



**PASIG MONTHLY CITATION BLAST: No.77**

**November 2012**

Dear Performing Arts SIG members:

I would like to draw your attention to the change in venue and date for this year's APTA Combined Sections Meeting.

***The 2013 APTA Combined Sections Meeting will be held  
January 21-24 in San Diego, CA.***

<http://www.apta.org/csm/>

Our PASIG courses at CSM will be held on:

***Wednesday, January 23, 2013***

Part 1 from 8:00 am–10:00 am, and Part 2 from 11:00 am–1:00 pm

Our PASIG topic this year is:

***Dancers, Runners, Jumpers: Same Diagnoses, Similar Presentations—  
Unique Interventions?***

***Part 1: Low Back Pain and Patellar Tendinopathy, and PASIG Programming***

***Part 2: Achilles Tendinopathy and PASIG Business Meeting***

Our speakers are:

**Jo Armour Smith, PT, MManTher, OCS**

**Kornelia Kulig, PT, PhD, FAPTA**

**Krissy Sutton, PT, DPT, ATC**

It's not too early to apply for student scholarship for next year's conference.

<http://www.apta.org/CurrentStudents/ScholarshipsAwards/PASIGStudentsScholarship/>

News from the Orthopaedic Section:

The Orthopaedic Section 2012 Election period is now open! Please click on the following link to view the slate and cast your votes:

<https://www.orthopt.org/ballot.php>

You will first need to login to the site by entering the following information in this order:

Username: **Your LAST NAME, capitalizing the first letter**

Password: **Your APTA ID NUMBER**

Please consider compiling and contributing a brief summary of Performing Arts-related abstracts for citation blast this year. It's easy to do, and a great way to become involved with PASIG! Just take a look at our Performing Arts Citations and Endnotes, look for what's missing, and email me your contribution!

[http://www.orthopt.org/content/special\\_interest\\_groups/performing\\_arts/citations\\_endnotes](http://www.orthopt.org/content/special_interest_groups/performing_arts/citations_endnotes)

This month's abstract citation and topic summary on Adolescent Idiopathic Scoliosis and Postural Training is brought to us by Jenna Bythrow PT, DPT, MS of Washington, DC. She introduced herself and her topic of interest by looking at our site for what is missing and emailing me. Wonderful! Thank you, Jenna!

Best regards,

*Annette*

Annette Karim, PT, DPT, OCS  
Chair, PASIG Research Committee

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## PERFORMING ARTS CONTINUING EDUCATION, CONFERENCES, AND RESOURCES

Orthopaedic Section Independent Study Course. [20.3 Physical Therapy for the Performing Artist](#).

Monographs are available for:

- Figure Skating (J. Flug, J. Schneider, E. Greenberg),
- Artistic Gymnastics (A. Hunter-Giordano, Pongetti-Angeletti, S. Voelker, TJ Manal), and
- Instrumentalist Musicians (J. Dommerholt, B. Collier).

Contact: Orthopaedic Section at: [www.orthopt.org](http://www.orthopt.org)

Orthopaedic Section Independent Study Course. [Dance Medicine: Strategies for the Prevention and Care of Injuries to Dancers](#).

This is a 6-monograph course and includes many PASIG members as authors.

- Epidemiology of Dance Injuries: Biopsychosocial Considerations in the Management of Dancer Health (MJ Liederbach),
- Nutrition, Hydration, Metabolism, and Thinness (B Glace),
- The Dancer's Hip: Anatomic, Biomechanical, and Rehabilitation Considerations (G. Grossman),
- Common Knee Injuries in Dance (MJ Liederbach),
- Foot and Ankle Injuries in the Dancer: Examination and Treatment Strategies (M. Molnar, R. Bernstein, M. Hartog, L. Henry, M. Rodriguez, J. Smith, A. Zujko),
- Developing Expert Physical Therapy Practice in Dance Medicine (J. Gamboa, S. Bronner, TJ Manal).

Contact: Orthopaedic Section at: [www.orthopt.org](http://www.orthopt.org)

Orthopaedic Section-American Physical Therapy Association,  
Performing Arts SIG

[http://www.orthopt.org/content/special\\_interest\\_groups/performing\\_arts](http://www.orthopt.org/content/special_interest_groups/performing_arts)

Performing Arts Citations and Endnotes

[http://www.orthopt.org/content/special\\_interest\\_groups/performing\\_arts/citations\\_endnotes](http://www.orthopt.org/content/special_interest_groups/performing_arts/citations_endnotes)

ADAM Center

<http://www.adamcenter.net/>

Publications:

<http://www.adamcenter.net/#!vstc0=publications>

Conference abstracts:

<http://www.adamcenter.net/#!vstc0=conferences>

Dance USA

Annual conference: Philadelphia, PA, June 12-15, 2013

<http://www.danceusa.org/>

Research resources:

<http://www.danceusa.org/researchresources>

Professional Dancer Annual Post-Hire Health Screen:

<http://www.danceusa.org/dancerhealth>

Dancer Wellness Project

<http://www.dancerwellnessproject.com/>

Becoming an affiliate:

<http://www.dancerwellnessproject.com/Information/BecomeAffiliate.aspx>

Harkness Center for Dance Injuries, Hospital for Joint Diseases

<http://hjd.med.nyu.edu/harkness/>

Continuing education:

<http://hjd.med.nyu.edu/harkness/education/healthcare-professionals/continuing-education-courses-cme-and-ceu>

Resource papers:

<http://hjd.med.nyu.edu/harkness/dance-medicine-resources/resource-papers-and-forms>

Links:

<http://hjd.med.nyu.edu/harkness/dance-medicine-resources/links>

Informative list of common dance injuries:

<http://hjd.med.nyu.edu/harkness/patients/common-dance-injuries>

Research publications:

<http://hjd.med.nyu.edu/harkness/research/research-publications>

International Association for Dance Medicine and Science (IADMS)

<http://www.iadms.org/>

Resource papers:

<http://www.iadms.org/displaycommon.cfm?an=1&subarticlenbr=186>

Links:

<http://www.iadms.org/displaycommon.cfm?an=5>

Medicine, arts medicine, and arts education organization links:

<http://www.iadms.org/displaycommon.cfm?an=1&subarticlenbr=5>

Publications:

<http://www.iadms.org/displaycommon.cfm?an=3>

Performing Arts Medicine Association (PAMA)

<http://www.artsmed.org/>

Annual symposium: July 20-23, 2013 Medical Problems of Performing Artists:

“Maximizing Performance, Artistry, Implementation, and Empowerment”

<http://www.artsmed.org/symposium.html>

Interactive bibliography site:

<http://www.artsmed.org/bibliography.html>

Related links:

<http://www.artsmed.org/relatedlinks.html>

Member publications:

<http://artsmed.org/publications.html>

(Educators, researchers, and clinicians, please continue to email me your conference and continuing education information and I will include it in the upcoming blasts.)

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## Adolescent Idiopathic Scoliosis and Postural Training

It has been proposed that adolescent dancers are at a higher risk for developing idiopathic scoliosis than non-dancing adolescents potentially due to delayed menarche and the asymmetrical demands of their sport (Warren, 1986). In addition, scoliosis may increase the risk of spondylolisthesis, which is already prevalent in the dance community (Crostelli, 2012), and scoliotic dancers have been shown to have a higher rate of injury when compared to non-scoliotic dancers (Steinber 2012).

Treating patients with adolescent idiopathic scoliosis using a combination of postural training, balance, and corrective exercises may decrease their overall risk of injury. This citation review provides articles regarding postural training and the exercise-based treatment of adolescent idiopathic scoliosis published in the last 5 years.

Jenna Bythrow PT, DPT, MS  
Washington, DC

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Assaiante, C., S. Mallau, et al. (2012). "Do adolescent idiopathic scoliosis (AIS) neglect proprioceptive information in sensory integration of postural control?" *PLoS One* 7(7): e40646.

**INTRODUCTION:** It has been reported that AIS rely much more on ankle proprioception to control the amplitude of the balance control commands as compared to age-matched healthy adolescents. Our hypothesis was that AIS do not neglect proprioceptive information to control posture probably because of their vestibular deficits. We investigated the proprioceptive contribution to postural control in AIS which expresses spinal deformity during a crucial transitional period of ontogenesis.

**METHODS:** 10 adolescents with idiopathic scoliosis (AIS) with moderate spinal deformity (10 degrees < Cobb Angle >35 degrees ) and 10 control adolescents (CA) had to maintain vertical stance while very slow oscillations in the frontal plane (below the detection threshold of the semicircular canal system) were applied to the support with the eyes open and closed. Postural orientation and segmental stabilisation were analysed at head, shoulder, trunk and pelvis levels. **RESULTS:** Scoliosis

did not affect vertical orientation control and segmental stabilization strategies. Vision improves postural control in both CA and AIS, which seem more dependent on visual cues than adults. CONCLUSIONS: AIS as CA were unable to control efficiently their postural orientation on the basis of the proprioceptive cues, the only sensory information available in the EC situation, whereas in the same condition healthy young adults present no difficulty to achieve the postural control. This suggests that AIS as CA transiently neglect proprioceptive information to control their posture. These results and previous studies suggest the existence of different afferent pathways for proprioceptive information subserving different parts in sensory integration of postural control. We conclude that the static proprioceptive system is not affected by the idiopathic scoliosis, while the dynamic proprioceptive system would be mainly affected.

Bas, P., M. Romagnoli, et al. (2011). "Beneficial effects of aerobic training in adolescent patients with moderate idiopathic scoliosis." *Eur Spine J* **20 Suppl 3**: 415-419.

AIM AND METHODS: The major aim of this study was to determine whether after 6 weeks of aerobic training adolescent idiopathic scoliosis (AIS) girls who suffer from mild scoliotic curvatures (n = 6) behaved in a similar way than healthy controls (n = 6) in different biochemical, anthropometric, and cardio respiratory parameters. RESULTS: The maximal power output and the power output achieved at the anaerobic threshold (AT), during the maximal exercise test, were significantly increased in both experimental groups, when compared with resting conditions. The training program caused significant changes in body composition (i.e., a decrease in body fat %) only in the scoliotic group. Regarding the cardio respiratory measurements, VO<sub>2</sub>max was increased by 17% in AIS group and 10% in the healthy group. CONCLUSIONS: Our results suggest that physical activity should be encouraged in scoliotic girls with mild curvatures.

Beaulieu, M., C. Toulotte, et al. (2009). "Postural imbalance in non-treated adolescent idiopathic scoliosis at different periods of progression." *Eur Spine J* **18**(1): 38-44.

The aim of this study was to test the hypothesis that imbalance in patients with a severe deformity of the spine is associated with an increase in the sensory integration disorder. This paper is a case comparison study. Patients were divided into three groups: able-bodied (n = 53), observation (n = 23), and pre-brace (n = 26) groups. Time domain parameters (sway area, position and displacement) and structural posturographic parameters [mean distance (MD) and mean peak (MP)] were calculated from the COP excursion using a force platform. A sensory integration disorder could be an important factor in the progression of the scoliotic curve. Significant

differences were found in time domain between observation, pre-brace and able-bodied groups. The results for the structural posturographic parameters showed significant differences between the pre-brace and the able-bodied groups ( $P = 0.018$  MD and  $P = 0.02$  MP) demonstrating a perturbation in sensory integration system by an increase of imbalance. The absence of statistical difference between the observation and the pre-brace groups for the structural posturographic parameters indicates a perturbation of sensory integration system associated with curve progression. Our study has demonstrated that the pre-brace group is less stable than the able-bodied group. The severity of scoliosis in pre-brace scoliotic girls could be related to an increase in the sensory integration disorder.

Crostelli, M. and O. Mazza (2012). "AIS and spondylolisthesis." *Eur Spine J.*

**INTRODUCTION:** The association of scoliosis and spondylolisthesis is well documented in literature; the nature and modalities of the relationship of the two pathologies are variable and not always clear. Also, etiologic particulars of scoliosis associated with spondylolisthesis are not well defined, even in cases where scoliosis is called idiopathic. In this paper, we review previous literature and discuss the different aspects of the mutual relationship of scoliosis and spondylolisthesis in the adolescent age.

**MATERIALS AND METHODS:** It is a common notion that the highest occurrence of scoliosis associated with spondylolisthesis is at the lumbar level, both in adolescent and in adult patients. It is probable that the scoliosis that is more heavily determined by the presence of spondylolisthesis is at the lumbar level and presents curve angle lower than 15 degrees Cobb and mild rotation. The scoliosis with curve value over 15 degrees Cobb that is present at the lumbar level in association with spondylolisthesis probably is not prominently due to spondylolisthesis: in these cases, spondylolisthesis is probably only partially responsible for scoliosis progression with a spasm mechanism and/or due to rotation of slipping "olisthetic" vertebra.

**DISCUSSION:** We think that the two pathologies should be treated separately, as stated by many other authors, but we would highlight the concept that, whatever be the scoliosis curve origin, spasm, olisthetic or mixed together, this origin has no influence on treatment. The curves should be considered, for all practical effects, as so-called idiopathic scoliosis. We think that generally patient care should be addressed to treat only spondylolisthesis or only scoliosis, if it is necessary on the basis of clinical findings and therapeutic indications of the isolated pathologies, completely separating the two diseases treatments.

**CONCLUSIONS:** Scoliosis should be considered as an independent disease; only in the case of scoliosis curve progression over time, associated scoliosis must be treated, according to therapeutic principles of the care of any so-called idiopathic scoliosis of similar

magnitude, and a similar approach must be applied in the case of spondylolisthesis progression or painful spondylolisthesis.

Diab, A. A. (2012). "The role of forward head correction in management of adolescent idiopathic scoliotic patients: a randomized controlled trial." Clin Rehabil.

Objective: To investigate the effectiveness of forward head correction on three-dimensional posture parameters and functional level in adolescent idiopathic scoliotic patients. Design: A randomized controlled study with three-month follow-up. Setting: University research laboratory. Subjects: Seventy-six adolescent idiopathic scoliotic patients with Cobb angle ranged from 10 degrees to 30 degrees and craniovertebral angle less than 50 degrees were randomly assigned to a study or a control group. Interventions: All the patients (n = 76) received traditional treatment in the form of stretching and strengthening exercises. In addition, patients in the study group (n = 38) received a forward head posture corrective exercise programme. Outcome measures: >Craniovertebral angle, Functional Rating Index and posture parameters, including: lumbar lordosis, thoracic kyphosis, trunk inclination, trunk imbalance, lateral deviation, surface rotation and pelvis torsion were measured before treatment, after 10 weeks, and at three-month follow-up. Results: There was a significant difference between the study and control groups adjusted to baseline values at 10 weeks post treatment with respect to the following parameters: craniovertebral angle (P = 0.006), trunk inclination (P = 0.005), lordosis (P = 0.01), kyphosis (P = 0.001), trunk imbalance (P = 0.001), lateral deviation (P = 0.001), pelvic torsion (P = 0.004) and surface rotation (P = 0.013). At three-month follow-up, there were still significant differences in all the previous variables (P < 0.005). In contrast, while there was no significant difference with respect to Functional Rating Index at 10 weeks (P = 0.8), the three-month follow-up showed a significant difference (P = 0.001). Conclusion: A forward head corrective exercise programme combined with conventional rehabilitation improved three-dimensional scoliotic posture and functional status in patients with adolescent idiopathic scoliosis.

Fusco, C., F. Zaina, et al. (2011). "Physical exercises in the treatment of adolescent idiopathic scoliosis: an updated systematic review." Physiother Theory Pract **27**(1): 80-114.

Two years ago we published an update of another of our previous systematic reviews about the effectiveness of physical exercises (PEs), and we found that the evidence on exercises for AIS was of level 1b. Now we have updated these results in the field of exercises for AIS with the final aim to find the strongest evidence as possible about PEs. Our goal was to verify if treatment with specific exercises for AIS has changed in these years. The study design was a systematic review. A bibliographic



search with strict inclusion criteria (patients treated exclusively with exercises, outcome Cobb degrees, all study designs) has been performed on the main electronic databases. We found a new paper about active autocorrection (Negrini et al, 2008 b), a prospective controlled cohort observational study on patients never treated before so the number of manuscripts considered in the systematic review was 20. The highest quality study (RCT) compared 2 groups of 40 patients, showing an improvement of the curve in all treated patients after 6 months. All studies confirmed the efficacy of exercises in reducing the progression rate (mainly in early puberty) and/or improving the Cobb angles (around the end of growth). Exercises were also shown to be effective in reducing brace prescription. Appendices of the popular exercise protocols that have been used in the research studies that are examined are included with detailed description and illustrations. This study (like the previously published systematic reviews) showed that PEs can improve the Cobb angles of individuals with AIS and can improve strength, mobility, and balance. The level of evidence remains 1b according to the Oxford Centre for Evidence-based Medicine, as previously documented.

Kuo, F. C., C. Z. Hong, et al. (2011). "Postural control strategies related to anticipatory perturbation and quick perturbation in adolescent idiopathic scoliosis." Spine (Phila Pa 1976) **36**(10): 810-816.

STUDY DESIGN: Cross-sectional study. OBJECTIVE: To investigate the automatic balance correction related to anticipatory perturbation (AP) and quick backward perturbation in adolescent idiopathic scoliosis (AIS). SUMMARY OF BACKGROUND DATA: Most previous studies on AIS patients focused on posture sway and lacked analysis of muscle activated patterns in dynamic standing control. METHODS: Thirty-two AIS patients and 23 age-matched normal subjects received perturbation balance tests on an unstable platform. The tilting angle of the platform and the muscle activity of the bilateral lumbar multifidi, gluteus medii, and gastrocnemii muscles were recorded. Electromyographic (EMG) amplitude, onset latencies, and duration were calculated with software accompanied with machine. RESULTS: The AIS group had less posture tilting but higher muscle activities than normal subjects under both perturbation conditions ( $P < 0.05$ ). Under the AP test, AIS showed earlier onset and prolonged activation of left multifidus and right gastrocnemius compared with normal subjects ( $P < 0.05$ ). The latency of the multifidus on the lumbar convex side occurred earlier than on the concave side. However, the asymmetric onset timing of the gastrocnemius was the opposite of the multifidi in the AIS group ( $P < 0.05$ ). In contrast to the AP condition, bilateral leg and trunk muscles activated at similar latencies and durations in the AIS group ( $P < 0.05$ ). Under the quick backward perturbation test, the control group had longer active duration of right multifidus and bilateral gastrocnemii

than AIS to cope with larger platform tilting. In addition, asymmetric onset of gluteus medii and duration of multifidi was observed in the control group ( $P < 0.05$ ). CONCLUSION: There were significant differences in posture control patterns between AIS and normal subjects. AIS subjects have asymmetric habitual muscle activities for AP, whereas when coping with sudden balance threats, they react with synchronized recruitment of bilateral postural muscles.

Kuo, F. C., N. H. Wang, et al. (2010). "Impact of visual and somatosensory deprivation on dynamic balance in adolescent idiopathic scoliosis." Spine (Phila Pa 1976) **35**(23): 2084-2090.

STUDY DESIGN: A cross-sectional study of balance control in adolescents with idiopathic scoliosis (AIS). OBJECTIVE: To investigate the impact of visual and somatosensory deprivation on the dynamic balance in AIS patients and to discuss electromyographic (EMG) and posture sway findings. SUMMARY OF BACKGROUND DATA: Most studies focus on posture sway in quiet standing controls with little effort on examining muscle-activated patterns in dynamic standing controls. METHODS: Twenty-two AIS patients and 22 age-matched normal subjects were studied. To understand how visual and somatosensory information could modulate standing balance, balance tests with the Biodex stability system were performed on a moving platform under 3 conditions: visual feedback provided (VF), eyes closed (EC), and standing on a sponge pad with visual feedback provided (SV). Muscular activities of bilateral lumbar multifidi, gluteus medii, and gastrocnemii muscles were recorded with a telemetry EMG system. RESULTS: AIS patients had normal balance index and amplitude and duration of EMG similar to those of normal subjects in the balance test. However, the onset latency of right gastrocnemius was earlier in AIS patients than in normal subjects. In addition, body-side asymmetry was noted on muscle strength and onset latency in AIS subjects. Under EC condition, lumbar multifidi, and gluteus medii activities were higher than those under SV and VF conditions ( $P < 0.05$ ). Under SV condition, the medial-lateral tilting angle was less than that under VF and EC conditions. In addition, the active duration of right gluteus medius was shorter under SV condition ( $P < 0.05$ ). CONCLUSION: The dynamic balance control is particularly disruptive under visual deprivation with increasing lumbar multifidi and gluteus medii activities for compensation. Sponge pad can cause decrease in frontal plane tilting and gluteus medii effort. The asymmetric muscle strength and onset timing are attributed to anatomic deformation as opposed to neurologic etiological factors.

McIntire, K. L., M. A. Asher, et al. (2008). "Treatment of adolescent idiopathic scoliosis with quantified trunk rotational strength training: a pilot study." J Spinal

Disord Tech 21(5): 349-358.

STUDY DESIGN: Prospective clinical trial. OBJECTIVES: To test the hypothesis that quantified trunk rotational strength training will equalize any strength asymmetry, increase strength overall, and stabilize adolescent idiopathic scoliosis. SUMMARY OF BACKGROUND DATA: Bracing, the only generally accepted form of adolescent idiopathic scoliosis nonoperative therapy, has many shortcomings. Paraspinal muscle abnormalities, which have been extensively documented in these patients, are generally considered to be secondary. A normal female's trunk strength in flexion and extension decreases from her juvenile to adolescent years, whereas a male's increases. METHODS: Patients received a 4-month supervised followed by a 4-month home trunk rotational strength training program. Trunk rotational strength was measured in both directions at 5 positions at baseline, 4 months, and 8 months. The patients were followed clinically. RESULTS: Fifteen patients (12 females and 3 males), with an average age of 13.9 years and an average main Cobb of 33 degrees were enrolled. At baseline there was no significant asymmetry. After 4 months of supervised strength training, involving an average of 32 training sessions, each lasting about 25 minutes, their strength had significantly increased by 28% to 50% ( $P < 0.005$  to  $P < 0.001$ ). After 4 months of unsupervised home strength training their strengths were unchanged. The 3 patients with baseline curves of 50 to 60 degrees all had main or compensatory curve progression and 2 had surgery. For patients with 20 to 40-degree curves, survivorship from main curve progression of  $\geq 6$  degrees was 100% at 8 months, but decreased to 64% at 24 months. CONCLUSIONS: Quantified trunk rotational strength training significantly increased strength. It was not effective for curves measuring 50 to 60 degrees. It appeared to help stabilize curves in the 20 to 40-degree ranges for 8 months, but not for 24 months. Periodic additional supervised strength training may help the technique to remain effective, although additional experimentation will be necessary to determine this.

Negrini, S., S. Atanasio, et al. (2008). "Rehabilitation of adolescent idiopathic scoliosis: results of exercises and bracing from a series of clinical studies. Europa Medicophysica-SIMFER 2007 Award Winner." Eur J Phys Rehabil Med 44(2): 169-176.

AIM: Rehabilitation of adolescent idiopathic scoliosis (AIS) requires a careful choice from among the possible treatments, such as bracing and exercises, according to the patient's needs. According to the literature, there is little evidence regarding the efficacy of these rehabilitation instruments. During the past few years, a full series of studies has been carried out to investigate their efficacy. The aim of this paper was to summarize all these results. METHODS: Three systematic reviews (two

on exercises and one on manual therapy), and four cohort prospective studies were performed. The prospective studies included two trials with a prospective control group on exercises (one to avoid bracing and one in preparation to bracing) and two trials with retrospective control group on a new brace developed by the Authors (Sforzesco brace and SPoRT concept of correction versus Lyon brace and Risser cast). RESULTS: Results show that in literature there is proof of level 1b on exercises but no studies on manual therapy. High quality exercises like Scientific Exercises Approach to Scoliosis (SEAS) have more efficacy than usual physiotherapy, significantly reducing brace prescription in one year from 25% of cases to 6%. Moreover, such exercises help to obtain the best results in bracing first correction. The Sforzesco brace has proved to have more efficacy than the Lyon brace, whereas it has the same efficacy--but reduced side effects and impact on quality of life--than the Risser brace. CONCLUSION: With an efficient management of data collection, it is possible to develop a set of studies aimed at verifying the efficacy of clinical daily rehabilitation approaches.

Negrini, S., C. Fusco, et al. (2008). "Exercises reduce the progression rate of adolescent idiopathic scoliosis: results of a comprehensive systematic review of the literature." *Disabil Rehabil* **30**(10): 772-785.

BACKGROUND: A previously published systematic review (Ped.Rehab.2003 - DARE 2004) documented the existence of the evidence of level 2a (Oxford EBM Centre) on the efficacy of specific exercises to reduce the progression of AIS (Adolescent Idiopathic Scoliosis). AIM: To confirm whether the indication for treatment with specific exercises for AIS has changed in recent years. STUDY DESIGN: Systematic review. METHODS: A bibliographic search with strict inclusion criteria (patients treated exclusively with exercises, outcome Cobb degrees, all study designs) was performed on the main electronic databases and through extensive manual searching. We retrieved 19 studies, including one RCT and eight controlled studies; 12 studies were prospective. A methodological and clinical evaluation was performed. RESULTS: The 19 papers considered included 1654 treated patients and 688 controls. The highest-quality study (RCT) compared two groups of 40 patients, showing an improvement of curvature in all treated patients after six months. We found three papers on Scoliosis Intensive Rehabilitation (Schroth), five on extrinsic autocorrection-based methods (Schroth, side-shift), four on intrinsic autocorrection-based approaches (Lyon and SEAS) and five with no autocorrection (three asymmetric, two symmetric exercises). Apart from one (no autocorrection, symmetric exercises, very low methodological quality), all studies confirmed the efficacy of exercises in reducing the progression rate (mainly in early puberty) and/or improving the Cobb angles (around the end of growth). Exercises were also shown

to be effective in reducing brace prescription. CONCLUSION: In five years, eight more papers have been published to the indexed literature coming from throughout the world (Asia, the US, Eastern Europe) and proving that interest in exercises is not exclusive to Western Europe. This systematic review confirms and strengthens the previous ones. The actual evidence on exercises for AIS is of level 1b.

Negrini, S., F. Zaina, et al. (2008). "Specific exercises reduce brace prescription in adolescent idiopathic scoliosis: a prospective controlled cohort study with worst-case analysis." J Rehabil Med **40**(6): 451-455.

OBJECTIVE: To compare the effect of Scientific Exercises Approach to Scoliosis (SEAS) exercises with "usual care" rehabilitation programmes in terms of the avoidance of brace prescription and prevention of curve progression in adolescent idiopathic scoliosis. DESIGN: Prospective controlled cohort observational study. PATIENTS: Seventy-four consecutive outpatients with adolescent idiopathic scoliosis, mean 15 degrees (standard deviation 6) Cobb angle, 12.4 (standard deviation 2.2) years old, at risk of bracing who had not been treated previously. METHODS: Thirty-five patients were included in the SEAS exercises group and 39 in the usual physiotherapy group. The primary outcome included the number of braced patients, Cobb angle and the angle of trunk rotation. RESULTS: There were 6.1% braced patients in the SEAS exercises group vs 25.0% in the usual physiotherapy group. Failures of treatment in the worst-case analysis were 11.5% and 30.8%, respectively. In both cases the differences were statistically significant. Cobb angle improved in the SEAS exercises group, but worsened in the usual physiotherapy group. In the SEAS exercises group, 23.5% of patients improved and 11.8% worsened, while in the usual physiotherapy group 11.1% improved and 13.9% worsened. CONCLUSION: These data confirm the effectiveness of exercises in patients with scoliosis who are at high risk of progression. Compared with non-adapted exercises, a specific and personalized treatment (SEAS) appears to be more effective.

Romano, M., S. Minozzi, et al. (2012). "Exercises for adolescent idiopathic scoliosis." Cochrane Database Syst Rev **8**: CD007837.

BACKGROUND: Adolescent idiopathic scoliosis (AIS) is a three-dimensional deformity of the spine . While AIS can progress during growth and cause a surface deformity, it is usually not symptomatic. However, in adulthood, if the final spinal curvature surpasses a certain critical threshold, the risk of health problems and curve progression is increased. The use of scoliosis-specific exercises (SSE) to reduce progression of AIS and postpone or avoid other more invasive treatments is controversial.

OBJECTIVES: To evaluate the efficacy of SSE in adolescent patients with AIS. SEARCH METHODS: The following databases (up to 30 March 2011)

were searched with no language limitations: CENTRAL (The Cochrane Library 2011, issue 2), MEDLINE (from January 1966), EMBASE (from January 1980), CINHALL (from January 1982), SportDiscus (from January 1975), PsycInfo (from January 1887), PEDro (from January 1929). We screened reference lists of articles and also conducted an extensive handsearch of grey literature. SELECTION CRITERIA: Randomised controlled trials and prospective cohort studies with a control group comparing exercises with no treatment, other treatment, surgery, and different types of exercises. DATA COLLECTION AND ANALYSIS: Two review authors independently selected studies, assessed risk of bias and extracted data. MAIN RESULTS: Two studies (154 participants) were included. There is low quality evidence from one randomised controlled study that exercises as an adjunctive to other conservative treatments increase the efficacy of these treatments (thoracic curve reduced: mean difference (MD) 9.00, (95% confidence interval (CI) 5.47 to 12.53); lumbar curve reduced:MD 8.00, (95% CI 5.08 to 10.92)). There is very low quality evidence from a prospective controlled cohort study that scoliosis-specific exercises structured within an exercise programme can reduce brace prescription (risk ratio (RR) 0.24, (95% CI 0.06 to 1.04) as compared to usual physiotherapy (many different kinds of general exercises according to the preferences of the single therapists within different facilities). AUTHORS' CONCLUSIONS: There is a lack of high quality evidence to recommend the use of SSE for AIS. One very low quality study suggested that these exercises may be more effective than electrostimulation, traction and postural training to avoid scoliosis progression, but better quality research needs to be conducted before the use of SSE can be recommended in clinical practice.

Schmid, A. B., L. Dyer, et al. (2010). "Paraspinal muscle activity during symmetrical and asymmetrical weight training in idiopathic scoliosis." J Sport Rehabil **19**(3): 315-327.

CONTEXT: Various studies report decreased muscle activation in the concavity of the curve in patients with scoliosis. Such decreased muscle-performance capacity could lead to sustained postural deficits.

OBJECTIVE: To investigate whether specific asymmetrical sports therapy exercises rather than symmetrical back strengthening can increase EMG amplitudes of paraspinal muscles in the concavity of the curve. DESIGN: Cross-sectional. SETTING: Laboratory. PARTICIPANTS: 16 patients with idiopathic scoliosis. INTERVENTIONS: Patients performed 4 back-strengthening exercises (front press, lat pull-down, roman chair, bent-over barbell row) during 1 test session. Each exercise was performed in a symmetrical and asymmetrical variant and repeated 3 times. MAIN OUTCOME MEASURE: EMG amplitudes of the paraspinal muscles were recorded in the thoracic and lumbar apexes of the scoliotic curve during

each exercise. Ratios of convex- to concave-side EMG activity were calculated. RESULTS: Statistical analysis revealed that the asymmetrical variants of front press at the lumbar level ( $P=.002$ ) and roman chair and bent-over barbell row at the thoracic level ( $P<.0001$ ,  $.001$  respectively) were superior in increasing EMG amplitudes in the concavity of the scoliotic curve. CONCLUSIONS: Specific asymmetrical exercises increase EMG amplitudes of paraspinal muscles in the concavity. If confirmed in longitudinal studies measuring improvements of postural deficits, these exercises may advance care of patients with scoliosis.

Smania, N., A. Picelli, et al. (2008). "Neurophysiological basis of rehabilitation of adolescent idiopathic scoliosis." *Disabil Rehabil* **30**(10): 763-771.

BACKGROUND: Knowledge on mechanisms of neurophysiological control of trunk movement and posture could help in the development of rehabilitation programs and brace treatment in adolescent idiopathic scoliosis (AIS). AIMS: Reviewing up-to-date research on neurophysiology of movement and posture control with the aim of providing basis for new researches in the field of AIS rehabilitation and background understanding for clinicians engaged in management of AIS. METHODS: Review of literature. RESULTS: We considered several neurophysiological issues relevant for AIS rehabilitation, namely, the peculiar organization of patterns of trunk muscle recruitment, the structure of the neural hardware subserving axial and arm muscle control, and the relevance of cognitive systems allowing mapping of spatial coordinates and building of body schema. DISCUSSION AND CONCLUSION: We made clear the reason why trunk control is generally carried out by means of very fast, feedforward or feedback driven patterns of muscle activation which are deeply rooted in our neural control system and very difficult to modify by training. We hypothesized that augmented sensory feedback and strength exercises could be an important stage in a rehabilitation program aimed at hindering, or possibly reversing, scoliosis progression. In this context we considered bracing not only as a corrective biomechanical device but also as a tool for continuous sensory stimulation that could help awareness of body misalignment. Future research aimed at developing strategies of trunk postural control learning is essential in the rehabilitation of adolescent idiopathic scoliosis.

Steinberg, N., I. Siev-Ner, et al. (2012). "Extrinsic and intrinsic risk factors associated with injuries in young dancers aged 8-16 years." *J Sports Sci* **30**(5): 485-495.

In the present study, we tried to determine the association between joint ranges of motion, anatomical anomalies, body structure, dance discipline, and injuries in young female recreational dancers. A group of 1336 non-professional female dancers (age 8-16 years), were screened. The risk

factors considered for injuries were: range of motion, body structure, anatomical anomalies, dance technique, and dance discipline. Sixty-one different types of injuries and symptoms were identified and later classified into four major categories: knee injuries, foot or ankle tendinopathy, back injuries, and non-categorized injuries. We found that 569 (42.6%) out of the 1336 screened dancers, were injured. The following factors were found to be associated with injuries ( $P < 0.05$ ): (a) range of motion (e.g. dancers with hyper hip abduction are more prone to foot or ankle tendinopathies than dancers with hypo range of motion); (b) anatomical anomalies (scoliotic dancers manifested a higher rate of injuries than non-scoliotic dancers); (c) dance technique (dancers with incorrect technique of rolling-in were found to have more injuries than dancers with correct technique); (d) dance discipline (an association between time of practice en pointe and injury was observed); and (e) early age of onset of menarche decreased risk for an injury. No association between body structure and injury was found. Injuries among recreational dancers should not be overlooked, and therefore precautionary steps should be taken to reduce the risk of injury, such as screening for joint range of motion and anatomical anomalies. Certain dance positions (e.g. en pointe) should be practised only when the dancer has already acquired certain physical skills, and these practices should be time controlled.

Warren, M. P., J. Brooks-Gunn, et al. (1986). "Scoliosis and fractures in young ballet dancers. Relation to delayed menarche and secondary amenorrhea." N Engl J Med **314**(21): 1348-1353.

In a survey of 75 dancers (mean age, 24.3 years) in four professional ballet companies, we found that the prevalence of scoliosis was 24 percent and that it rose with increases in age at menarche. Fifteen of 18 dancers (83 percent) with scoliosis had had a delayed menarche (14 years or older), as compared with 31 of 57 dancers (54 percent) without scoliosis ( $P$  less than 0.04). The dancers with scoliosis had a slightly higher prevalence of secondary amenorrhea (44 percent vs. 31 percent), the mean ( $\pm$  SD) duration of their amenorrhea was longer (11.4  $\pm$  18.3 vs. 4.1  $\pm$  7.4 months;  $P$  less than 0.05), and they scored higher on a questionnaire that assessed anorectic behavior. The incidence of fractures was 61 percent (46 of 75 dancers), and it rose with increasing age at menarche. Sixty-nine percent of the fractures that were described were stress fractures (mostly in the metatarsals), and their occurrence had an even stronger correlation with increased age at menarche. The incidence of secondary amenorrhea was twice as high among the dancers with stress fractures ( $P$  less than 0.01), and its duration was longer ( $P$  less than 0.05). In 7 of 10 dancers in whom endocrine studies were performed, the amenorrheic intervals were marked by prolonged hypoestrogenism. These data suggest that a delay in menarche and prolonged intervals of



amenorrhoea that reflect prolonged hypoestrogenism may predispose ballet dancers to scoliosis and stress fractures.

Wnuk, B., J. Frackiewicz, et al. (2012). "Short-term effects of combination of several physiotherapy methods on the respiratory function - a case report of adolescent idiopathic scoliosis." Stud Health Technol Inform **176**: 402-406.

The aim of the study was to evaluate the positive effects of combination of several physiotherapy methods on the respiratory function on example of a case report. MATERIAL AND METHODS: 14 years old girl with an adolescent idiopathic scoliosis (AIS), right thoracic (primary curve, Cobb angle = 40 degrees , AVR = 12 degrees ) and left lumbar (secondary curve, Cobb angle = 33 degrees , AVR = 24 degrees ) participated in the study. She was 2 years after menarche. She underwent stationary (in-patient) treatment for 3 weeks with use of standard medical care (DoboMed). Treatment also included manual therapy (OMT Kaltenborn-Evjenth) and Dynamic Brace System (DBC) device, produced by Meditrack. Then she continued exercises at home. Respiratory system function was analyzed with use of SpiroPro electronic spirometer (Jaeger) and the strength of respiratory muscles with use of portable digital pressure meter equipped with the Omega PX 25 +/- 35 kPa pressure transducer. Range of movement of the spine was examined with Rippstein V plurimeter, angle of apical trunk rotation (ATR) with the Bunnell scoliometer. Measurement was performed 4 times: before treatment, after one week and 3 weeks after the beginning of the treatment and 3 months after finalization of the treatment period. RESULTS: Examination showed that DoboMed medical care treatment, manual therapy and use of DBC device in period of 3 weeks caused improvement of respiratory parameters (MIP - maximal inspiration pressure by 6.7%; MEP - maximal expiratory pressure by 12.6%, PEF - peak expiratory flow by 16.1%). Spinal range of lateral movement and angle of apical trunk rotation has also improved. CONCLUSION: In short term treatment, the manual therapy aided with DBC system has improved the respiratory parameters and trunk morphology values. Such a composition of various physiotherapy methods can help to conduct further specialized exercises of DoboMed method.

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