



Craniovertebral Junction and Cervical Spine Injuries Associated with some YOGA Asanas: Two Case Reports and Literature Review

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DOI: 10.31080/ASNE.2024.07.0714

Received: January 11, 2024

Published: February 19, 2024

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Abstract

Objective: The main purpose of our case reports and literature review is to make individuals aware about possible catastrophic events which may be associated with some particular Yoga asanas, which result too much straining on craniovertebral junction and cervical spine, particularly in individuals with congenital anomalies of craniovertebral junction and cervical spine as well as osteoporotic and degenerative weakness of this region.

Method: We presented our two case reports and literature review of case reports of compressive myelopathy and vascular accidents of this region associated with various Yoga asanas.

Results: Both of the patients in our case reports had Os odontoideum, one was taking steroid for bronchial asthma and they were practicing Sirsasana (Headstand) and Halasana (plow pose). In review of literature we found four cases of compressive myelopathy, two cases were associated with multilevel cervical spondylosis and other two cases were associated with osteoporosis. Three of these patients were practicing Sirsasana (Headstand) and one Halasana (plow pose). We also found three cases of vascular accidents at craniovertebral junction. Two cases related to vertebral artery and one related to basilar artery while practicing Setubandha (Bridge pose), Sarvangasana (Shoulder stand) and Sirsasana (Headstand) respectively.

Conclusion: Though yoga practices are considered safe and without harmful effects, some yoga asanas, resulting significant strain on craniovertebral junction and cervical spine, may land up individuals in catastrophic complications such as quadriplegia, stroke and respiratory paralysis with ventilator dependency. Individuals wishing to commence these asanas should have prior proper assessment osteoligamentous structures of this region to rule out underlying osteoporosis, any osseous pathology, congenital osseous malformations, basilar invagination, vascular malformations etc.

Keywords: Craniovertebral Junction; Cervical Spine; Sirsasana, Yoga

Introduction

Yoga has been in practice in ancient India since its inception around 5000 years ago as a discipline embracing principles of Asanas (body postures), Pranayama (controlled breathing exercises) and Dhyana (meditation). Its original aim is uniting body, mind and soul through physical, ethical and spiritual practices [1,2]. This practice is thought to bring physical and psychological well-being to its practitioners [3,4]. Because of increased awareness regarding physical and mental health, yoga practice has recently gained momentum in India and internationally. A survey conducted in 2008, estimates that about 15.8 millions (6.9%) people practicing yoga in America [5] and 30 millions people worldwide [6]. Yoga practice is relatively easy and cheap as compared to other physical activities because of widely available yoga classes and media programs.

Traditionally Yoga has often been considered safe without any harmful side effects. But recently this view has been changing because of appearance of some cases reports and meta-analysis articles regarding yoga associated injuries. Studies suggest that injuries associated with yoga are comparable to the other modes of exercise if not practiced under proper supervision and frequencies of these injuries increase with old age. There are no studies available till date revealing specific side effects associated with particular types of Asanas. Here in this article, we focus our attention on craniovertebral junction and cervical spine region, which are more vulnerable for injuries with some particular type of Asanas and may land up its practitioners with respiratory paralysis and quadriplegia and even death if not managed properly at time. Here we reported two cases of cervical spine injuries associated with Headstand (Sirsasana) and Plow pose (Halasana), along with review of literature regarding cervical spine and craniovertebral junction injuries associated with yoga.

Case Reports

Case 1

A 45 year old adult male, regular yoga practitioner for last 5 years, known case of bronchial asthma for last 10 years, while performing Sirsasana, she suddenly developed weakness bilateral upper and lower limbs without any sensory loss. On examination in emergency department, GCS was E4V5M6, key

muscles strength RUL4/5 LUL2/5 RLL5/5LLL5/5, deep tendon reflexes B/L UL1+ and B/L LL2+, decreased muscle tone in upper limbs as compared to lower limbs with grip strength right side80% and left side20%. Computed tomography scan and MRI of the cervical spine was done which depicted Os odontoideum with anterior and posterior ligamentous disruption with anterior Epidural hematoma and cord compression (Figure 1). Patient was operated in emergency with posterior decompression and Occipito-cervical fixation. Intra-operatively, posterior C1 arch was excised along with the inferior lip of foremen magnum to relieve the cord compression. Patient showed gradual improvement and had complete neurological improvement at 6 months follow up.

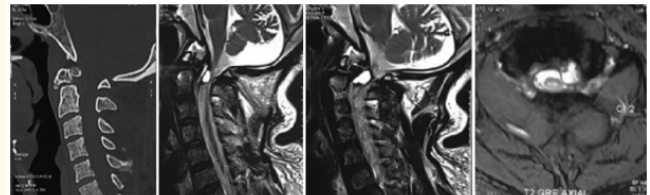


Figure 1: (a) Computed tomography cervical spine sagittal section showing Os odontoideum with anterolisthesis of C1 over C2 vertebrae. (b and c) Magnetic resonance imaging SAG T2 weighted image shows tectorial membrane disruption with anterolateral epidural hematoma with severe cord compression with T2 hyper intensity in posterior Atlanto occipital membrane and adjoining muscular plane suggestive of traction injury. (d) Magnetic resonance imaging T2 gradient recalled echo axial image shows compression at C1/C2 vertebral level with left anterolateral epidural hematoma.

Case 2

A 25 year old adult male student, practicing Halasana yoga for last 1 year, presented with sudden weakness of all four limbs while performing this asana. He narrated an event of sudden hyperrotation at the time of hyper-flexion stage in the asana. On examination in emergency department, power was RUL0/5, LUL3/5, RLL1/5 and LLL3/5, hand grip right side0% and left side50%, tone increased all four limbs, deep tendon reflexes B/L UL and LL3+ and B/L planters extensor. On radiological investigations, patient was

found to have Atlanto-axial Dislocation (AAD) with Congenital Os Odontoideum with Spinal cord injury with Myelomalacia at CVJ (Figure 2). Patient immediately underwent Excision of C1 posterior arch with C1 Lateral mass and C2 Pars Screw and rod fixation with Fusion of C1/C2 joints with autologous bone graft. Postoperative period was uneventful. Patient gradually recovered from paresis. On discharge, power was RUL1/5, LUL4+/5, RLL4-/5 and LLL4+/5, handgrip Right side 10% and Left side 80% and fully continent. He was planning to rejoin his college soon.

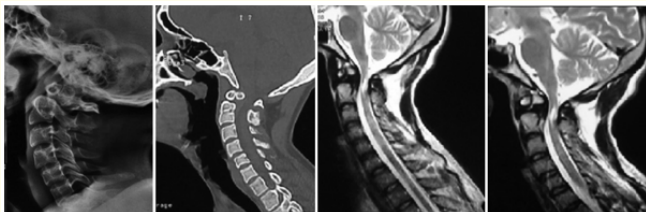


Figure 2: (a) Lateral Cervical spine X ray shows Os odontoideum with posterior atlanto axial dislocation. (b) Computed tomography cervical spine sagittal section shows C1 arch and Os odontoideum displacement with significant canal compromise. (c and d) Magnetic resonance imaging T2 weighted image sagittal section depicts compression at craniovertebral junction along with T2 hyper intense changes in the spinal cord suggestive of cord contusions. Anterior arch of C1 with Os odontoideum are displaced posteriorly over a foreshortened axis vertebrae.

Yoga asanas associated with craniovertebral junction and cervical spine injuries

Some Yoga asanas may pose threat to our Craniovertebral junction and cervical spine if not practiced under proper guidance and precautions. Among them are Sirsasana (Headstand- supported and unsupported), Sarvangasana (Shoulderstand- supported and unsupported), Halasana (Plow pose) and Setubandha (bridge pose) (Figure 3). These asanas require supporting majority of body weight on neck, henceforth on cervical spine and craniovertebral junction, making them vulnerable to trauma, particularly in individuals with weak neck muscles or those with hidden or inapparent congenital malformations of craniovertebral junction and cervical spine as well as osteoporotic and degenerative conditions of this region.



Figure 3: Postoperative X rays (a) Case 1 – Occipito cervical fixation and (b) Case 2 – C1 lateral mass and C2 pars screw and rod fixation with fusion of C1/C2 joints with bone graft.

Discussion and review of literature

“A lover forsaken a new love may get, but a neck when once broken can never be set”. - William Walsh (1663-1708).

Craniovertebral junction and cervical spine is a transition zone in between the skull and rest of the spine. The portion of spinal cord in this region contains nervous connections for controlling respiratory system, cardiovascular system, autonomous nervous system, motor and sensory functions of upper and lower limbs as well as bowel and genitourinary sphincter control. In other words it serves as the only conduit to control rest of the body from the brain except few spinal level activities. Therefore any injuries to craniovertebral junction and cervical spine will have significant impact on body activities ranging from mild paresis to quadriplegia, stroke, incontinence and respiratory paralysis rendering the patient ventilator dependent for rest of the life. Craniovertebral junction is an osteoligamentous complex with unique anatomy comprising lack of intervertebral discs, atypical vertebrae and ligaments and atlanto-occipital articulations [7]. While this ligamentous complex of CVJ and cervical spine have crucial role in spinal stability of this region, the osseous trauma of cervical spine, particularly axis vertebrae, sometimes may result into catastrophic physiological consequences [8].

According to our traditional teachings, Yoga has been considered safe without any ill effects. Latest research suggests that if practiced under proper guidance, it improves muscular strength, flexibility, coordination, blood pressure, respiratory and cardiovascular functions. It also alleviates anxiety, depression and

stress by stimulating the release of endogenous opioids called endorphins, body's natural painkillers. But according to some latest case reports, like other sports activities and modes of exercise, yoga may result injuries and severe complications if not practiced under proper supervision. All the Asanas may not be suitable for individuals of all ages and a particular Asana may require some minimal physical fitness to perform it properly. The integrity of particular body structure, which is supposed to under strain in particular asana, should be properly assessed prior commencing it. Musculoskeletal injuries associated with yoga asanas may present as an acute insult, a prolonged repetitive strain or a combination of acute event superimposed on chronic strain. Anatomically the structures which are more vulnerable to injuries are fibrocartilage, tendons and myotendinous junctions [9].

The cervical spine and craniovertebral junction contain paired vertebral arteries which pierce dura nearby craniovertebral junction, course anteriorly around medulla to form basilar artery in front of the brain stem. The vertebral arteries as well as basilar artery are vulnerable to damage by yoga asanas involving manipulation of cervical spine and craniovertebral junction especially in cases with aberrant anatomy. The patients coming up with the complaints of occipital headaches following yoga practices, may have possibilities of basilar artery occlusion, vertebral artery dissection or occlusion. Vertebral artery dissection can occur at craniovertebral junction as a result of minor trauma to the neck in the form of twisting or torquing movement during yoga practice. These patients should undergo full neurological assessment including CT head and CT angiogram of brain to rule out these catastrophic events. A few available case reports of vascular accidents associated with some yoga postures mentioned below.

Nagler W [10] reported a case of 28 years old female doing Setubandha (Bridge pose), suffered from Left cerebellar infarction due to Left vertebral artery narrowing at C1-C2 level and after extensive rehabilitation only partial recovery after 2 years.

Hanus S., *et al.* [11] reported a case of 25 years old male doing Head hyper rotation and Sarvangasana (Shoulder stand) suffered from Left dorso-medullary syndrome after two hours of exercise due to occlusion of Left vertebral artery at C1-C2 level and only partial recovery after 2 month of rehabilitation.

Fong KY, *et al.* [12] reported a case of 34 years old female practicing Sirsasana (Headstand) for 2 months suffered from Basilar artery occlusion and fully recovered after one year of rehabilitation therapy.

First statistic analysis of human cadaveric cervical spine by Pinter FA, *et al.* [13] reported failure loads of cervical spine with in the range of 300N- 17kN with males having 600N greater loading capacity than women. They also analyzed that carrying larger load without inciting damage doesn't appear to be a product of practice.

Le Corroller, *et al.* [14] conducted a large retrospective analysis in a tertiary care centre of the imaging studies of 38 patients regarding yoga related musculoskeletal injuries over a period of 9 years, concluded that tendinous injuries were the most encountered musculoskeletal injuries and spine injuries were present only in two patients.

Smith EN, *et al.* [15] conducted a large scale review of literature (1966-2011) regarding risks and benefits moderate weight bearing exercises like Yoga to the spine in individuals particularly with osteoporosis. They concluded that moderate weight bearing activities like yoga help in strengthening muscles supporting vertebral column, promote balance, improve posture and enhance the quality of life. But they found ample evidences supporting moderate weight bearing activities like yoga preserve the health and strengthening the vertebral bodies in osteoporotic individuals. They opined that exercise modifications suitable for higher risk individuals may be counterproductive for those at low risk of vertebral fractures. They cautioned yoga therapists not to apply one-size-fit-all approach for all individuals. They finally opined that some well designed empirical studies are needed for in depth understanding of risks and benefits of various yoga asanas in osteoporotic individuals.

Cramer H, *et al.* [16] presented a systematic review of published case reports and case series regarding adverse effects associated with yoga by searching various electronic databases from their inception through feb.2013. They reported total 76 cases of adverse events, 27 adverse events (35.5%) related to musculoskeletal system and 14 events (18.4%) related to nervous system. Among the adverse events of nervous system, there were two cases of vertebral artery occlusion and one case of basilar artery occlusion

at craniovertebral junction. On the basis of their observations they advised beginners should avoid extreme practices like as lotus position, headstand and forceful breathing. Individuals with pre existing medical conditions should work with their physician and yoga therapist for appropriate postures and those with compromised bones should avoid forceful yoga practices.

Hector R., *et al.* [17] studied weight-bearing capacity of head and neck at the moment of peak loading during various headstand maneuvers (symmetrical extended, symmetrical flexed and asymmetrical flexed) and they concluded that entering the posture with symmetrical extended legs may result in slower loading and rate of change of the load.

Cramer H., *et al.* [18] systematically assessed and meta analyzed the frequency of adverse events yoga randomized controlled trials. They suggested that the frequency and severity of adverse events associated with yoga are comparable to the levels associated with other physical activities or usual care.

Swain TA., *et al.* [19] performed descriptive epidemiological study of yoga related injuries in the United States from 2001 to 2014. They concluded that participants of age 65 or above, have higher frequency of adverse events as compared with other age groups. They maintained that there are many health related benefits from Yoga, but the participants should still consult with their physician prior commencing to these physical activities and should perform under the guidance of qualified instructors.

Here are few case reports of Yoga related cervical spine injuries.

Sinaki M [20] in her case series of yoga flexion positions and vertebral compression fractures in osteoporosis and osteopenia, reports a case of 70 year old female, who performed “Halasana” for 10 weeks on the instructions of her daughter for neck and back pain and her symptoms worsened much more after yoga. On examination she revealed some neck stiffness and discomfort on foramina compression test. On radiographs, there was advanced osteopenia, degenerative Cervical spondylosis C4-C7 region with degenerative changes in thoracic spine.

Ferreira MA., *et al.* [21] reported a case of 52 year old female presenting with bilateral hands numbness, practicing yoga for last 30 years with daily headstand asanas. On examination, there was

weak bilateral grip, Hoffman sign on right side, unable to tandem walk with impaired vibration and proprioception. Radiological studies revealed multilevel cervical spondylosis, canal stenosis with compressive myelopathy and myelomalacia worst at C5 level.

Williams L., *et al.* [22] reported a case of 28 year old female suffered from traumatic spinal cord injury due to fall while performing Sirsasana (Headstand). On examination she was having C5 ASIA-B Tetraplegia. Radiological studies revealed C4 and C5 burst fractures with severe canal stenosis with cord contusions. Only identifiable risk factor was low vitamins D level. Patient underwent C5 corpectomy with C4 to C6 fusion. After 4 weeks of Acute rehabilitation, she regained only mild strength in her hands and requiring moderate to maximal assistance for all activities of daily life.

Sethi P., *et al.* [23] reported a case of 63 years old female, who was practicing Sirsasana for last 25 years, presenting with h/o numbness and tingling sensations in toes and fingers over a period of 5 months followed by spastic weakness of all four limbs with urinary incontinence for last one month. Neurological examination revealed spastic quadriparesis with C4 spinal level. Lateral X-ray C-spine showed C4-C5 anterolisthesis with C5-C6 block vertebrae. MRI cervical spine findings were suggestive of spinal cord compression at C3-C4 and C4-C5 levels.

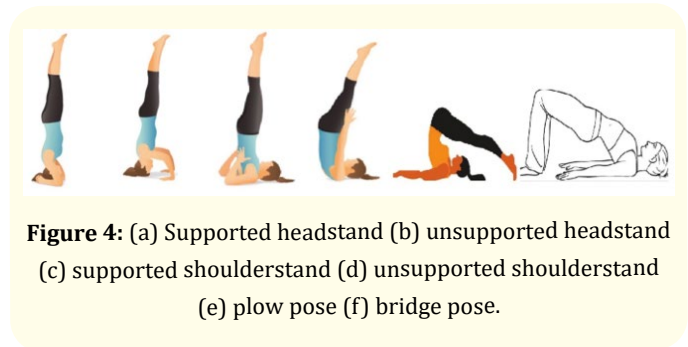


Figure 4: (a) Supported headstand (b) unsupported headstand (c) supported shoulderstand (d) unsupported shoulderstand (e) plow pose (f) bridge pose.

Conclusion

Though yoga practices are considered safe and without harmful effects, some asanas may land up individuals in catastrophic complications as the asanas requiring and resulting significant strain on craniovertebral junction and cervical spine. Individuals wishing to commence these asanas should have prior proper

assessment osteoligamentous structures of this region to rule out underlying osteoporosis, any osseous pathology, congenital osseous malformations, basilar invagination, vascular malformations etc. These individuals should undergo prior strengthening of neck and paravertebral muscles which may help to reduce strain on osseoligamentous structures. A proper set of investigations and guidelines should be developed for these asanas.

Conflict of Interests

The authors declare that they have no conflict of interests.

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