistently attending physical therapy. She was limited in time due to her work schedule. Despite her varying attendance, she continued to show a steady improvement over her course of treatment.

The results of this case study demonstrate the importance of using a patient centric model in the examination of patients in physical therapy. The Maitland-Australian approach was used in this case, which focuses not only on the biomedical information that we think we know based on patient diagnosis, but also, and more importantly at times, the patient's presentation. Maitland likens this concept of cross referencing both our biomedical knowledge and the patient's presentation to a permeable brick wall.[9] The left side of the wall contains all the biomedical knowledge that has been learned and is believed to be true, and the right side consists of the patient's actual clinical presentation. The focus on the right side of the wall is what a clinician hears, sees, and feels from the patient, one's history, signs and symptoms, and the use of comparable signs. Clinical reasoning encompasses the combination of the two sides of the brick wall that allows a therapist to derive hypotheses that will lead his or her examination and treatment. In this case, the patient had very little alteration of normal jaw movement and no comparable sign at her jaw that was reproduced with examination of the TMJ. Through examining her cervical spine, specifically with passive accessory movements, it was determined that the patient's jaw pain could be recreated and subsequently reduced through treatment of her cervical spine.

Limitations to this case would consist of the multiple co-morbidities and the chronicity of the reported issues. However, this case reflects a more typical presentation of patients in a general orthopedic practice. Although the patient was young, she had been dealing with fibromyalgia, headaches, neck pain, back pain, TMD, and an acute onset of ankle pain due to a sprain suffered during the same time period of her treatment for TMD. Therefore, at times, the patient would present with pain throughout her body at various sites depending on the weather, her previous activity levels, sleep, and lifestyle choices. Another limitation was the patient's irregular attendance. This was mostly due to her work schedule that included out of town travel. Therefore, it was difficult to carry out the individualized plan of care set for the patient with some of the outcomes likely limited by this factor. She also reported being inconsistent with the exercises prescribed.

CONCLUSION

This case highlights that listening to and understanding all aspects of the patient's subjective report, coupled with an evaluation focusing on the patient's presentation and comparable sign, allows therapists to funnel through the information presented and arrive at a solid hypothesis and treatment approach for the patient, regardless of where the symptoms are reported. In considering the definition of clinical reasoning and the literature, this case highlights structures closely related to the TMJ and potential approaches for effective treatment. The patient's jaw pain was not reproduceable through the evaluation process specific to the jaw, which drew the therapist to hypothesize that it was likely referred pain from the cervical spine. This was confirmed as the patient's TMD symptoms were successfully reduced through treatment directed towards the cervical spine and a positive longer-term outcome was reached.

Based on the effectiveness of the cervical spine treatment in this case study, and the limited scientific evidence in the use of cervical spine mobilizations for patients with TMD, further research is warranted. Randomized controlled trials comparing patients with TMD treated with manual therapy specifically at the TMJ versus manual therapy to the cervical spine would be beneficial to further delineate the use of treatment to the cervical spine in these cases.

REFERENCES

1. Dutton M. *Orthopaedic Examination, Evaluation, & Intervention.* New York, NY: McGraw-Hill; 2004:1105-1106.
2. Pedroni CR, de Oliveira AS, Berzin F. Pain characteristics of temporomandibular disorder - A pilot study in patients with cervical spine dysfunction. *J Appl Oral Sci*. 2006;14(5):388-392. doi: 10.1590/s1678-77572006000500016.
3. Rakesh N, Yashoda Devi BK, Patil DJ, Nagi R. Assessment of cervical postural disorders in patients with temporomandibular dysfunction - a radiographic evaluation. *Oral Radiology*. 2013;30:38–44.
4. Reneker J, Paz J, Petrosino C, Cook C. Diagnostic accuracy of clinical tests and signs of TMJ disorders: a systematic review of the literature. *J Orthop Sports Phys Ther*. 2011;4(6):408-416. doi: 10.2519/jospt.2011.3644. Epub 2011 Feb 18.
5. von Piekart H, Pudelko A, Danzeisen M, Hall T, Ballenberger N. Do subjects with acute-subacute temporomandibular disorder have associated cervical impairments: A cross-sectional study. *Man Ther*. 2016;26:208-215. doi: 10.1016/j.math.2016.09.001. Epub 2016 Sep 23.
6. Walczynska-Dragon K, Baron S, Nitecka-Buchta A, Tkacz E. Correlation between TMD and cervical spine pain and mobility: is the whole body balance TMJ related? *BioMed Res Int*. 2014;2014:582414. doi: 10.1155/2014/582414. Epub 2014 Jun 19.
7. Weber P, Castilhos Rodrigues Corrêa E, dos Santos Ferreira F, Corrêa Soares J, de Paula Bolzan G, Maria Toniolo da Silva A. Cervical spine dysfunction signs and symptoms in individuals with temporomandibular disorder. *J Soc Bras Fonoaudiol*. 2012;24(2):134-139. doi: 10.1590/s2179-64912012000200008.
8. De Laat A, Meuleman H, Stevens A, Verbeke G. Correlation between cervical spine and temporomandibular disorders. *Clin Oral Investig*. 1998;2:54–57. doi: 10.1007/s007840050045.

9. Higbie E, Seidel-Cobb D, Taylor LE, Cummings GS. Effect of head position on vertical mandibular opening. *J Orthop Sports Phys Ther*. l999;29(2):127-130. doi: 10.2519/jospt.1999.29.2.127.
10. La Touche R, Fernandez-De-Las-Penas C, Fernandez-Carnero J, et al. The effects of manual therapy and exercise directed at the cervical spine on pain and pressure pain sensitivity in patients with myofascial temporomandibular disorders. *J Oral Rehabil*. 2009;36(9):644–652. doi: 10.1111/j.1365-2842.2009.01980.x. Epub 2009 Jul 14.
11. Maitland J.D. *Maitland's Peripheral Manipulation. 3rd ed*. Butterworth-Heinemann Oxford, UK: Elsevier; 1997:293-297.
12. Cook C. *Orthopedic Manual Therapy: An Evidence-Based Approach. 2nd ed*. Upper Saddle River, NJ: Pearson Education Inc; 2012:41.
13. Jones M, Rivett D. *Clinical Reasoning for Manual Therapists*. Edinburgh UK: Butterworth-Heinemann; 2004:3.
14. Walker N, Bohannon RW, Cameron D. Discriminant validity of temporomandibular joint range of motion measurements obtained with a ruler. *J Orthop Sports Phys Ther*. 2000;30(8):484-492. doi: 10.2519/jospt.2000.30.8.484.
15. Youdas J, Carey J, Garrett T. Reliability of measurements of cervical spine range of motion – comparison of three methods. *Phys Ther.* 1991;71(2):98-104, discussion 105-106. doi: 10.1093/ptj/71.2.98.
16. Resnick D. Subjective outcome assessments for cervical spine pathology: A narrative review. *J Chiropr Med*. 2005;4(3):113-134. doi: 10.1016/S0899-3467(07)60121-9.
17. Vemon H, Mior S. The Neck Disability Index: a study of reliability and validity. *J Manip Physiol Ther*. 1991;14:409-415.
18. Johnston K, Bird L, Bright P. Temporomandibular joint effusion and its relationship with perceived disability assessed using musculoskeletal ultrasound and a patient-reported disability index. *Ultrasound*. 2015;23:90–96. doi: 10.1177/1742271X14568608. Epub 2015 Feb 5.
19. Howell E. The association between neck pain, the Neck Disability Index and cervical ranges of motion: a narrative review. *J Can Chiropr Assoc*. 2011;55(3):211-221.
20. Cleland J, Palmer J. Effectiveness of manual physical therapy, therapeutic exercise, and patient education on bilateral disc displacement without reduction of the temporomandibular joint: a single-case design. *J Orthop Sport Phys Ther*. 2004;34(9):535-548. doi: 10.2519/jospt.2004.34.9.535.
21. Maitland G, Hengeveld E, Banks K, English K. *Maitland's Vertebral Manipulation. 6th ed*. Oxford UK: Butterworth-Heinemann; 2001:253-254.
22. Hall T, Briffa K, Hopper D, Robinson K. Comparative analysis and diagnostic accuracy of the cervical flexion–rotation test. *J Headache Pain*. 2010;11:391–397. doi: 10.1007/s10194-010-0222-3. Epub 2010 May 28.

Spontaneous Regression of Cervical Disc Herniation: Literature Review

Ashley Wilson, SPT
Kelly Ansley, SPT
Emily Paslay, PT, DPT, OCS

Department of Physical Therapy, University of North Texas Health Sciences Center, Fort Worth, TX

ABSTRACT

Background and Purpose: Spontaneous regression of lumbar disc herniation is well-documented in the literature. Therefore, conservative treatment is considered an effective alternative to surgery in the lumbar spine. The aim of this study is to perform a literature review on spontaneous regression of cervical disc herniation. **Methods:** A search of PubMed and Scopus was performed. Search terms included "cervical disc spontaneous regression not thoracic", "spontaneous cervical disc regression not thoracic", and cervical disc natural healing". No limitation on year published was set due to a limited body of evidence within the past 10 years. Additional literature was identified within referenced articles. Only cases written in English, those using nonsurgical treatment, and those with magnetic resonance imaging (MRI) were included in this review. **Outcomes:** A total of 43 articles were reviewed and 13 articles met the inclusion criteria. Patients ranged from 27 to 77 years old with herniations throughout the cervical spine but specifically at C3-7. Patients reported symptoms of arm pain, neck pain, radiating pain, weakness, hypoesthesia, tingling, and numbness. Partial to complete resolution of symptoms occurred between 2 weeks and 28 months. Similarly, MRI demonstrated partial to complete regression of herniation between 3 weeks and 28 months. All patients received only nonsurgical treatment including physical therapy, medications, cervical collar, rest, acupuncture, or a combination thereof. **Clinical Relevance:** The findings in this review suggest conservative treatment can be successful in reducing disc herniation size and associated symptoms in patients with large cervical disc herniations. **Conclusion:** This review suggests spontaneous regression of cervical disc herniation is indeed similar to the lumbar spine; however, the current level of evidence is low and needs further investigation.

Key Words: conservative, healing, myelopathy, radiculopathy

INTRODUCTION

Cervical disc herniations are a common pathological reason for several deficits noted in patients referred to physical therapy. Possible deficits associated with cervical disc herniations include neck pain, arm pain, cephalalgia, paresthesia, radiculopathy, and/or myelopathy.[1-4] Herniations are classified into 3 types based on magnetic resonance imaging (MRI): protrusion, extrusion, and sequestration.[5] In order of severity, protrusion consists of the nucleus bulging at the level of the disc but not rupturing, extrusion consists of disc material migrating but is still connected to the disc, and sequestration consists of the herniated material detaching from the disc.[5]

Spontaneous regression of lumbar disc herniation is well-established in the literature.[6-8] Conservative treatment is considered an effective alternative to surgery in the lumbar spine.[9] A significant association between larger lumbar herniated discs and decreased time to regression has been documented, indicating that disc extrusions and sequestrations have a higher likelihood of regressing spontaneously.[9-12] According to a recent literature review completed in 2016, the average time to regression of lumbar herniated disc is 5.54 months[9] with most occurring within one year.[11]

Clinically, many patients are offered surgery as a first line of defense for cervical disc herniations by their medical provider.[6] Surgery is usually recommended when patients present with nerve root compression noted on imaging, pain despite conservative treatment greater than 6 to 12 weeks, motor deficits, and/or myelopathy. Myelopathy is considered the most severe presentation due to compression of the cervical spinal cord causing sensory and motor deficits affecting upper and lower extremity function. Physical findings related to myelopathy include hyperreflexia, subjective and objective weakness, and sensory changes. Examples of objective weakness and sensory signs include slow/unsteady gait, weakness in arms/hands, and sphincter disruptions.[4] Therefore patients with signs and symptoms of myelopathy are routinely referred for surgical intervention.

The preferred surgical intervention to treat pathologies related to spinal cord and spinal nerve root compression is an anterior cervical discectomy and fusion.[13] This surgery has its risk of complications, however, including but not limited to injury to the spinal cord and spinal nerve root, hoarseness, hematoma, hardware loosening, and even death.[1,14] It can also be a considerable financial burden as compared to nonsurgical internvention.[13]

Conservative treatment for lumbar disc herniation is well supported in the literature due to the high likelihood of herniations to regress spontaneously within the first year, notably in the first 3 months.[5,6,11] Literature has shown in the lumbar spine, larger disc herniations such as extrusions and sequestrations, which could have more detrimental signs and symptoms due to spinal cord and nerve compression, have a better likelihood to regress spontaneously.[5,10,11] On the contrary, there is no consensus as to whether nonsurgical treatment is appropriate for large cervical disc herniation. Therefore, the aim of this study is to perform a literature review on spontaneous regression of cervical disc herniation.

METHODS

A review of two databases, Scopus and PubMed, as well as individual searches from reference lists were performed by two of the authors. Search terms included "cervical disc spontaneous regression not thoracic" using Scopus, "spontaneous cervical disc regression not thoracic" using PubMed and "cervical disc natural healing" using PubMed. No limitation on publication year was set due to a limited body of evidence within in the past 10 years. Using these search terms and filters, a total of 43 total relevant articles were identified.

From the 43 literature results, inclusion criteria were used to select those studies that measured spontaneous regression following conservative treatment, studies written in or translated to English, and regression documented with MRI. These criteria were selected to exclude any case that may include a patient who underwent surgical intervention as a main treatment. Due to language barriers, only English literature was considered so no information would be misconstrued or misrepresented. An MRI has been docu-

mented to be superior to computed topography (CT) scanning and cervical myelography in the diagnosis of cervical herniations especially when paired with conventional radiography. Cases that included patients with a cervical mass, surgical intervention, nonhuman subjects, and disc calcifications were excluded from this literature review.

OUTCOMES

Thirteen cases met the inclusion and exclusion criteria for this review (Table 1). The patients ranged from 27 to 77 years old. All 3 types of disc herniation were represented. Levels of herniation ranged from C3-7. Symptoms reported by patients included arm pain, neck pain, radiating pain, weakness, hypoesthesia, tingling, and numbness.

Following conservative treatment, symptom resolution occurred between 2 weeks and 28 months with a mean and median of 32 weeks. Magnetic resonance imaging showed partial to complete regression between 3 weeks and 28 months. The manner in which conservative treatment was prescribed to patients was not standardized or homogenous throughout this review. Conservative treatments documented in the articles reviewed included physical therapy, medications, a cervical collar, rest, acupuncture, or a combination thereof.[1,2,5-7,15-17]

A summary of the articles is listed in Table 1. The criteria include author, year published, level of study, age/sex of participants, initial symptoms, MRI demonstrated regression, regression status, symptom regression, herniation level, and herniation type.

DISCUSSION

In this review, spontaneous regression was documented on MRI anywhere from 3 weeks to 28 months. Regression was even noted in patients with signs and symptoms of myelopathy including MRI documented spinal cord compression, dizziness, difficulty walking, quadriparesis, and paresthesia of both upper and lower extremities. In patients with cervical disc herniations who exhibit signs and symptoms of myelopathy, previous studies have documented that surgical intervention is warranted.[6,8] In one case report reviewed, a patient with cervical disc herniation who presented with severe myelopathy including symptoms of urinary disturbance, hyperreflexia, and a positive Hoffman's sign on the left upper extremity, continued to exhibit symptoms even after complete regression of herniation was confirmed on the MRI. While some patients may benefit from ongoing conservative treatment, cases similar to this potentially could warrant surgical intervention immediately to prevent long term deficits.

To our knowledge, this is the first literature review of spontaneous regression of cervical disc herniation performed since 2003 by Kobyashi.[6] In this more recent literature review, 12 case reports and 1 case series document spontaneous regression of cervical disc herniation using MRI. Though evidence found in this literature review suggests cervical disc herniations are indeed similar to lumbar herniations and do spontaneously regress following conservative treatment, the level of evidence continues to be comprised of case reports and case studies.

Lumbar disc regression has been reported and substantiated in the literature.[5,6,11] There is a significant association between larger lumbar herniated discs and decreased time to regression.[9-12] Lumbar discs have been documented to be comparable to cervical discs in their pattern of healing.[4] In this review, most herniations described were extrusions and sequestrations and all herniations demonstrated partial or complete regression on MRI. Kobayashi et al[6] and Song et al[8] noted similar findings. These findings suggest that cervical disc healing may be similar to lumbar disc healing.[6,8,11,21]

In these case reports, MRI was the most common imaging medium used for monitoring cervical herniation.[3] Magnetic resonance imaging has been documented to be superior to CT scanning and cervical myelography in the diagnosis of cervical herniations especially when paired with conventional radiography.[21] The authors recommend that MRI be used in future studies to document cervical disc regression.

Currently the gold standard for treating cervical herniations is anterior cervical discectomy and fusion that has established surgical risks and financial burden as compared to conservative treatment. In this review, evidence was identified that suggests cervical herniations were managed successfully with conservative treatment. Higher levels of studies with a larger number of patients and improved homogeneity are warranted. These studies should include retrospective and randomized controlled trials that measure regression of MRI documented cervical disc herniation and related symptoms in patients who receive nonsurgical interventions. Studies that assess the incidence of cervical disc herniation as well as the likelihood and amount of regression in asymptomatic individuals could also be valuable to our practice, as well as improve our understanding of natural cervical disc healing.

This review is not without limitations. In the reports reviewed, patients were only documented to have complete or partial regression of the disc on MRI and lacked an objective tool to determine the size or degree of regression. In the case describing a lumbar disc sequestration, resorption of the disc fragment was noted on MRI at the 6-month follow-up.[5] Using a valid tool to measure the degree of regression or resorption could be a potential improvement with studies moving forward. Also, symptoms were measured only subjectively and documented inconsistently at the time of complete regression via MRI, thus making conclusions on symptom improvement challenging. However, it was noted that some patients experienced complete resolution of symptoms with only partial regression of the herniation.[5-7] In the last 10 years, only 8 studies have been published on MRI documented regression of cervical disc herniation, and the total body of evidence found in this literature search is comprised of case studies and one case series.

CONCLUSION

Spontaneous regression of cervical disc herniation has been documented on MRI to occur between 3 weeks and 28 months following conservative care. Symptoms related to disc herniation also resolved within this timeframe. Conservative treatment may be considered as an option for a patient with cervical disc herniation within this time frame; excluding those that have signs of a progressive motor deficit or have worsening neurological signs.[4]

This review suggests that following conservative treatment, the regression of cervical disc herniation is similar to lumbar disc herniation. However, the current body of evidence for cervical discs is low. Though the number of case reports in the past decade has grown compared to previous decades, more studies with higher levels of design are warranted.

REFERENCES

1. Di Ciaccio E, Polastri M, Gasbarrini A. Cervical disc herniation: is the regression flawed by age? A case report. *Int J Ther Rehabil*. 2013;20(12):612-616. doi: 10.12968/ijtr.2013.20.12.612.
2. Mahajan PS, Moosawi NA, Hasan IA. A rare case of near complete regression of a large cervical disc herniation without

Table 1. Summary of Articles Evaluated in this Literature Review

Author, Year	Level of Study	Age of patient, Sex	Initial Symptoms	MRI Demonstrated Regression	Regression Status	Symptom Regression	Herniation Level	Herniation Type
Krieger et al 1992[18]	Case Report	38-year-old, male	Neck pain after whiplash from Motor vehicle accident	10 months	Unreported	Completely pain free 11 months post-accident	C5-6	Unreported
Westmark et al 1997[19]	Case Report	48-year-old, female	Right-sided scapular pain	Unreported	Partial	2 weeks after initial MRI, symptoms had resolved	C5-6, C6-7, and C3-4	Unreported
Mochida et al 1998[3]	Case Series	26-77 year olds	Radicular pain and paresthesia (21 participants)	Unreported	15/38 partially regressed	Unreported	C3-4, C4-5, C5-6, C6-7	14 extrusion, 1 protrusion
Song et al 1999[8]	Case Report	37-year-old, female	Quadriparesis, whole body paresthesia, urinary difficulty	28 months post	Complete	Strength intact and sensation intact at 28 months after initial examination	C5-6	Extrusion
Kobayashi et al 2003[6]	Case Report	27-year-old, male	Severe pain in L arm, slight neck pain in the morning	3 weeks 12 months	Partial Complete	Pain free at 3-week mark	C5-6	Lateral, extrusion
Pan et al 2010[15]	Case Report	32-year-old, male	Weakness, walking impairments, sensory disturbances, neck pain at night	6 months	Complete	Regained strength, resolution of numbness at 3 months	C6-7	Large herniation
Kim et al 2012[20]	Case Report	59-year-old, female	Intense neck pain, radiating in C7 dermatome	12 months	Complete	Pain free and no symptoms of nerve root compression at 12 months	C6-7	Unreported
Orief et al 2012[5]	Case Report	40-year-old, male	Acute cervical pain and numbness	5 months	Resorption	Resolved after 3 months	C5-6	Sequestration
Ciaccio et al 2013[1]	Case Report	74-year-old, female	Neck arm burning pain, light headed	12 months	Complete	Pain had significantly decreased within 2 months	C3-4	Unreported
Delen 2014[17]	Case Report	54-year-old, female	Neck muscle spasms, radiating pain to left upper extremity	13 months	Complete	Unreported	C6-7	Unreported
Han, Choi 2014[7]	Case Report	39-year-old, female	Hypoesthesia on right C4-5 dermatome	24 months	Partial	Symptom resolution after 2 weeks	C4-5	Extrusion
Mahajan et al 2014[2]	Case Report	29-year-old, male	Severe neck pain, tingling/numbness in right upper extremity	5 months	Partial	Significant symptom reduction via patient subjective at 3-4 months	C5-6	Extrusion
Radulovic et al 201816	Case Report	31-year-old, female	Neck pain associated with numbness in all 4 extremities	11 months	Partial	Resolved within 1 year	C5-C6	Extrusion

any intervention demonstrated on MRI. *Case Rep Radiol*. 2014;2014:832765. doi: 10.1155/2014/832765. Epub 2014 Jan 6.
3. Mochida K, Komori H, Okawa A, Muneta, Haro H, Shinomiya K. Regression of cervical disc herniation observed on magentic resonance images. *Spine (Phila Pa 1976)*. 1998;23(9):990-995; discussion 996-997. doi: 10.1097/00007632-199805010-00005.
4. Carette S, Fehlings MG. Clinical practice. Cervical radiculopathy. *N Engl J Med*. 2005;353(4):392-399. doi:10.1056/NEJMcp043887.
5. Orief T, Orz Y, Attia W, Almusrea K. Spontaneous resorption of sequestrated intervertebral disc herniation. *World Neurosurg*. 2012;77(1):146-152. doi: 10.1016/j.wneu.2011.04.021.
6. Kobayashi N, Asamoto S, Doi H, Ikeda Y, Matusmoto K. Spontaneous regression of herniated cervical disc. *Spine J*. 2003;3(2):171-173. doi:10.1016/s1529-9430(02)00556-9.
7. Han SR, Choi CY. Spontaneous regression of cervical disc herniation: a case report. *Korean J Spine*. 2014;11(4):235-237. doi:10.14245/kjs.2014.11.4.235.
8. Song JH, Park HK, Shin KM. Spontaneous regression of a herniated cervical disc in a patient with myelopathy. Case report. *J Neurosurg*. 1999;90(1 Suppl):138-140. doi:10.3171/spi.1999.90.1.0138.
9. Yang X, Zhang Q, Hao X, Guo X, Wang L. Spontaneous regression of herniated lumbar discs: report of one illustrative case and review of the literature. *Clin Neurol Neurosurg*. 2016;143:86-89. doi:10.1016/j.clineuro.2016.02.020.
10. Autio RA, Karppinen J, Niinimaki J, et al. Determinants of spontaneous resorption of intervertebral disc herniations. *Spine J*. 2006;31(11):1247-1252. doi:10.1097/01.brs.0000217681.83524.4a.
11. Chiu CC, Chuang TY, Chang KH, Wu CH, Lin PW, Hsu WY. The probability of spontaneous regression of lumbar herniated disc: a systematic review. *Clin Rehabil*. 2015;29(2):184-195. doi:10.1177/0269215514540919.
12. Mackia M, Hernandez-Hermanna M, Bydona M, Gokaslan A, McGovern K, Bydona A. Spontaneous regression of sequestrated lumbar disc herniations: literature review. *Clin Neurol Neurosurg*. 2014;120:136-141. doi: 10.1016/j.clineuro.2014.02.013.
13. Martin CT, D'Oro A, Buser Z, et al. Trends and costs of anterior cervical discectomy and fusion: a comparison of inpatient and outpatient procedures. *Iowa Orthop J*. 2018;38:167-176. PMID:30104941.
14. Gutman G, Rosenzweig DH, Golan JD. Surgical treatment of cervical radiculopathy: meta-analysis of randomized controlled trials. *Spine J*. 2018;43(6):E365-E372. doi:10.1097/BRS.0000000000002324.
15. Pan H, Xiao LW, Hu QF. Spontaneous regression of herniated cervical disc fragments and its clinical significance. *Orthop Surg*. 2010;2(1):77-79. doi:10.1111/j.1757-7861.2009.00067.x.
16. Radulović D, Vujotić L, Cvrkota I, Bogosavljević V, Jovanović I. Spontaneous regression of cervical disc herniation in a patient with myelopathy. *Srp Arh Celok Lek*. 2018;146(7-8):445-446. doi: https://doi.org/10.2298/SARH170504023R.
17. Delen E. Spontaneous regression of a cervical disk herniation. *J Clin Analy Med*. 2014;6(6). doi: 10.4328/JCAM.2430.
18. Krieger AJ, Maniker AH. MRI-documented regression of a herniated cervical nucleus pulposus: a case report. *Surg Neurol*. 1992;37(6):457-459. doi:10.1016/0090-3019(92)90135-a.
19. Westmark RM, Westmark KD, Sonntag VK. Disappearing cervical disc. Case report. *J Neurosurg*. 1997;86(2):289-290. doi:10.3171/jns.1997.86.2.0289.
20. Kim SH, Park MY, Lee SM, et al. Acupuncture and spontaneous regression of a radiculopathic cervical herniated disc. *J Pharmacopuncture*. 2012;15(2):36-39. doi: 10.3831/KPI.2012.15.2.036.
21. Nakstad PH, Hald JK, Bakket SJ, Skalpe IO, Wiberg J. MRI in cervical disk herniation. *Neuroradiol J*. 1989;31:382-385. doi:10.1007/bf00343860.

Soft Tissue Mobilization in the Management of Individuals with Patellar Tendinopathy: A Critically Appraised Topic

Melinda H. Avery, DPT[1]
Dhinu J. Jayaseelan, DPT, OCS, FAAOMPT[1,2]
Michel McMurray, DPT, OCS, FAAOMPT[2,3]
Kevin M. Cross, PT, PhD, ATC[3]

[1]*The George Washington University, Program in Physical Therapy, Washington, DC*
[2]*Virginia Orthopedic Manual Physical Therapy Institute (VOMPTI), Charlottesville, VA*
[3]*UVA Encompass Health Rehabilitation Hospital, Charlottesville, VA*

ABSTRACT

Background and Purpose: Patellar tendinopathy is a common condition affecting athletes that can lead to significant functional disability. While soft tissue mobilization (STM) is a commonly used manual therapy intervention, its effects on patellar tendinopathy are unclear. The purpose of this review was to investigate whether or not soft tissue mobilization improves the outcomes of pain and/or function in individuals with patellar tendinopathy. **Methods:** A systematic search was performed using CINAHL, the Cochrane Library, PubMed, Scopus, and SportDiscus. Inclusion criteria included diagnosis of patellar tendinopathy, randomized controlled trials (RCT) or cohort study designs, at least one STM technique, outcome measures of pain and/or function, full-text in English language, and human subjects. **Findings:** Three studies met the inclusion criteria. One RCT demonstrated an additive effect on pain and function when transverse friction mobilization (TFM) was combined with exercise; a second RCT demonstrated no statistical improvement with TFM as a stand-alone treatment. The third study demonstrated reduced pain for all participants using fascial manipulation of the quadriceps. **Clinical Relevance:** Conflicting evidence exists related to the efficacy of soft tissue mobilization for patellar tendinopathy. There may be a benefit to improving outcomes when STM is added to an exercise program; however, its usage as an independent intervention does not appear to be beneficial.

Key Words: knee, manual therapy, pain, rehabilitation, tendon

INTRODUCTION

Patellar tendinopathy is an overuse condition often related to sport participation, with reported incidence rates of 5.5-22.7% and a prevalence as high as 14.4%.[1,2] Tendinopathy describes a spectrum of tendon related pathology. While a host of clinical presentations exists, tendinopathy commonly refers to a tendon problem marked by an absence of inflammatory markers, broadly characterized by disorganized collagenous orientation and abnormal tendon structure.[3] Patellar tendinopathy clinically presents as localized tenderness at the inferior pole of the patella, with symptoms being load-dependent, increasing as the demand on the knee extensors also increases. Common risk factors for developing the condition include but are not limited to reduced quadriceps strength, reduced flexibility in the lower leg, and are correlated with an increased training intensity.[4]

Many patients with patellar tendinopathy may be unable to return to their prior level of function. One study reported nearly one-third of athletes were unable to return to sport after 6 months,[5] while another study reported 53% of athletes were forced to retire completely from their sport.[6] Given the large population affected by the condition and fair outcomes, additional research into optimal interventions is necessary.

Current evidence supports a staged progression of exercise for controlled tendon loading and enhancement of load tolerance to manage patellar tendinopathy.[7,8] In a recent systematic review, rehabilitation including isometric exercises, eccentric exercises, and heavy slow resistance training resulted in a reduction of pain and/or improved function in a variety of patients that suggests various forms of exercise could be beneficial.[8] Although therapeutic exercise for the rehabilitation of patellar tendinopathy appears effective, there is still a large proportion of individuals that does not respond to exercise alone. Possible reasons for persistent symptoms may include factors such as ongoing mobility restrictions that may predispose the patellar tendon to excessive strain, an exercise program that did not appropriately increase load capacity or tolerance, or an unaddressed nervous system sensitization.[9,10]

Given the chronic symptoms in many cases, it is important to consider all potential treatments to improve a patient's pain and function in addition to therapeutic exercise, such as manual therapy to modulate mobility restrictions and pain. Soft tissue mobilization (STM), which is often used in the management of a variety of musculoskeletal disorders, encompasses a number of techniques intended to promote pain reduction, improved mobility, relaxation and tissue healing. One such technique, transverse friction mobilization (TFM) has been proposed by Cyriax in the management of tendinopathy to create a controlled inflammatory response and reduction in abnormal collagen cross-linkage, in turn facilitating an opportunity to normalize tendon structure and reduce symptoms.[11] Other proposed physiological effects of STM include increased fibroblast proliferation, increased viscoelasticity of the tissue, optimal collagen synthesis and alignment, and increased blood flow to the area promoting the body's own healing response.[12,13] However, while often used clinically, the effects of STM in the management of individuals with patellar tendinopathy are not well described.

This review investigates the clinical question of whether or not STM improves the outcomes of pain and/or function in individuals with patellar tendinopathy.

METHODS

Five different electronic databases (CINAHL, the Cochrane Library, PubMed, Scopus, and SportDiscus) were searched using relevant keywords and MeSH terms as appropriate. Example search terms included patellar tendinopathy, jumper's knee, Sinding-Larsen-Johansson disease, soft tissue mobilization, transverse friction, and deep transverse.

Inclusion criteria were patients with patellar tendinopathy, randomized controlled trials (RCT) or cohort study designs, at least one STM technique performed as part of the intervention, an outcome mea-

sure of pain and/or function, peer-reviewed full-text available in the English language, and human subjects. Studies were excluded if they did not meet the inclusion criteria, used instrument-assisted techniques (ie, Graston, dry needling, ASTYM), symptoms were present for one month or less, or were published more than 20 years ago.

Final inclusion of a study was based on consensus agreement of two authors. Each trial was screened for quality using the PEDro or Critical Appraisal Skills Programme (CASP) scales. While the PEDro is commonly used to evaluate RCT quality, given its lack of utility for single-arm cohort designs, the CASP checklist was used for the remaining paper. Of the 3 selected studies, there was substantial variability between the study design and outcomes measured. Information related to study design, participants, interventions, outcomes, study quality, and conclusions can be found in Table 1. Of the studies excluded, the most frequent reason was study design (ie, case report, review article) or intervention used (ie, instrument assisted techniques).

Results of the Search

After filtering results based on inclusion and exclusion criteria, 3 studies were retained: 2 RCTs and 1 prospective cohort interventional trial (see Table 1). Of the 3 included studies, 2 trials used TFM while the third integrated fascial manipulation. Primary outcomes were pain and/or function. Follow-up measurement time points were short term, ranging from immediate to 12 weeks.

Blackwood and Ghazi investigated the additive effect of TFM when combined with exercise.[14] All participants completed eccentric exercise on a decline board and proprioceptive exercises, while the TFM group also received TFM prior to exercise. Although the only follow-up in the study by Blackwood and Ghazi was at 3 weeks after the initiation of the intervention, participants in both the exercise-only group and the TFM + exercise group reported significant increases in function and decreases in pain. Moreover, the TFM + exercise group demonstrated a 25.75-point improvement on the Victorian Institute of Sport Assessment scale (VISA-P) as compared to a 13.5-point improvement in the exercise-only group.[14] This resulted in a Cohen's *d* effect size of 1.11 for the addition of TFM.[14] Similarly, VAS-pain (visual analog scale-pain) decreased by 12.16 mm with exercise-only and 23.25 mm with the incorporation of TFM. The corresponding VAS-pain Cohen's *d* effect size was also large (1.32).[14]

Stasinopoulous and colleagues investigated 3 groups to determine the effects of exercise, pulsed therapeutic ultrasound, and TFM on individuals with patellar tendinopathy.[15] One group performed stretching and eccentric exercises, a second received pulsed ultrasound to the patellar tendon for 10 minutes, and a third group received TFM directly on the patellar tendon for 10 minutes. Statistical analysis between groups found significant difference in pain levels for the exercise group at all follow-up intervals: immediate ($p < 0.01$), one month ($p < 0.001$), and 3 months ($p < 0.001$).15 The TFM-only and ultrasound groups showed no statistical improvement.[15]

The third reviewed study by Pedrelli and colleagues found that fascial manipulation of the quadriceps was beneficial in reducing patellar tendinopathy-related pain.[16] Participants rated their pain on a VAS scale from 0 to 10 during two specific movement tests: a 30 cm step-down while weight bearing on the suffering limb, and a flat-feet jump while starting from a squatting position of total knee flexion. The VAS measurements were taken pre-treatment and immediately post-treatment, as well as at a one month follow-up. The single treatment of fascial manipulation lasting approximately 5 minutes was shown to significantly reduce pain during movement tests immediately after treatment in all patients ($p < 0.0001$).[16] At one month follow-up, all participants had reduced symptom severity, with 50% reporting complete resolution of pain.[16]

Both the Blackwood and Stasinopoulos articles scored 8/11 on the PEDro scale, indicating high quality RCTs.[14,15] The study by Pedrelli scored 10/11 on the Critical Appraisal Skills Programme (CASP) scale, indicating a high quality single-arm cohort trial.[16]

CLINICAL APPLICATION

Patellar tendinopathy can be a functionally disabling health condition, linked to a number of risk factors. Tendon abnormality on diagnostic ultrasound and reduced soft tissue flexibility at the knee have been described as risk factors for developing patellar tendon dysfunction.[17] As such, Cyriax's application of TFM in the management of tendinopathy makes sound theoretical sense, as does addressing soft tissue or joint restrictions local to the knee complex. However, the clinical efficacy of these interventions has not been synthesized.

Patellar tendinopathy is typically associated with sports, particularly jumping sports, and finding methods to manage pain in order to facilitate continued participation is important to both the clinician and the athlete. Isometrics have shown preliminary evidence in short term pain modulation for the condition.[18] However, the persistence of symptoms in many cases suggests additional interventions should be considered. A variety of factors may contribute to a patient's pain and dysfunction, including decreased range of motion. Decreased joint flexibility may be influenced by a restriction in the joint capsule or surrounding connective tissues and ligaments or by decreased length of the musculotendinous unit at a joint.

For these patients, the use of manual therapy may provide another method to improve pain and function. Manual therapy has been shown to help decrease localized muscle spasm, induce localized hypoalgesic responses, and reduce inflammatory markers during recovery.[19] By applying STM locally, a clinician may improve a patient's range of motion and flexibility potentially allowing for improved overall pain and function. There is also evidence of both peripheral and central neurophysiological effects with manual therapy. Several studies have indicated there may be a more widespread central nervous system pain sensitization response in patients that can be modulated through the use of manual therapy.[9,10,19] Through the use of STM, one may improve the variety of local and systemic physiologic factors that contribute to functional capacity and pain modulation.

However, few studies have investigated the use of manual therapy specifically in the management of patellar tendinopathy, exposing the lack of current evidence on this topic. In this critically appraised topic, two RCTs used TFM,[14,15] while one cohort study investigated the effects of fascial manipulation.[16] There is conflicting evidence that STM can be beneficial at improving pain or function for individuals with patellar tendinopathy. The addition of TFM to an exercise program may be beneficial for improving symptomatic and functional outcomes, while its independent use cannot be recommended based on reviewed studies. Mobilizing soft tissue in the thigh may also be useful for individuals with patellar tendinopathy.

Limitations exist within the reviewed studies that should be considered when determining the utility of STM for patellar tendinopathy. Variability of study design makes comparison between studies challenging. Readers must use caution when interpreting results as small sample sizes reduce generalizability and clinical utility, emphasizing the

Table 1. Characteristics of Included Studies in this Review

	Blackwood[5]	Pedrelli[7]	Stasinopoulos[6]
Study design	RCT	Prospective cohort	RCT
Participants	A convenience sample of 14 participants (8 men, 6 women) diagnosed with infrapatellar tendinopathy were included in the study. Minimum symptom duration was 6 weeks. There were 8 subjects in the exercise and TFM group (mean age: 43 years) and 6 in the exercise only group (mean age 38 years).	18 participants (13 men, 5 women) with unilateral patellar tendon pain. The mean duration of symptoms was 8.6 months. The mean age was 29.2 years.	A single center recruited 30 participants (18 men, 12 women) for this study. Each was diagnosed with chronic patellar tendinopathy with a minimum symptom duration of 3 months. Participants were randomly divided into 1 of 3 groups (10 in each group): exercise program (mean age: 28.12 ± 2.03), pulsed ultrasound (mean age: 29.17 ± 3.76), or TFM (mean age: 26.34 ± 4.17).
Intervention investigated	Both groups were treated with an exercise program consisting of: (1) Eccentric squat on 25° incline board with resistance sufficient to create pain in the tendon: 3 sets of 15 reps and (2) Single leg stance program progressing from head straight, cervical rotation and then wobble cushion: 10 reps of 20 sec hold. The experimental group also received TFM treatment to teno-osseous junction of infrapatellar tendon using technique and duration as recommended by the Society of Orthopaedic Medicine. Patient received treatment twice per week for 3 weeks and was requested to perform the exercises at home.	A single intervention session was performed. After evaluating each MFU involved in knee joint movement tests according to the fascial manipulation protocol, the most dysfunctional MFUs were selected for treatment. Static pressure was applied to each focal point of pain, followed by intermittent deep friction or mobilization for 5 minutes, until fascia moved freely.	Exercise group included static stretching of quadriceps and hamstrings (30" hold) before and after eccentric exercises (unilateral squat 3 sets of 15). Ultrasound group received 10 minute pulsed ultrasound to patellar tendon 0.4-0.8 w/cm^2 pulse ratio 1:4 duration pulse 2 ms and frequency 1 MHz. The TFM group received TFM to the patellar tendon for 10 minutes continuously as described by Cyriax. All treatments were performed by the same therapist 3 times weekly for 4 weeks. No HEP was provided.
Outcome measures	VISA-P and VAS pain score: Both were measured before the beginning of first treatment and after 3 weeks of treatment.	VAS on a 0-10 scale to measure pain during movement tests. Movement tests included a 30 cm step-down on the involved limb, and a flat-feet jump, starting from a squat position. Measurements were taken prior to treatment, immediately after treatment, and at a 1 month follow-up.	Pain rating categorized as worse, no change, somewhat better, much better, or no pain. Evaluated at 4 weeks, 8 weeks, and 16 weeks.
Main findings	Pre/post change scores for VAS and VISA-P were significantly better for both groups after 3 weeks of treatment with large effect sizes. However, the Exercise+TFM group had significantly improved VAS pain scores and VISA-P scores compared to the Exercise only group with a medium effect size.	Mean VAS score improved from 67.8/100mm to 25.6/100mm immediately after treatment (p<0.0001). Improvements were noted in all participants at 1 month follow-up, including complete resolution of symptoms in 50% of participants.	The exercise group showed statistically significant improvement vs no change in the ultrasound and transverse friction massage groups. There were significant differences between groups in the pain reported at the end of the treatment ($p < 0.01$), 1 month follow-up ($p < 0.001$) and 3 month follow-up ($p < 0.001$).
Level of evidence	Level 2	Level 2	Level 2
Validity score	8/11 on PEDro Scale	4/11 on PEDro Scale 10/11 on CASP Scale	8/11 on PEDro Scale
Conclusion	The addition of TFM to an exercise program increases function and decreases pain more than exercise alone after 3 weeks of treatment.	Application of one treatment session of fascial manipulation was associated with significant reductions in pain during movement tests immediately after treatment in all patients, with many patients experiencing continued pain reduction 1 month later.	An exercise program was more effective at pain reduction than ultrasound treatment or TFM at the end of the initial treatment as well as at the short and intermittent term follow-ups.

Abbreviations: CASP, critical appraisal skills programme; HEP, home exercise program; MFU, myofascial unit; RCT, randomized controlled trial; TFM, transverse friction mobilization; VAS, visual analog scale; VISA-P, Victorian institute of sport assessment – patellar tendon, PEDro Scale, Physiotherapy Evidence Database Scale; CASP Scale, Critical Appraisal Skills Programme scale

need for larger scale trials. Nonetheless, the results presented within this article should provide some guidance for clinicians working with patients with patellar tendinopathy. This review only investigated studies whose participants had persistent symptoms. As such, the authors were unable to evaluate the effects of STM earlier in the tissue healing process.

Further research could investigate larger scale trials, potentially comparing a control group to a STM group and to a STM + exercise group, allowing for a between-groups comparison and determination of the effect size of the intervention. Comparing different types of STM for tendinopathy at varying time points of tissue healing would also be interesting to establish the effects of this intervention. As evidenced by this review, there is a gap in the current literature investigating the effects of soft tissue mobilization in the management of patellar tendinopathy. For patients who present with mobility restrictions or other factors for which therapeutic exercise alone is less beneficial, it is imperative for clinicians to understand the effects of using additional interventions, such as STM. As such, future research is needed to continue exploring the efficacy of other interventions such as manual therapy techniques as part of the management of patellar tendinopathy.

REFERENCES

1. Lopes AD, Hespanhol Junior LC, Yeung SS, Costa LO. What are the main running-related musculoskeletal injuries? A systematic review. *Sports Med*. 2012;42(10):891-905. doi: 10.2165/11631170-000000000-00000.
2. Maffulli N, Wong J, Almekinders LC. Types and epidemiology of tendinopathy. *Clin Sports Med*. 2003;22(4):675-692.
3. Zwerver J, Bredeweg SW, van den Akker-Scheek I. Prevalence of jumper's knee among nonelite athletes from different sports: A cross-sectional survey. *Am J Sports Med*. 2011;39(9):1984-1988. doi: 10.1177/0363546511413370.
4. Morgan S, Janse van Vuuren EC, Coetzee FF. Causative factors and rehabilitation of patellar tendinopathy: A systematic review. *S Afr J Physiother*. 2016;72(1):e1–e11.
5. Cook JL, Khan KM, Harcourt PR, Grant M, Young DA, Bonar SF. A cross sectional study of 100 athletes with jumper's knee managed conservatively and surgically. the Victorian institute of sport tendon study group. *Br J Sports Med*. 1997;31(4):332-336.
6. Kettunen JA, Kvist M, Alanen E, Kujala UM. Long-term prognosis for jumper's knee in male athletes. A prospective follow-up study. *Am J Sports Med*. 2002;30(5):689-692. doi: 10.1177/03635465020300051001.
7. Malliaras P, Cook J, Purdam C, Rio E. Patellar tendinopathy: Clinical diagnosis, load management, and advice for challenging case presentations. *J Orthop Sports Phys Ther*. 2015;45(11):887-898. doi: 10.2519/jospt.2015.5987.
8. Lim HY, Wong SH. Effects of isometric, eccentric, or heavy slow resistance exercises on pain and function in individuals with patellar tendinopathy: A systematic review. *Physiother Res Int*. 2018;23(4):e1721.
9. Jayaseelan DJ, Weber MJ, Jonely H. Potential nervous system sensitization in patients with persistent lower extremity tendinopathies: 3 case reports. *J Orthop Sports Phys Ther*. 2019;49(4):272–279. doi:10.2519/jospt.2019.8600.
10. van Wilgen CP, Konopka KH, Keizer D, Zwerver J, Dekker R. Do patients with chronic patellar tendinopathy have an altered somatosensory profile? A quantitative sensory testing (QST) study. *Scand J Med Sci Sports*. 2013;23:149–155. doi: 10.111/j.1600-0838.2011.01375.
11. Cyriax J. *Textbook of Orthopaedic Medicine. Vol 2: Treatment by Manipulation, Massage and Injection*. Philadelphia, PA: Bailliere Tindall; 1984.
12. Lambert M, Hitchcock R, Lavallee K, Hayford E, Morazzini R, Wallace A, Conroy D, Cleland J. The effects of instrument-assisted soft tissue mobilization compared to other interventions on pain and function: A systematic review. *Phys Ther Rev*. 2017;22(1-2):76-85. doi: 10.1080/10833196.2017.1304184.
13. Imai K, Ikoma K, Chen Q, Zhao C, An K-N, Gay RE. Biomechanical and histological effects of augmented soft tissue mobilization therapy on Achilles tendinopathy in a rabbit model. *J Manip Physiol Ther*. 2015;38(2):112-118.
14. Blackwood J, Ghazi F. Can the addition of transverse friction massage to an exercise programme in treatment of infrapatellar tendinopathy reduce pain and improve function? A pilot study. *Int Musculoskel Med*. 2012;34(3):108-114.
15. Stasinopoulos D, Stasinopoulos I. Comparison of effects of exercise programme, pulsed ultrasound and transverse friction in the treatment of chronic patellar tendinopathy. *Clin Rehabil*. 2004;18(4):347-352.
16. Pedrelli A, Stecco C, Day JA. Treating patellar tendinopathy with fascial manipulation. *J Bodyw Mov Ther*. 2009;13(1):73-80. doi: 10.1016/j.jbmt.2008.06.002.
17. Witvrouw E, Bellemans J, Lysens R, Danneels L, Cambier D. Intrinsic risk factors for the development of patellar tendinitis in an athletic population. A two-year prospective study. *Am J Sports Med*. 2001;29(2):190-195. doi: 10.1177/03635465010290021201.
18. Rio E, van Ark M, Docking S, et al. Isometric contractions are more analgesic than isotonic contractions for patellar tendon pain: An in-season randomized clinical trial. *Clin J Sports Med*. 2017;27(3):253-259. doi: 10.1097/JSM.0000000000000364.
19. Bialosky JE, Bishop MD, Price DD, Robinson ME, George SZ. The mechanisms of manual therapy in the treatment of musculoskeletal pain: A comprehensive model. *Man Ther*. 2009;14(5):531-538. doi: 10.1016/j.math.2008.09.001.

Dry Needling in Physical Therapy Practice: Adverse Events
Part 1: Types and Frequency of Adverse Events

Vanessa R. Valdes, DPT, OCS, L.Ac.

Mount Sinai Physical Therapy, New York, NY

ABSTRACT

Dry needling (DN) is an increasingly-used modality employed by physical therapists for the treatment of musculoskeletal pain and dysfunction. Continuing educational programs in DN targeted to licensed physical therapists have proliferated in the past decade and research into the efficacy of this intervention is accelerating. When using any new treatment technique, the potential risks involved must be weighed against the potential therapeutic benefits. Knowledge of the adverse events (AE) associated with DN is essential in the risk management of physical therapy practice and can help minimize their occurrence. Part 1 of this clinical commentary will review the types and frequencies of mild AE associated with DN. Part 2 will consider the more significant and serious AE that may occur during DN. A discussion of the concerns of treating pregnant patients with this modality will also be included.

Key Words: acupuncture, pneumothorax, trigger point

INTRODUCTION

Dry needling (DN) has become an increasingly-used modality in the treatment of musculoskeletal pain and dysfunction by physical therapists in the United States. In 2012, the American Physical Therapy Association updated the professional scope of practice to include DN as a skilled intervention useful in alleviating physical impairment and functional limitations.[1] Post-graduate training programs and research into the use and effectiveness of DN in clinical practice continue to grow. These educational programs are often of a short duration as they build upon the knowledge and skills already obtained in the entry-level formal training of physical therapists.[2] Internationally, DN courses developed for physical therapists are also short in duration (initial introductory courses in Canada and Israel are often 32 hours in length) and it has been shown that the technique is easy for physical therapists to learn safely.[3]

In some states, the addition of DN into the physical therapy scope of practice has involved protracted legal attacks from the acupuncture community, which, for the most part, opposes this development. Acupuncturists claim that physical therapists are actually practicing acupuncture by performing DN interventions and are unqualified to do so. They argue that the brevity of DN courses threatens public safety.[4,5] Despite this rhetoric, there is no evidence thus far of serious adverse events (AE) associated with DN by physical therapists.[6]

Both acupuncture and DN are generally considered to be low-risk interventions but serious complications have occasionally been reported in the literature. Since DN is an invasive intervention, practitioners must be cognizant of the risks involved.

WHAT ARE ADVERSE EVENTS?

An adverse event is "an unexpected and undesired incident directly associated with the care or services provided to the patient; an incident that occurs during the process of providing health care and results in patient injury or death; or an adverse outcome for a patient, including an injury or complication."[7] Unfortunately, any treatment that can have a therapeutic effect can also have an adverse effect.[8] Given that medical errors are the third leading cause of death in the United States, a culture of safety is imperative in medicine. Traditionally, orthopaedic physical therapy is considered to be safe, in part because the training of physical therapists embraces traditions of wide error margins to help minimize risk.[9] Safety is a vital consideration for physical therapists who embrace intervention modalities that have the potential for serious risks (ie, high velocity cervical manipulation or DN).

FREQUENCY OF ADVERSE EVENTS ASSOCIATED WITH NEEDLING MODALITIES: A LITERATURE REVIEW

Any invasive technique that involves a needle insertion involves risks. Broadly speaking, DN is an intervention modality that uses thin, solid filament needles to create a therapeutic effect when the skin is punctured. Unlike treatment interventions involving injections to create a clinical effect ("wet needling"), no substance is introduced into the body when performing DN treatments. Dry needling is an umbrella term that encompasses many types of approaches (Table 1).

Currently there are no national or international systems for tracking data on AE associated with DN or acupuncture. The usual method of tracking AE is to conduct prospective surveys sent to either practitioners or patients designed specifically for this purpose. Self-reporting by practitioners regarding AE is limited in both accuracy and reliability as recall and selection bias in reporting can occur. Adverse effects may appear after a treatment session and a practitioner may not even be aware of their development. Patients will often underreport an AE as a result of a treatment if there is no change or decline in functional status.[10] Frequency of AE is therefore difficult to determine and may be underreported in prospective surveys.

Publishing *case reports* can also be helpful to learn about types and treatments of AE but they do not give reliable data on frequency. Most case reports are published by practitioners who treat the patients with AE such as pneumothorax or a broken or a forgotten needle in the tissue following a DN intervention.[11,12]

Adverse events may be classified according to severity: mild or minor, significant and serious.[13] Generally speaking, mild AE are of a short duration, reversible, and cause minimal inconvenience to the patient. Significant AE will require some medical intervention and/or will interfere with a patient's activities. Adverse effects are considered serious if they require a hospitalization or prolong an existing hospitalization, cause a persistent or significant disability, or are life-threatening or even result in death.[14] The timeframes for AE severity has not yet been clearly defined but mild AE will usually last a few hours while significant and serious AE can persist for days or weeks. The lack of standardization of AE has contributed to an absence of

Table 1. Common Dry Needling Styles

DRY NEEDLING STYLE	DEFINITION/SOURCE
Trigger Point Dry Needling	Myofascial trigger point model[14]
Intramuscular Manual Therapy	American term associated with the myofascial trigger point model[1]
Intramuscular Stimulation	Chan Gunn's "radiculopathy model," a neurosegmental model[39]
Superficial Dry Needling	Baldry model[40]
Spinal Segmental Sensitization Model	Dr. Andrew Fisher: combines features of trigger point model and Gunn's radiculopathy model[41]
Classical or Traditional Acupuncture	Acupuncture is an ancient form of Chinese medicine involving the insertion of solid filiform needles into the skin at specific points on the body to achieve a therapeutic effect[42]
Western Medical Acupuncture	A therapeutic modality that is an adaptation of Chinese acupuncture using current knowledge of anatomy, physiology, pathology and the principles of evidence-based medicine[43]

Adapted from the Health Quality Council of Alberta. The Safe Practice of Dry Needling in Alberta. October 2014.

clarity on this subject. The ability to grade AE associated with DN (both in frequency and severity) would be helpful in developing an informed consent for patients undergoing these interventions.[15]

A summary of published research from the past two decades of AE related to acupuncture and DN by various practitioners is found in Table 2. Most research has focused on AE related to acupuncture rather than DN. Although both use the same tools (mono-filament needles of varying lengths and gauges), there are differences in the techniques. Dry needling often involves a deeper needle insertion and needle manipulation to obtain a reaction called a *local twitch response*. Needle retention may not occur. Acupuncture involves needling to the depth of the acupuncture point and needle manipulation to get "de qi".[16,17] "De qi" is defined as a tingling, heaviness, numbness, or other feeling that occurs after an acupuncture needle has been properly placed in the body. Needle retention is common and may last 15 to 20 minutes or longer. Because of the differences in needle techniques, it is uncertain whether data based primarily on acupuncture interventions applies to DN interventions.[18]

Reviews of the research in Table 2 show that design limitations and format variations limit the comparison of results. Some research analyzed practitioner-reported data while others relied on patient's responses to questionnaires. Methodology variables and lack of reliability and validity in the research limit their usefulness in determining the frequency of AE. When performed by adequately trained practitioners, both acupuncture and DN appear very safe but there have been documented fatalities and serious AE like pneumothorax and infections as a result of interventions.[19,20] A review of these studies has shown some changes in the frequency and types of AE over the decades. Advances in education standards and the advent of single-use disposable needles have reduced the frequency of infections, for example.

Only the Brady study[18] has specifically focused on AE occurring as a result of DN performed by physical therapists. This prospective study recruited 51 volunteers from a group of 183 Irish physiotherapists who had received the *64-hour David G. Simons Academy* trigger point DN training. The participants completed two questionnaires surveying the number of trigger point DN interventions they performed and any AE that occurred as a result. Of the 39 physiotherapists who completed the survey, 19.18% reported mild AE associated with the 7,629 treatments. Bleeding and bruising were the most common AE but all were deemed to be mild and not significant. Compared with research that looked at AE related to acupuncture, this rate was higher but other research looked at AE from a patient's perspective.[21] It is noted that patients often underreport an AE as a result of an intervention if there is no change or decline in their functional status.[10] A major limitation of the Brady paper is that the data were self-reported and practitioners volunteered to participate, which may result in an inaccurate reporting of AE. The study has also been criticized for not reaching a target level of interventions that would be required to identify a serious AE.[22]

The New Zealand Physiotherapy professional organization has implemented a voluntary system to report AE in physical therapy interventions, including DN and acupuncture.[23] The system is unique in that it also allows for anonymous reporting of AE by physiotherapists and differentiates treatments of trigger point DN and other styles of needling that involve sustained needle retention (like acupuncture and auriculotherapy). The McDowell study reviewed 176 voluntary self-reported AE associated with interventions performed by New Zealand physiotherapist-acupuncturists from 1998 to 2013. Eighty-one percent of the AE reported were considered to be minor. Dry needling treatments accounted for 14.8% of the AE reported compared with >71% for treatment methods that involved sustained needle retention. Dry needling treatments were associated with a 3% higher ratio of major-to-minor AE compared with sustained needling styles but some AE like vasovagal reactions (VVR), were higher with sustained needling treatments. The underreporting of AE is probable and the needling style could not always be determined from the reporting, a factor which could have skewed the data and conclusions.

To summarize: AE from both DN and acupuncture interventions are usually mild and transient in nature (Table 3). The most common mild AE include bruising and bleeding, pain (during and after intervention), and syncope/vasovagal response.[24,25] Significant or severe AE are rare, although individual case studies have described injuries associated with DN. Serious AE are commonly associated with practitioner negligence and poor adherence to practice standards.[26] These more serious AE will be reviewed in Part 2 of this clinical commentary. Precautions related to treating pregnant women will also be examined.

MILD ADVERSE EVENTS

Bleeding and Bruising

Mild bleeding and bruising are the most

Table 2. Research of Adverse Events in Acupuncture and Dry Needling (2001-2018)

Author of Study	Study location and type	Practitioner type	Source of results
White et al 2001[44]	UK/Prospective study	Physicians, physical therapists	Practitioner
MacPherson et al[13]	UK/Prospective study	Acupuncturists	Practitioner
Ernst E et al 2001[45]	Europe and Far East/Prospective study review	Medical physicians, acupuncturists	Practitioner or patient
Witt et al 2001[21]	Germany/Prospective study	Medical physicians	Patients
Lao L et al 2003[38]	UK/Review of Case reports 1965-1999	All included (physician, chiropractors, acupuncturists, osteopaths)	Published case reports
Melchart et al 2004[46]	Germany/Prospective study	Medical physicians	Practitioner
White et al 2006[14]	UK/Prospective study	Medical physicians/physical therapists/ acupuncturists	Practitioners
Ernst E et al 2011[47]	International/Systematic review of clinical research and case reports between 2000-2009	Acupuncturists	Published systematic reviews and case research
Xu et al 2013[48]	International/Review of Case Reports 2000-2011	Acupuncturists/physical therapists/ physicians/ Unspecified	Published case reports
Brady et al 2014[18]	Ireland	Physical therapists	Practitioners
McDowell JM et al 2014[23]	New Zealand/Cross-sectional descriptive study	Physical therapists	Practitioners

Table 3. Types of Dry Needling/Acupuncture Adverse Events by Severity and Frequency

Severity	Mild/Minor	Significant	Serious
Frequency	Common: (1-10%)	Uncommon: (0.1% - 1%)	Rare: (0.01-.1%)
	• Bleeding • Bruising • Pain - during/after • Dizziness • Temporary symptoms aggravation • Nausea • Sweating • Fatigue	• Prolonged pain • Excessive bleeding or bruising • Nerve injury • Headache • Vomiting • Forgotten needles • Seizures • Extreme fatigue • Severe emotional reactions	• Pneumothorax/Haemothorax • Other organ puncture • Infection • Broken needle • Cardiac Tamponade
Data derived from MacPherson et al,[13] White A,[14] Witt et al,[21] Brady et al.[18]			

common AE associated with DN and are difficult to prevent.[27] Bleeding can occur outwardly or inwardly as a result of needling, and small hematomas can develop in the muscles or skin. Mild pressure over the needle site with a cotton ball is usually sufficient to minimize bleeding.

Screening patients for bleeding disorders (such as thrombocytopenia) and the use of anticoagulants and certain medications and supplements are recommended prior to DN interventions.[28] McCulloch et al conducted a systematic review of the literature to evaluate the safety of patients taking anticoagulant medications.[29] The study asked the question, "Does acupuncture in anticoagulated patients present a higher-than-expected risk of bleeding?" The bleeding complication rate was 1.4% (56 incidents in 3,974 intervention sessions) with the vast majority being either an asymptomatic bruise or a minor drop of blood, as is common in many needling procedures. None of the bleeding was considered significant and all incidents were stopped with digital pressure. The authors concluded that acupuncture has a high degree of safety with patients taking anticoagulant medications. Since similar needles are used with DN, this conclusion may apply to this type of treatment as well. The complications of bleeding and bruising would increase if larger gauge needles like syringes were used to perform DN treatments.

Some practitioners advocate the use of anti-bruising topical products to help minimize bruising. *Arnica Montana* is a perennial herb thought to be an anti-ecchymosis as a result of a vasodilation effect and possible up-regulation of macrophage activities. In fact, the majority of randomized controlled trials show that homeopathic *Arnica Montana* is no better than a placebo in treating bruising, swelling, and pain.[30]

More serious bleeding occurs if arteries or veins are punctured during DN. Arterial bleeding is rare but will spread quickly and pulsate. Blood vessels can be avoided with an understanding of underlying vascular anatomy and palpation of the area prior to needling. If a blood vessel is punctured, a sharp, painful sensation may be felt (especially with arteries). Bleeding into a fascial compartment is dangerous as increased pressure can cause tissue damage.

Case studies describing serious AE associated with bleeding illustrate the importance of anatomical knowledge. Peuker and Gronemeyer described 4 cases of blood vessel lesions (including the development of an anterior compartment syndrome) as a result of acupuncture.[31] Recently, Berrigan et al reported on the development of an epidural hematoma as a result of DN.[32] An otherwise healthy 62-year-old woman with a body mass index (BMI) of 19.2 was treated for myofascial neck pain with DN of the infraspinatus, rhomboids, trapezius and upper cervical multifidus muscles. On the 4th treatment session, she felt a "warm sensation" throughout her body after a needle insertion. Later that day, she began experiencing increased pain and neck stiffness. Three days post-intervention her daughter found her in her home with an altered mental status. She was transferred to an emergency room where an evaluation revealed a complex epidural hematoma, which necessitated admission into an intensive care unit. A gradual resolution of neuropathic pain symptoms occurred in the 2 months after hospital discharge. This case illustrates the importance of specific anatomy and needle trajectory knowledge and understanding of the relationship of needle depth and BMI.

Pain During or After Intervention

Increased pain during treatments is more commonly associated with DN than acupuncture. Brady et al[18] found the frequency of pain *during* DN interventions to be 3.01% while the frequency of pain *after* the DN intervention was slightly lower (2.19%). The pain may be the result of neuromuscular injury or hemorrhagic and inflammatory changes caused by the needling. The area of pain is often in the area that was needled or in the trigger point referral pain pattern. The number of needle insertions and the pain perceived during the needling had a positive correlation to the pain experienced post-treatment. The number of local twitch responses elicited during treatment did not affect post-needling soreness.[33]

Post-intervention pain is often described as a dull aching or a constant pressure and usually will persist for less than 72 hours. Travell and Simons recommended the avoidance of strenuous activities for 2-3 days after trigger point injection (which involved a larger gauge needle) to avoid soreness but no research supports this advice.[34] It is also likely that the duration of post-treatment pain may have been longer and more severe because larger gauge syringe needles were used instead of the solid filiform needles more commonly employed today. Patients with a low baseline of myofascial pain may show a reduced tolerance to post-treatment soreness compared with those who present with higher myofascial trigger point pain levels pre-treatment. Communication with patients about the possibility of some short-term post-treatment pain is recommended and the pain may even be reframed as a positive therapeutic sign.[35] Additional therapies may help decrease post-needling soreness and include low load exercises, hot packs, transcutaneous nerve stimulation and Kinesio Tape application but few guidelines regarding their efficacy are available.

Vasovagal Response

A VVR is an autonomic nervous response that occurs as an indirect result of needling or other stimuli. The autonomic nervous system responds through sensory impulses along autonomic afferent fibers. This stimulation can cause bradycardia, hypotension, and syncope as a result of a transient withdrawal of sympathetic tone and an increase in vagal tone. The signs and symptoms are variable and may include dizziness, nausea, sweating, and paleness. The patient may also report feeling lightheaded, blurred or tunneling of vision, or yawning. Symptoms can progress to eventual unconsciousness.

Vasovagal responses are a relatively rare AE associated with acupuncture and DN, occurring in .02 - 7% of all interventions.[36] Christensen et al reviewed clinic data from an 18-month period of patients receiving acupuncture interventions, primarily performed by interns at the University of Minnesota Masonic Children's Hospital in conjunction with the Northwestern Health Sciences University. A retrospective chart review of 281 interventions showed 5 cases of documented VVR that resulted in intervention termination or alteration. Of these 5 cases, 3 had received acupuncture for the first time. Common features of patients who had a VVR included those with increased stress levels, irregular sleep, and disruption of regular lifestyle patterns.

Patients and practitioners can find the occurrence of a VVR to produce anxiety despite the quick recovery that generally occurs. Practitioners must be well versed in the prevention and treatment of VVR. Awareness of patients who have a fear of needles or phobias concerning blood or injury is essential prior to DN. Vasovagal responses are more common among patients who are nervous, fatigued, having DN for the first time, hungry, or dehydrated.[37] Recommendations to eat and drink 1-2 hours prior to interventions are helpful. Patients should be treated in a comfortable position in a supine or prone position or a zero-gravity chair. Vigorous needle manipulation in a seated position may cause a marked vasodilation and lead to hypotension.[38] Minimizing the number of needles and avoiding aggressive needling dependent on patient response is important, especially in the initial treatments.

The treatment environment should be comfortable and quiet. Symptom recognition is important, and communication (both verbal and non-verbal) with patients during DN is essential. If a person is showing signs of a VVR, removal of the needles and elevation of the feet with the patient being supine is helpful. Monitoring of airway, blood pressure, and pulse is required. Patients who have this type of reaction should notify health care professionals prior to future blood draws or DN sessions.

CONCLUSION

Dry needling is a treatment modality that is commonly used by physical therapists in clinical practice. As an invasive technique, the potential for AE exists and is not without some risk to the patient. Most of the AE related to DN are of a mild and transient nature and include bruising and bleeding, pain, and the possibility of a VVR. Part 2 of this series will discuss some of the rare severe complications that can occur with DN treatments in the next edition of *OP.*

REFERENCES

1. American Physical Therapy Association (APTA) Department of Practice and APTA Government Affairs. Physical Therapist and the Performance of Dry Needling – An Educational Resource Paper. January 2012. https://www.liveoakacupuncture.com/wp-content/uploads/2015/05/DryNeedlingResourcePaper1.pdf. Accessed September 15, 2020.
2. Caramagno J, Adrian L, Mueller L, Purl J. Analysis of Competencies for Dry Needling by Physical Therapists: Final Report. July 10, 2015. https://www.fsbpt.org/Portals/0/documents/free-resources/DryNeedlingFinalReport_20150812.pdf. Accessed September 15, 2020.
3. Kalichman L, Vulfsons S. Dry needling in the management of musculoskeletal pain. *J Am Board Fam Med*. 2010;23(5):640-646. doi: 10.3122/jabfm.2010.05.090296.
4. Ries E. Dry needling: getting to the point. *Orthop Phys Ther Practice*. 2015;7(4):12-22.
5. Fan AY, Xu J, Li Y. Evidence and expert opinions: dry needling versus acupuncture (III) – The American Alliance for Professional Acupuncture Safety White Paper 2016. *Chin J Integr Med*. 2017;23(3):163-165. doi: 10.1007/s11655-017-2542-x. Epub 2017 Feb 28.
6. Dommerholt J, Fernández-de-Las-Peñas C., eds. *Trigger Point Dry Needling: An Evidence and Clinical-Based Approach*. London, England: Churchill Livingstone Elsevier Ltd.; 2013.
7. Physiotherapy Alberta College + Association. Dry Needling Critical Event Management. https://www.physiotherapyalberta.ca/files/practice_guideline_dry_needling_critical_event_management.pdf. Accessed June 28, 2019.
8. Edwards IR, Aronson JK. Adverse drug reactions: definitions, diagnosis, and management. *Lancet*. 2000;356(9237):1255-1259. doi: 10.1016/S0140-6736(00)02799-9.
9. Carlesso LC, Macdermid JC, Santaguida LP. Standardization of adverse event terminology and reporting in orthopaedic physical therapy: application to the cervical spine. *J Orthop Sports Phys Ther*. 2010;40(8):455-463. doi: 10.2519/jospt.2010.3229.
10. Carlesso LC, Cairney J, Dolovich L, et al. Defining adverse events in manual therapy: an exploratory qualitative analysis of the patient perspective. *Man Ther*. 2011;16(5):440-446. doi: 10.1016/j.math.2011.02.001. Epub 2011 Mar 5.
11. Grusche F, Egerton-Warburton D. Traumatic pneumothorax following acupuncture: a case series. *Clin Pract Cases Emerg Med*. 2017;1(1):31-32. doi: 10.5811/cpcem.2016.11.32757. eCollection 2017 Mar.
12. Synder DD. Acupuncture gone awry: a case report of a patient who required surgical removal of two single-use filament needles following acupuncture treatment. *J Man Manip Ther*. 2019;27(3):180-184. doi: 10.1080/10669817.2019.1608010. Epub 2019 Apr 25.
13. MacPherson H, Thomas K, Walters S, Fitter M. A prospective survey of adverse events and treatment reactions following 34,000 consultations with professional acupuncturists. *Acupunct Med*. 2001;19(2):93-102. doi: 10.1136/aim.19.2.93.
14. White A. The safety of acupuncture – Evidence from the UK. *Acupunct Med*. 2006;24(Suppl):53-57.
15. Dommerholt J, Fernández-de-Las-Peñas C. *Trigger Point Dry Needling – An Evidence and Clinical-Based Approach*. 2nd ed. Elsevier Ltd; 2018.
16. Deadman P, Baker K, Al-Khafaji M. *A Manual of Acupuncture*. J Chinese Medicine Publications; 2007:68.
17. Seem M. *A New American Acupuncture: Acupuncture Osteopathy – The Myofascial Release of the Bodymind's Holding Patterns*. Denver, CO: Blue Poppy Press; 1993:3.
18. Brady S, McEvoy J, Dommerholt J, Doody C. Adverse events following trigger point dry needling: a prospective survey of chartered physiotherapists. *J Man Manip Ther*. 2014; 22(3):134-140. doi: 10.1179/2042618613Y.0000000044.
19. Ernst E. Acupuncture – A intervention to die for? *J R Soc Med*. 2010;103(10):384-385. doi: 10.1258/jrsm.2010.100181.
20. White A. A cumulative review of the range and incidence of significant adverse events associated with acupuncture. *Acupunct Med*. 2004;22(3):122-133. doi: 10.1136/aim.22.3.122.
21. Witt CM, Pach D, Brinkhaus B, et al. Safety of acupuncture: results of a prospective observational study with 229,230 patients and introduction of a medical information and consent form. *Forsch Komplementmed*. 2009;16(2):91-97.
22. Gilmartin S. Dry Needling: A critical commentary of its effectiveness and safety profile. *Physio Pract Res*. 2018;39(2):155-159.
23. McDowell JM, Johnson GM. Acupuncture needling styles and reports of associated adverse reactions to acupuncture. *Med Acupunc*. 2014;26(5):271-277.
24. Vulfsons S, Ratmansky M, Kalichman L. Trigger Point Needling: techniques and outcome. *Curr Pain Headache Rep*. 2012;16(5):407-412. doi: 10.1007/s11916-012-0279-6.
25. Park JE, Lee MS, Choi JY, Bo-Young K, Sun-Mi C. Adverse events associated with acupuncture: a prospective survey. *J Altern Complement Med*. 2010;16(9):959-963. doi: 10.1089/acm.2009.0415.
26. Yamashita H, Tsukayama H, White AR, Sugishita C, Ernst E. Systematic review of adverse events following acupuncture: the Japanese literature. *Compliment Ther Med*. 2001;9(2):98-104. doi: 10.1054/ctim.2001.0446.
27. Furuse N, Shinbara H, Uehara A, et al. A multicenter prospective survey of adverse events associated with acupuncture and moxibustion in Japan. *Med Acupunct*. 2017;29(3):155-162. doi: 10.1089/acu.2017.1230.
28. Australian Society of Acupuncture Physiotherapists. *Guidelines for Safe Acupuncture and Dry Needling Practice*. April 2013. https://www.dryneedling.com.au/wp-content/uploads/2016/01/ASAP_Guidelines_2013.pdf. Accessed June 30, 2019.
29. McCulloch M, Nachat A, Schwartz J, Casella-Gordon V, Cook J. Acupuncture safety in patients receiving anticoagulants: a systematic review. *Perm J*. 2015 Winter;19(1):68-73. doi: 10.7812/TPP/14-057. Epub 2014 Nov 24.
30. Kouzi SA, Nuzum DS. Arnica for bruising and swelling. *Am J Health Syst Pharm*. 2007;64(23):2434-2443. doi: 10.2146/ajhp070155.
31. Peuker E, Gronemeyer D. Rare but serious complications of acupuncture: traumatic lesions. *Acupunct Med*. 2001;19(2):103-108. doi: 10.1136/aim.19.2.103.
32. Berrigan WA, Whitehair CL, Zorowitz

RD. Acute spinal epidural hematoma as a complication of dry needling: a case report. *PM R*. 2019;11(3):313-316. doi: 10.1016/j.pmrj.2018.07.009. Epub 2019 Feb 22.
33. Marin-Pintado-Zugasti A, Mayoral Del Moral O, Gerwin RD, Ferbabdez-Carbero J. Post-needling soreness after myofascial trigger point dry needling: Current status and future research. *J Bodyw Mov Ther*. 2018; 22(4):941-946. doi: 10.1016/j.jbmt.2018.01.003.Epub 2018 Jan 17.
34. Travell JG, Simons DG. *Myofascial Pain and Dysfunction: The Trigger Point Manual Volume 1. 2nd ed*. Baltimore, MD: Williams & Wilkins; 1999:93.
35. Dommerholt J, Hooks T, Grieve R, Layton M. A critical overview of the current myofascial pain literature – July 2015. *J Bodyw Mov Ther*. 2015;19(3):482-493. doi: 10.1016/j.jbmt.2015.05.003. Epub 2015 May 30.
36. Christensen KA, Gosse BJ, Hildebrand C, Gershan LA. Acupuncture-associated vasovagal response: revised terminology and hospital experience. *Med Acupunc*. 2017;29(6):366-376. doi: 10.1089/acu.2017.1245.
37. He W, Zhao X, Li Y, et al. Adverse events following acupuncture: a systematic review of the chinese literature for the years 1956–2010. *J Altern Complement Med*. 2012;18(10):892-901. doi: 10.1089/acm.2011.0825. Epub 2012 Sep 11.
38. Lao L, Hamilton GR, Fu J, Berman BM. Is acupuncture safe? A Systematic review of case reports. *Altern Ther Health Med*. 2003;9(1):72-83.
39. Gunn CC. *Intervention of Chronic Pain*. 2nd ed. Edinburgh, Scotland: Churchill Livingston; 1996.
40. Baldry PE. *Myofascial Pain and Fibromyalgia Syndromes: A Clinical Guide to Diagnosis and Management*. Edinburgh, Scotland: Churchill Livingstone; 2001.
41. Fisher AA. Intervention of myofascial pain. *Muscoskelet Pain*. 1997;7(1-2):131-142.
42. Acupuncture Canada. What is Acupuncture? 2015 https://www.acupuncturecanada.org/acupuncture-101/what-is-acupuncture. Accessed September 15, 2020.
43. White A, Editorial Board of Acupuncture in Medicine. Western Medical acupuncture: a definition. *Acupunct Med*. 2009;27(1):33-35. doi: 10.1136/aim.2008.000372.
44. White A, Hayhoe S, Hart A, Ernst E, BMAS and AACP. Survey of adverse events following acupuncture (SAFA): a prospective study of 32,000 consultations. *Acupunct Med*. 2001;19(2):84-92. doi: 10.1136/aim.19.2.84.
45. Ernst E, White AR. Prospective research of the safety of acupuncture: a systematic review. *Am J Med*. 2001;110(6):481-485. doi: 10.1016/s0002-9343(01)00651-9.
46. Melchart D, Weidenhammer W, Streng A, et al. Prospective investigation of adverse effects of acupuncture in 97,733 patients. *Arch Intern Med*. 2004;164(1):104-105. doi: 10.1001/archinte.164.1.104.
47. Ernst E, Lee MS, Choi TY. Acupuncture: Does it alleviate pain and are there serious risks? A review of reviews. *Pain*. 2011;152(4):755-764. doi: 10.1016/j.pain.2010.11.004.
48. Xu S, Wang L, Cooper E, et al. Adverse Events of Acupuncture: A Systematic Review of Case Reports. *Evid Based Complement Alternat Med*. 2013;2013:581203. doi:10.1155/2013/581203.

Meet Your Newly Elected Officers

TREASURER

Judith Hess, PT, DHS, OCS, CMPT

A physical therapist since 1992, I am currently an Associate Professor at Midwestern University in Downers Grove, Illinois. In addition to teaching in the entry-level DPT program, I continue to see patients at an orthopedic private practice in the Chicago area. After obtaining a BS and MS in Kinesiology at the University of Illinois, I completed my entry-level master's in Physical Therapy at Duke University. In 2015, I received a Doctor of Health Science degree, with an emphasis on Health Professionals Education, from Midwestern University. Clinically, I enjoy the challenge of working with patients who are experiencing spine and lower extremity dysfunction, with a strong affinity for the foot and ankle. To maintain and further develop my clinical reasoning skills, I am in the process of completing a fellowship in orthopedic manual therapy. When not working, I enjoy woodworking, painting, and getting in over my head with DIY projects around the house. I have had the pleasure to serve the Academy of Orthopaedic Physical Therapy as a member of the Finance Committee from 2014 to 2020 and look forward to assuming the role of Treasurer in the coming months.

DIRECTORS

Beth Collier, PT, DPT

When is the last time you thought about how amazing it is to be a physical therapist? Every day, physical therapists become part of someone's story of resilience and health. We often see people in their most vulnerable states and are invited to see the intimacies of their lives. We often get to witness people striving to overcome their greatest physical and mental challenges and celebrate their accomplishments. Despite the challenges of reimbursement, documentation, and inequitable resources, I believe that physical therapists have a unique potential to influence the health and wellness of our communities. I have worked clinically in hospital-based, private practice, and academic clinics in rural and urban areas. I am grateful for the opportunities I have been afforded to enter the lives of so many wonderful people in each of these communities and for the impact each person has had on my personal growth. Through my self-reflection and personal growth journey, I have recognized the role of leadership in our profession to impact the culture of health in the communities we serve. I believe in human potential and I believe that physical therapists can be the design architects to help people thrive in their environments. My desire, as someone who identifies as a servant leader, is to uplift and empower physical therapists around the country and around the world to serve as ambassadors of health. As a newly elected Director of the Academy of Orthopaedic Physical Therapy, I look forward to connecting with physical therapists who are working in their unique ways to transform the health of society. I am interested to hear your stories, challenges, and ideas to advance our profession. Please reach out to me at any time at bcollier@orthopt.org. Thank you for this opportunity and I look forward to connecting with you!

Derrick Sueki, PT, DPT, PhD

Change is hard, but it can be beneficial. Over 20 years ago, I was an architect, designing and building structures and homes. At that time, the decision was made for walking away from architecture and became a physical therapist aide wanting to create a more tangible difference in lives and not structures. While that was not an easy discussion to have with my family, moving forward sometimes requires the willingness to travel alternative pathways. Since then, my career has allowed me to attain a DPT, complete post-graduate studies in Australia, earn a PhD, and open two practices. Each progression along the journey was not easy, requiring several steps: it required having a vision for the future, developing a plan to get there, the willingness to take a risk, and the determination to work through the procedure to its end. These steps are required again as the COVID pandemic, and social injustice have had a significant impact on society and our profession. While many hope for a quick return to ways of the past, 2020 has provided opportunities to move forward. Telehealth, online education, virtual learning, developing technologies, and an increased focus on non-pharmacological alternatives for health and wellness provide the profession with new possibilities. Moving forward sometimes means stepping onto other pathways and a willingness to walk a different route than we are accustomed to traveling. I am honored to be elected to the Director position with the Academy of Orthopaedic Physical Therapy and look forward to helping the Academy on this new journey. It will not be easy; change never is, but there are legitimate opportunities for the profession and the Academy on the other side of the pandemic. The job of the Director is to represent you on this journey. Reach me at dsueki@orthopt.org with your thoughts and visions for the Academy so that together we can move the profession forward.

Congratulations to Our Centennial Scholars!

The Academy of Orthopaedic Physical Therapy is pleased to announce the following AOPT-sponsored Centennial Scholars. The AOPT will be sponsoring the participation of these three individuals and help to guide their pursuit of leadership opportunities, both at the component and national levels.

The APTA Centennial Scholars Program is designed to build a cadre of future association leaders and demonstrates the AOPT and APTA's investment in a diverse and prepared group of future leaders. This 12-month program will run throughout 2021 with a goal of engaging 100 scholars via live and virtual learning experiences. Additionally, scholars will work directly with the AOPT to design and complete a capstone project that addresses an existing need of the Academy.

MEET OUR SCHOLARS!

Mary Beth Geiser, PT, DPT, OCS, FAAOMPT

I am excited to represent the Academy of Orthopaedic Physical Therapy (AOPT) as a Centennial Scholar. I graduated from Marquette University (BS in PT) and advanced my education at Concordia University, Wisconsin (tDPT), and Regis University (Fellow). I love serving our field through my numerous roles: PT, board-certified specialist, clinician, student mentor, volunteer, colleague, spouse, working mother, and advocate for you, our patients, and this excellent profession. As therapists, we should listen to each person's voice and story. What we do with that story and the actions we take are what matter the most.

As your AOPT Centennial Scholar, I am looking forward to a path where each brick laid has the potential to create or reinvent positive and lasting effects for our physical therapy profession. I want to show others how and where orthopaedic physical therapy fits into an individual's plan of care. I will embrace opportunities where collaboration, innovation, and education intersect. My goal is to bring these experiences to the public and inter-professional audiences, so the value of physical therapy is understood. This12-month journey will hone skills needed to create change, one person or project at a time.

Yusra Iftikhar, PT, DPT

Hi everyone! My name is Yusra Iftikhar and I am a recent graduate of the Duke Doctor of Physical Therapy Program. I recently accepted a position in an outpatient orthopedics and sports clinic in Indiana, where I currently reside with my family, and I am excited to get to work. I am a writer, and my favorite topics to write about are my biggest PT passions: mental wellness and diversity, equity, and inclusion initiatives. I am also a former Zumba instructor and any day with coffee, Carolina basketball, and a dance party with friends is my kind of day.

I am very grateful to be an APTA Centennial Scholar. I hope to serve as a role model and mentor to those who will come after me, particularly students of minority, underrepresented, or underserved status. I want to show pre-PT and pre-PTA students that people who look like them can not only hold space in this profession, but that they can thrive and achieve their highest potential as they work in service of others and themselves. As a Centennial Scholar, I hope to expand pipeline initiatives for students at all levels of their pursuit of a career in physical therapy.

Zach Walston, PT, DPT, OCS

I serve as the National Director of Quality and Research and Orthopedic Residency Program Coordinator for PT Solutions Physical Therapy. My primary roles comprise of overseeing research efforts, developing and teaching continuing education courses, and developing quality improvement initiatives. I earned my B.S. in Human Nutrition, Foods, and Exercise at Virginia Tech and my DPT from Emory University. I currently serve on the APTA Science and Practice Affairs Committee and within the RM Barney Poole Leadership Academy. I am also the host of the Clinical Gap Podcast. I live in Marietta, GA with my wife and two kids.

One of my primary career goals is to facilitate a bridge between private practices and universities in the areas of research and profession advocacy. I believe there are many missed opportunities to combine the resources of each. The Centennial Scholars Program will help in my development of fostering relationships between relevant parties within our profession. The opportunity to complete a capstone project will provide me another avenue to apply my current skills towards a meaningful endeavor for the profession. The project and the feedback from mentors would provide further value and growth opportunities for my personal and profession goals.

2021 AOPT Call for Nominations

Are you interested in running for an open AOPT position? If so, one of these positions may be a right fit for you!

Positions Open for Election:

- 1 - President (3-year term)
- 1 - Director (3-year term)
- 1 - Nominating Committee Member (3-year term)

To learn more about the qualifications necessary for being considered to run for these option positions and to access the potential candidate form, click here: https://www.orthopt.org/content/governance/committees/nominating/2021-aopt-election

If you have questions, please contact the AOPT office: tfred@orthopt.org.

TISSUE TOLERANCES

Independent Study Course 30.2

Learning Objectives

1. Understand muscle and tendon anatomy and biomechanics.
2. Interpret the physiological mechanisms and processes associated with pathologic muscle and tendon tissue to clinical care.
3. Describe clinical and diagnostic tools used in identifying muscle-tendon abnormality.
4. Apply the current body of evidence underlying the physical therapy management for injury to the muscle-tendon unit.
5. Know how to apply concepts to improve the tolerance of muscle-tendon tissue to load, and implement such concepts to injury prevention strategies.
6. Describe the anatomy and physiology of a healthy ligament and capsular tissue.
7. Describe the pathophysiological processes that occur in the event of an injury to ligament or capsule.
8. Identify the phases of healing following a ligamentous injury.
9. Apply pathophysiological concepts of ligamentous integrity to the examination and treatment of specific conditions for the extremities.
10. Understand the structure and functional rigor of articular cartilage.
11. Appreciate the scientific basis of why cartilage regeneration is limited.
12. Describe the most common mechanisms for articular cartilage damage.
13. Describe the link between articular cartilage damage and early osteoarthritis.
14. Describe the medical interventions currently used in the repair of articular cartilage.
15. Specifically apply rehabilitation goals and precautions for patients who have undergone patellar and femoral articular cartilage repair.

Editorial Staff

Christopher Hughes, PT, PhD, OCS, CSCS—Editor
Gordon Riddle, PT, DPT, ATC, OCS, SCS, CSCS—Associate Editor
Sharon Klinski—Managing Editor

For Registration and Fees, visit orthopt.org
Additional Questions—Call toll free 800/444-3982

Description

This course will provide the clinician with an appreciation of the structure and function of tissue and its tolerance for injury and its potential for healing. Physiological concepts and biomechanics are covered for muscle and tendon, ligament and capsule, and articular cartilage. Each author brings a unique perspective for how to integrate basic science to clinical scenarios. An interesting array of cases accompanies each monograph. The cases serve to facilitate clinical decision-making and to provide examples of evaluation and treatment. This is a unique course series that should satisfy the scientific and clinical curiosity of every clinician.

Topics and Authors

Tissue Tolerances of the Muscle-Tendon Unit
Dhinu J. Jayaseelan, DPT, OCS, FAAOMPT

Tissue Tolerances of the Ligament and Capsule
Katherine Wilford, PT, DPT, Cert. MDT;
Hazel Anderson, PT, DPT, Cert. MDT;
Navpreet Kaur, PT, DPT, PhD, MTC;
Manuel A. (Tony) Domenech, PT, DPT, MS, EdD, OCS, FAAOMPT;
Nicole P. Borman, PT, PhD, MTC, OCS, CSCS

Tissue Tolerances of the Articular Cartilage
Ann Smith, PT, DPT, OCS, PCS

Continuing Education Credit

Contact hours will be awarded to registrants who successfully complete the final examination. The Academy of Orthopaedic Physical Therapy CEUs are accepted by the majority of state physical therapy licensure boards as allowed by the type of course requirements in state regulations. For individual state requirements, please visit your state licensure board website.

Course content is not intended for use by participants outside the scope of their license or regulation.

ACADEMY OF ORTHOPAEDIC PHYSICAL THERAPY

APTA American Physical Therapy Association

President's Message

Rick Wickstrom, PT, DPT, CPE, CME

The OHSIG has several ongoing initiatives to empower our members to excel and thrive in occupational health during this time of COVID-19 uncertainty. Our Membership Committee led by Caroline Furtak, Chair has created opportunities for OHSIG members to serve as State Resource Liaisons to disseminate OHSIG information or respond to inquiries about occupational health practice and payment policy. Our Practice Committee led by Lorena Payne, Chair is putting final touches on the first evidence-based Work Rehab Clinical Practice Guideline. Our Research Committee led by Marc Campo, Chair is steering our advanced practice educational credential initiative to qualify and promote expertise of physical therapists in occupational health. This issue of *Orthopaedic Physical Therapy Practice* introduces the update to our Current Concepts description of "The Role of Physical Therapists in Occupational Health." This document was produced by the OHSIG Communications Committee led by Chair, Cory Blickenstaff and Vice Chair, Peter McMenamin. It informs physical therapy professionals in all specialties and external stakeholders about the history, knowledge, and practice of physical therapists in occupational health. Enjoy!

Current Concepts in Occupational Health: Role of Physical Therapists in Occupational Health

Peter McMenamin, PT, DPT, MS, OCS; Rick Wickstrom, PT, DPT, CPE, CME; Cory Blickenstaff, PT, MSPT, OCS; Justin Bagley, PT, DPT; Connie Johnson, PT, DScPT, PCS; Kevin Jones, PT, DPT, OCS; Diane Newquist, PT; Jeff Paddock, PT, MPT, MBA, CSCS

PREFACE

The purpose of this document is to provide an overview of the history, knowledge, and professional roles of physical therapists in the broad field of occupational health. This document is retitled and represents an update, replacing "PHYSICAL THERAPIST IN OCCUPATIONAL HEALTH GUIDELINES" that was adopted by the Academy of Orthopaedic Physical Therapy (AOPT) on July 11, 2011. The target audience includes all health care professionals, administrative, and regulatory stakeholders who may find it beneficial to be aware of the full scope of physical therapist's knowledge and skills in maintaining the health and functional ability of workers. This document will also guide physical therapists interested in fostering system improvements that incorporate the value of physical therapy services in the occupational health space.

Hyperlinks are provided to underlined text to access information on other websites about key regulations, best practice examples, or interpretive guidance. An electronic pdf version of this document with active hyperlinks is available at: https://www.orthopt.org/content/special-interest-groups/occupational-health/current-concepts-in-occ-health.

INTRODUCTION

Occupational health, as defined by the World Health Organization, is a multidisciplinary activity aimed at the protection and promotion of the health of workers.[1] This approach considers an individual's physical, mental, and social well-being, general health, and personal development. Regulatory compliance in the United States for all aspects of health and safety in the workplace is led by the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH). Occupational health is a specialized area for physical therapy practice that requires continuing education to develop advanced competencies in prevention, evaluation, and management of injuries and illnesses that affect the health and activity participation of workers.

Human movement is central to worker health and productivity. The 2013 House of Delegates of the American Physical Therapy Association (APTA) adopted a new vision stating that optimizing human movement represents the core professional identity for the physical therapy profession.[2] This vision challenges all physical therapists to monitor an individual's movement system across the lifespan, to diagnose dysfunction, and to prevent or reduce impairments and restrictions that limit participation in work and other lifestyle activities. This APTA vision is reflected in the OHSIG's 2020 vision to "lead the world in optimizing movement, musculoskeletal health, and work participation from hire to retire."

Physical therapists (PTs) fulfill a vital role in delivery of occupational health services because they focus on optimizing movement to promote activity-participation that influences sustained worker productivity. PTs are doctoral trained and versatile healthcare professionals who examine, evaluate, and diagnose movement impairments, and prescribe safe therapeutic interventions for individuals of all ages and settings to:

- improve ability to move functionally,
- reduce or manage pain,
- facilitate job or lifestyle accommodations, and/or
- alleviate disability.

PTs deliver effective care to improve quality of life through prescribed physical activity, hands-on care, patient education, and program development consultation. PTs collaborate with physicians, other healthcare providers, fitness professionals, insurance professionals, case managers, safety professionals, risk professionals, and human resource professionals. PTs use their knowledge of disease, signs and symptoms, mechanisms of injury, outcomes and prognosis, treatment response, and relevant individual and environmental factors to arrive at a differential diagnosis, quantify movement impairments, clarify functional limitations, and improve work and lifestyle participation.

PHYSICAL THERAPY EDUCATION ADVANCES

The goal of physical therapy education is to develop clinicians who use scientific evidence, clinical expertise, and client preferences to optimize patient/client outcomes. Currently, the curriculum in PT education programs includes differential diagnosis, understanding pharmaceutical and radiological considerations and identifying red flags to determine when it is necessary to refer to

the appropriate healthcare providers. Consistent with the increasing depth of the physical therapy body of knowledge, entry-level PT education transitioned from certificate programs to bachelor's degree, then to master's, and finally to the professional doctorate (DPT). The DPT degree is reflective of the extensive education and training of today's PTs. To be licensed to practice physical therapy, the candidate must pass a national examination. Eligibility to sit for the examination requires that the candidate's DPT degree was granted by a program accredited by the Commission on Accreditation in Physical Therapy Education (CAPTE). The DPT curriculum prepares PTs for triage and primary care duties such as differential diagnosis, referral for imaging, medication impacts, and identification of abnormal findings that warrant referral to physicians and other healthcare providers.

The PT in occupational health has professional and ethical responsibilities to remain current through lifelong learning and professional development through the pursuit of advanced knowledge, skills, and abilities general to healthcare and physical therapy as well as specific to occupational health. PTs may choose to complete a residency or fellowship to gain experience or become board-certified in clinical specialty areas of practice accredited through the American Board of Physical Therapy Specialties. Along with advancements to physical therapist education, came legislative and practice act updates throughout state jurisdictions. Over time, all 50 states and the District of Columbia have allowed for direct access to PT services. Direct access affords consumers of healthcare services access to PT services as an entry point into the healthcare system.

The Model Practice Act (MPA) is the preeminent standard and tool available for revising and modernizing state PT practice acts and Workers' Compensation rules that differ between state jurisdictions.[3] The expertise of PTs in examination and evaluation as entry-point healthcare practitioners is well described in the Guide to Physical Therapist Practice: "Physical therapists engage in an examination process that includes taking the individual's history, conducting a standardized systems review, and performing selected tests and measures to identify potential and existing movement-related disorders. The data gathered during history taking, including answers to review of systems questions, enables the physical therapist to generate diagnostic hypotheses and select specific tests and measures to identify and characterize signs, symptoms, and risk of movement dysfunctions. To establish the individual's specific diagnosis, prognosis, and plan of care through the evaluation process, physical therapists synthesize the collected examination data and determine whether the potential or existing disorders to be managed are within the scope of physical therapist practice."

HISTORY OF PHYSICAL THERAPY IN OCCUPATIONAL HEALTH

Credentialing for Primary Care of Musculoskeletal Disorders in the US Military Service

The origins of physical therapy are in occupational health and can be traced back to Sweden where, in the early 1800s, rigorous methods of physical training ("medical gymnastics") of military recruits and rehabilitation of injured soldiers by a trained cadre of professional therapists emerged.[4] These methods spread to Great Britain as a PT profession emerged to treat injured soldiers and members of the public in the 1890s. Likewise, in the United States, the PT profession was born in response to a dire need to rehabilitate American soldiers injured during World War I.

The military setting also presented the first opportunity for PTs to serve as primary healthcare workers. In the early 1970s, the roles and responsibilities for PTs were greatly expanded to entry-point healthcare practitioners when orthopedic surgeons struggled to manage the high volume of nonsurgical cases in addition to their surgical caseloads. Military PTs received additional training to be credentialed for an expanded role as primary care providers for military workers with musculoskeletal disorders. This entry point role in military settings includes the ordering of diagnostic imaging and lab tests, prescribing medications, managing referrals to other practitioners, prescribing duty limitations, and performing electromyographic and nerve conduction studies.[5]

Converging Specialty Roles in Occupational Health

Traditionally, orthopaedic PTs have been the primary physical therapy providers within occupational health because the majority of workplace injuries involve the musculoskeletal system. However, work participation barriers are priorities that must be addressed in the care of other patient groups as well, such as those with developmental, cardiopulmonary, neurologic, and oncologic conditions. For example, cancer survivors have a vital need for services to properly match their possibly altered post-cancer abilities with the workplace. Older workers are at risk for non-occupational health conditions such as cardiopulmonary disorders that may impact work participation. Thus, PTs who practice in occupational health in a variety of settings often collaborate and coordinate care with physical therapists in other specialties to maximize the profession's ability to enhance work-participation across the entire working lifespan.

Growth of the Occupational Health Special Interest Group (OHSIG)

The need for performance-based functional evaluation was identified in the 1980s by state workers' compensation programs that required accurate information about worker functional capacities and limitations to expedite return to work. In 1991, APTA established the Industrial Rehabilitation Advisory Council (IRAC) to classify the levels of work rehabilitation to accurately reflect contemporary practice, standardize terminology, and address the needs of patients/clients, providers, regulators, and payers. The APTA Board of Directors adopted initial practice guidelines for Work Conditioning and Work Hardening in 1992.

The Occupational Health Special Interest Group (OHSIG) was formed as the first specialty group in the AOPT in 1993. From that point on, the OHSIG has been a resource for professionals, professional organizations, and regulatory agencies related to population health and productivity of the workforce. The OHSIG mission is to empower members to excel in occupational health. The OHSIG is involved in collaborative initiatives that include sharing evidence-based guidelines for practice, contributing to multi-professional initiatives, and advocating for regulatory improvements. An evidence-based Work Rehab Clinical Practice Guideline will soon replace the consensus-based version of ADVANCED WORK REHABILITATION GUIDELINES.

KNOWLEDGE REQUIRED FOR OCCUPATIONAL HEALTH SERVICES

Critical Inquiry and Evidence-Based Practice

Critical inquiry is a key knowledge area in occupational health practice as the PT may be asked to answer questions about activi-

ties and tasks associated with a specific injury or broader health or injury trends in a workplace. This data is critical for leadership communication and awareness to support program financing needed for hazard controls, return to work programming, and employee wellness. The PT in occupational health must possess the analytical skills to use data related to injuries and employee health to establish the course and nature of the patient's injury, condition, or functional impairment and the plan of care for that injury, condition, or impairment within the scope of physical therapy. For this reason, PTs in occupational health have up-to-date knowledge of scientific evidence regarding risks, incidence, causative factors, biomechanics, ergonomics, and biopsychosocial components associated with musculoskeletal injuries. Critical inquiry as part of the PT's clinical evaluation and interventions with patients primarily involves the use of sound clinical reasoning in the application of evidence-based physical therapy practice for individual care or population health interventions. PTs in occupational health also have the opportunity to use critical inquiry to influence systems improvements that contribute to the scientific body of knowledge through applied research and published clinical commentary.

Functional Implications of Health Conditions

Work-related musculoskeletal (MSK) disorders are associated with high costs to employers from absenteeism, lost productivity, and increased health care, disability, and workers' compensation costs. Therefore, PTs working with this population should possess a solid foundation of evaluation and management of MSK disorders. PTs practicing in occupational health should also be trained and prepared to work with individuals who present with a broad range of non-occupational health conditions, functional limitations, and work participation barriers. Therefore, competence in identifying a wide range of body systems' disorders (such as neurological, cardiovascular, endocrine, and pulmonary) is necessary for PTs to effectively treat this population.

Understanding how the MSK system is impacted by systemic disorders will improve the PT's ability to evaluate and manage altered functional movement. This synthesis of the patient's presentation will facilitate implementation of safe therapeutic interventions to optimize movement and safe work participation. PTs are prepared for entry-level practice with an extensive clinical education that covers a broad range of settings and complex health conditions. As curriculum in PT programs includes understanding the interconnectivity of the body systems and the MSK system, PTs are prepared to function as an initial point of entry into the healthcare system and to manage functional activity progression after injury or illness.

Job Analysis and Ergonomics

Physical therapists who engage with employers to prevent injuries and disability due to MSK disorders require advanced training and/or credentialing to analyze job demands and implement Elements of Ergonomics Programs that are recommended by the Centers for Disease Control and Prevention (CDC)6 and other agencies. In gathering and examining evidence for workplace MSK disorders to determine whether symptoms are work-related, PTs use ergonomic assessment tools to identify injury risk factors such as injury-prone postures, forceful exertions, repetitive motions, contact stresses, and vibration. The goal is to fit the work task or physical work environment to the capacities of the worker. This follows a prevention-through-design approach and the NIOSH Hierarchy of Controls within a workplace safety culture that is supported by top-down leadership.

PTs in occupational health acquire additional knowledge and training in the objective measurement and analysis of job demands and MSK risk factors, as contained in the Dictionary of Occupational Titles (DOT), the Bureau of Labor Statistics (BLS) Occupational Requirements Survey, and ergonomic risk assessments. A PT's understanding of posture and movement disorders helps them identify awkward and sustained postures that can contribute to injury.

Social, Industrial, and Commercial Systems

PTs in occupational health may interact with a variety of stakeholders to assist with worker/client management or to develop workplace programs. Interaction also occurs in obtaining financial and managerial support for workplace safety and health programs. PTs may also be asked to facilitate an interactive process between the worker and management to implement accommodations that support remaining at work or returning to work.

Claims management and treatment authorization often follow a different process for work-related injuries than for non-occupational health conditions. Larger employers may contract directly with occupational health professionals for on-site services, whereas smaller employers may establish preferred provider relationships with community-based medical, therapy, or case-management providers.

Science of Population Health

Occupational health physical therapy requires a population health perspective. Population health is a broad approach focused on understanding the conditions and factors that influence the health of populations over lifetimes. Edington et al suggest that as the number of health risks and negative health behaviors increases, employee health costs also increase.[7] PTs have the expertise to work with populations to improve overall health and avoid preventable health conditions. These roles may include education, intervention, research, advocacy, and consultation in the workplace or clinic to meet the profession's vision of optimizing movement to improve the human experience. For example, a workplace may seek consultation regarding changes to workplace procedures or design to address the health of an entire department or workplace "population."

Program development must consider this population's social determinants of health, which are non-medical factors in the environments in which people are born, live, learn, work, play, worship, and age, all of which can impact a wide range of health, functioning, and quality-of-life outcomes and risks.[8] NIOSH has embraced the importance of addressing the social determinants of health through its Total Worker Health® initiative. Total Worker Health is defined as policies, programs, and practices that integrate protection from work-related safety and health hazards with the promotion of injury and illness-prevention efforts to advance worker well-being.

Occupational Health and Safety Regulations

Occupational health practice requires interaction, collaboration, and strategic planning with stakeholders as well as familiarity with laws and regulations that govern workplace safety, health, and job accommodation. The General Duty Clause from the OSHA Act of 1970 requires that, in addition to compliance with haz-

ard-specific standards, all employers provide a work environment "free from recognized hazards that are causing or are likely to cause death or serious physical harm." Compliance necessitates a clear understanding of service expectations during examinations, interventions, or other consultations to support:

- Federal or state-specific Workers' Compensation Insurance Programs,
- Short- and long-term disability insurance programs,
- Family and Medical Leave Act,
- Social Security Administration Disability Programs,
- Regulations that protect against employment discrimination (based on age, sex, race, disability) [enforced by EEOC, etc.],
- Safety regulations (OSHA accident reporting, first aid),
- Workforce Innovation and Opportunity Act (WIOA), and
- Health Insurance Portability and Accountability Act (HIPAA)

Regulations that impact occupational health services are further described in Current Concepts in Occupational Health: Regulatory Compliance.

Business Management of Occupational Health Services

As healthcare and disability costs rise, physical therapy occupational health consultants are a valuable asset for employers seeking to reduce these costs. This is accomplished with early assessment and measures to reduce MSK disorders and improve overall worker health and fitness. A classic example of "lean" improvements achieved with physical therapy at the entry point of care is the Intel-led Healthcare Marketplace Collaborative model that reduced the care duration of lower back pain.[9]

The PT must be aware of business processes and possess skills to effectively execute occupational health practice requirements. For example, the therapist develops and maintains corporate and institutional clients, prepares detailed business or professional service proposals, provides consultative services, performs needs-analysis, defines work products, targets work-related outcomes, and writes reports detailing critical findings, and strategic recommendations. Additionally, PTs participate with employers and other stakeholders in the development of financial models that demonstrate a positive return on investments in worker safety, health, and disability programs.

The occupational health PT has training and experience in initiating stakeholder dialog and meetings to set the stage for a systems approach to program implementation. Development of solutions for employers necessitates a review of claims history, costs, and OSHA logs, and identification of strengths and weaknesses of existing programs. The PT consultant must be able to present solutions to employers as a formal written proposal.

AREAS OF PRACTICE WITHIN OCCUPATIONAL HEALTH

Physical therapists in occupational health provide prevention, wellness, and therapy care directly to individual workers, and consult in multiple areas:

Workforce Health Promotion

The PT in occupational health delivers health promotion services related to employer-based programs, injury prevention, ergonomic solutions, wellness initiatives, work accommodations, and chronic disease management. A main objective of workplace-based services is timely delivery of prevention, intervention, and education strategies to reduce group health and workers' compensation costs and related time loss, absenteeism, and presenteeism while increasing overall health, well-being, sustainability, and productivity of the workforce and their families. The PT diagnoses movement system dysfunctions and related findings that put the worker at risk for MSK disorders. Although these services are usually administered at the workplace, it may be necessary to establish access at a nearby clinic or through telehealth, to support employees who work unusual shifts or from home or remote sites.

Workplace Ergonomic Program Consultation

PTs deliver a range of services to support employer-based ergonomic programs in a variety of settings. Ergonomic programs are designed to improve worker comfort and well-being by identifying and correcting ergonomic risk factors for MSK disorders. An emerging need addressed by ergonomic programs is design compliance with CDC guidelines for the COVID-19 pandemic. Employers often use safety committees to address ergonomic concerns in their workplace, with PTs serving as committee members and subject matter experts.

Ergonomic tests and measures are performed to examine the environment, site, tools, equipment, materials, machinery, workflow, production processes and requirements, physical demands, physical stressors, and task rotation. Ergonomic interventions include administrative controls (coaching in job-specific exercises or safe work methods) and engineering controls (tools and equipment) to mitigate specific risks and hazards. Clinicians examine workers with MSK complaints and analyze job demands to investigate causality and diagnose movement dysfunctions. They administer appropriate measures in accordance with OSHA first aid regulations and guidelines for safe therapeutic care.

Functional Job Analysis and Employment Exams

PTs in occupational health assess job activity demands to clarify performance expectations for workers, promote workplace interventions that ensure safety, and design and administer functional employment examinations. Job analysis is an important first step to ensure that MSK risks have been reduced to the extent feasible by safety controls. Examiners validate the physical demands for essential job functions and criteria for job qualifications before administering a functional employment screen of new hires or injured workers to ensure suitable work assignments. PTs perform objective physical fitness tests to assess baseline health status and prescribe suitable physical activity as a component of functional employment exams.

Job analysis may be done as an early intervention to investigate MSK injury claims or to engage the worker and supervisor in an interactive process to facilitate remain-at-work or return-to-work with workplace interventions such as transitional work or job modifications. For example, the Ohio Bureau of Workers' Compensation (BWC) established special billing codes for PTs to perform an ergonomic study or functional job analysis as remain at work or return to work services. Job analysis is a major component of Ohio BWC's Transitional Work Grants Program to help injured workers remain at work or return to work by identifying suitable transitional work.

Several states recognize PTs' expertise in using these analyses and exams in the management of injured workers. For example, the Washington State Labor and Industries is a leading workers'

compensation insurer in best practices that seek to prevent needless work disability. According to RCW 51.32.090 (4) (b), the injured worker or his or her legal representative is entitled to a job analysis to support job-specific care and Ability-to-Work Assessments. This process leverages and respects the expertise of physical or occupational therapists who render care or conduct a functional capacity evaluation to review an employer's Job Analysis (F252-072-000) and certify whether the worker may be released to full duty, return to work with job modifications, is temporarily unable to perform the job, or is permanently restricted from performing the physical activities as described on the job analysis.

In some states, PTs are eligible providers who may become credentialed as Certified Medical Examiners to perform Department of Transportation (DOT) Physical Examinations of Commercial Truck Drivers in accordance with rules and guidelines that have been established by the Federal Motor Carrier Safety Administration (FMCSA).[10] The purpose of a DOT Physical Examination is to determine and certify a driver's medical fitness for duty. Examiners educate and refer drivers for further evaluation if an undiagnosed or worsening medical problem is suspected. The responsibilities of Medical Examiners are further described in CFR Title 49, Chapter II Subpart E §391.43 Medical examination; certificate of physical examination.

Entry Point Care for Workers With Job Participation Barriers

This area of practice involves early intervention, acute care, and disability management of workers who are unable to perform a specific job due to MSK, developmental, cardiovascular, pulmonary, neurologic, oncologic, or other impairments. PTs serve a vital role in managing employees who have work participation barriers. When an injury happens to an employee, a PT performs a wide array of evaluation, triage, and intervention techniques as soon as that injury occurs. In states where the law allows direct access to physical therapy care, a PT can typically assess the injury immediately and make appropriate injury management recommendations.

Provision of services at the job site expedites the triage process. Treatment for specific health conditions to improve the employee's ability to perform necessary job demands occurs at the job site (onsite physical therapy and transitional work) or more traditional settings. The PT uses their training and education in exercise prescription to match interventions to specific job demands to enhance productivity. If the prognosis is poor for return to most recent employment, PTs collaborate with vocational specialists to make legally-required accommodations and/or recommendations for return to appropriate job options.

The PT in occupational health may have the opportunity to not only identify and assess prognostic indicators in both the individual and the workplace setting but also to create actions for change at each level. This necessitates the ability to navigate the work environment and its stakeholders to communicate actionable plans and motivate change. This may involve education on the expected course or duration of a given condition that may be informed by various published guides such as ODG by MDG and MDGuidelines. PTs are able to assist a workplace in updating their approaches to improve an injured worker's prognosis for return to work. Examples include instituting transitional work practices that support stay at work or early return to modified duties.

The CPT codes typically reported by PTs of billing services rendered may not always be sufficient to describe interventions provided for workers with work performance barriers. The Ohio BWC recognized this and established special codes for on-site transitional work services that are provided by a physical or occupational therapist at the workplace with a focus on using the injured worker's functional work tasks to progress the worker to a target job. More information on this topic is contained in Current Concepts in Occupational Health: Managing an Acute Injury that Limits Work Participation.

Rehab Programs for Workers with Complex Health Behaviors

There is a long list of non-musculoskeletal factors that, when present, indicate a less desirable prognosis and contribute to variable recovery patterns in patients with similar conditions.[11] The biopsychosocial nature of illness dictates that the comorbidities such as depression and anxiety, poor social support structures, financial difficulties, and medical issues like diabetes and heart disease may all impact the presentation and course of a given illness affecting a person's work performance.[12] Additionally, the workplace would be considered part of the social milieu and would include factors such as job satisfaction, relationships with co-workers and those in positions of authority, changes in employment status, and specific workplace approaches to issues like approaches toward the handling of injured workers and return to work. There may also be larger societal factors at play such as issues of justice, discrimination, and disparities in opportunity or access to care.[13]

Complex cases involving workers often require advanced work rehabilitation designed to address physical, behavioral, and vocational needs that include other medical and workplace stakeholders. Such workers require more in-depth examination and evaluation with functional testing as well as communication and coordination with other stakeholders. The treatment plan involves multiple components and stratification of care. PTs help workers to cope effectively and recover function during structured intensive programs that are work-focused and include work-place interventions when appropriate. Work rehabilitation uses various therapeutic interventions including activity coaching to emphasize the role of the worker and work activities. More information on this topic is contained in OHSIG's Advanced Work Rehabilitation Guidelines.

An emerging area of practice for PTs serving public schools is incorporating occupational health concepts to prepare students with developmental and other disabilities for successful transition to community-based employment. The Workforce Innovation and Opportunity Act (2015) specifies 4 types of employment: competitive, integrated employment; supported employment; customized employment; and nonintegrated employment. Physical therapists practicing in public school settings perform evaluations of a student's physical abilities to identify work-related strengths and barriers to work, make recommendations for activities that will increase vocational task performance, and consult and collaborate with educators and vocational specialists within Individualized Educational Programs (IEPs) that support the acquisition of needed skills and transitions to gainful employment.[14] These programs can take place in the school and community, ideally using a population health model supported by PTs.

Functional Capacity Evaluation and Impairment Ratings:

PTs in occupational health provide Functional Capacity Evaluation (FCE) services that may be job-specific or exploratory to support job search for any suitable occupation. More information about FCE is contained in Current Concepts in Functional Capacity Evaluation: A Best Practices Guideline. An FCE is "a compre-

hensive performance-based medical assessment of an individual's physical and/or cognitive abilities to safely participate in work and other major lifestyle activities." A "job-specific" FCE is performed when the worker has an option to return to work in a specific job with or without accommodation, whereas an "any occupation" FCE is done to support job search or eligibility for disability benefits.

An FCE is usually administered as a stand-alone evaluation with components that include an intake interview, medical records review, physical examination, and validated functional testing that reflects consideration and understanding of job-specific demands and limiting health conditions. Greater expertise and complexity are necessary to perform a stand-alone FCE than for physical capacity tests to measure functional progress in response to physical therapy. For example, the Oregon Workers' Compensation Division rules describe 3 levels of evaluation and require insurers to select a PT or occupational therapist from a credentialed Director's List of Authorized IME Providers.

Objective findings from an FCE that is performed to address work disability issues may also be used to determine an anatomical rating of impairment when workers reach a functional plateau during recovery that is termed "maximum medical improvement." PTs undergo training and credentialing to determine impairment ratings. The 6th edition of the AMA Guides to the Evaluation of Permanent Impairment defines an impairment rating as "consensus-derived percentage of loss of activity reflecting severity for a given health condition, and the degree of associated limitations in ADLs." Activities of daily living refer to basic self-care activities such as feeding, bathing, personal hygiene, and dressing. The main consideration during an impairment exam is to determine relationships between established diagnoses, level of impairment severity, and functional performance. AMA Guides methodology in its current form does not address the severity of an injured worker's occupation disability resulting from their impairments. AMA Guides impairment ratings are used to calculate financial compensation without regard to impact on ability to work, resulting in claims of unfairness by workers who experience job loss. A job/occupation match method using the results of a best-practice FCE has been proposed to remedy these concerns.[16]

SUMMARY

PTs are versatile, doctoral-trained health practitioners who are qualified to serve in a variety of practice roles and settings to optimize worker safety, health, and productivity. Workers benefit from early access to PTs as entry-point practitioners who possess the clinical skills to work with individuals and populations having a broad range of health conditions, functional limitations, and work participation barriers. PTs offer a unique and practical emphasis on functional diagnosis and prescription of suitable physical activity and safe therapeutic interventions to support worker safety and productivity from hire to retire.

REFERENCES

1. World Health Organization. Occupational health: A manual for primary healthcare workers. World Health Organization; 2002. https://apps.who.int/iris/bitstream/handle/10665/200733/dsa191.pdf?ua=1. Accessed November 11, 2020.
2. Sahrmann SA. The human movement system: our professional identity. *Phys Ther*. 2014;94(7):1034-1092.
3. Federation of State Boards of Physical Therapy. The model practice act for physical therapy. Sixth Edition Version 6.1. Revised 2020. https://www.fsbpt.org/Free-Resources/Regulatory-Resources/Model-Practice-Act. Accessed November 11, 2020.
4. Hansson N, Ottosson A. Nobel Prize for Physical Therapy? Rise, Fall, and Revival of Medico-Mechanical Institutes. *Phys Ther*. 2015;95(8): 1184–1194.
5. Moore JH, Goffar SL, Teyhen DS, Pendergrass TL, Childs JD, Ficke JR. The role of U.S. military physical therapists during recent combat campaigns. *Phys Ther*. 2013;93(9):1268-1275. doi: 10.2522/ptj.20120136. Epub 2013 May 2.
6. U.S. Department of Health and Human Services. Elements of ergonomics programs. 2017. https://www.cdc.gov/niosh/topics/ergonomics/ergoprimer/default.html. Accessed November 11, 2020.
7. Edington DW, Pitts JS, Schultz AB. Health as an economic strategy: special emphasis on the workplace. *Analytic Review*. 2014:330-335.
8. Braveman P, Gottlieb L. The social determinants of health: it's time to consider the causes of the causes. *Public Health Rep*. 2014;129:19–31.
9. McDonald PA, Mecklenburg RS, Martin LA. The employer-led health care revolution. Harv Bus Rev 2015;93(708):38-50, 133.
10. Allison S, Wickstrom R. The role of the physical therapist to promote fitness-for-duty of commercial drivers. *Orthop Phys Ther Pract*. 2020;32(3):162-166.
11. Artus M, Campbell P, Mallen CD, Dunn KM, van der Windt DA. Generic prognostic factors for musculoskeletal pain in primary care: a systematic review. *BMJ Open*. 2017;7(1):e012901. doi: 10.1136/bmjopen-2016-012901.
12. Kamper SJ, Apeldoorn AT, Chiarotto A, et al. Multidisciplinary biopsychosocial rehabilitation for chronic low back pain: cochrane systematic review and meta-analysis. *BMJ*. 2015;350:h444. doi: 10.1136/bmj.h444.
13. D'Anna LH, Hansen M, Mull B, Canjura C, Lee E, Sumstine S. Social discrimination and health care: a multidimensional framework of experiences among a low-income multiethnic sample. *Soc Work Public Health*. 2018;33(3):187-201. doi: 10.1080/19371918.2018.1434584. Epub 2018 Feb 9.
14. Office of Special Education and Rehabilitative Services. A transition guide to post secondary education and employment for students and youth with disabilities. Revised May, 2017. https://www2.ed.gov/about/offices/list/osers/transition/products/postsecondary-transition-guide-2017.pdf. Accessed November 11, 2020.
15. Rondinelli R, Genovese E, Katz R, et al. Guides to the evaluation of permanent impairment. 6th ed. American Medical Association; 2007.
16. Allison S, Wickstrom R. Differentiating between anatomic impairment and occupational disability. *Orthop Phys Ther Practice*. 2019;31(4):234-237.

President's Message

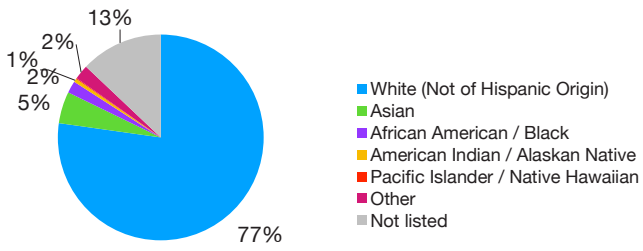
Laurel Daniels Abbruzzese, PT, EdD

PASIG Identity

Who are the members of PASIG? Who do we want to be? One of the priorities of the PASIG leadership team is to ensure that all physical therapists that work with performing artists feel included in the PASIG community. We want to see the diversity of our members in our educational programming, in our leadership team, and the images depicted on the web. We are proud to highlight our new PASIG banner, which captures the diversity within the PASIG and our patients. If you have ideas for transforming the PASIG into a more diverse, inclusive, and equitable group, do not hesitate to reach out to me directly at PASIG email: labbruzzese@orthopt.org.

Membership Committee Update - Jessica Waters

Of our 744 members, we have 278 members in our closed Facebook group. We created a PASIG membership survey to better capture the distribution of artists that we treat and to better meet the needs of our members. Our gender breakdown is 558 female, 159 male, 27 not listed. Our racial diversity is depicted below.



Show your PASIG pride! PASIG merchandise, featuring our new logo designed by Victoria Lu, will be available for purchase by members on our AOPT website. The revenue generated will support PASIG strategic initiatives.

Education Committee Update - VP, Rosie Canizares

All CSM 2021 conference activities will be virtual. Although it is challenging to plan, we are hopeful that the virtual format will allow more of our members to participate. The PASIG will host the educational session, "From the Clinic to the Big Top: Interprofessional Management of the Circus Artist"- featuring Stephanie Greenspan, Luc Fecteau, Dawn Muci, and Evert Verhagen. We are still planning to host some of our traditional events including a PASIG membership meeting, a Performing Arts Fellowship Q&A session, and a Performing Artist Screening meeting. We would also like to plan a session for all of the performing arts poster presenters. We will push out programming updates to our PASIG members closer to February. Be sure to join PASIG if you want to stay informed.

Our preconference course collaboration with the Imaging SIG, "Musculoskeletal Sonography of the Lower Limb Focused in Sport & Performing Arts" will be a live 1-day didactic session the first week of March (with the hope that we will be able to offer the hands-on experience as a pre-con for the next live CSM). We also have a newly formed ISC Task Force, led by Katrina Lee and Sarah Edely-Altas, working with authors Emily Scherb and Matt Greenfeld on "Physical Therapy for Circus Artists." Stay tuned for more information on this exciting project.

Outreach Committee Update - Brooke Winder

Long-awaited outreach materials have been added to our PASIG Website resources:

- Common Injuries in Circus Performers
- Common Injuries in Dancers
- Common Injuries in Figure Skating
- Common Injuries in Musical Theater
- Common Injuries in Instrumental Musicians
- PASIG - The Role of the Performing Arts PT
- PASIG - The Interprofessional Team

The committee will continue to move completed educational resources through the approval process and will work with the Education Committee on potential multi-media micro learning resources.

Communications Committee Update - Dawn Muci

The Communications Committee has been working closely with AOPT to push our messages out through various social media accounts. Be sure to follow the Twitter handle: @OrthopedicAPTA, Instagram handle: @APTA_Orthopaedic, and Facebook: @PT4Performers.

This committee also organized the PASIG member spotlight initiative. If you missed the Spotlight Series on social media, archived posts are also on the web. https://www.orthopt.org/content/special-interest-groups/performing-arts/member-spotlight

Research Committee Update - Mark Romanick

The Research Committee has worked with Communications to promote submission of abstracts and platform presentations for CSM 2021. We have a strong PASIG representation for the upcoming virtual conference. The PASIG continues to produce

Citation Blasts on a diverse array of topics that are sent directly to members and posted to the web. Thank you to the following authors for your contributions this fall:

AUGUST
Body Awareness Techniques in Musicians
Stephen Cabebe, SPT

SEPTEMBER-OCTOBER
Guidelines for the Dancer's Transition Back to Dance Post Initial Peak Phase of COVID-19: A Lens from the Organizational Level
Sarah Edery-Altas, PT, DPT, OCS
Will Zinser, MS, ATC
Elisa LaBelle, PT, MSPT, OCS

NOVEMBER
Injury Prevention in Dancers
Hanwen Wong, SPT

DECEMBER
Gymnastics Biomechanics and Injury
Anna Thatcher, PT, DPT, ATC

Performing Arts Update - Tiffany Marruli

A Performing Arts Fellowship is a great way to increase your knowledge and skill set for the management of performing arts patients. We are fortunate to have 4 Performing Arts Fellowship programs that offer a variety of opportunities for clinical practice, onsite coverage, and mentorship with performing artists. Fellowships are open to individuals who have completed an accredited physical therapy residency and/or a current specialist certification from the ABPTS. If you are interested in furthering your performing arts career, please contact the program directors below for more information regarding each program.

- **Columbia University Irving Medical Center and West Side Dance Performing Arts Fellowship**
  - Program Director: Laurel Abbruzzese la110@cumc.columbia.edu
  - https://www.ps.columbia.edu/education/academic-programs/programs-physical-therapy/performing-arts-fellowship
- **Harkness Center for Dance Injuries Performing Arts Fellowship**
  - Program Director: Angela Stolfi harkness@nyulangone.org
  - https://med.nyu.edu/departments-institutes/orthopedic-surgery/specialty-programs/harkness-center-dance-injuries/education/professional-development-students-healthcare-practitioners/academic-observation-fellowship
- **The Johns Hopkins Hospital Performing Arts Fellowship**
  - Program Director: Andrea Lasner danceFIT@jhmi.edu
  - https://www.hopkinsmedicine.org/physical_medicine_rehabilitation/education_training/therapy-residency/physical-therapy/performing-arts-pt-fellowship.html
- **The Ohio State University Wexner Medical Center Performing Arts Fellowship**
  - Program Director: Tiffany Marulli tiffany.marulli@osumc.edu
  - https://hrs.osu.edu/academics/graduate-programs/clinical-doctorate-in-physical-therapy/residencies-and-fellowships/performing-arts

Performing Arts -SIG Featured Content

Last but not least, the PASIG would like to thank Morgan Alexander, PT, DPT, Board Certified Clinical Specialist in Orthopaedic Physical Therapy and Fellowship Trained Performing Arts Medicine Physical Therapist at The Ohio State University Wexner Medical Center Jameson Crane Sports Medicine Institute, for her case study on the return-to-dance rehabilitation protocol of a pre-professional dancer s/p clavicle ORIF.

Return to Dance After an Upper Extremity Injury: A Descriptive Case Report

Morgan Alexander, PT, DPT, OCS
Fellowship-trained Performing Arts Medicine Physical Therapist
The Ohio State University Wexner Medical Center, Department of Sports Medicine Rehabilitation, Columbus, OH

INTRODUCTION

The upper extremities are an integral part of expression and movement in dance. However, there is a relatively low incidence of upper extremity injuries in dancers. Liederbach et al[1] reported upper extremity injuries make up 3% to 8% of total injuries for dancers. These injuries are more common in modern and hip hop dance due to these styles being characterized by dynamic upper extremity weight bearing moves. With a low rate of upper extremity injuries there is a significantly limited amount of research about physical therapy management and appropriate return to dance protocols. It is important to establish appropriate physical therapy interventions and a return to dance progression for upper extremity injuries to return dancers to full participation in classes and performances safely.

Clavicle fractures are a common upper extremity injury in athletes.[2,3] However, there is no research reporting incidence of clavicle fractures in dancers. The sports with the highest incidence of clavicle fractures are football, hockey, rugby, cycling, and horseback riding.[2] Clavicular fractures cause significant time lost from sport and have the third-longest timeline for return to play (RTP) among all sports-related fractures.[2,4] Studies reported an average of 3.47 months for a player to return to play in the National Football League and 65 days to return to the National Hockey League after a clavicle fracture.[5,6] Robertson and Wood[4] reported that almost all athletes return to play after sustaining a clavicle fracture with 80% returning to their previous level of participation.

It is necessary to establish appropriate physical therapy interventions and return to dance progression to safely return dancers to class and performance following a clavicle fracture. There is limited research on physical rehabilitation and return to dance protocols status post clavicle open reduction internal fixation (ORIF). The purpose of this case report is to describe the physical therapy management and return to dance progression of a pre-professional ballet dancer status post clavicular fracture with ORIF.

CASE DESCRIPTION

History

The patient was a right-handed 19-year-old female pre-professional ballet dancer. On average she danced 8 hours per day for 5-6 days a week, a total of 40-48 hours per week. She primarily studied ballet, but also modern, Pilates, musical theater, and partner work. She fell in a parking lot carrying groceries and sustained a left distal

clavicle fracture (Figure 1). She underwent surgery for an ORIF of the clavicle. The patient's past medical history was insignificant. The patient's left shoulder was immobilized in a sling for 6 weeks. At postoperative week 7, she was cleared to initiate physical therapy and return to barre work in ballet class.

Imaging

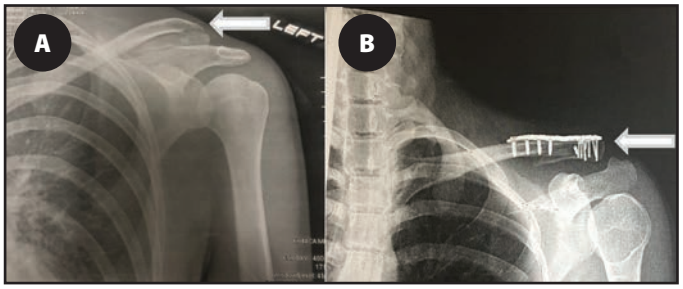


Figure 1. Radiographic imaging of left shoulder after patient fall. A, left distal clavicle fracture (arrow). B, Open reduction internal fixation of left clavicle fracture (arrow).

PHYSICAL EXAMINATION

The patient presented to physical therapy at postoperative week 7 no longer wearing a sling. At examination, the patient demonstrated limited left shoulder active range of motion (ROM) and passive ROM and left shoulder and elbow strength (Table 1). She demonstrated full cervical ROM and strength. The neurological screen was negative. The patient reported mild tenderness to palpation of left upper trapezius and levator scapulae. The Beighton score was 4/9, categorizing her as "hypermobile."[7] On the Quick DASH she reported 50% total impairment and 56.25% impairment for the performing arts category. She reported 2/10 pain on the Defense and Veterans Pain Rating Scale (DVRPS). The patient's chief complaints were limitations with dressing, carrying a backpack to the dance studio, sleep, and return to work as a preprofessional ballet dancer. She verbalized concern and a high level of fear of using her left arm. The patient's main goal was to return to participation in ballet, Pilates, modern, partner work and performances without limitation.

INTERVENTION

The patient attended 19 visits over the course of 16 weeks. The initial phase of rehabilitation, protection phase, consisted of sling immobilization and no participation in dance for 6 weeks. The patient presented to physical therapy at 7 weeks post-ORIF with the sling discharged by the surgeon, allowing transition to the second phase of rehabilitation. The restoration phase focused on restoring shoulder active ROM, passive ROM, and strength. This was achieved via manual therapy techniques, neuromuscular re-education, and therapeutic exercise (Table 2). The surgeon placed the patient on lifting restrictions of only the "weight of a coffee cup" for postoperative weeks 7-9 and no full weight bearing on the left upper extremity until week 12. The third phase, return to sport phase, consisting of therapeutic exercise focused on dynamic weight-bearing exercises, plyometrics, and dance specific interventions (Table 2).

Return to Dance Progression

In a ballet class, barre is the first portion of the class. Barre work consists of nonimpact exercises and movements assisted by the upper extremity on the barre for balance and support. The patient was cleared for return to barre work at postoperative week 7 with light pressure of the left upper extremity on the barre. As previously mentioned, the patient was fearful of movement and use of her surgical arm. Also, on examination she had significant limitations in left shoulder mobility and strength. The patient and therapist collaboratively decided to return to barre work with the left arm at or below 90º in her flat ballet shoes (Figure 2). They decided to start in flat ballet shoes instead of wearing pointe shoes (en pointe) as pointe shoes are more unstable and may require increased upper extremity support for balance and catching herself if she were to fall. After a week of these modifications, the patient reported improved confidence in the use of her arm but complained of moderate fatigue with holding her arm at 90° for long periods.

The second component of a ballet class is termed centre. Dancers will perform pirouettes, jumps (petite and grande allegro), and sustained motions or changes in body position (adagio) in the middle of the dance floor without upper extremity support. At week 8, the patient was cleared for barre work en pointe with arm still at 90º or below and added centre work of adagio, tendus, and pirouettes in flat shoes at 90º or below. At postoperative week 9, she was able to add petite allegro, small jumps, in flat shoes with arm 90º or below. Now the patient reported significantly less fatigue with holding her arm at 90° for a significant amount of time and consistently demonstrated full left shoulder active ROM without upper trapezius compensation for one week.

At postoperative week 10, she was able to perform full shoulder ROM at barre and centre work, except for jumping. At 11 weeks, the patient was cleared by the surgeon for full weight bearing of the left upper extremity.

The patient was able to perform all of ballet class en pointe without modification of shoulder ROM at week 13. At this point, she had been unable to return to modern class, which was typically at the end of an 8-hour day and only once or twice a week. This was secondary to patient report of moderate muscle fatigue, pain with large repetitive circular movements, and non-clearance for return to floor work requiring pushing off of left arm and inversions. A progress note or re-evaluation was performed demonstrating improved shoulder active ROM, passive ROM, improved shoulder strength, but poor performance on upper extremity functional testing (see Table 1). On week 14, she was able to return to modern class with modifications of no floor work.

At week 15, the patient was cleared to return to a beginner level partnering class performing assisted pirouettes, turns, and arabesques, but no overhead press lifts. Partner work often requires one arm supported by another person and used to help turn, jump and catch, and with overhead lifts. It may also require support of one dancer at the waist as she maintains an extreme position on one leg. All of these movements require a level of safety and is important that the dancer would be able to catch herself safely if she were to fall. At this time, she had been cleared by the surgeon for full weight-bearing for 4 weeks, able to repetitively catch herself within her physical therapy session, and the patient reported confidence in a graded return to partner work.

The patient was able to achieve her goal of returning to performance at week 16 as it required no lifts or partner work and she had been able to perform all of her ballet classes for 3 weeks without limitation. Upper extremity plyometric training was initiated at week 18 as she needed power and explosive strength for

Table 1. Objective Measures

	Evaluation		Progress Note (10th visit)		Discharge	
Objective Measure	**Right**	**Left**	**Right**	**Left**	**Right**	**Left**
SHOULDER PASSIVE RANGE OF MOTION						
Flexion	180°	165°	180°	180°	180°	180°
Abduction	180°	155°	180°	180°	180°	180°
External Rotation	110°	90°	110°	110°	110°	110°
Internal Rotation	60°	50°	60°	60°	60°	60°
SHOULDER ACTIVE RANGE OF MOTION						
Flexion	180°	130°	180°	180°	180°	180°
Abduction	180°	125°	180°	180°	180°	180°
External Rotation	T2	T1	T2	T1	T2	T1
Internal Rotation	T3	T4	T3	T4	T3	T4
UPPER EXTREMITY STRENGTH TESTING						
Shoulder Flexion	4/5	3+/5	4/5	4-/5	5/5	5/5
Shoulder Abduction	4/5	3+/5	4/5	4/5	5/5	5/5
Shoulder External Rotation	4/5	3+/5	5/5	4/5	5/5	5/5
Shoulder Internal Rotation	5/5	5/5	5/5	5/5	5/5	5/5
Shoulder Extension	5/5	5/5	5/5	5/5	5/5	5/5
Middle Trapezius	4-/5	3+/5	4/5	4/5	5/5	5/5
Lower Trapezius	3+/5	3/5	4/5	4-/5	5/5	5/5
Elbow Flexion	5/5	4/5	5/5	5/5	5/5	5/5
Elbow Extension	4/5	4/5	5/5	5/5	5/5	5/5
UPPER EXTREMITY FUNCTIONAL TESTING						
Modified Push-Up Test	not tested		0		25 repetitions	
Closed Kinetic Chain Upper Extremity Stability Test	not tested		15 repetitions		23 repetitions	

floor work and other modern dance movements. These exercises were not initiated before this time due to the primary focus being to return to performance at week 16. By week 19, the patient was able to perform 13 modified push-ups and 20 taps of the Closed Kinetic Chain Upper Extremity Stability Test (CKCUEST) (see Table 1). Her performance met the minimal clinically important difference threshold for these functional upper extremity tests.[8] With this improvement, she was cleared for 2 handed inversions or handstands in modern dance and overhead lifts in partner class. She did well with this progression and was able to quickly progress from two-handed to one-handed floor work in modern at week 20. This now allowed her to participate in all dance classes without modification or limitation. For the next 3 weeks, the patient continued to improve upon dynamic power and strength in the clinic to discharge at 23 weeks postoperative (Figure 2).

OUTCOMES

At visit 10 (13 weeks post-ORIF), the patient's left shoulder strength, mobility, and functional upper extremity performance was re-evaluated (see Table 1). At this time the patient demonstrated full shoulder active ROM, passive ROM, and improved shoulder and elbow strength. She reported an improvement from 50% to 0% total impairment and from 56.25% to 6.25% impairment for the performing arts category. She was still reporting intermittent shoulder pain of 2/10 on the DVPRS with large shoulder movements and after several dance classes. At the initial evaluation, the patient was unable to perform functional upper extremity testing due to limitations in full weight-bearing of the upper extremity. She was cleared by the surgeon at 11 weeks post-op for full weight-bearing allowing her to safely perform the modified push-up test and the CKCUEST.

The modified push-up test is a push-up performed on the knees and is recommended by the American College of Sports Medicine to assess upper-body endurance in women (Figure 3).[9] Low muscular endurance has been associated with elevated risk for injury. Adequate muscular endurance is essential in partner dancing, maintaining positions such as handstands or inversions, and transitioning from one posture to another. For these reasons the modified push-up test was selected as a functional test for discharge from physical therapy. Ambegaonkar et al[9] found that collegiate modern dancers were able to perform 22 modified push-ups when compared to age-matched physically active non-dancers. Mozum-

Table 2. Physical Therapy Interventions

	Restorative Phase (6-8 weeks post-op)	Restorative Phase (8-12 weeks post-op)	Return to Sport Phase (12-15 weeks post-op)	Return to Sport Phase (15+ weeks post-op)
Manual Therapy	• STM • Passive ROM	• STM		
Neuromuscular Re-education	• Scapular retraction • Supine alphabet • Supine and sidelying perturbations in multiple shoulder ranges	• Seated on stability with perturbations in ballet arm positions for 30 seconds in each position • Disc arm weight shifts on counter top • Quadruped perturbations with arm overhead		
Therapeutic Exercise	• Shoulder active assistive ROM • Table slides flexion & abd • Prone row & extension • Sidelying shoulder ER & abd • Supine weighted ballet arm positions	• Shoulder row, extension, IR, ER, and horizontal abd on Pilates reformer • Wall push-ups • Shoulder taps on edge of counter top • Weighted serratus punches • Prone scapular 6 • ½ Turkish get up • Prone plank • Overhead kettlebell carry	• Modified push-ups • Shoulder taps in plank • Serratus plus • Full Turkish get up • Side plank • Plank on Pilates reformer • Superman on Pilates reformer	• Prone shoulder reach, roll & lift • Full push-up • Tall kneeling overhead press on Pilates reformer
Plyometrics	none	none	• Chest press throw • Shuttle press push outs in tall kneeling • Pilates reformer press outs in tall kneeling	• Overhead ball toss to rebounder • Weighted slam ball • Weight squat to overhead ball toss • Pilates reformer press outs with arms overhead in prone

Abbreviations: STM, soft tissue mobilization; FWB, full weight-bearing, ROM, range of motion; ER, external rotation; IR, internal rotation; abd, abduction

dar et al[10] reported 26 repetitions of modified push-ups was the 100th percentile normative for college-age females. Based on these studies, a goal of 25 modified push-ups for discharge from physical therapy was created. At her 10th visit, the patient was unable to perform any repetitions with proper set-up and position (see Table 1).

The CKCUEST is a dynamic upper extremity test that is correlated with good muscular strength and stability.[8] The test is performed in a push-up position for males and modified push-up for females with the hands placed 36 inches apart (Figure 4). The participant is asked to touch one hand with the opposite hand, alternating for 15 seconds. This is repeated 3 times with a 45-second rest in between each round. Silva et al[8] reported a normal values of 25 repetitions for males in full push-up position and 30 repetitions for females in a modified push-up position. A goal was created for the patient to perform 30 repetitions in a modified push-up position or 20 repetitions or greater in a full push-up position in order to be discharged from physical therapy.

The patient was discharged at postoperative week 23, following 19 physical therapy visits over a 16-week period. At discharge, the patient reported 0/10 shoulder pain on the DVRPS and Quick DASH score of 0 for all categories. She was able to perform 23 repetitions on the CKCUEST and 25 modified push-ups (see Table 1). She was able to return to all dance styles and participate in 40-48 hours of dance a week without limitation.

DISCUSSION

This case report describes the successful return to dance progression of a pre-professional ballet dancer following a distal clavicle fracture with ORIF. Although she was able to return to her prior level of function, her time frame for a return to dance was longer than what has previously been reported in other athletes.[5,6] There were many factors that influenced her return to dance timeline and progression.

Upper extremities are a key component of expression and movement in dance. However, the usage and demand of the upper extremity is determined by the style of dance. Ballet is characterized by more repetitive lower body movements than upper body movements.[11] Comparatively, modern dance is an amalgamation of dance styles that require significant demand of the upper body

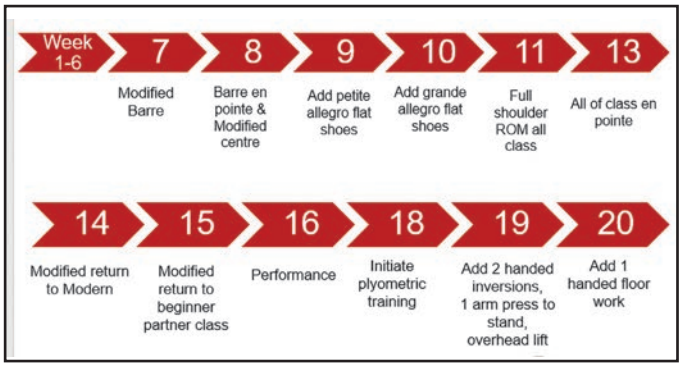


Figure 2. Return to dance progression.

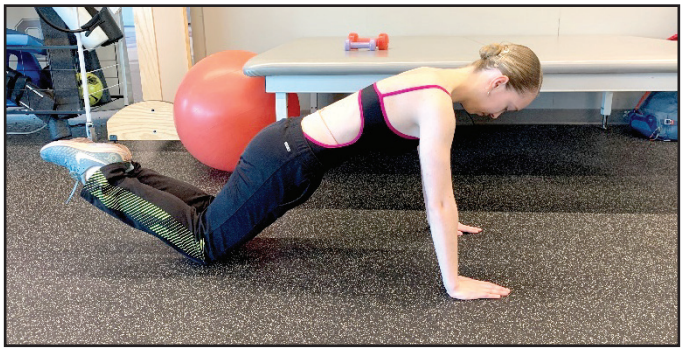


Figure 3. Modified push-up test.

Figure 4. Closed Kinetic Chain Upper Extremity Stability Test.

such as falls, handstands, and partner lifts.[9] This helps explain why the patient was able to return to full ballet class without modifications before returning to modern class.

At examination, the patient reported moderate fear avoidance behavior with use of the left upper extremity despite being medically cleared by her surgeon. This was a theme throughout the restoration phase of physical therapy. She often required verbal encouragement and education to increase use of the arm in daily activities, dance, and in the physical therapy clinic. This may have affected the speed of her progression for return to pointe work and use of the arm above 90º during dance class. However, once in the return to sport phase the patient no longer demonstrated these concerns so a referral to sports psychology was not made.

The patient did not do any form of strength training or cross-training outside of dance. It has been found that dance alone is not sufficient exercise to create physical fitness and muscular endurance gains.[9] At examination, the patient did not demonstrate full shoulder strength of the uninvolved and dominant limb. This eludes to the lower level of upper extremity strength the patient had before injury. She also had limited knowledge of upper body exercises and techniques requiring moderate time spent on education and technique training.

The patient was able to quickly achieve full shoulder active ROM and passive ROM within the first two weeks of initiating physical therapy. She was a highly motivated patient who was ready to learn and open-minded to new forms of exercise. She reported compliance with doing her home exercise program daily. These factors most likely contributed to her ability to return to full dance participation, achieve full bilateral upper extremity strength, and meet all discharge criteria.

The increased weight bearing demand of specific dance styles, fear avoidance behavior, and limited upper body and strength training before injury may have contributed to why this patient returned to full dance participation later than prior studies for return to sport after a clavicle fracture. However, this patient was able to successfully return to dance and performance without limitation.

CLINICAL APPLICATION

It is important to understand that return to dance may take longer than the time frame that has been previously reported for other athletes to return to sport. This may be due to the dynamic demands of upper extremity in dance. Using the modified push-up test and the CKCUEST were beneficial in assessing the patient's upper extremity strength, endurance, and stability needed for dance. However, a dance specific upper extremity test that simulates the lifting and floor work requirements of dance may be beneficial in clearance for return to these activities safely.

Dance requires repetitive movement and long duration holds of the arm in specific positions, which was challenging for the patient to progress early on in her rehab program. Focusing on neuromuscular control and endurance of ballet specific arm positions during the restorative phase (Table 2 and Figure 5) were the most beneficial for improving her in class endurance of the upper extremity. Safety is imperative when performing partnering and dynamic floor work. Instruction of falling safely and high repetitions of practice was integral in improving the patient's confidence and clearance for return to partnering and floor work. Lastly, challenging the power of the upper extremity with plyometric exercises in weight bearing and multiple ranges of motion (Figure 6) was most beneficial for her progression for return to partner and floor work.

Figure 5. Seated perturbations with arm in 5th position.

Traditionally, dancers do not engage in cross-training or strength training outside of their dance requirements. This patient demonstrated a significant lack of upper body strength before injury and poor knowledge of

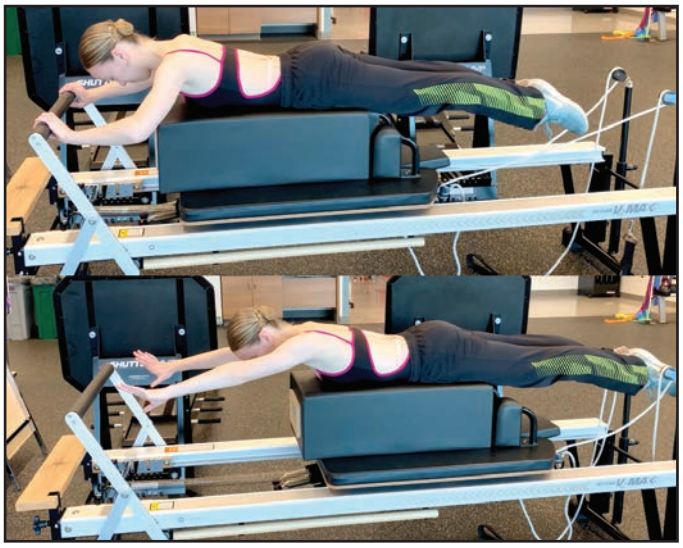


Figure 6. Prone plyometric press out on Pilates reformer.

upper body strengthening. This patient may make a case for upper body strengthening and conditioning in dancers outside of class to meet the demands of their sport and improve the timeline for return to dance after an upper extremity injury.

This dancer reported a high rate of fear-avoidance of the use of the arm in the early phases of rehabilitation that may have affected her return to dance time frame. It would be beneficial to give the patient a patient-reported outcome measure at initial evaluation to help screen for psychosocial factors that may affect the patient's prognosis and plan of care. This will help identify factors that need to be addressed by physical therapist education and possible referral to other healthcare providers such as sports psychologist.

There is limited research on physical therapy return to dance progressions for dancers with upper extremity injuries. This case describes the management and return to dance and performance training for a dancer status post distal clavicle ORIF. This case report can help guide the clinician in physical therapy management and return to dance progression for dancer's surgical post clavicular ORIF and possibly other upper extremity injuries.

REFERENCES

1. Liederbach M. Epidemiology of Dance Injuries: Biopsychosocial Considerations in the Management of Dancer Health. *AOPTA Independent Study Course 18.3.1*. 2008.
2. Court-Brown CM, Wood AM, Aitken S. The epidemiology of acute sports-related fractures in adults. *Injury.* 2008;39(12):1365-1372. doi:10.1016/j.injury.2008.02.004.
3. Tassel DV, Owens B, Pointer L, Wolf JM. Incidence of clavicle fractures in sports: analysis of the NEISS Database. *Int J Sports Med*. 2013;35(01):83-86. doi:10.1055/s-0033-1345127. Epub 2013 Jun 14.
4. Robertson GAJ, Wood AM. Return to sport following clavicle fractures: a systematic review. *Br Med Bull*. 2016;119:111-128. doi:10.1093/bmb/ldw029. Epub 2016 Aug 22.
5. Vora D, Baker M, Pandarinath R. Impact of clavicle fractures on return to play and performance ratings in NFL athletes. *Clin J Sport Med*. 2019;29(6):459-464. doi:10.1097/JSM.0000000000000548.
6. Hebert-Davies J, Agel J. Return to elite-level sport after clavicle fractures. *BMJ Open Sport Exerc Med*. 2018;4(1):e000371. doi:10.1136/bmjsem-2018-000371. eCollection 2018.
7. Grahame R, Bird HA, Child A. The revised (Brighton 1998) criteria for the diagnosis of benign joint hypermobility syndrome (BJHS). *J Rhuematol*. 2000;27(7):1777-1779.
8. Silva YA, Alves Novaes W, Pereira H, et al. Reliability of the Closed Kinetic Chain Upper Extremity Stability Test in young adults. *Phys Ther Sport*. 2019;38:17-22. doi:10.1016/j.ptsp.2019.04.004. Epub 2019 Apr 9.
9. Ambegaonkar JP, Caswell SV, Winchester JB, Caswell AA, Andre MJ. Upper-body muscular endurance in female university-level modern dancers: a pilot study. *J Dance Med Sci*. 2012;16(1):3-7.
10. Mozumdar A, Liguori G, Baumgartner TA. Additional revised push-up test norms for college students. *Meas Phys Educ Exerc Sci*. 2010;14(1):61-66. doi:10.1080/10913670903484835
11. Sides SN, Ambegaonkar JP, Caswell S v. High incidence of shoulder injuries in collegiate modern dance students. *Athl Ther Today*. 2009;14(4):43-46. doi:10.1123/att.14.4.43.

Hello AOPT Foot and Ankle SIG members!

We write this newsletter amidst the increasing spread of the SARS-CoV 2 virus nationally as we approach the end of November 2020. This has certainly been a year of struggle and adaptation. We have now transitioned to a digital world, impacting our patient care, teaching, and learning. This will continue as the Combined Sections Meeting in 2021 will allow us to gather virtually – stay tuned for our FASIG meetings and presentations. We continue to lead several initiatives that will impact FASIG members and recognize the contributions from all those pushing these along.

- We continue to work on our foot and ankle fellowship initiative. Working closely with the American Board of Physical Therapy Residency and Fellowship Education (ABPTRFE) we are in the final stages of distributing a *Practice Analysis Survey*. The survey was reviewed at the ABPTRFE's August 2020 meeting and, working closely with the AOPT office, the survey is now adapted for release using an online survey tool. Many thanks to the Practice Analysis Coordinators, Project consultant, and the entire task-force working on this. The information gathered during the last quarter of 2020 sets the stage for the final steps of the process outlined by ABPTRFE during 2021. We continue to work diligently towards the goal!
- The FASIG Practice Committee together with guidance from the AOPT Public Relations Committee has created infographics to share information about common foot and ankle pathologies. The first two of these are now available on our website. A special thanks to the FASIG Practice Chair, Megan Peach, DPT, OCS, CSCS, who is coordinating this effort. Additional infographics are being drafted and if you want to help, or have an idea for a new one, please contact Megan directly (contact links for FA leadership available on our website).
  https://www.orthopt.org/content/special-interest-groups/foot-ankle/fasig-infographics
- Our partnership with the American Orthopaedic Foot and Ankle Society (AOFAS) continues with a series of webinars that are available to FASIG members. Keep an eye out for another webinar coming in the first quarter of 2021. We will be communicating these opportunities via Academy social media, email, and Facebook.
  www.facebook.com/groups/FASIG/
- Make sure to check-out our quarterly newsletters posted to our website (listed below) if you didn't catch them in your email! Dr. Jennifer Zellers at Washington University works closely with a great group of student FASIG members to develop these newsletters. They include summaries of our SIG activity, member spotlights, and a citation blast for hot-off-the press foot and ankle research.

We wish everyone in the AOPT and the FASIG well and look forward to a start to 2021 with an innovative CSM in February.

The FASIG Leadership
https://www.orthopt.org/content/special-interest-groups/foot-ankle

PRESIDENT'S MESSAGE

With kind regards from Nancy Robnett Durban, PT, MS, DPT

Hello All…I hope this report finds you well and safe.

Thank You

Thank you to all who completed our members' survey. The results are in…the members have spoken. We had 98 members respond to the survey. Our results indicate that the majority of our members are satisfied however, we can do better. We hear you loud and clear that you like Evidence-Based Reviews and Article Alerts. Your answers have given us many ideas for programming in the future. Thank you to all who completed the survey, volunteered to help in the future, and provided us with your email. The Pain SIG leaders will be in touch. We have a lot of work to do.

We would like to thank all our outgoing officers, Vice President Mark Shepherd, PT, DPT, OCS, FAAOMPT, and Nominating Chair Brett Neilson, PT, DPT, OCS, FAAOMPT, for their dedication to the Pain SIG and their hard work for 3 years. A sincere thank you for all you have done and your continued support of the Pain SIG.

Congratulations

Congratulations to Derrick Sueki, PT, PhD, DPT, GCPT, on his election to the position of AOPT Director. Dr. Sueki has served as the SIG Public Relations Committee Chair for several years. We wish him well in his new role and thank him for all his past work as the PR Committee Chair. We will be working on identifying a member who would like to step into this role. This appointed person will be announced at our CSM Pain SIG Membership Meeting.

CSM

CSM is going to have a different look this year. Combined Sections Meeting information is available on the APTA.org site. The APTA is promising that the virtual meeting will be bigger than ever with seating for all. The virtual format will allow attendees to have unlimited access to hundreds of educational sessions and digital posters, plus platform presentations. The APTA CSM site indicates that most "content will be provided on-demand starting Feb. 1, and CSM's live sessions during February will be recorded so you can catch up on anything you miss."

The Pain SIG is excited to sponsor the presentation entitled: 21st Century Pain Education – Meeting Recommended Core Competencies and Implementation into DPT Curriculum. This will be presented by Shana Harrington, PT, PhD; Meryl Alappattuu, DPT, PhD; Marie Hoeger Bement, PT, PhD; Craig Wassinger, PT, PhD; Kathleen Sluka, PT, PhD, FAAPTA; and Kory J. Zimney, PT, DPT. The presentation is listed under the AOPT Live Content section on Monday, February 15, 2021, from 7:00 - 8:30 p.m.

The Course/session learning objectives include:

1. Discuss the interprofessional pain core competencies for prelicensure education in physical therapy.
2. Explain the importance and urgency of integrating content related to the multidimensional nature of pain, pain assessment, management of pain, and common clinical conditions within entry-level DPT curriculum.
3. Understand how a variety of faculty has implemented pain content into their curricula as either an independent course or threaded throughout a variety of courses.

Podcast

Three Pain Specialists from the SIG talked about pain on Move Forward Radio. The talk was titled, Physical Activity and Pain Management. Dr. Marie Bement, Dr. Dana Dailey, and I participated in this project. https://aptacasts.com/2020/10/14/physical-activitys-role-in-pain-avoidance-and-management/

Officer Reports: as of November 2020

Vice President: Mark Shepherd, PT, DPT, OCS, FAAOMPT

- Dr. Shepherd continues to work on the Pain Education Manual. The commitment is progressing forward and will move on to the final Phase III. The goal is to have a final product by CSM 2021 and ACAPT "sponsorship" by October 2021. The Pain Education Manual will help to standardize entry-level physical therapy education across programs in the United States.

Nominating Chair: Brett Neilson PT, DPT, OCS, FAAOMPT

- Thank you to Dr. Neilson and the rest of the Nominating committee members--Rebecca Vogsland, PT, DPT, and Max Jordan, PT, DPT, PhD, for putting together a phenomenal slate of candidates.

Research Chair: Dana Dailey, PT, PhD

- Thank you to Dr. Dailey for compiling the Membership survey results.
- Dr. Dailey has a list of volunteers willing to work on the SIG Clinical Pearls. Stay tuned for a Pearl coming your way soon.

Public Relations Committee Chair: Derrick Sueki, PT, PhD, DPT, GCPT

- As the PR Committee Chair, Dr. Sueki is the representative from the Pain SIG to the AOPT Public Relations Committee. In the future, the SIG PR Committee will be responsible for the creation and maintenance of a private Facebook page and a Pain Website. Dr. Sueki will be stepping down from his leadership role as he is a newly elected AOPT Director. We will be appointing a new leader and announcing the new PR Chair at our CSM Membership Meeting.
- Dr. Sueki is also the lead of the Pain Specialization and Residency/Fellowship workgroup. The Pain Specialization workgroup has its pilot survey ready. It will be sent out to members shortly. The goal of the survey is to determine the elements and components of pain specialty practice in physical therapy.

Residency and Fellowship Chair: Katie McBee, DPT, OCS

Dr. McBee continues to work on pathways for post-professional training. Currently, the workgroup is pursuing avenues towards

(Continued on page 59)

Imaging News & Updates

Charles Hazle, PT, PhD

With CSM nearing, much of the focus of this Imaging SIG report is directed at CSM, including adaptations made for the virtual format.

The Pre-Con Becomes Post-Con

As you may recall, the Imaging SIG co-sponsored with the Performing Arts SIG an extremely successful 2-day lower quadrant "hands-on" ultrasound course at CSM 2019 in Washington, DC. The goal for 2021 was to have a similar upper quadrant course, again co-sponsored with the Performing Arts SIG. The 2-day course was proposed and selected for the Orlando setting, but the COVID-related virtual format has caused a shift in this planned pre-conference course. With "hands-on" ultrasound instruction being universally affected, the decision was made to revise the proposal to an introductory ultrasound course more amenable to the virtual format. "Next Level Clinical Reasoning: Integration of Diagnostic Ultrasound into PT Practice" is the new course format and is specifically targeted at those individuals interested in pursuing the addition of ultrasound to their clinical practices. The presenters are Colin Rigney, Mohini Rawat, and Jon Umlauf---all of whom possess the RMSK or Registered in Musculoskeletal Sonography credential and have extensive experience in teaching.

This course will be a live/synchronous session on Tuesday, March 2 from 9:00 a.m. until 5:20 p.m. If you have an interest in augmenting your practice skills with ultrasound imaging, this is a course by physical therapists for physical therapists that will elevate your understanding of how ultrasound can expand your practice capabilities and perhaps provide a vision for your future practice potential.

Assuming we make a return to regular CSM programming for San Antonio in 2022, the tentative plan is to resubmit the originally planned two-day upper quadrant course for presentation as a pre-conference course then.

The Imaging SIG Educational Session

As some jurisdictions rely on existing practice acts and other codified language toward incorporating referral for imaging in physical therapist practice, other states seek to gain referral privileges through passage and enactment of specific legislation. The battles occurring in these states for legislative change are often opposed with hypothetical arguments around inappropriate or over-use of the imaging by physical therapists as well as the increased cost of care associated with that use. We now have, however, a growing volume of data from civilian settings in which physical therapists have imaging referral privileges. This evidence effectively negates those hypothetical arguments of increased cost and inappropriate or excessive utilization. These data, paired with the advocacy message from jurisdictions managing legislative efforts, serves as the basis for the Imaging SIG's Educational Session at CSM. The session entitled "Advances in Imaging Referral: Generating a New Pulse in Autonomous Physical Therapist Practice" brings together evidence and professional advocacy toward the expanding use of referral for imaging by physical therapists. Former Wisconsin Chapter President, Kip Schick, and current Rhode Island President, Michelle Collie, will offer their first-hand perspectives of the measures required to gain passage of legislation, while Steve Kareha, Evan Nelson, and Aaron Keil will present data from their respective areas on physical therapist referral for imaging. The session will be moderated by Marie Corkery, Imaging SIG Vice President and Education Chair.

Leaders within states with an interest in pursuing imaging referral privileges will likely benefit from this unique presentation to be more prepared for the challenge of legislative change. Please encourage your state leaders to participate in this session. While the session will be recorded and available on-demand, a live discussion panel is scheduled for Monday, February 15, 2021, from 9:30 - 10:00 p.m. More details of this will be forthcoming.

Imaging-Related CSM Programming

Approaching the time of CSM, the Imaging SIG will publish a list by email and social media of all the imaging-related presentations at CSM. Stay tuned for those announcements before the start of the conference. We certainly want to recognize new work, supporting those researching imaging and distribute the word such that all may benefit from the information available at CSM.

Scholarship

As of the time of this writing, approximately 10 applications for the Imaging SIG CSM scholarship were received by the November 1 deadline. By the time this *OPTP* issue has been published, the work group, led by Lena Volland, will have reviewed the applications and accepted abstracts for CSM in order to determine a winner. This is the fourth year of the scholarship being offered with the winner receiving $500 and being recognized by the Imaging SIG. Please keep this scholarship in mind as you move forward in your work with imaging and remind any colleagues conducting research with imaging in physical therapist practice of this scholarship is available.

AIUM & Inteleos Page

For several months, APTA/the Imaging SIG have been working with Inteleos and the American Institute for Ultrasound in Medicine (AIUM) on a cooperative effort to expand musculoskeletal ultrasound education within the physical therapist practice and better allow physical therapists to advance toward earning the RMSK (Registered in Musculoskeletal Sonography) credential. Another step has been accomplished on this path and more will be evolving in the coming months. Recently published on the Imaging SIG web pages on the AOPT website is now a pathway toward outlining educational content serving as preparatory for the RMSK credential. By clicking on "MSK Ultrasound Education and Credentialing" on the left side of the Imaging SIG pages, a list of courses and resources from AIUM are now provided. Those interested in learning MSK ultrasound and potentially working toward the RMSK are encouraged to explore this information. A link to Inteleos and the process of earning the

RMSK is also provided. Soon, both AIUM and Inteleos will have physical therapist specific information on their websites.

The recognition by these external entities of physical therapists as experts in the care of patients with musculoskeletal disorders that is enhanced by the use of ultrasound is a significant step in imaging in physical therapist practice overall.

Imaging SIG Research Committee

The Imaging SIG Research Committee, headed by George Beneck, continues to produce remarkable work and reach into new directions. This has included several presentations at conferences and the recently published "A Survey of Physical Therapists' Attitudes, Knowledge, and Behaviors Regarding Diagnostic Imaging" by Sean Rundell, Murray Maitland, Rob Manske, and George Beneck in the *Physical Therapy Journal*. The e-pub ahead of the print version of this manuscript appeared in October 2020. The Committee has other works in progress.

You may recall the Research Committee has previously published its listing of imaging research mentors on the webpages of the Imaging SIG. This remains available for those interested.

Membership

The interest in imaging as a part of physical therapist practice continues to grow as reflected in our expanding number of Imaging SIG members. In April 2016, we had marginally over 250 members. As of this writing, that number has doubled with approximately 500 members now being part of the Imaging SIG.

Elections and New Directions

At the time of this submission, elections for Vice President and the Nominating Committee were underway. By the time of publication, the new Imaging SIG Vice President and Nominating Committee member will have been announced with both assuming their roles immediately after CSM.

Thanks to Marie Corkery for finishing out the last year of the term from previous Vice President, Jim Elliott. Both contributed remarkably to the mission of the Imaging SIG. Mohini Rawat has finished her term on the Nominating Committee with her last year as Chair and the SIG having an outstanding slate of candidates for those available positions. Please thank them for their service when you have an opportunity.

The new Nominating Committee Chair is Kimiko Yamada with Lynn McKinnis also serving on the Committee along with the newly elected at-large member. This Committee will soon begin its work for the next round of elections, which will include SIG President and Nominating Committee member, each for 3-year terms. Thus, the time will soon be present to think about transitioning for new leadership for the SIG.

PAIN SIG

(Continued from page 57)

pain residency training as the process parallels specialty certification. In the future, we will need to find candidates and institutions for residency. She is working on collaborating with other programs. For additional information, make sure to view the virtual CSM presentation, "#PTtheClinicalPainExperts – Pain education, specialization, residencies, and fellowships. Are we ready to take our role as pain experts?"

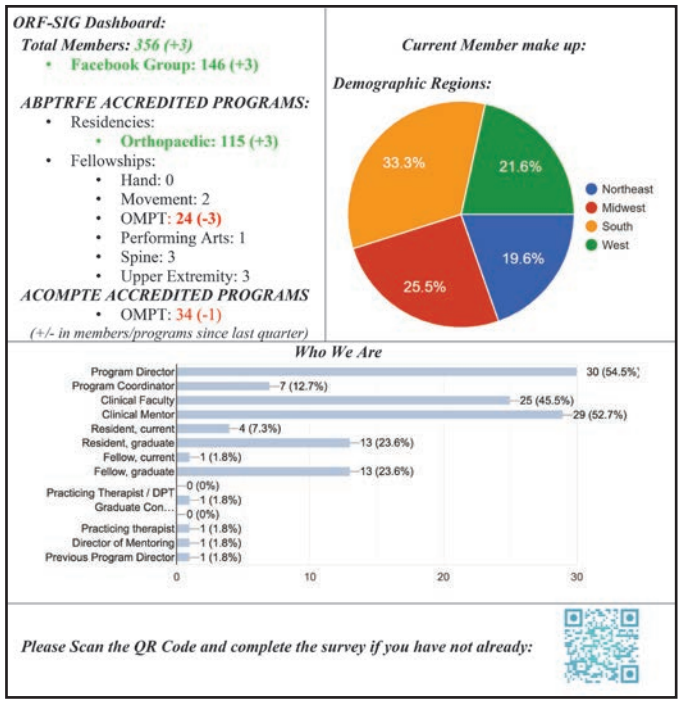
In closing, the Pain SIG would like to thank President, Joseph M Donnelly, PT, DHSc, and all of the AOPT staff for their continued support and guidance.

We owe a debt of gratitude to our outgoing leaders, Vice President, Mark Shepherd, PT, DPT, OCS, FAAOMPT, and Nominating Chair, Brett Neilson, PT, DPT, OCS, FAAOMPT. Thank you again once again for all your hard work.

We presently have multiple opportunities for SIG involvement on the membership, public relations, and research committees. Please contact me or any other Pain SIG leader to volunteer to help our initiatives.

Index to Advertisers

ORF-SIG Dashboard:



ORF-SIG Members,

Normally the past few months, we are scrambling around seeing family and friends through the holidays and gearing up for another great Combined Sections Meeting (CSM) in some beautiful destination. Often this means coming back together with colleagues from across our great nation to share ideas and create change for our profession in the future. This year while we will still be coming together, it will not be so up close and personal but cozier as we relax in our favorite chair or recliner for educational programming at our leisure all while still getting a peaceful night of sleep in our own beds. Yes, CSM will be a bit different this year; but with more time at home, we can take a step back and enjoy bringing the work-life balance back to our everyday lives holding those nearest to us a little closer.

Despite not being able to be physically with each other, we do still plan on the same great experience CSM brings us every year. Now instead of just 3-4 days of intense interaction, collaboration, and learning, we will get to enjoy this the full month of February. No longer will you be having to choose between competing courses but instead choose from the full list and sit down and enjoy at a time most convenient to you. Given February will be set aside for programming, **we will be moving our annual CSM Business Meeting into March**.

Please make sure to still attend our annual CSM business meeting. This meeting is always a little more special as we honor our leaders whose terms have come to an end and welcome our new leaders. This year is even just a little more special as we will be honoring the final two members of our inaugural ORF-SIG leadership. I cannot thank Kathleen Geist our Vice President and Mary Derrick our Nominating Chair enough for their time and commitment to the development of the ORF-SIG over our initial 3 years.

Kathleen will be greatly missed as she helped lead several committees including the Research and Communication Committees while also serving as the SIG Education Chair bringing educational programming annually to CSM. Throughout Kathleen's time as Vice President, she helped create a resident/fellow scholarship for best poster presentation at CSM, identified barriers program directors were having with administration of their resident/fellowship programs, evaluated and provided recommendations for various accreditation standards as well as updates to the AOPT residency curriculum, and provided resources for programs to adapt to the COVID-19 pandemic as well as countless other projects to help the ORF-SIG membership. Kathleen's contributions will be greatly missed but not forgotten…and who knows maybe we will still be able to recruit her for a few other items.

Mary, too, will be missed as she helped with our member and leadership recruitment over the past 3 years. In doing so, she helped with the development of our website, communicated with new and future members, as well as generated ideas for our annual SWAG including pens, koozies, and our famous shaker bottle. Thank you, Mary, for helping to engage our members.

I look forward to working with the new leadership in 2021!

Matt Haberl
President, ORF-SIG

As 2020 has ended, we look forward to bigger and better things again in 2021. Look at what our current Committees and Subcommittees are working on:

COMMITTEE UPDATES

Research: Kathleen Geist, Mary Kate McDonnell

Currently accepting **Resident and Fellow 2021 CSM Poster submissions** for publication in *Orthopaedic Practice (OP)* and **a cash prize of $250**. Visit the ORF-SIG website at https://www.orthopt.org/content/special-interest-groups/residency-fellowship to enter your poster information to be considered for a cash award. Two winners will be chosen during the virtual CSM poster session. Contact Kathleen Geist (kgeist@emory.edu) if you have any questions about the submission process.

Practice/Reimbursement: Darren Calley and Kirk Bentzen

During the development of a mentorship survey, Dr. Kirk Bentzen was in the process of developing his dissertation for his PhD studies. Due to these common interests around the topic of mentorship, it was decided to conjoin these two projects. Recently, Dr. Bentzen completed his review of the literature, including the exploration of mentorship across a variety of professions and levels of education.

A **mentorship survey** has since been developed to identify how mentoring is delivered across orthopaedic residency and fellowship

programs. It recently received IRB approval and will be sent out shortly to program directors. Make sure to check your inbox. With this we hope to better understand how mentoring is implemented across programs, which will give ORF-SIG programs ideas for how others are delivering mentoring and future content development. Thank you to members of the Practice/Reimbursement Committee for their efforts with developing this survey.

Communication: Kirk Bentzen, Kris Porter, Kathleen Geist

ABPTRFE Updates: Recently the American Board of Physical Therapy Residency and Fellowship Education (ABTPRFE) released updates to their Policies and Procedures and the use of Primary Health Conditions. See their updates here.

Policies and Procedures Updates: Policy 13.5: Addition of Clinical Sites

Primary Health Conditions Update

Look to our next *OP* message for an ABPTRFE Commonly Asked Questions form regarding these and other ABPTRFE changes from the Chair of ABPTRFE, Mark Weber.

Membership: Bob Schroedter, Tyrees Marcy

Some of you may have received emails regarding your membership status with the ORF-SIG and AOPT. Please make sure to renew your AOPT and ORF-SIG status when you renew your APTA membership as this does not do so if you are set up for auto-renewal. Moving forward in 2021, we will be creating more member-only access to several of our great resources. Please make sure to share the benefits of the ORF-SIG with your colleagues!

- **Communication** of up to date changes and developments in Residency and Fellowship Education
- **Access to Collaborate** with other ORF-SIG Members engaged in Residency and Fellowship Education
- **Program Resources** for members including program directors and coordinators, faculty, mentors, and prospective residents/fellows
- **Scholarship Awards** for residents and fellows in training
- **Grant Funding** and **Curricular Options** for programs and faculty
- Opportunities to **Get Involved** with various leadership roles within the SIG

Take advantage of our member only communication forums to share and develop ideas.

ORF-SIG Facebook group

AOPT ORF-SIG Communities HUB

Nominating: Mary Derrick, Bob Schroedter, Tyrees Shatzer

Thank you to those individuals who agreed to be slated for filling the ORF-SIG Vice President and Nominating Committee openings. By the time this is published, we will know who these wonderful individuals are and look forward to building our community of excellence in residency and fellowship education.

Additionally, the ORF-SIG will be trialing the use of Microsoft Teams to enhance our committee and subcommittee communication for project development. We are excited to continue to bring our membership new and exciting things in 2021.

Other Resources:

If you have not already done so, please make sure to review the continually evolving ORF-SIG **CoVid-19 Resource Manual**. This manual provides further information in how residency and fellowship programs are overcoming accreditation challenges, ensuring patient participation, and program sustainability.

You can also find more great information from the Academy of Education's Residency and Fellowship SIG (RFESIG). Here you will find a variety of Podcasts they have completed for Residency and Program Directors. Please make sure to check these out as well as the Think Tank resources.

Identification of Intradural Extramedullary Tumor in a Patient with Low Back Pain and Urinary Incontinence: A Case Study

Alyssa Sherer, PT, DPT, OCS, GCS.
Residency Graduate, UChicago Medicine's Orthopedic Physical Therapy Residency Program Clinic, UChicago Medicine Therapy Services

INTRODUCTION

Low back pain (LBP) is a common musculoskeletal condition that can affect 80% of people at some point in their lifetime, with a 1-year incidence ranging from 1% to 36%.[1,4] Low back pain is more prevalent in women than men and is the leading cause of activity limitation often recurring between 24% and 33% among individuals.[1] Additionally, it is estimated that up to 78% of women with LBP also suffer from urinary incontinence (UI).[4] The majority of LBP is not due to serious medical conditions and will improve with conservative treatment.[2] According to the LBP Clinical Practice Guidelines, it can be classified as acute/subacute LBP with mobility deficits, acute/subacute/chronic LBP with movement coordination impairments, acute LBP with related/referred lower extremity pain, acute/subacute/chronic LBP with radiating pain, acute/subacute LBP with cognitive or affective tendencies, or chronic LBP with related generalized pain.[1] However, LBP can be caused by serious spinal pathology. Although spinal malignancy is the most common of these diseases, it affects less than 1% of primary care patients with LBP.[5] The combination of red flags such

as unexplained weight loss, age >50, previous history of cancer, failure to improve with conservative therapy in 1 month is helpful to screen for cancer.[1,5] The purpose of this study is to describe a patient with LBP and UI whose failed conservative treatment and the presence of red flags prompted referral back to primary care for further evaluation.

PATIENT HISTORY

A 70-year-old woman with a history of arthritis, breast cancer, hypertension, hypercholesterolemia, obesity, and obstructive sleep apnea was referred to physical therapy by her primary care physician (PCP) for subacute left-sided low back pain with radiating pain into her left hip and posterior thigh. The pain began insidiously 2 months before evaluation, waking her up early in the morning and taking 60 minutes to subside. She rated her pain as 0/10 on the Numeric Rating Pain Scale at the time of initial evaluation, and 7-8/10 in the mornings. Standing up from sitting was her only aggravating factor. Alleviating factors include walking, movement, and taking acetaminophen. The patient described the pain as deep, occasionally traveling down the back of her left leg down to the top of her calf. She had radiographs indicating osteoarthritis of the lower lumbar spine and left sacroiliac joint, as well as minimal anterolisthesis of L4 on L5. She reported a history of chronic constipation, urinary urgency/incontinence, and losing 40 pounds over the past year. Her PCP was already aware of these symptoms. However, the absence of other red flags (eg, fevers, sweats, night pain) prompted the initiation of physical therapy treatment.

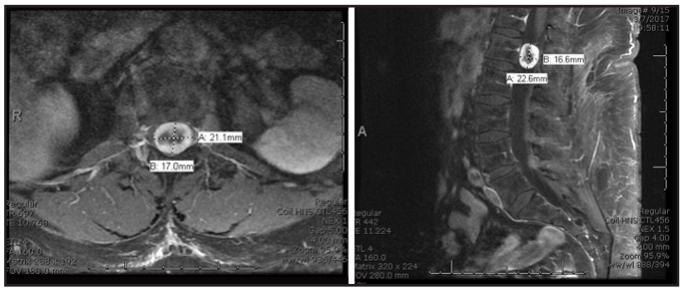
EXAMINATION FINDINGS

Physical examination revealed decreased lumbar active range of motion in all directions, decreased lumbar segmental mobility, hip musculature weakness, left quadricep tightness, and a negative neurological screen. She had an exacerbation of symptoms with passive accessory motion testing from T12-L3, repeated lumbar extension range of motion, left straight leg raise test, left FABER test, and sacral thrust. Other sacroiliac joint provocation special tests were unremarkable. Her Oswestry Disability Index (ODI) was 21/50, a score indicating severe disability.[3] Based on these findings, the patient's clinical impression was subacute low back pain with mobility deficits and radiating pain into her left lower extremity.

INTERVENTION

The patient was seen for 5 physical therapy sessions over 3 weeks with improvements in radicular pain. Manual therapy treatment included low-velocity mid-range joint manipulation of L4-5 as well as soft tissue mobilization of left gluteus maximus, piriformis, and lumbar paraspinals. Therapeutic exercise treatment included repeated lumbar flexion range of motion, hip extension strengthening, core stabilization training, and sciatic nerve sliders. Due to worsening rectal pain and urinary urgency, she was referred to a pelvic health physical therapist. She was treated for pelvic floor hypertonicity for 5 sessions with improvements in urinary urgency. Treatment included soft tissue mobilization to the levator ani and obturator internus, stretching of gluteus maximus, hamstrings and piriformis, as well as repeated lumbar extension active range of motion exercises. At initial evaluation, she had a directional preference for flexion, yet it oddly changed to extension during her last 3 visits. Initially her pain improved, however, the location of pain changed to her right side and bilateral groin. Additionally, her buttock pain worsened and her symptoms were not consistent with a mechanical pattern. These findings combined with her ODI increasing to a 28/50 prompted a referral back to PCP with request of further imaging follow-up.

OUTCOME



Lumbar spine magnetic resonance imaging identified a 17x21x23 mm intradural extramedullary tumor filling the spinal canal at L1 displacing the conus medullaris to the right. The patient underwent emergency surgery for L1 laminectomy with tumor resection. The tumor was found to be benign, and the patient had full resolution of pain, urinary, and bowel symptoms. At this time, her ODI was 18/50, a score indicating moderate disability.[3] Postoperatively she was referred back to physical therapy for improving her functional mobility so she could return to being independent in activities of daily living and independent activities of daily living. At discharge, the patient's ODI score was 2/50 indicating minimal disability.[3]

DISCUSSION

Physical therapy can help improve pain and function in patients with mechanical LBP with and without urinary incontinence.[1,4] However in the case of failed conservative management over 1 month with the presence of red flags (unexplained weight loss, age >50, previous history of cancer), a referral to the patient's PCP was warranted for further medical work-up to identify other serious spinal pathology causing the patient's pain.[1,5]

REFERENCES

1. Delitto A, George S, Van Dillen L, et al. Low Back Pain Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability, and Health from the Orthopaedic Section of the American Physical Therapy Association. *J Orthop Sports Phys Ther*. 2012;42(4):A1–A57. doi: 10.2519/jospt.2012.42.4.A1.
2. Deyo RA, Diehl AK. Cancer as a cause of back pain: frequency, clinical presentation, and diagnostic strategies. *J Gen Intern Med*. 1988;3(3):230-238. doi: 10.1007/BF02596337.
3. Fairbank JC, Pynsent PB. The Oswestry Disability Index. *Spine (Phila Pa 1976)*. 2000;25(22):2940-2952; discussion 2952. doi: 10.1097/00007632-200011150-00017.
4. Fariba G, Mohammadi K, Amir Sasan R, Niko Kheslat S, Oskouei AE. Effects of stabilization exercises focusing on pelvic floor muscles on low back pain and urinary incontinence in women. *Urology*. 2016;93 50-54. doi: 10.1016/j.urology.2016.03.034. Epub 2016 Apr 5.
5. Henschke N, Maher CG, Refshauge KM. Screening for malignancy in low back pain patients: a systematic review. *Eur Spine J*. 2007;16(10):1673-1679. doi: 10.1007/s00586-007-0412-0. Epub 2007 Jun 14.

President's Message

Francisco Maia, PT, DPT, CCRT

Even though you are all reading this letter in January 2021, I had to turn this in during the first week of November for publication. Needless to say that one way or the other a lot has changed in our country since then; however, there have been 2 things that have been consistent with the Animal PT SIG since I took over the role of President: first, we have been working hard behind the scenes to get things going with our 4 committees, and second, we are gearing up for Virtual CSM 2021.

In the October edition of the publication, I introduced myself and went over our plan to establish 4 different committees: legislation, research, membership, and communications. I am excited to say that we got 8 Rockstar individuals who have stepped up to the plate and we have been able to get the ball rolling on several initiatives. But before we continue, let me introduce them to you:

Legislation: Karen Atlas and Mary Beth Nunes
Research: Linda Marie Denney and Farley Schweighart
Membership: Jennifer Lyons and Katie Murphy
Communications: AJ Salch and Natalie Ullrich

By now you have already seen some of the work they have done, such as the more consistent posts in the AOPT social media pages about animal rehabilitation. We have also started to use the #PT4Animals to promote our field and we ask for you all to use that hashtag with your social media posts about animal rehabilitation as well. We have also added another resource to our website, a list of links to the physical therapy and veterinary practice acts for all 50 states, and we have been working on other resources that will soon be added to the website as well including an ongoing database of research articles in our field for you all to have access to the most recent research. These are just some of the projects that we have started and I wanted to invite you all to attend Virtual CSM 2021 to learn more about what we have accomplished and what we have planned for this year!

I have been attending CSM every year since 2017 and have seen consistent growth in physical therapists and students interested in making a career in this field. I find it fascinating that I have met a lot of students who have told me that their ultimate goal is to work with animals, and my goal has been to continue laying down the groundwork that was initiated by others in this field so we can continue to expand the ability for physical therapists to work with animals in all 50 states. The field of animal rehabilitation continues to grow exponentially, and I know we will need more and more physical therapists trained and certified in animal rehabilitation. I will certainly miss the personal connections that we can make during an event such as CSM and the ability to have an excuse to escape Chicago's winter for a few days; however, I am excited for the opportunities that arise from hosting a virtual event.

One of the biggest complaints I have heard in the past from our members was the fact that they were unable to attend CSM, and therefore would feel left out on what had been going on in our field and with the SIG. Well, this year you can all attend CSM from the comfort of your home! As I write this, we are still learning how CSM 2021 will work. Therefore, I don't have any details on how each section or academy will host their meetings and lectures; however, I highly encourage all of you to go online as soon as you are done reading this publication to look up when the Animal PT SIG will meet and mark that on your calendar! As I mentioned before, we will be able to fill you in on what we have accomplished in 2020 and go through our plan and vision for 2021. I want every single member to understand what we have been doing for them and see the value that our SIG brings to the field of animal rehabilitation. We are the only national organization in the United States led by physical therapists working in animal rehabilitation, and the future of our profession relies on what we do and your support.

Thank you,
Francisco Maia, PT, DPT, CCRT
Animal PT SIG President
francisco@thek9pt.com

Application of Trauma Informed Care in Animal Rehabilitation: A Case Report

Noriko Yamaguchi, PT, DPT, CSCS[1]
Grace E. Peck[2]

[1]Noriko Yamaguchi, PT, DPT, CSCS has been a CCRT since 2009. She is a Clinical Assistant Professor of Physical Therapy at the University of Southern California. She is Board Certified in Geriatric Physical Therapy and enjoys applying her expertise with aging and exercise to improve the mobility and physical well-being of her older patients, both canine and human.

[2]Grace E. Peck (KPA-CPT, CPDT-KA, Fear Free® Trainer) is a certified animal trainer and veterinary assistant with Synergy Behavior Solutions. She lives just outside Portland, Oregon with her dog, 5 hens, and human partner.

TRAUMA INFORMED CARE IN HUMAN HEALTH CARE

Trauma informed care (TIC) refers to care that recognizes the effect of trauma on patients' health and implements patient-centered strategies that are sensitive to patients' trauma experiences. Originally used in mental health care, TIC is now recognized as an important component of all aspects of health care. Survivors of trauma will often use maladaptive coping behaviors that can lead to poorer physical health outcomes. Furthermore, trauma survivors may be high users of sick visits and the emergency room but be less likely to seek preventative care.[1]

Constant exposure to stress in children results in changes in behavior, including hyperarousal, over-reaction to non-threatening triggers, and disruptions in emotional attachment.[2] These behavioral changes can then lead to future challenges at home, at school, and eventually in the community as adults. Campbell et al[2] found an association between the number of adverse childhood experiences (ACE) and at-risk behaviors and morbidity. Children with ACE scores ≥ 4 (13.7% of the respondents in their study) had

increased odds of binge or heavy drinking, smoking, risky HIV behavior, DM, MI, CAD, CVA, and depression.[2]

Patients as well as coworkers in a physical therapy clinic may have trauma histories and thus warrant clinical policies and practices that are trauma-informed. In addition, trauma survivors may seek physical therapy services specifically for injuries sustained from abuse or torture. Common areas of orthopedic injury from abuse and torture include the spine, shoulder girdle, and feet.[3] Manual therapy can decrease distress and disability in survivors of torture even though the survivors report no changes in their pain perception.[4]

While there are many ways in which providers can implement TIC in their respective fields, the basic principles of TIC include:

1) *Trauma Awareness* – understanding the prevalence and impact trauma can have on their patient population and within their workforce and adopting policies and practices that reflect this understanding.
2) *Safety* – adopting policies and practices that are committed to maintaining emotional and physical safety for the patients and employees.
3) *Choice and Empowerment* – avoiding re-traumatization by allowing patients and employees to feel empowered to make decisions about the services they receive or provide, respectively.
4) *Strengths Based Interventions* – focusing on building strength and resilience during interventions to help patients move in a positive direction.

(Adapted from Hopper et al, 2010[5])

In a medical or physical therapy setting, these principles can be adopted by first creating an environment that is as comfortable and non-threatening as possible, which may include allowing for longer sessions or plans of care with visits spaced further apart so that the therapeutic relationship can develop more slowly over time.[3,6] Use of sensitive language can play a large role in building trust. Examples of trauma-informed communication outlined by Ravi and Little[6] include:

1) Explicitly explaining why and how a procedure will be done,
2) Allowing opportunities for the patient to have a choice and be involved in the procedure (example – try to perform procedures in their position of comfort; have the patient move clothing out of the way instead of the clinician), and
3) Using suggestive instead of instructive language (example – instead of saying "take a deep breath and relax", say "some people find deep breathing to help them relax during this procedure").

Trauma in Animals

Animal abuse and neglect often precedes or accompanies human abuse. Seksel[7] reported that in the United Kingdom, 88% of animals living in households with domestic (human) abuse are either abused or killed, suggesting that human domestic violence problems directly affect animal welfare. Data on animal cruelty in the United States has been collected by the National Incident-Based Reporting System (NIBRS) since 2016. A total of 3200 cases of animal cruelty were reported to the NIBRS in 2017, but only one-third of the US population participated in reporting that year, suggesting that the number of reported cases is likely much higher.[8]

Similar to humans, abuse and neglect in dogs can lead to pain and functional impairments, and physical rehabilitation may help to improve the quality of life of canine survivors of trauma. However, manual therapy, exercise instruction, and application of modalities by an animal rehabilitation practitioner will often be a new experience for our canine patients and therefore be perceived as threatening. Hyperexcitability, anxiety, and displays of aggression or fear, whether as a direct result of trauma or due to other genetic, medical, or experiential causes, may also present barriers to participation in therapy activities. By implementing trauma-informed care strategies, animal rehabilitation practitioners will likely be able to create more positive experiences for the canine patient and therefore improved physical and functional outcomes.

This case report summarizes a case of a 15-year-old Maltese mix with a trauma history and how TIC was integrated into the canine patient's plan of care. The goal of this case is to exemplify how TIC in humans can be translated into a canine patient with a trauma history.

Olive, 15-year-old Maltese Mix, Spayed Female

The patient, Olive was referred to physical therapy upon the request of the client (Olive's guardian) due to hindlimb ataxia and weakness after an adverse reaction to Gabapentin. Although "80% better" at the time of physical therapy consultation, Olive continued to demonstrate decreased gait endurance, intermittent buckling of the front limbs during gait, and residual hindlimb ataxia. The client also endorsed that Olive had been more hesitant to sit over the past year. The client's goal for physical therapy was to increase Olive's comfort and safety in her later years.

Olive's past medical history was unknown when she was adopted at 5 years old. Before her adoption, she sustained a 5-year history of trauma as a breeder dog in a puppy mill. She lived with multiple dogs in 38"x38" stacked cages and only taken out of her cage twice a year for breeding. She was so severely emaciated that she could not walk more than 20 feet and could not ascend or descend stairs. After being rescued, she exhibited learned helplessness[9] during grooming and veterinary visits, as shown through severe trembling followed by shut down acquiescence to procedures.

By using innovations related to consent and cooperative care training,[10] Low Stress Handling®,[11] and Fear Free®[12] veterinary handling, Olive has been able thrive in her safe, nurturing, and enriching environment since adoption. These veterinary training strategies align with the principles of TIC:

1) *Trauma Awareness* – Communicating the patient's trauma history to her health care providers and enlisting their partnership in policies and practices that make treatment procedures predictable and low stress.
2) *Safety* – Using an antecedent arrangement of the treatment setting, predictor cues (verbal and gesture cues to inform the patient of the type of handling to be expected), and the 3 seconds/3 times rule to maintain emotional and physical safety of the patient and care providers. The 3 seconds/3 times rule states that if a canine patient struggles for longer than 3 seconds and/or each of 3 times when a procedure is attempted, this indicates a need to stop and reassess if the procedure is necessary or can be attempted using a different method or at a future time.
3) *Choice and Empowerment Training* – Using trained behaviors as "Start" and "Stop" buttons to enable communication of choice and consent.

These strategies were applied during her physical therapy consultation under the guidance of the client. For example, Olive was seen at her home to eliminate the stress of being in a new clinic environment. The physical therapy evaluation focused on posture analysis, movement observation, and active range of motion screening with the client providing verbal encouragement and treats to decrease the need for handling by the physical therapist. Handling was eventually performed later in the appointment time and was initially performed by the client, allowing the physical therapist to observe Olive's behavior and reaction to touch by a loved one. Before touch was initiated, the physical therapist gave a verbal cue "Touching" and a clear presentation of hand to lend predictability to the interaction. The client also provided insight into Olive's triggers, including being touched from above and having her front paws handled. These actions were avoided, and palpation and manual assessment were not performed by the physical therapist until Olive communicated adequate comfort. Olive's carrier was accessible at all times as her "safe space" and her retreat towards her carrier was her "Stop" button to indicate when she was uncomfortable with a procedure. She was allowed to go back to her carrier at any time, and periodically encouraged to retreat away from the treatment area to give her a break and relieve some of the social pressure that could result from continuous treatment.

By incorporating TIC strategies and collaborating with Olive and her guardian, we were able to develop a gentle therapeutic exercise program to improve Olive's hindlimb functional strength and gait endurance. Her plan of care focused on a home program that the client could perform in a stress-free environment, using training and communication principles already in practice by the client. This case highlights how physical therapists can apply principles of TIC to our canine patients to maximize participation and promote their physical and emotional well-being. Initiating Olive's physical therapy with these principles at the forefront of her care may increase the likelihood of the client seeking rehabilitative services at an earlier stage and may allow us to consider a wider range of treatment modalities in the future.

ACKNOWLEDGMENT

We'd like to thank Dr. Valli Parthasarathy, PhD, DVM, ACVB Resident, of Synergy Behavior Solutions for her review and counsel of this manuscript.

REFERENCES

1. Raja S, Hasnain M, Hoersch M, Gove-Yin S, Rajagopalan C. Trauma informed care in medicine: current knowledge and future research directions. *Fam Community Health*. 2015;38(3):215-226.
2. Campbell JA, Walker RJ, Egede LE. Associations between adverse childhood experiences, high-risk behaviors, and morbidity in adulthood. *Am J Prev Med*. 2016;50(3):344-352.
3. Franklin C. Physiotherapy with torture survivors. *Physiotherapy*. 2001;87(7):374-377.
4. Baird E, Williams ABDC, Hearn L, Amris K. Interventions for treating persistent pain in survivors of torture. *Cochrane Database Syst Rev*. 2017;8:DC012051.
5. Hopper EK, Bassuk EL, Olivet J. Shelter from the storm: trauma-informed care in homelessness services settings. *Open Health Serv Policy J*. 2010;3(2):80-100. doi: 10.2174/1874924001003020080.
6. Ravi A, Little V. Providing trauma-informed care [Commentary]. *Am Fam Physician*. 2017;95(10):655-657.
7. Seksel K. The behavioural manifestations of animal cruelty/abuse. *AVA & AVAWE Conference Proceedings*. 2004. https://www.canadianveterinarians.net/pdf/sekselbehavabuse.pdf. Accessed May 20, 2020.
8. Cima G. FBI gathers animal cruelty data, but patterns have yet to emerge. *JAVMA News*. 2019. https://www.avma.org/javma-news/2019-04-15/fbi-gathers-animal-cruelty-data-patterns-have-yet-emerge. Accessed May 20, 2020.
9. Seligman M. Learned Helplessness. *Annu Rev Med*. 1972;23:407-412.
10. Dixon S, Fraser L, Edlund E. What is *Cooperative Care? The IAABC Journal*. https://fall2018.iaabcjournal.org/2018/10/25/cooperative-care/. Accessed October 14, 2020.
11. Yin S. Low stress handling, restraint and behavior modification of dogs and cats: techniques for patients who love their visits. Davis, CA: CattleDog Publishing; 2009.
12. Dunn L. The Positive impact of fear free certification in veterinary practices. https://fearfreepets.com/wp-content/uploads/2019/11/The-Positive-Impact-of-Fear-Free-Certification-in-Vet-Practices.pdf. Accessed October 28, 2020.

Orthopaedic Physical Therapy Practice
2920 East Avenue South, Suite 200
La Crosse, WI 54601

ACADEMY OF
ORTHOPAEDIC
PHYSICAL THERAPY