PASIG MONTHLY CITATION BLAST: No.19 **April 2007**

Dear PASIG members:

Although it seems like we just returned from CSM 2007 in Boston (and what intrepid folks we all were to get there through the snow and travel disasters), it's already time to start submitting abstracts for next year's conference. CSM 2008 will be held on Feb 6 – 10 in Nashville, TN. Abstract submissions opened on March 22, 2007 and will close on June 15, 2007 at 11:59 PM EST. Go to http://www.apta.org/csm for more information and to connect to Scholar One Abstract Central for electronic submission.

Don't forget, the PASIG sponsors an annual student research scholarship. This award is to recognize students, who have had an abstract accepted to CSM, for their contribution to performing arts medicine and research. We encourage you to mentor your students in PA-related research and have them apply! If the PASIG Research Committee can assist students, please contact us. For more information on the research award please check our webpage (www.orthopt.org/sig_pa.php). And clinicians, if you accept students for a performing arts clinical affiliation, please contact me so that we can update our webpage. The PASIG is an important clearinghouse for this information.

The PASIG Nominating Committee requests your nominations for PASIG officers. These include president, treasurer and nominating committee member. You may nominate yourself or another PASIG member. Here's a chance for you to contribute to the ongoing growth and success of our group by running for office in 2007. Nominations are due by 5.31.07. Contact Stephania Bell PT, Nominating Committee Chair at StephaniaB@comcast.net for more information.

I'd like to share with our members an update on the Dance/USA Medical Task Force's work on the *Annual Post-Hire Health Screen for Professional Dancers*. Three dance companies (Alvin Ailey, Boston Ballet, and Pittsburgh Ballet Theatre) piloted the Screen in summer 2006. The Screen required approximately 45 min per dancer from start to

finish, including time to administer it and privately discuss the results with each dancer. Each company reported nearly 100% dancer participation, and each received favorable feedback from the dancers as to the usefulness of the information. This is an exciting next step in providing a new standard of health care to dancers.

The Dance/USA Task Force met again in March in NYC to revise and streamline the *Screen* based on the feedback from the pilot groups. It is anticipated that the revised *Screen* should take only 30 min. In addition to the initial pilot companies, 10 additional companies have expressed interest in using the Screen in 2007-2008. In addition to the Taskforce Chair, Richard Gibbs MD, PASIG members have been the backbone of this work. Particular thanks go to Heather Southwick PT and Micky Cassella PT who put all the taskforce suggestions together into a coherent screening document.

Plans for PASIG Citation Blasts in 2007 include more special interest topics. Our topic this month is *Thoracic Outlet Syndrome*, contributed by former PASIG President, Jeff Stenback PT, OCS. The format is an annotated bibliography of articles on the selected topic from 1996 – 2006. Each month's citations will be added to EndNote libraries available on the PASIG webpage for our members to access and download. (Information about EndNote referencing software can be found at http://www.endnote.com, including a 30-day free trial). If you'd like to suggest a topic or create one, please let me know. As always, your comments and entry contributions to these Citation Blasts are always welcome. Please drop me an e-mail anytime.

Regards,
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Thoracic Outlet Syndrome

Thoracic Outlet Syndrome is a term used to describe several syndromes and overlapping conditions that are described with varying degrees of specificity in the literature. The performing artist can develop various cervical and upper quarter dysfunction from overuse, poor technique, concomitant injury, or medical involvement. I asked myself the questions, "Where would I look for literature on the various presentations of thoracic outlet syndrome and related syndromes? Would I be able to identify various presentations of this syndrome? What are differential diagnoses?" Many of the more seminal descriptions in the literature go back a few years or appear in foreign languages. Others refer more to sports-related injuries, but the association with activities that affect the upper quarter is still applicable here. In this citation blast, I have tried to compile articles that focus more on recognition of these conditions/related syndromes and non-surgical approach(es) with regards to treatment since we obviously hope to avoid a surgical outcome in our performing artists. That being said, the EndNotes program that accompanies this citation blast on the PASIG website also

includes some surgical references for those that may want a starting point with cases where an operative approach was employed.

Jeff Stenback, PT, OCS

Atasoy E (2004). Thoracic outlet syndrome: anatomy. Hand Clin **20**(1): 7-14, v.

The thoracic outlet region contains three important structures: the brachial plexus, the subclavian artery, and the subclavian vein. As they travel from the upper mediastinum to the upper extremity, these structures run through three important spaces: the interscalene triangle, the costoclavicular space, and the subpectoral space. Compression can occur in any of these three spaces because of structural anomalies or trauma.

Berthe A (2000). [Considerations on rehabilitation of cervicothoracobrachial outlet syndrome]. Chir Main **19**(4): 218-22.

The conservative treatment of the thoracic outlet syndrome (TOS) as proposed by Peet in 1956 prevailed a long time and still remains, for many physiotherapists, the technique of reference. However, during these last 20 years, many authors have published improvements to this technique. The Walsh program, published in 1996, is advantageous on the one hand because it utilizes all the evaluation data, and on the other hand, it separates compressive TOS from entrapment TOS, with the latter limiting plexus mobility in proportion to extraneural and/or intraneural fibrosis. The treatment program includes three stages. The goal of the first stage is to control symptomatology and to obtain comfort. The second stage concerns more directly the pathological tissues: musculoskeletal surroundings for compressive components and mobilization of the nervous system according to Butler, Totten and Hunter protocols for entrapment components. The third stage aims to condition and strengthen the postural muscles. A home rehabilitation program is also addressed. The patient's ability to tolerate daily living and professional activities depends on the pursuit of the home program in accordance with evolution.

Corwin HM (2006). Compression neuropathies of the upper extremity. Clin Occup Environ Med **5**(2): 333-52, viii.

Nerve compression syndromes of the upper extremity occur at predicable locations. The diagnosis of nerve compression or nerve entrapment is based on the neurologic and electrodiagnostic examinations. The anatomy, neurophysiology, and electrodiagnosis of nerve compression are discussed. Common and uncommon compression and entrapment syndromes of the upper extremity are described. Errors in diagnosis occur when the neurologic or electrodiagnostic examinations are incomplete or inaccurate.

Crosby CA, Wehbe MA (2004). Conservative treatment for thoracic outlet syndrome. Hand Clin **20**(1): 43-9, vi.

Conservative treatment of thoracic outlet syndrome consists initially of pain control and medicinal and physical measures. Therapy then addresses tight muscles, with strengthening of weakened neck and shoulder girdle muscles. Range of motion and nerve gliding exercises are instituted simultaneously, and the patient is educated in proper posture and ergonomics at home and in the work setting.

DeFranca GG, Levine LJ (1995). The T4 syndrome. J Manipulative Physiol Ther **18**(1): 34-7.
OBJECTIVE: To discuss two cases of the T4 syndrome in order to raise awareness and aid its clinical recognition. CLINICAL FEATURES: Paresthesias, numbness, or upper extremity pains associated with or without headaches and upper back stiffness characterize the T4 syndrome. In addition, no hard neurological signs are present. Upper thoracic joint dysfunction, especially in the region of the T4 segment, appeared to be the major cause of the upper extremity symptoms and headaches. A nontraumatic onset is common and the peculiar glove-like distribution of hand or forearm pain can often lead to a mistaken diagnosis, including psychogenesis. INTERVENTION AND OUTCOME: Joint manipulation, stretching, and strengthening exercises directed at the upper thoracic dysfunctional segments were used with good results. CONCLUSION: Upper extremity symptoms of nocturnal or early morning paresthesias, especially in a glove-like distribution, coupled with headaches and a stiff upper thoracic spine without neurological signs of disease may indicate a T4 syndrome. Manipulation of the dysfunctional upper thoracic segments may relieve these symptoms.

Dugas JR, Weiland AJ (2000). Vascular pathology in the throwing athlete. Hand Clin **16**(3): 477-85, x.
Vascular pathology in the upper extremity of a throwing athlete comprises a spectrum of serious disorders apt to threaten the patient's career and the viability of the involved parts. Such pathology includes digital vessel thrombosis, proximal thrombosis with distal embolization, vessel aneurysm, and vessel compression, such as in thoracic outlet syndrome and quadrilateral space syndrome. This article provides a description of vascular disorders prone to result from sports activities and a review of published data relevant to throwing athletes. Recognition of vascular compromise as a cause for dead arm syndrome or painful digital dysfunction among athletes is essential to prevent the grave consequences of progressive ischemia.

Green RM (1998). Vascular manifestations of the thoracic outlet syndrome. Semin Vasc Surg **11**(2): 67-76.
The thoracic outlet syndrome describes a variety of conditions caused by compression of one or a combination of neurovascular structures traversing the thoracic outlet. Although some believe that the neurological syndrome is overdiagnosed, the vascular syndromes each have characteristic symptoms, physical findings, definitive diagnostic tests, and a low incidence.

Hoppmann RA (2001). Instrumental musicians' hazards. Occup Med **16**(4): 619-31, iv-v.
In the last two decades, injuries to instrumental musicians have been well documented. Major categories of performance-related injuries include musculoskeletal overuse, nerve entrapment/thoracic outlet syndrome, and focal dystonia. Other areas of concern to instrumentalists include hypermobility, osteoarthritis, fibromyalgia, and hearing loss. This chapter reviews the epidemiology, risk factors, physical exam, treatment, and prevention of common problems of instrumentalists. Emphasis is placed on the team approach of treatment and prevention and the need for close collaboration of the various health professionals, music educators, and performers. Additional resources are presented for those interested in pursuing performing arts medicine in greater detail.

Huang JH, Zager EL (2004). Thoracic outlet syndrome. Neurosurgery **55**(4): 897-902; discussion 902-3.
OBJECTIVE: Thoracic outlet syndrome (TOS) is one of the most controversial clinical entities in medicine. We provide a review of this difficult-to-treat disorder, including a

brief overview, clinical presentations, surgical anatomy, treatment options, and outcomes. METHODS: TOS represents a spectrum of disorders encompassing three related syndromes: compression of the brachial plexus (neurogenic TOS), compression of the subclavian artery or vein (vascular TOS), and the nonspecific or disputed type of TOS. Neurovascular compression may be observed most commonly in the interscalene triangle, but it also has been described in the costoclavicular space and in the subcoracoid space. Patients present with symptoms and signs of arterial insufficiency, venous obstruction, painless wasting of intrinsic hand muscles, paresthesia, and pain. A careful and detailed medical history and physical examination are the most important diagnostic tools for proper identification of TOS. Electromyography, nerve conduction studies, and imaging of the cervical spine and the chest also can provide helpful information regarding diagnosis. Clinical management usually starts with conservative treatment including exercise programs and physical therapy; when these therapies fail, patients are considered for surgery. Two of the most commonly used surgical approaches are the supraclavicular exposure and the transaxillary approach with first rib resection. On occasion, these approaches may be combined or, alternatively, posterior subscapular exposure may be used in selected patients. CONCLUSION: TOS is perhaps the most difficult entrapment neuropathy encountered by neurosurgeons. Surgical intervention is indicated for vascular and true neurogenic TOS and for some patients with the common or nonspecific type of TOS in whom nonoperative therapies fail. With careful patient selection, operative intervention usually yields satisfactory results.

Lindgren KA (1997). [TOS (thoracic outlet syndrome)--a challenge to conservative treatment]. Nord Med **112**(8): 283-7.

Functional impairment and pain in the upper extremities may indicate a functional deficit in the thoracic outlet. Static work posture, trauma and whiplash injury may be predisposing factors. The younger generation who often spend long hours in front of a computer are in danger of becoming a future risk group. The primary care physician should be familiar with the syndrome which can be identified by careful clinical examination. Timely intervention can prevent much of the disabling symptomatology. Treatment is primarily conservative and should be aimed at the restoration of functional capacity. As in other disorders, the individual constellation of symptoms is dependent on circumstantial factors, an aspect meriting particular attention in treatment and follow-up. Optimisation of ergonomic conditions is important feature of treatment, and long-term follow-up is necessary. Transient exacerbation is not an indication for surgical treatment. If cervical and thoracic outlet function has normalised but the patient still has symptoms, then the differential diagnosis should be reconsidered. Examination and treatment of patients with pain in the upper extremities requires the collaboration of the physician and physical and occupational therapists. Treatment can be delivered in the primary care setting.

Lindgren KA (1997). Conservative treatment of thoracic outlet syndrome: a 2-year follow-up. Arch Phys Med Rehabil **78**(4): 373-8.

OBJECTIVE: To evaluate a conservative therapy program that aims to restore normal function to the upper thoracic aperture in patients with thoracic outlet syndrome (TOS). DESIGN: A descriptive study of consecutive patients with a positive TOS index seen from 1988 to 1993. After therapy, the patients were followed for a mean period of 24.6 months. SETTING: Therapy was initiated primarily in an inpatient rehabilitation ward over an 11.4-day (range 4-24 days) stay. PATIENTS: One hundred nineteen patients (28 men and 91 women) with a positive TOS index participated. At admission, 50% of the

patients were employed, 48% were on sick leave or retired, and 2% were unemployed. INTERVENTIONS: The patients received instructions on how to restore the normal function of their cervical spine and upper thoracic aperture by means of home exercises. MAIN OUTCOME MEASURES: The efficacy of the treatment program was assessed by the frequency of return to work, normalization of the motion of the cervical spine and upper thoracic aperture, and subjective satisfaction with the outcome. RESULTS: At the follow-up examination, 88% of the patients were satisfied with the outcome of their treatment, and the ranges of motion of the cervical spine and upper thoracic aperture had normalized in 8 of 10 patients. Seventy-three percent of the patients returned to work after the therapy, either directly or after retraining, and 88% of the patients carried through the recommendations given at discharge during long-term follow-up. Normalized grip strength and Tinel's sign predicted patient satisfaction ($p < .001$) and return to work ($p < .001$). Return to work was more often successful if the work was sedentary rather than heavy ($p < .05$). CONCLUSIONS: The treatment program provides relief to most patients with symptoms of TOS. If the symptoms are not relieved, the differential diagnosis should be reviewed. Conservative therapy with the aim of restoring the function of the upper thoracic aperture is to be recommended, and long-term follow-up is advisable.

McGillicuddy JE (2004). Cervical radiculopathy, entrapment neuropathy, and thoracic outlet syndrome: how to differentiate? Invited submission from the Joint Section Meeting on Disorders of the Spine and Peripheral Nerves, March 2004. J Neurosurg Spine **1**(2): 179-87.

The common diagnoses of cervical radiculopathy and upper-extremity entrapment neuropathies can at times be difficult to differentiate. Additionally, thoracic outlet syndrome is often diagnosed when, in fact, the problem is radiculopathy or neuropathy. Another source of confusion, especially in older patients, is neuralgic amyotrophy, brachial plexitis, or the Parsonage-Turner syndrome. The differential diagnosis of unilateral arm pain, weakness, and/or sensory loss includes all of these problems. The clinical and electrodiagnostic features of each are discussed as an aid to distinguishing between these common and similar entities.

Nakatsuchi Y, Saitoh S, et al. (1995). Conservative treatment of thoracic outlet syndrome using an orthosis. J Hand Surg [Br] **20**(1): 34-9.

We describe a strapping device for elevation of the shoulder in patients with thoracic outlet syndrome (TOS). The device was used by 86 patients with TOS whose symptoms had been alleviated by passively raising the shoulder. Symptoms of TOS were classified as proximal, including pain in the shoulder girdle, and distal, in which there were neurological deficits related to the brachial plexus. The device was more effective in patients with distal symptoms: pain disappeared or improved in 67% of patients; numbness in 85%; sensory disturbance in 84%; and motor disturbance in 80%. However, proximal symptoms were relieved in only 65% of the patients. The ability to perform activities of daily living was rated as excellent in 33% of patients, good in 44%, fair in 12%, and poor in 9%. The shoulder orthosis described in this report can counterbalance downward traction on the brachial plexus and reduce the tension on it, thereby relieving symptoms of TOS.

Narakas AO (1990). The role of thoracic outlet syndrome in the double crush syndrome. Ann Chir Main Memb Super **9**(5): 331-40.

The association between thoracic outlet syndrome (TOS) and carpal tunnel syndrome (CTS) (40 cases), ulnar neuropathy (UN) (19 cases) and radial tunnel syndrome (29 cases) is investigated. The possibility of a double crush syndrome is considered with

reference to the difficulties in diagnosis. It is demonstrated that in approximately half of all cases the proximal neuropathy precedes the distal one. Despite the fact that surgical treatment of the thoracic outlet syndrome appears to improve the distal neuropathy it is still difficult to decide, in a given case, which decompression takes priority with the exception of carpal tunnel release which is generally to be performed first. The historical background and theoretical basis of the management of double crush syndrome is outlined and arguments for and against the association of the various neuropathies are presented.

Nichols AW (1996). The thoracic outlet syndrome in athletes. J Am Board Fam Pract **9**(5): 346-55.

BACKGROUND: The array of symptoms that characterize thoracic outlet syndrome (TOS) often lead to a failure or delay in diagnosing this condition in persons who are physically active. METHODS: Using the key words and phrases "thoracic outlet syndrome," "sport," "exercise," and "athlete," the MEDLINE files from 1991 to April 1996 were searched. Articles dating before 1991 were accessed by cross-referencing the more recent articles. RESULTS and CONCLUSIONS: TOS results from compression of the neural or vascular structures of the upper extremity at the thoracic outlet. Clinical manifestations can include upper extremity pain, paresthesias, numbness, weakness, fatigability, swelling, discoloration, and Raynaud phenomenon. Four symptom patterns have been described: upper plexus, lower plexus, vascular, and mixed. The lower brachial plexus pattern is the most common. Specific causes of outlet compression include injury to the scalene or scapular suspensory muscles, anomalous fibromuscular bands, cervical ribs, clavicular deformity, and pectoralis minor tendon hypertrophy. The diagnosis of TOS is established on the results of the history and physical examination. Ancillary studies are most helpful to rule out other conditions rather than confirm the diagnosis of TOS. In most cases the initial treatment is nonoperative with an emphasis on rehabilitative exercises for the neck and shoulder girdle. Surgery is indicated for acute vascular insufficiency, progressive neurologic dysfunction, and refractory pain that fails conservative treatment. The surgical technique involves the release or removal of the structures that cause compression and can involve scalene muscle release, first rib resection, cervical rib excision, and resection of fibromuscular bands.

Palmer JB, Uematsu S, et al. (1991). A cellist with arm pain: thermal asymmetry in scalenus anticus syndrome. Arch Phys Med Rehabil **72**(3): 237-42.

We report on a cellist with pain and coldness of the upper extremity. Abnormal thermographic studies were instrumental in uncovering intermittent compression of the subclavian artery, and this prompted us to study the effects of cello playing on skin temperature asymmetry. Temperature asymmetry was defined as the temperature difference (delta-T) from one hand to the other. In 57 controls, mean delta-T at rest was .309 +/- .254C. Exercising the upper extremities by prolonged elbow flexion or by movements mimicking cello playing in controls did not significantly affect delta-T. In our patient, delta-T was ten times control (3.6C). Angiography showed extrinsic compression of the subclavian artery occurring only after cello playing; sympathetic ganglion block relieved the pain. Our patient's abnormal skin temperature may have reflected sympathetic vasomotor hyperactivity. Intermittent neurovascular compression and sympathetic hyperactivity appear to be factors in scalenus anticus syndrome.

Pascarelli EF, Hsu YP (2001). Understanding work-related upper extremity disorders: clinical findings in 485 computer users, musicians, and others. J Occup Rehabil **11**(1): 1-21.

Four hundred eighty five patients whose chief complaints were work related pain and other symptoms received a comprehensive upper-body clinical evaluation to determine the extent of their illness. The group had a mean age of 38.5 years. Sixty-three percent of patients were females. Seventy percent were computer users, 28% were musicians, and 2% were others engaged in repetitive work. The time between the onset of symptoms and our initial visit ranged from 2 weeks to over 17 years. A majority sought care within 30 months with the greatest number of them seeking care before 12 months. Fifty nine percent of subjects were still working when seen despite increasing pain and symptoms such as weakness, numbness, tingling, and stiffness. Following a history, a physical assessment utilizing commonly employed clinical tests were performed including evaluation of joint range of motion, hyperlaxity, muscle tenderness, pain, strength, and imbalance. Neurologic tests included Tinel's sign performed in wrist, elbow, tricipital sulcus, and neck and tests for thoracic out syndrome (TOS). Specific tests such as Finkelstein's test for deQuervain's tenosynovitis, Phalen's test for carpal tunnel syndrome and grip strengths were included in the examination protocol. Significant findings included postural misalignment with protracted shoulders (78%), head forward position (71%), neurogenic TOS (70%), cervical radiculopathy (0.03%), evidence of sympathetic dysfunction (20%), and complex regional pain syndrome (RSD) (0.6%). Hyperlaxity of fingers and elbows was found in over 50%, carpal tunnel syndrome in 8%, radial tunnel syndrome in 7%, cubital tunnel in 64%, shoulder impingement in 13%, medial epicondylitis in 60%, lateral epicondylitis in 33%, and peripheral muscle weakness in 70%. We conclude that despite initial presentation distally, work-related upper-extremity disorders are a diffuse neuromuscular illness with significant proximal upper-body findings that affect distal function. While neurogenic TOS remains a controversial diagnosis, the substantial number of patients with positive clinical findings in this study lends weight to the concept that posture related neurogenic TOS is a key factor in the cascading series of physical events that characterize this illness. A comprehensive upper-body examination produces findings that cannot be obtained through laboratory tests and surveys alone and lays the ground work for generating hypotheses about the etiology of work related upper-extremity disorders that can be tested in controlled investigations.

Safran MR (2004). Nerve injury about the shoulder in athletes, Part 2: Long thoracic nerve, spinal accessory nerve, burners/stingers, thoracic outlet syndrome. Am J Sports Med **32**(4): 1063-76.

Nerve injuries about the shoulder in athletes are being recognized with increasing frequency. Prompt and correct diagnosis of these injuries is important to treat the patient and to understand the potential complications and natural history, so as to counsel our athletes appropriately. This 2-part article is a review and an overview of the current state of knowledge regarding some of the more common nerve injuries seen about the shoulder in athletes, including long thoracic nerve, spinal accessory nerve, burners and stingers, and thoracic outlet syndrome. Each of these clinical entities will be discussed independently, reviewing the anatomy, mechanism of injury, patient presentation (history and examination), the role of additional diagnostic studies, differential diagnosis, and management.

Schwartzman RJ (1991). Brachial plexus traction injuries. Hand Clin **7**(3): 547-56.

Brachial plexus traction injuries most frequently occur following acute flexion or extension of the neck. The symptomatology following this injury may be defined clearly into the anatomic patterns of upper trunk, lower trunk, posterior cord, medial cord, and lateral cord radiations. This injury is the most common cause of the neurogenic form of

thoracic outlet syndrome and is frequently seen in conjunction with cervical spine disease as well as peripheral entrapment syndromes of the ulnar, radial, and medial nerves.

Toth C, McNeil S, et al. (2005). Peripheral nervous system injuries in sport and recreation: a systematic review. Sports Med **35**(8): 717-38.

Many sports are associated with a variety of peripheral nervous system (PNS) injuries specific to that sport. A systematic review of sport-specific PNS injuries has not been attempted previously, and will assist in the understanding of morbidities and mortality associated with particular sporting activities, either professional or amateur. A systematic review of the literature using PubMed (1965-2003) was performed examining all known sports and a range of possible PNS injuries attributable to that sport. Numerous sporting activities (53) were found to have associated PNS injuries. The sports most commonly reported with injuries were football, hockey, soccer, baseball and winter activities. There are a number of sporting activities with injuries unique to the individual sport. This review should be of assistance for the neurologist, neurosurgeon, orthopaedic surgeon, physiatrist, sports medicine doctor, athletic trainer and general physician in contact with athletes possessing neurological injuries.

Wehbe MA, Schlegel JM (2004). Nerve gliding exercises for thoracic outlet syndrome. Hand Clin **20**(1): 51-5, vi.

Nerve gliding exercises (NGE) are an important part of the treatment of thoracic outlet syndrome (TOS), whether conservative or surgical. They also can be useful for other peripheral nerve problems.

Wishchuk JR, Dougherty CR (2004). Therapy after thoracic outlet release. Hand Clin **20**(1): 87-90, vii.

The authors believe that early motion after thoracic outlet syndrome surgery helps minimize scarring and enhances the healing process. This article describes the authors' protocol of treatment at the various stages of the postoperative period.