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ANATOMICO-SURGICAL REVIEW OF KRIKATIKA MARMA

Brijkishor Soni[1], Neha Soni[2]

[1]Lecturer, Dept. of Rachana Sharir, Bharti Ayurved Medical College, Durg, Chhattisgarh, India
[2]M.D. Scholar, Dept. of Dravyaguna, Govt. Ayurved College, Raipur, Chhattisgarh, India

Email: brijkishorsoni@gmail.com

ABSTRACT

Ayurveda is mother of all medical sciences and has been authentic source of knowledge covering its different aspects. *Acharya Suhsruta* has contributed to the field of surgery by introducing the concept of *marma* i.e. vulnerable areas of body which we can regard as ancient traumatology. There are 107 *marma* points over the body and *Krikatika marma* is one among them. As being a *sandhi marma*, it is mainly constituted by joints, located at cranio-cervical junction. Extent of vulnerable area is approximately half *angula* (1cm). Injury of this *marma* exhibits the *chalmurdhata i.e.* instability of cranio-cervical joint. Actually craniocervical joint is further constituted by atalanto-occipital and atalanto-axial joints. Cranio-cervical junction has unique kinematic properties enabling it to perform complex motions. In this article we will discuss about causes, mechanism and outcome of craniocervical injury rendering it unstable and also about the elements like occipital condyles, lateral masses, alar ligament, odontoid process, anterior, posterior arches of atlas and ligaments etc which gets involved in the trauma thus disrupting the stability of Cranio-cervical junction. This systematic review will helps us to establish vulnerability and anatomico-surgical importance of *krikatika marma* once again proving relevance of *Sushruta*'s ancient concept of *marma* in this modern age.

Keywords: *Krikatika marma* ,cranio-cervical junction, *Chala-murdhata*, atalanto-occipital joint, atalanto-axial joint

INTRODUCTION

In this fast age there emerges a new risk of trauma in day to day life extending from inside in-home to road traffic accidents. Trauma not only effects daily life routine, productivity and earning capability but poses psychological pressure. Science of *Marma* is form of ancient traumatology which 107 *marma* points or vital points of the body. These anatomical locations are vital in the sense that any injury to these parts can lead to sudden death, death within some days, debilitation and pain. Out of 107 vital spots, *krikatika marma* is one which is situ-

ated on *shirogreeva sandhane i.e.* at craniocervical joint on the neck so it is *sandhi marma* i.e. vital point constituted by joints. Injury of these *marma* leads to condition called *chalmurdhata* i.e. instability of cranio-cervical junction[1]. These joints are involved in various movements of neck. The joints of cranio-cervical junction have unique kinematic properties that contribute to the complex motion exhibited by neck and head. When the elements of these joints get affected by the trauma, they disrupt the stability of cranio-cervical junction. Various clinical and experimental observational studies help to substantiate the traumatic effect of *krikatika marma*.

AIM AND OBJECTIVE

Aim of this study is to find out Anatomico-surgical importance of *krukatika marma* and to find out its relevance with reference to modern traumatology by finding out vital structures involved.

ANATOMY OF KRIKATICA *MARMA*

The vital points (*marma*) comprises matrix of confluence of *māmsa* (muscular tissue), *sirā* (vascular tissue), snāyu (nervous or connective tissue), *asthi* (bone/cartilage), *sandhi* (joints) between which *prāna* (vital energy) resides. In each *marma* there is a dominancy of one of the above elements (*māmsa*, *sirā* etc). Depending upon the dominancy of the involved structures, the clinical symptoms are manifested[1]. Different *marma* exhibits different grades of severity. Further severity depends upon the involvement of area of that *marma* because each *marma* is having its own dimensions. If peripheral area of the *marma* is injured then different clinical feature are seen. Out of fourteen *marma* are present in the neck region, *krikatika* are two among them, located at the junction of *shirah* (head) and *greevā* (neck)1 constituted by *sandhi* (joints) and measures only 1 cm (half *angula*) dimension. Injury to this give rise to *chalmurdhata* (loss of stability of head), therefore this is included under *vaikalykara* (deformity) category.

Cranio-cervical Junction[2]

Krikatika marma is located in the region of cranio-cervical junction. The craniocervical junction represents the complex transitional zone between the cranium and the cervical spine. The craniocervical junction is composed of two major joints: the atlanto-occipital joint and the atlanto-axial join. It is composed of osseous structures articulated with synovial joints and binded by intrinsic ligaments and membranes and muscles. These two joints are responsible for the majority of the movement available in the entire cervical spine and the anatomical structure of each is based on different biomechanical principles. The mechanical properties of the atlanto-occipital joint are primarily determined by bony structures, whereas those of the atlanto-axial joint are primarily determined by ligamentous structures. As well as housing the spinal cord and multiple cranial nerves and vasculature supplying both the brain and the cervical spinal cord. As a result, injury to the craniocervical junction carries the potential for devastating morbidity and mortality.

Stabilizing Ligaments[3]

- Alar ligaments-These paired ligaments attach the axis to the base of the skull. Functionally, the alar ligaments play an important role in strapping the occiput-C1-C2 complex together. The alar ligaments limit axial rotation and lateral flexion of occiput. strong

stabilizers of the atlas preventing anterior displacement in the event of rupture of the transverse ligament

- Transverse ligament- The transverse ligament of the cruciform ligament complex is largest, thickest and crucially the strongest of the craniocervical junction ligaments and therefore, a primary stabilizer of the craniocervical junction. Transverse ligament permits rotation at the atlanto-axial joints while, at the same time, the alar ligaments will prevent excessive rotation. It arches behind the odontoid peg attaching to a tubercle arising from the medial aspect of each lateral mass of the atlas transverse ligament is primary restraint to anterior translation of atlas in relation to the lower cervical spine;
- Tectorial membrane- This thin structure represents an upward extension of the posterior longitudinal ligament. It forms the posterior border to the supraodontoid space or apical "cave" and runs posterior to the cruciform ligament. It extends cranially to the clivus (as far cranially as the spheno-occipital synchondrosis) and caudally to the posterior surface of the body of the axis. It attaches as far laterally as the hypoglossal canals and, at the level of C0-C1, merges with the atlanto-occipital capsular ligaments .The cranial portion of the membrane is adherent to and anatomically indistinguishable from dura.
- Posterior atlanto-ocipital membrane- posterior atlanto-occipital membrane attaches the posterior arch of the atlas to the posterior margin of the foramen magnum. It is continuous with the posterior atlantoaxial membrane and, subsequently, the ligamentum flavum myoligamentous complex. An important consideration in trauma of this component of the craniocervical junction is the vertebral artery which pierces the posterior atlanto-occipital membrane
- Nuchal ligament (ligamentum nuchae)-This is a cephalic extension of the supraspinous ligament and extends from the spinous process of the C7 vertebra attaching to the inion of the occipital bone. It limits hyper flexion of the cervical spine
- Accessory ligaments-
  - Accesory atalnto-axial ligament
  - Lateral atalanto-occipital ligament
  - Barkow ligament
  - Apical ligament
  - Tectorial membrane
  - Capsular ligaments of atlanto-occipital and atlanto-axial joints

JOINT KINEMATICS[4]

The predominant movements at the atlanto-occipital joint are flexion and extension. Lateral flexion at the atlanto-occipital joint is significantly limited by the contra lateral alar ligament. The atlanto-axial joints allow mobility in flexion, extension, axial rotation and, to a lesser degree, lateral flexion as a result of the biconvex and inherently unstable construct of the joint; it is the ligaments (transverse ligament and alar ligaments) related to this particular articulation which stabilizes the joint complex. In the event of traumatic disruption of these ligaments, the atlanto-axial joints are poorly equipped to tolerate axial rotation.

POSSIBLE SOURCES OF INJURY

- Inertial Motor vehicle injury (Whiplash injury)
- Fall from height
- Sudden fall on back of neck
- Assault
- Sport injuries

- Combat sport injuries
- Axial loading(Bearing excessive on head)
- Hyper mobility(Excessive exercise)
- overuse injuries
- Wrong posture and overstretching
- *Stress, strain and spasm of neck muscles*
- *High energy and low energy trauma*
-

CLINICAL MENIFESTATIONS OF INJURY[5]

- Basi-occiput fracture- neurological, brainstem, vascular, internal carotid, cranial nerve. Can also cause hematoma
- Occipital condyle fracture- Excessive axial loading may be cause of this injury. brain stem and lower cervical nerve injury, hypoglossal nerve and vertebral artery injury
- Atalanto-occipital dislocation- Due to relatively wide cross-sectional area of the spinal canal at the CCJ, spinal cord injury is less common. However, when present, neurological injury from AOD can be with high mortality and significant neurological morbidity including lower cranial nerve deficits, unilateral or bilateral weakness, or even quadriplegia. More prevalent in pediatrics due to underdeveloped ligaments. May also associated with cerebrovascular injury.
- Atalanto-occipital subluxation
- Fracture of atlas- injury to vertebral artery, cranial nerve and cervico-medullary parenchymal injury
- Jefferson fracture- may be with or without transverse ligament injury
- Fracture of axis- associated with neurological mortality and morbidity. Includes odontoid and hangman's fracture
- Ligament injury without fracture-These are usually non diagnosed and under diagnosed. If not treated have long term effects. Most important are transverse and alar ligament injuries
- Transverse ligament- can lead to anterior translational instability of the C1–2 vertebra. Diffuse motor loss if pyramidal tract is affected
- Atalanto-axial subluxation

DISCUSSION

Every *marma* of our body is a point where vital energy resides. *Krikatica marma* is a structure of high surgical importance because complex anatomical structure of the neck balances much needed stability with profound degree of movements. It mounts most important organ of our body, *uttamang*a i.e.head. This complexity makes neck vulnerable and surgically important. Due to complexity of the anatomic stabilizers of the cranio-cervical junction posses challenges in diagnostic imaging make surgical decision making difficult.

Krikatika marma is located in the region of cranio-cervical junction which comprises atalanto-occipital and atalanto-axial joint. The junction between the skull and the cervical vertebrae is stabilized by ligaments joining the axis and atlas to the clivus, occipital bone, and occipital condyle. The craniocervical junction must accommodate a wide variety of motions, which require ligaments for stabilization. Atlanto-occipital joint is stabilized by an articular capsule. The anterior atlanto-occipital membrane serves to prevent excessive neck extension. The alar ligaments limit contra lateral flexion and axial rotation at the atlanto-occipital joint. The apical ligament attaches from the tip of the odontoid process to the basion. The Barkow ligament connects the tip of the dens to the occipital condyle and it assists in preventing excessive neck extension. The transverse occipital liga-

ment sometimes joins the alar ligaments and may help prevent excessive lateral bending, flexion, and axial rotation. The cruciform or cruciate ligament limits lateral motion of C1 relative to the dens and prevents posterior displacement of the dens, thus limiting anterior C1-2 subluxation to 3-5 mm. The tectorial membrane limits both excessive flexion and extension[3].

We can designate *chalmurdhata* as craniocervical instability which further includes craniocervical instability due to either atalanto-occipital instability or atalanto-axial instability or both. It can be mainly due to ligament injuries causing dislocation, subluxation, hypermobility and loss of sense of balance of head etc. Injury to craniocervical junction can directly or indirectly produce instability which may be directly due to injury causing laxity of ligaments and indirectly by poor control or poor sense of head position. Any structure which is more is movable less is stable and less is stable more is vulnerable. Atalanto-occipital Joint more stable than Atalanto-axial Joint, so AA Joint is more vulnerable for instability. *Vikalata* can be attributed as irreversible destabilizing deformity. *Vikalata* is produced by destruction of stabilizers, *snayu*. All ligaments are more or less responsible for stability of craniocervical junction, but we will choose out most appropriate one on the basis of clinical significance is destabilization. Chal murdhata –instability of head can also be due to poor sense of head and neck position and feeling of instability i.e. in case of alar ligament injury. Together with the transverse ligament the alar ligaments are primary stabilizers of the craniocervical junction. Under the heading *chalmurdhata* we include dislocation, subluxation , instability, hyper mobility, loss of sense of balance of head. Trauma generated deformity persists long term due to fact that ligament have poor blood supply and are not usually regenerated naturally. Imaging of blunt traumatic injuries of craniocervical junction is difficult and is often under diagnosed. There is always a risk for other critical injuries related to vital neighboring structures such as vasculature, brain stem, cranial nerves and spinal cord. An understanding of bony and ligamentous injury patterns can assist greatly in predicting risk for other critical injuries related to vital neighboring structures such as vasculature, brain stem, cranial nerves and spinal cord

This discussion substantiates the *Sushruta*'s clinical view about this *Marma* i.e. *Chalmurdhata*. This clinical observational data helps to determine the structure to be included under this *Marma*. They are atlanto-occipital joint, Atlanto-axial joint, the tectorial membrane, the alar ligament, the cruciate ligament, the apical ligament, capsular ligament, accessory atlanto-axial ligament, the anterior and posterior atlanto-occipital membranes, Posterior ramus of C1,vertebral artery. These all structures are arranged bilaterally in a very small area i.e.in half *angula* circumference. Depending on the involvement of side these are giving rise to the symptoms. Out of all ligaments, transverse ligament is most important. Treatment decisions whether it will be conservative or surgical are often based on the integrity of the transverse ligament. Second most important ligament is alar ligament.

CONCLUSION

From above discussion following conclusions can be drawn-

- *Krikatika* can be compared with craniocervical region

- *Krikatika marma* being a *sandhi marma,* can be compared with cranio-cervical junction which consists of atalanto-occipital joint and atalanto-axial joint with its surrounding ligamentous structures attached to the same within 1cm (half *angula*) area on either side and underlying in depth of 1 cm can be included under the term *krikatika marma*
- Out of all anatomical structures, ligaments are most important because they are main stabilizers of joints and are vulnerable to injuries
- Out of atalanto-occipital joint and atalanto-axial joint, atalanto-axial joint is more movable contributing more towards vulnerability of cranio-cervical junction.
- Out of all ligaments, transverse ligament and alar ligament is most important because treatment decisions whether it will be conservative or surgical are often based on the integrity of the transverse ligament and alar ligament.
- We can designate *chalmurdhata* as cranio-cervical instability which further includes craniocervical instability due to either atalanto-occipital instability or atalanto-axial instability or both. It can be mainly due to ligament injuries causing dislocation, sbluxation, hypermobility and loss of sense of balance of head etc.
- Knowledge of *krikatika marma* help us to improving morbidity and mortality related to neck injury.

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