[Orthopaedic Surgery]

Predicting Chronic Stinger Syndrome Using the Mean Subaxial Space Available for the Cord Index

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A 21-year-old division I collegiate football player who had a history of several stingers presented with 5 days of persistent left neck and shoulder pain associated with paresthesias and upper extremity weakness. His symptoms began immediately during a game when he was struck on the right side of his helmet, which induced a compression-extension mechanism of injury to his neck. Clinical and electrodiagnostic evaluation was consistent with a left C5 radiculopathy, but magnetic resonance imaging of the cervical spine yielded normal results. The mean subaxial cervical space available for the cord (MSCSAC) index is a novel tool to predict chronic stinger syndrome. It is calculated by subtracting the sagittal diameter of the spinal cord from the disc-level sagittal diameter of the spinal canal at levels C3 through C6 and then averaging these values. A cutoff of < 4.3 mm has been shown to predict a greater-than-13-fold increase in risk of developing chronic stinger syndrome. This patient had a MSCSAC index of 3.2 mm, which correlated with his history of multiple stingers. The MSCSAC index may be a useful tool to help counsel athletes on the risk of developing future stingers, although more extensive research on this measurement tool is indicated.

Keywords: stinger, burner, radiculopathy, cervical spondylosis

A 21-year-old right-hand-dominant starting center for a division I collegiate football team presented to an outpatient physical medicine and rehabilitation clinic with a stinger. The patient's past medical history was significant for multiple stingers throughout his playing career. He complained of 5 days of persistent left-sided neck and shoulder pain associated with upper extremity paresthesias and weakness with overhead activities. His symptoms began immediately during a game when he was struck on the right side of his helmet, which induced a compression-extension mechanism of injury to his neck. His team physicians diagnosed the stinger and treated him conservatively, but his symptoms persisted.

On physical examination, he had full active and passive cervical spine range of motion in all planes. Spurling's maneuver[15] to the left reproduced his arm paresthesias. Strength testing of the left shoulder abductors, external rotators, and elbow flexors were 4/5. Sensation to light touch and pinprick revealed deficits in the left C5 dermatome. All other upper extremity myotomes and dermatomes were intact. The left biceps reflex was slightly diminished compared with the right side. There were no upper motor neuron signs, and his gait pattern was symmetric with a narrow base of support. No radiographs were performed, but magnetic resonance imaging (MRI) of the cervical spine showed a small left paracentral disc protrusion at C7-T1 without significant central neural foraminal narrowing (Figure 1). There were no significant degenerative changes or cord signal abnormalities. On postinjury day 10, he underwent electrodiagnostic evaluation, which revealed 1+ fibrillation potentials in the left deltoid, infraspinatus, rhomboids, and cervical paraspinal muscles. There was also decreased motor unit recruitment of the deltoid and infraspinatus muscles. He was diagnosed as an acute mild C5/C6 radiculopathy. Treatment course included rest, Medrol dose pack taper (day 1, 24 mg; day 2, 20 mg; day 3, 16 mg; day 4, 12 mg; day 5, 8 mg; day 6, 4 mg), physical therapy, and modalities.

DISCUSSION

A stinger, or burner, is a transient reversible peripheral nerve injury of the upper extremity caused by trauma to the cervical spine and shoulder; the classic injury occurs with football tackling.[2,7,13] A study of collegiate American football players shows that stingers occur in 50% to 65% of these athletes over the course of their careers, with relatively high recurrence

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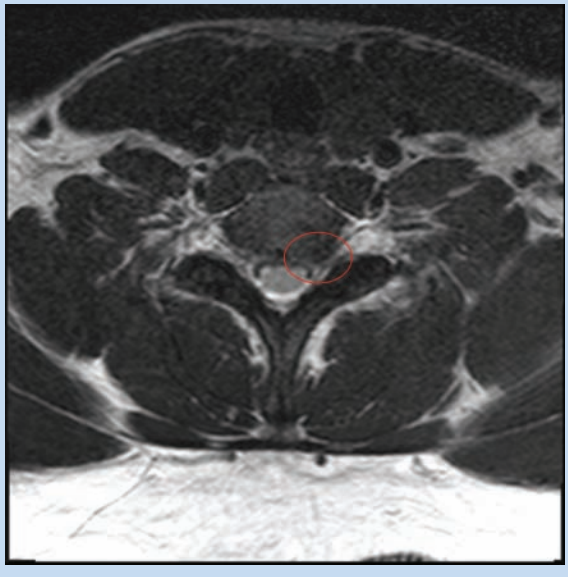

Figure 1. MRI of the cervical spine C7-T1 level showing small left paracentral disc protrusion (circle) without significant central or neural foraminal narrowing.

Figure 2. Lateral cervical radiograph used for calculation of Torg ratio (A/B).

rates.[8] The primary symptom, which begins immediately after contact, is burning pain radiating down an upper extremity in a circumferential rather than dermatomal distribution.[4] Other symptoms include weakness, numbness, and paresthesias.[6,12] A range of clinical courses have been described following a stinger injury, although pain lasting more than 24 hours is generally uncommon.[13]

Recent literature has focused on distinguishing acute one-time stingers from chronic stinger syndrome (> 24 hours).[12] The acute disorder occurs because of transient foraminal narrowing or brachial plexus stretch injury.[1] The chronic syndrome occurs from degenerative spondylotic changes in the cervical spine.[12] The latter is defined as a chronic or recurrent neurapraxia and/or axonotmesis of a cervical root associated with prolonged weakness, necessitating time loss from sports. Levitz et al[8] reported that 93% of athletes that developed chronic stinger syndrome had evidence of disc disease or foraminal narrowing due to degenerative changes.[8] These spondylotic changes are the result of repetitive microtrauma to the head and neck region due to participation in contact sports.[5,9] It should be emphasized that despite degenerative changes causing foraminal narrowing, a stinger is a peripheral nerve injury.

Predicting the development of chronic stinger syndrome was originally based on the Torg ratio,[11,16,17] which assesses cervical spinal canal stenosis. However, subsequent studies have demonstrated that this ratio has a high sensitivity but poor positive predictive value in predicting neurologic symptoms.[5,10] The Torg ratio is calculated with a lateral cervical radiograph—specifically, the measurement of the shortest distance from the midpoint between the superior and inferior endplates of the posterior aspect of the vertebral body to the nearest point on the corresponding spinolaminar line (Figure 2A), divided by the anteroposterior diameter at the midpoint between the superior and inferior endplates of the vertebral body (Figure 2B). The Torg ratio is the smallest individual value through the subaxial cervical spine. However, lateral radiographs cannot detect soft tissue changes important in the underlying pathogenesis in chronic stinger syndrome, which may explain the poor predictive values previously described in the literature.[3,11,16-18]

A novel tool to predicting the development of chronic stinger syndrome is the mean subaxial cervical space available for the cord (MSCSAC) index,[12] which is calculated with the midsagittal view on cervical MRI—specifically, subtracting the sagittal diameter of the spinal cord from the disc-level sagittal diameter of the spinal canal at the levels C3 through C6 and then averaging these values (Figure 3 and Table 1). Presciutti et al[12] obtained MRI and cervical spine radiographs of 103 athletes participating in the National Football League Scouting Combine and 43 age-matched nonathlete controls. Torg and MSCSAC values were calculated at cervical levels C3 through C6 and then averaged for each participant to produce mean subaxial cervical Torg ratios and MSCSAC composite indexes. There was a statistically significant difference in MSCSAC values between athletes with and without chronic stingers and between athletes and controls. A critical value of ≤ 5.0 mm for the MSCSAC achieved the best results as a screening test, with a sensitivity of 80%. In National Football League athletes, a cutoff of < 4.3 mm predicts a greater-than-13-fold increased risk of developing chronic stinger syndrome, with a specificity of 96%.[12]

In this player, the MSCSAC index was 3.2 mm, which correlated with his history of multiple stingers and his prolonged clinical course. The patient was cleared to "play as tolerated" by the team physician 10 days after his injury,

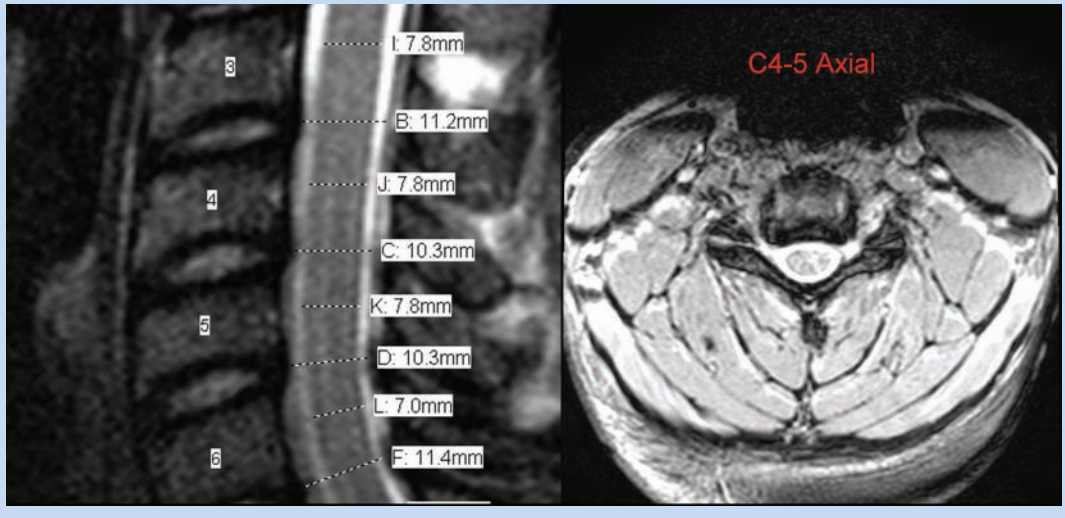

Figure 3. Left, midsagittal view on cervical MRI used to calculate mean subaxial cervical space available for the cord (MSCSAC) index; right, axial view on cervical MRI at C4-5 level demonstrating lack of focal disc pathology or nerve root impingement.

Table 1. Calculation of mean subaxial space available for the cord index.

	Diameter, mm		
Level	Canal	Cord	Difference, Δ
C3	11.2	7.8	3.4
C4	10.3	7.8	2.5
C5	10.3	7.8	2.5
C6	11.4	7.0	4.4
Average			3.2

and he participated in full competition 4 days later. He was counseled on the increased risk of chronic stingers because of his MSCSAC index and educated on mechanisms of injury, including traction, compression, and direct blows. Before this injury, he wore a "cowboy collar,"[14] a plastic collar to prevent cervical hyperextension, and he resumed wearing this in practice and competition. He continued isometric cervical stabilization exercises taught by the athletic training staff. During a 2-week follow-up, the patient reported a return to his preinjury level of play, with near 100% improvement in pain, weakness, and cervical range of motion in all planes. Fourteen months after this stinger, he reported 8 subsequent stingers, none lasting longer than 24 hours.

The MSCSAC index has not been studied in collegiate athletes. Normal MSCSAC indexes are not known in nonprofessional football players and other types of athletes prone to stingers. MSCSAC index limitations include the need for MRI and susceptibility to confounding factors, such as congenital spinal stenosis, multilevel asymptomatic cervical degenerative disk disease, disc herniation, and foraminal disc osteophyte without central spondylosis.

CONCLUSION

A stinger is a common injury in contact sport athletes, especially football players. While most stingers resolve quickly, chronic stinger syndrome can delay an athlete's quick and safe return to competition. The MSCSAC index is a novel tool that may predict the development of prolonged or chronic stinger syndrome. The MSCSAC index may be useful to counsel athletes on the risk of developing future stingers.

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