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Research Article

Ossified pterygo-spinous ligament: incidence and clinico-anatomical relevance in the adult human skulls of North India

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ABSTRACT

Study of skulls has attracted the attention of anatomists since ages and sporadic attempts have been made to study skulls from time-to-time. Talking about the pterygoid processes of sphenoid bone, the irregular posterior border of lateral pterygoid plate usually presents, towards its upper part, a pterygo-spinous process, from which the pterygo-spinous ligament extends backwards and laterally to the spine of sphenoid. This ligament sometimes gets ossified as pterygo-spinous bar and a foramen is then formed named pterygo-spinous foramen, for the passage of muscular branches of mandibular nerve. The present study was undertaken to observe the incidence and status of pterygo-spinous bony bridge and foramen, its variations and clinical relevance in the adult human skulls of North India. For this purpose, 50 skulls were observed, pterygo-spinous bars were found to be present in 7 skulls, out of which completely ossified pterygo-spinous bony bridges were present in 2 skulls while 5 skulls had incompletely ossified pterygo-spinous ligaments. Such variations are of clinical significance for radiologists, neurologists, maxillo-facial & dental surgeons and anaesthetists, too.

Keywords: Skull, Sphenoid, Lateral pterygoid plate, Pterygo-spinous ligament

INTRODUCTION

The vertebrate skull is the most modified part of axial skeleton and its study has attracted the attention of anatomists and anthropologists since ages. Sporadic attempts have been made to study skulls, from time- to-time, in the past centuries, but its individual bones and their ligaments in particular, have somehow not received as much attention. Sphenoid bone lies in the base of skull, 'wedged' between the frontal, temporal and occipital bones. It has a central body, paired greater and lesser wings spreading laterally from it and two pterygoid processes. Each of these processes, descending perpendicularly from the junctions of greater wings and body of sphenoid, consists of a medial & a lateral plate. The medial pterygoid plate is narrower and longer while the lateral pterygoid plate is broad, thin and everted; a variable pterygo-spinous process on its irregular posterior border is connected by a ligament (sometimes ossified) to the sphenoid spine. (Williams & Warwick, 1995),[1] Jones (1946)[2] states that lateral pterygoid plate is broader and shorter than the medial and is directed backwards and slightly laterally. Its posterior border usually presents, towards its upper part, a sharp spine from which the pterygo-spinous ligament extends backwards and laterally to the spine of sphenoid. This ligament sometimes gets ossified and a foramen is then formed named pterygo-spinous foramen, for the passage of muscular branches of mandibular nerve. Sometimes there's another spine towards the lower end of this border for another pterygo-spinous ligament. Breathnach (1958)[3] states that a projection, more or less prominent on the posterior edge of the lateral pterygoid plate, a little way down, may mark the anterior attachment of a "pterygo-

spinous" ligament extending to the base of the sphenoidal spine. The ligament may be short, fastened higher up on the plate, or two ligaments, long and short, may be present: ossification may extend someway into these, so that a bony bar may be present here. The nerves emerging from the Foramen ovale have varying relations with these bands, which are probably modified fibres of the lateral pterygoid muscle. Wood Jones (1931)[4] reported an 8% pterygo-spinous ligament ossification in Hawaiian skulls. Krompotic et al. (1999)[5] reported ossified pterygo-spinous ligaments in 5 out of 100 skulls and emphasized that these bony bridges may be one of the reasons of Mandibular neuralgia. Kapur et al. (2000)[6] reported a prevalence of 18.36% of pterygo-spinous bar in a sample of 305 Croats skulls. Complete ossification of pterygo-spinous ligament was found in 3.6% skulls, 1.31% bilaterally as well as 1.31% on right side and 0.98% on left side. Incomplete type was found in 14.7% skulls, bilaterally in 12 skulls and unilaterally in 33 skulls. He emphasized that the presence of such an ossified PS ligament may prevent anaesthesia of Mandibular nerve at the lateral subzygomatic approach. Peker et al. (2002)[7] studied 452 adult dry crania in Anatolian population and observed completely ossified pterygo-spinous ligament in 5.5% skulls. In 14 out of 452 skulls (3.1%) complete pterygo-spinous osseous bridges were bilateral. The frequency of complete pterygo-spinous bony bridges was 4.2% on the right side and 6.4% on the left. The course of the branches of mandibular nerve was apparently affected by the ligament. Pinar et al. (2004)[8] found completely ossified pterygo-spinous ligament in 12 cases, out of 361 dry adult human crania and incompletely ossified ligaments in 35 cases. Ludinghausen et al. (2006)[9] reported that a complete osseous bar, arch or lamina connecting the posterior border of lateral lamina of pterygoid process and sphenoidal spine, existed in 6 of the 100 human dry skulls and 1.85% in cadavers. Nayak et al. (2007)[10] examined 416 dry human skulls of Indian (Dravidian) origin for pterygo-spinous bony bar and found total incidence to be 9.61%, incomplete pterygo-spinous foramen in 3.84% and complete pterygo-spinous bar in 5.76% skulls. Antonopolou et al. (2008)[11] observed 50 Greek dry skulls and reported completely ossified pterygo-spinous bridge in only 1 skull bilaterally and incompletely ossification in 25 out of 100 observations. These observations were made out in a three-dimensional reconstruction in a CT image. Shinde et al. (2011)[12] studied a total of 65 skulls and only in 2 cases, found incompletely ossified pterygo-spinous ligament in one case it belonged to left side and in the other to right. There was a small gap between the spine of sphenoid and the posterior border of lateral pterygoid plate. Agarwal et al. (2012)[13] studied 67 human skulls of Punjab region and revealed the incidence of pterygo-spinous bar as 9.7%, complete pterygo-spinous bridges in 2.99% and incomplete ones in 6.72% of skulls. Verma et al. (2013)[14] carried out their study on 116 macerated adult human skulls and reported a total incidence of 18.1% and described them in various types. Ossified Pterygo-spinous ligament seems to be a major cause of entrapment of lingual nerve or a branch of mandibular nerve and may cause mandibular neuralgia. Therefore this present study was undertaken to determine the incidence of pterygo-spinous bony bridge and foramen and its variations in the adult Human skulls of North India, to discuss its clinical relevance.

METHODS

For the present study, a total of 50 skulls were observed, the age and sex of the macerated skulls were not taken into consideration.

The skulls were washed and their bases were closely observed in regards with the pterygoid plates of sphenoid, for the presence of ossified pterygo-spinous bars and foramen.

RESULTS

Osseous bars were either complete or incomplete, i.e. if bony bridges were extending from lateral pterygoid plate to Sphenoid spine apex - it was termed complete and if pterygo-spinous ligament failed to make a contact with sphenoid spine, it was considered incomplete.

In case of presence of complete pterygo-spinous bar, a well-formed pterygo-spinous foramen was present while in case of incomplete bar, partial foramen was formed. Pterygo-spinous bars were found to be present in 07 skulls; out of which completely ossified pterygo-spinous bony bridges were present in 02 skulls and in none of the cases, it existed bilaterally. It was present in 01 skull on right side and in skulls on left side.

A total of 5 skulls had incompletely ossified pterygo-spinous ligaments in it was present on left side.

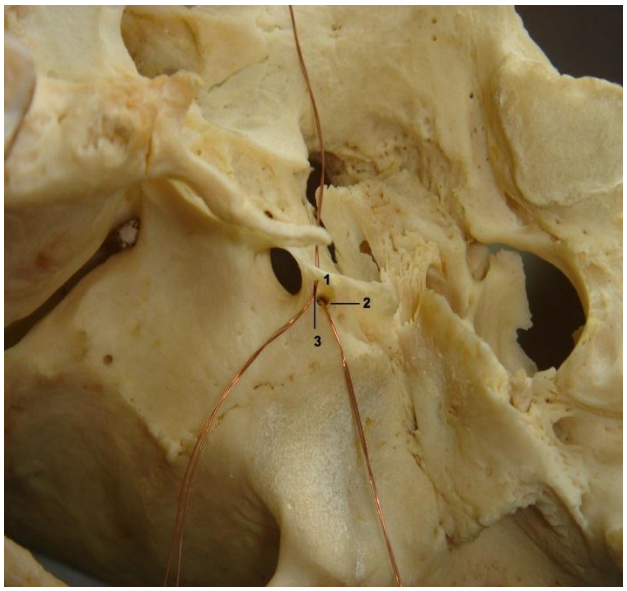

Figure 1: Complete ossified PS ligament. 1. ossified PS ligament 2. spinous foramen 3. PS foramen.

Figure 2: Incomplete ossified PS ligament (1).

DISCUSSION

Several ligaments are present in relation to sphenoid bone at the base of skull such as pterygospinous, interclinoid, caroticoclinoid, pterygoalar ligament, etc. Ossification of these ligaments may have different clinical implications. The pterygo-spinous ligament, described by Civinini in 1835 (cited by Tebo)[15] is directed from the spine of Sphenoid to the pterygo-spinous process, when ossified, establishing the pterygo-spinous foramen also known as civinini foramen. The incidence of pterygo-spinous bony bridges has been reported by different authors with different results, as can be seen in Table 1. Wood Jones[4] noted 8% incidence in Hawaiian population, Krompotic et al.[5] reported 5% while Kapur et al.[6] found 18.36% total incidence in Croats skulls, Peker et al. studied Anatolian population with an incidence of 5.5%, Pinar et al.[8] observed a total incidence of 13.02% while Ludinghausen et al.[9] revealed 6% in German skulls and Antonopoulou et al.[11] reported an incidence of 14% in Greek skulls. Among the Indian studies, Nayak et al.[10] observed an incidence of 9.6% in Dravidian race, Agarwal et al.[13] studied skulls of Punjab region, with an incidence of 9.7% while Verma et al.[14] found it to be as high as 18.1%. The present study reports an incidence of 10.2% - which is in sync with the earlier studies of Indian skulls by Nayak et al.[10] & Agarwal et al.[13]

Table 1: Comparison of various studies of ossified PS ligament.

Sr. No.	Research worker	Year	Race	Total incidence	Incomplete ossified PS ligament	Complete ossified PS ligament
1	Wood Jones	1931	Hawaiian	8%	-	-
2	Kapur et al.	2000	Croats	18.36%	14.7%	-
3	Peker et al.	2002	Anatolian	5.5%	-	5.5%
4	Von Luding Huasen et al.	2006	German	6%	-	6%
5	Nayak et al.	2007	Indian	9.61%	3.84%	5.76%
6	Antonopoulou et al.	2008	Greek	14%	12%	2%
7	Shinde et al.	2011	Indian	3.07%	3.07%	-
8	Agarwal et al.	2012	Indian	9.7%	6.72%	2.98%
9	Verma et al.	2013	Indian	18.1%	12.93%	1.72%
10	Present study	2014	Indian	14%	10%	4%

Complete ossification of pterygo-spinous bar, resulting in a well-formed pterygo-spinous foramen, was reported in 2 out of 50 skulls studied in the present study while few authors like Das & Paul[16] found only incompletely ossified pterygo-spinous ligament only 1 case in 50 skulls. Similarly, Shinde et al.[12] observed only incompletely ossified PS ligament in 2 out of 65 skulls. In most of the studies above, the incomplete variety was commoner than the complete one. These osseous variations are important not only in anatomy but also in clinical practice (Antonopoulou, 2008).[11] The distribution pattern of the mandibular nerve was affected by the positioning of the pterygo-spinous bar and ligament. It is likely that in humans, this bony bar represents a phylogenetic remnant. The presence of complete or incomplete pterygo-spinous bar is related with some important structures present in this region like Mandibular nerve, as it comes out of foramen ovale, and its branches, otic ganglion, middle meningeal artery and vein, tympanic nerve, medial and lateral pterygoid muscles. These structures may get compressed against these bony formations and can produce many clinical

symptoms like pain, especially during chewing and could provoke Trigeminal neuralgia. (Krompotic et al., 1999)[5] Peuker et al. (2001)[17] were the first to demonstrate the presence of ossified pterygo-spinous ligament causing compression of lingual nerve between the bony bridge and medial pterygoid muscle, which results in lingual numbness and pain, associated with speech impairment. Considering the close relationship of the chorda tympani nerve, it may also be compressed by the anomalous bar of bone and its involvement would result in abnormal taste sensation in the anterior two-thirds of the tongue (Das and Paul, 2007)[16]. Such compression may also produce a partial lesion of the nerve, which can lead to a distortion of signalling patterns or ectopic impulses within the damaged nerve fibres. In the presence of an ossified pterygo-spinous ligament, the main trunk of mandibular Nerve is redirected laterally and its dividing neural routes (Lingual nerve and inferior alveolar nerve) have to cross the extended lateral pterygoid plate. Because of this abnormal course, there is greater risk for neuralgia occurring due to the nerves becoming entrapped or compressed between the osseous structures and muscles (von Ludinghausen et al., 2006).[9] A wide pterygo-spinous bar exists in all skulls of herbivores, rodentia, carnivores and mature monkeys. The pterygo-spinous bony bridge can also pass among the fibres of the Lingual nerve and divide it into anterior and posterior parts. Anterior part passes medially and lies between tensor veli palatini muscle and the bony bridge, so these fibres are vulnerable to the risk of compression. (Erdogmus et al., 2009)[18] causes of ossification of pterygo-spinous ligament may not be known but these formations were more often present in males and unilateral presence was commoner than bilateral. While applying conductive anaesthesia on the mandibular nerve by lateral subzygomatic route, presence of these ossified structures at the lateral plate's posterior border of pterygoid process should be well considered and verified (Kapur et al., 2000)[6] lateral pterygoid plate forms an important landmark for mandibular anaesthesia and any anomaly in the lateral pterygoid plate is bound to confuse anaesthetists. Considering the phylogenetic and clinical significance of these pterygo-spinous bars and foramen, the present study is very important especially for surgeons, anaesthetists, dentists, anatomists and anthropologists to know the types of osseous bridges and their incidence in this region of cranial base. There may be failure of anaesthesia in cases of treatment of trigeminal neuralgia due to the presence of an ossified pterygo-spinous ligament; or it can also constitute an obstacle for the mandibular nerve block that is a preferred method for pain relief especially in fractures of mandible or cancer patients (Pinar et al.,[8] Peuker et al.[17]).

CONCLUSION

Out of 50 skulls, presence of pterygo-spinous bars and broad lateral pterygoid plates was reported in 7 (10.2%) skulls, completely ossified pterygo-spinous ligament in 2 skulls (4%) and incomplete ossification of pterygo-spinous ligament in 5 skulls (6.2%). Different authors have reported different results, though. Knowledge of these anatomical variations is important because ossification of pterygo-spinous ligament can result in formation of a foramina through which, mandibular nerve branches may pass; in most of the cases which may get compressed, depicting various clinical symptoms, depending upon the dimensions of the pterygo-spinous foramina and grades of compression. Therefore, this study is important to radiologists & neurosurgeons, maxillo-facial & dental surgeons and anaesthetists, along with anatomists and anthropologists.

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