Treatment of Repetitive Stress Injury in a High Altitude Saxophone Player with Pectus Excavatum and Scoliosis

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Repetitive stress injury is a common occurrence in serious musicians, especially those studying at a conservatory or university.[1-5] Faulty posture, breathing, and movement mechanics have been implicated in the development of overuse injury in the musician. Many authors have stressed the importance of addressing a musician's posture and movement mechanics to ensure the successful return to performance.[6-13] We believe that the musculoskeletal complaints that brought this young saxophone player to physical therapy were caused primarily by faulty movement mechanics and poor postural habits. It is also likely that long-term respiratory dysfunction, that this patient did not acknowledge, played a role in the development of poor habits and overuse injuries.

Wind players with faulty breathing mechanics are especially vulnerable to muscle tension and repetitive stress injury.[22,23] Many factors affect breathing efficiency in the wind player: embouchure and orofacial structures, skeletal structure, muscular strength and endurance, cardiovascular and pulmonary health, activity level, environment and emotional stress.[5-8,14-21,23,24] Medical problems of saxophone players are rarely discussed in the literature. This may be due to the fact that the saxophonist is not an orchestral player and thus not readily available for study. In addition the environmental influences of the club setting in which sax players often perform are difficult to control for.[25]

Structural, functional, and environmental factors play a significant role in the development of breathing problems and musculoskeletal pain in the saxophone player described in this case study. He presented with a chest deformity and scoliosis, played at high altitude, and has asthma. Pectus excavatum (PE) is a congenital depression of the sternum, which leads to a restrictive lung disorder. The heart is pushed into the lateral and posterior aspect of the left thorax.[26] Pectus excavatum alters the dynamics and mechanics of breathing and heart function.[26-30] Common symptoms include dyspnea on exertion, chest pain, wheezing, inability to take deep breaths, and decreased exercise tolerance. Significant pulmonary function changes have been reported.[31,33,34] The patient also was diagnosed with asthma, a reversible obstructive lung disorder, which is characterized by wheezing, dyspnea, chest tightness, and cough. It is often induced by exercise.[22] The patient first noticed shortness of breath and wheezing when he moved from sea level to 7,000 ft. Playing a wind instrument at altitude is not addressed in the literature. We therefore looked to research that addresses exercise at altitude. It is well documented that performing exercise at high altitude stresses the cardiovascular system.[32] This is true of trained athletes as well as of asthmatic children. A study by Cibella et al found a decrease in VO_{2max} and an increase in breathing workload in athletes training for 1 month at 15,150 ft.[35] A study of asthmatic children exercising in an atmosphere-changing chamber from sea level to 4,500 ft. found that respiratory rate and ventilatory anaerobic threshold were higher with exercise at altitude.[36] Thus aerobic power and oxygen diffusion were reduced when exercising at altitude.

The purpose of this case study is to identify the factors contributing to the development of repetitive stress injury in a young saxophone player. We present the unique combination of factors that adversely affected breathing mechanics and posture and describe the neuromuscular re-education process that allowed the musician to return to his desired level of practice and performance.

CASE DESCRIPTION

The patient was a 20-year-old male saxophone player, who was a music performance major at a high altitude university (7,000 ft.). He practiced the saxophone 2 hours daily, played the piano 1 hour daily (mainly for composing), and performed in 3 musical groups. In addition, he taught 2 saxophone students, was enrolled in 18 hours of classes, and worked 22 hours a week as a waiter. The patient presented with a chief complaint of pain in the dorsum of his right hand, wrist, and forearm that began 1 1/2 weeks ago. Symptoms coincided with increased practice on the saxophone and piano to prepare for upcoming concerts. Aggravating activities (from worst to least) included: (1) using the computer mouse, (2) writing, (3) playing the saxophone or piano for extended periods of time, and (4) waiting tables. Symptoms decreased with rest from aggravating activities. Patient also reported chronic mild low back pain. Patient did not exercise regularly.

Evaluation revealed the following structural abnormalities in standing: right thoracic scoliosis, right scapular winging and protraction, and significant pectus excavatum chest deformity. The patient was identified to have a sway-back posture as described by Kendall and McCreary.[22] When playing the saxophone this posture was exaggerated, the trunk was rotated to the right, and the right wrist was fixed in an extended position close to the right hip. His playing style was tense. Postural faults while seated at the keyboard were identified as rounded shoulders, sunken chest, rounded thoracic and lumbar spine, and extended cervical spine and head. Lumbar and thoracic spinal mobility were reduced so that it was difficult for the patient to maintain an upright posture in sitting. Manual muscle testing of the scapula and shoulder as described by Kendall[37] revealed weaknesses, R>L of the rhomboids, lower trapezius, middle trapezius, latissimus dorsi, and teres major. Strength testing of the wrist, hand, and fingers revealed weaknesses, R>L of the EPL, EPB, ODM, and ADM (see Table 1). Upper extremity sensation was WNL. Nerve tension tests as described by Butler[38] revealed slight irritability of the right median nerve at end range stretch when compared to the left. Tingling in the fingertips occurred with scapular depression and end range shoulder elevation. Bilateral pectoralis minor, scalene, and upper trapezius tightness was noted. Throughout the interview and when playing his saxophone the patient was short of breath and a slight wheeze could be heard. It was noted that he was a chest breather. When questioned about breathing problems, the patient noted some shortness of breath since beginning study at the university. He denied previous breathing problems and was unaware that he had a chest deformity.

Table 1.

	Initial		Re-evaluation (3 month)	
	Kendall Muscle Grades (normal=5)			
	R	L	R	L
Rhomboids	4	4	5	5
Lower Traps	3	3+	4	5
Mid Traps	3+	4	4+	5
Lat Dorsi	3	3+	4	4
Teres Major	3	3+	4	4+
EPB	3	3+	4+	4+
EPL	3	3+	4	4
ODM	3+	5	4	5
ADM	3	3	4+	4

We hypothesized that UE symptoms were due to muscle/tendon strain caused by repetitive use of the computer mouse, writing, and playing the saxophone and piano. Predisposing factors were determined to be structural abnormalities and faulty posture that led to poor trunk stabilization, muscular weakness, inefficient breathing mechanics, and muscle tension. We further hypothesized that scapular and shoulder strength would improve and hand pain would decrease with improved posture, trunk stabilization, and movement mechanics.

TREATMENT

A treatment plan was designed to address the following impairments: wrist, hand, and finger weakness and pain; shoulder and scapular weakness; structural abnormalities; faulty posture; inefficient breathing mechanics; and decreased spinal mobility. It was important to consider the environmental and situational factors of living at a high altitude; an intense school, performance, and work schedule; and lack of physical exercise. During initial intervention (the first 5 sessions over a 6-week period), the patient was instructed in relaxation training and diaphragmatic breathing exercises and neuromuscular re-education exercises to improve posture and movement mechanics. Training was based on the teachings of kinesiologist, Mabel Elsworth Todd and her student, Lulu Sweigard who developed ideokinesis, imagined movement exercises to change postural and movement habits.[16] Abdominal hollowing exercises as described by Richardson and Jull were used to train the transversus abdominis muscle to stabilize the pelvis and low back.[4] Posture and movement mechanics when sitting at the keyboard and when playing the saxophone were addressed at each session. When sitting at the keyboard, he was taught to re-establish the normal curvature of the spine and align his trunk without tension. When playing the saxophone in standing he was taught to prevent the hips from swaying forward and to avoid rotation of the trunk. This allowed him to hold the saxophone more in front and to relax the rigidly held extended right wrist. Back mobility and pelvic stabilization exercises enabled the patient to more easily maintain corrected alignment. The patient was instructed to chunk his practice time into 15- to 30-minute segments and to practice relaxation and breathing exercises during breaks. He also was encouraged to decrease writing and computer use. Finally, the patient was encouraged to consult with a respiratory specialist. During the third treatment session, patient reported decreased hand and wrist pain. He noted that paying attention to his posture while playing the saxophone was helpful. He was performing the exercises every other day but was having difficulties finding a quiet, comfortable place to do the breathing exercises. There was an 8-week break in therapy due to winter break and a busy schedule when the patient returned to school.

Sessions 6 through 10 took place over a 6-week period. During session 6 (3 months following the start of treatment), the patient reported that his symptoms had deceased significantly. His wrist and hand were rarely painful, and his low back no longer ached. He noted that his saxophone playing was much more relaxed. Symptoms no longer limited the amount of time the patient wished to devote to playing the saxophone or piano. When symptoms did present, they were minor and easily reversed. The patient reported continued wheezing and shortness of breath but had not yet seen a physician. Treatment during sessions 6 through 10 consisted primarily of fine-tuning posture and movement mechanics, and reviewing breathing and conditioning exercises. During this period, the patient demonstrated improved posture in sitting and standing and playing his instruments. His pelvis was no longer posteriorly tilted and his torso was lengthened, balanced, and supported. Manual muscle testing revealed increased strength in all muscles that had previously tested weak (Table 1). Nerve tension tests were negative. The patient consulted a respiratory specialist before visit 8. Pulmonary function studies revealed obstructive disease (decreased FEV 25-75, suggestive of asthma) and restrictive disease from marked pectus excavatum. Asthma reversed significantly with a bronchodilator. Patient was placed on Azmacort and Albuterol. During session 9, the patient was placed on an exercise program at the student recreation center. The program consisted of 30 minutes of cycling, pelvic stabilization, stretching, back conditioning exercises, and upper body weight training. The amount of weight lifted was determined by how much the patient could lift 20 times with relaxed, balanced alignment and efficient trunk stabilization. Performance of patient's exercise program was assessed 3 weeks later. Patient reported that he was exercising 2 times per week and that the aerobic and weight training and asthma medicine were helpful in improving breath control and endurance and decreasing stress. He was not consistent in performing the relaxation and breathing exercises because he still had not found a comfortable place to do so. He had no complaints of hand, arm, or low back pain. Patient demonstrated excellent posture and movement mechanics and was discharged from physical therapy. The following day he was re-evaluated by the respiratory specialist and repeat spirometry was performed. FEV 25-75 still showed a moderate decrease and significant improvement with the bronchodilator.

FOLLOW UP

The patient was interviewed 6 months later. Upper extremity symptoms were infrequent and when they did occur, they resolved quickly. The patient noted that continued attention to good alignment when playing the saxophone allowed him to play pain free. Hand and arm symptoms most commonly presented with composing on the piano due to tendencies to slouch when absorbed in his work. He was still exercising at the recreation center; however, this was becoming increasingly difficult due to increased school demands. Practicing balanced relaxed posture was a priority; however, he rarely performed the relaxation and breathing exercises. The patient noted increased jaw and embouchure tension when playing his saxophone. He did not follow up with care by the respiratory specialist because of money worries despite his concern that he was becoming increasingly dependent on the Albuterol inhaler. The patient was encouraged to work out a payment plan with the physician and to follow through with treatment. He was also encouraged to be consistent with his exercise training. Two weeks later he still had not followed through with these suggestions.

DISCUSSION

Serious musicians are similar to highly competitive athletes and dancers in that they push themselves to perform through pain. Only when the pain interferes with their ability to compete or perform do they seek professional help. The young saxophonist presented in this case study sought help only after his hands became part of the problem. He was oblivious to the structural faults, environmental factors and underlying postural faults, breathing problems, and muscular tension that preceded and were instrumental in producing his hand pain. Health professionals must be sensitive to the fact that he, like other serious student musicians, is an intense individual, who deals daily with a lot of stress. He is overworked and consumed with bettering his skills in preparation to exist in a highly competitive field. It is important to effect positive changes in as little time as possible and to get the musician involved in his treatment. Our patient experienced an immediate decrease in symptoms following changes in posture and was therefore more willing to follow through with treatment. Treatment must not impose upon the musician's already busy schedule. Thus, posture and movement retraining was integrated into daily functional activities. In addition, we attempted to insert his home program into time already set aside for practice. This was unsuccessful because he was not comfortable exercising in his practice space. The assumption that neuromuscular reeducation of posture and movement habits would result in improved strength of upper quadrant musculature proved to be correct. Several researchers including Janda, Kendall and McCreary, Sherrington, and Sahrmann profess that poor bony alignment creates muscular imbalances that adversely affect muscle strength.[3] Involvement in a conditioning program that included aerobic exercise appeared to be most helpful in decreasing the patient's muscular tension and breathing problems. During his 6-month follow up, the patient admitted that he was not as consistent with his exercise program. He reported increased muscle tension and increased dependency on his Albuterol inhaler. Treatment was effective in that the musician was able to return to his desired level of practice and performance on the saxophone and the piano. In addition he now has the knowledge and skills to control his symptoms and improve his physical well-being. Long-term follow though is in his hands.

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(continued on page 18)

wishing to care for this population. Training a dance science educator is a different matter. According to The National Association of Schools of Dance (NASD) standards, which is the accrediting body for dance programs in higher education in the United States of America, institutions of higher learning are not required but should consider anatomy and kinesiology course work important for undergraduate dance majors. The NASD does not mention it for graduate-level dance students in practice or research-oriented degree programs.[5] Individual graduate programs may choose to require course work in dance science or not. These graduate degree programs include: Masters of Fine Arts, Masters of Arts, Masters of Arts or Masters of Science in dance education or dance therapy, Specialist in Education, Masters of Arts in Dance History, Philosophy, Criticism, or Doctor of Philosophy in the Field of Dance Scholarship or Education.[5] In addition, only 3 universities offer graduate degrees in dance science or kinesiology. Although, a large percentage of masters and doctoral students in dance will seek and subsequently achieve full-time faculty appointments that require instructional skills in multiple areas of dance academics including dance science.

Cardinal and Hilsendager suggested each college or university dance program hire a full-time dance scientist.[6] Unfortunately, dance programs in higher education simply may not be able to train an adequate number of dance students qualified to teach performance enhancement through an understanding of anatomy and kinesiology. Compounding this picture, dance programs often cannot justify a salary line for a full-time dedicated dance scientist. Lack of educator training and resources for dance scientists obstructs the integration of dance science and dance training. Physical therapists can provide a useful public service by offering to teach dance kinesiology in institutions of higher learning as an adjunct faculty member.

RESEARCH

Research publications in dance medicine are directed at the scientific audience. While it is important that physicians, physical therapists, and other scientists can share scientific advances, often the dancer is able to gain new information only through happenstance. For example, if the dancer happens to have contact with a physical therapist they may gain information that leads to new insights. These will most likely be injury or issue specific rather than a broad understanding.

Articles generated on methods to improve dancer skill and the long-term benefits of dancing are of use to the dancing public at large. These articles are uncommon and often published in scientific journals that dancers may never see. One suggestion might be simultaneous publication of an article summary, comprehensible to the lay public, in popular magazines that dancers read.

SUMMARY

Physical therapists that educate dancers need to market the benefits of dance science in their geographical area and nationwide. The tone and language used with dancers should be positive. The psychological well-being of the dancer/athlete being should be considered. To introduce dancers to a variety of injuries is not fruitful and may not lead to long-term interest. Positive reinforcement and the promise of improved performance may yield greater results.

These approaches would sell the benefits of dance medicine and generate the dancer's own quest to learn and incorporate scientific advances. More dancers would be reached and information shared would serve to elevate dance science appreciation within the dance community.

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Saxophone Player *(continued from page 13)*

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