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Original Research Article

ANATOMICAL, RADIOLOGICAL AND SURGICAL PERSPECTIVES OF THE OSSIFIED LIGAMENTS IN THE INFRATEMPORAL REGION OF THE SKULL

Kumud Dharwal *[1], Rajkumar [2].

*[1] Professor & Head, Anatomy Department, Glocal Medical College Super Specialty Hospital and Research Centre, Mirzapur Pole, U.P., India. 247121

[2] Assistant Professor, Anatomy Department, Glocal Medical College Super Specialty Hospital and Research Centre, Mirzapur Pole, U.P, India.

ABSTRACT

Objective: In the infratemporal region, the ossified inter, pterygoid muscle, fascia becomes the foremost bony cause of a lancinating pain (trigeminal neuralgia), due to the entrapment or compression of the mandibular nerve or its branches. Main bony offenders have to be diagnosed radiologically in day to day practice.

Materials and Methods: One hundred and fifty eight dry macerated skulls of north Indian origin were studied to identify the presence of these ossified components named "the pterygospinous and pterygoalar bars and the enclosed foramina". The skulls showing these bars were subjected to different radiographic views to find out which one exhibited them clearly.

Results: The infratemporal region showed additional bony bars and foramina as incomplete pterygospinous bars in 12 cases (7.69%), unilaterally in 7 cases 4.48% (3 right-sided - 1.92%, 4 left-sided - 2.56%) and bilaterally in 5 cases 3.20% , complete in 2 cases (1.28%); the pterygoalar bars partial in 2 skulls (1.28%) but a complete bar was not seen. Radiologically these bars were found to be best visualized in the Hirtz axial view with 10-20^0 headward tube tilt. Whether these bars in a given patient of trigeminal neuralgia are the causative factor or not, can best be demonstrated in radiograph of the skull in this view.

Conclusion: Proper treatment for neuralgia can be well planned after assigning the cause and then tackling it by percutaneous trigeminal ganglion neurolysis under proper radiographic visualization.

KEY WORDS: Infratemporal Region, Mandibular Nerve, Trigeminal Neuralgia, Radiograph.

Address for Correspondence: Dr. Kumud Dharwal, Professor & Head, Anatomy Department, Glocal Medical College Super Specialty Hospital and Research Centre, Mirzapur Pole, U.P.,- 247121 India. **E-Mail:** kdharwal@gmail.com

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INTRODUCTION

The infratemporal region, much of which is cordoned off by the ramus of mandible, so it is not visible in routine antero-posterior / lateral roentgenograms. The fascia and /or aponeurosis of the main muscles of this region get ossified [1,2] . As Civinini observed, these osseous components appeared in different forms like spines, bars or sheets[4]. These ossified structures might entrap or compress the mandibular nerve [4-9] or the vascular channels around [2]. When these enlarged bars exert a traction, pulling on the nerve itself [10], it provokes many clinical neuropathies such as paresis, paresthesia, anaesthesia and trigeminal neuralgia [11]. The proper radiological study of this region may guide

us to understand these variations [9], and help the surgeons intervening in this area to manage with the patient's pain [10].

MATERIALS AND METHODS

The study was conducted on 158 dry macerated skulls of unknown age and sex, belonging to the north Indian region. Skulls with anomalous ossifications in the infratemporal region were radiographed in many positions to ascertain the best view to observe these osseous bars. Various skiagrams were taken by tilting the tube headward in different angles. The bars were best viewed in the range from 10 to 20^0 tilt.

Fig. 1: Skull 83 Showing a complete pterygospinous bar ' PSB' with 3 complete Foramen Civinini 'FC' one large and 2 small, 'FO' foramen ovale.

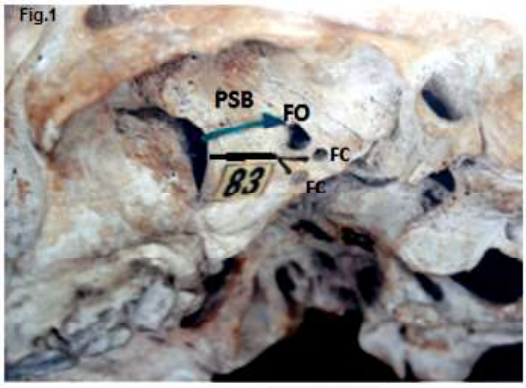


Fig. 2: Skull 157 showing both ends of incomplete Pterygoalar Bars 'PAB'on both sides, 'FO' foramen ovale.

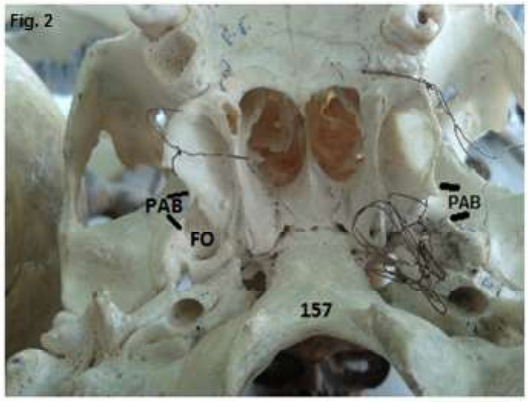
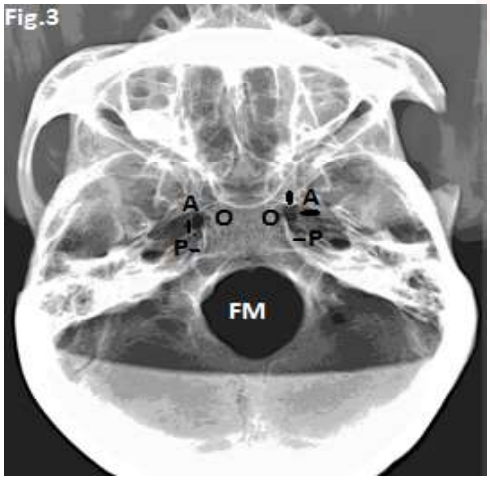


Fig. 3: Radiograph of skull of fig. 2 in Hirtz view Showing on both sides 2 spinous processes of Incomplete Pterygospinous bars 'P' and of Incomplete Pterygoalar Bars 'A', foramen ovale 'O' and foramen magnum 'FM'.



RESULTS AND DISCUSSION

The unusual osseous bars in the infratemporal region are not uncommon. Among the 158 cases studied, the lateral pterygoid plates were enlarged in 14 cases by 0.76mm to 2.34cm. They were of variable shapes like spines, bars or sheets and had variable positions in relation to the foramen ovale. The bars enclosed incomplete / complete; single / multiple foramina (2 - 4) in number. In 12 cases (7.69%), ossification extended up to the spine of the sphenoid, known as the pterygospinous bars enclosing incomplete foramina, unilaterally in 7 cases (4.48%): right 3 cases (1.92%), left 4 cases (2.56%) and bilaterally in 5 cases (3.2%). In 2 cases (1.28%) there were complete bilateral sheets with complete foramina, out of which one case had 3 complete, 1 large (5.64 mm _diameter) and 2 small foramina (Figure1, skull 83). In another skull bilateral incomplete bars with 2 complete and 2 incomplete foramina were seen. In another skull there was a large foramen 3/4th of a circle and 3 small foramina.

Furthermore these bars extended between the pterygoid plate and greater wing of the sphenoid, known as the pterygoalar bars in two cases (1.28%). It was present bilaterally, larger on the right side in first skull and on left side in second skull (figure 2, skull 157). These bars were formed by 2 spines: one spine arising from the root of the lateral pterygoid plate directed backwards and laterally (1.5 and 2.3 mm in skull 1 and 2 respectively); second spinous processes extending forward and laterally from the greater wing of the sphenoid, at the posterolateral ends of the foramen ovale (3.1 and 1.2 mm in size in skull 1 and 2 respectively). On the opposite sides of both skulls, small spines were seen at the similar positions. No complete pterygoalar bar was seen in the present study. Skull 157 (figure 2) had both pterygospinous and pterygoalar bars bilaterally. The radiograph in Hirtz view at 10-20^0 headward tilt of the skull 152 clearly showed

the pterygospinous bars as well as the pterygoalar bars (figure 3).

The unusual osseous bars in the infratemporal region might entrap the mandibular nerve [7,12] or its branches[13], thus producing trigeminal neuralgia or tic douloureux. These symptoms could be produced by these bony anomalies in 20%, microvascular compression and unusual nerve course in 80% cases[14]. A thick pterygoalar bar leaving a narrow porus crotaphitico buccinatorius is the most common bony offender. We tried to visualize these bars radiologically in many different views of the skulls. Ultimately the basal submento vertical axial view, the Hirtz view at the 10-20^0 headward tube tilt was found to clearly outline these bars.

Nomenclature: These bars have been named as pterygospinous and pterygoalar bars. The foramina enclosed are known as pterygospinous or Civinini foramen, earlier known as foramen interruptum / foramen innominatum[1] and the pterygoalar or Hyrtl foramen / foramen crotaphitico buccinatorius, due to the anatomist who first described it [5,6,8].

Location and morphology: The pterygospinous ligament extends from the posterior border of the lateral pterygoid plate to the spine of the sphenoid. Sometimes it gets partially or completely ossified and forms the pterygospinous bar[5,6,8] enclosing a foramen named as Civinini foramen. This bar always has a vertical disposition and lies medial to the foramen ovale[4,5,15]. It is mostly a partial plate or may be a single complete partition appearing as the continuation of lateral pterygoid plate or may be as multiple thin complete bars.

The pterygoalar ligament extends from the root of the lateral pterygoid plate to the greater wing (ala magna) of the sphenoid [4,5,16] . At times it gets ossified and forms the pterygoalar bar, which encloses a space called porus crotaphitico buccinatorius or the pterygoalar foramen. This bar always has an horizontal disposition lying parallel to the temporosphenoidal osseous plane at the skull base and lies lateral to the foramen ovale [4,5,15,16] and never extends up to the sphenoid spine[11]. This bar may be partial or complete, may be quite thick and enclose a single small flat foramen through which passes the motor division of the mandibular nerve, the ramus crotaphitico buccinatorius / the masticatory nerve[4,9]. Quite often there may be a shallow groove only at this site for the passage of this nerve. So this bar may compress the nerve to produce tic douloureux as well as can pose an obstruction to the needle used for the transovale gasserian ganglion block or retro gasserian plexus lysis for the relief of the pain[9,10].

Incidence: The bars are prevalent in all ethnic groups. The frequency however is quite variable in different studies as summarized in the table. The incidence of the pterygospinous bars as reported by Chouké[4], range between 2% - 23.5% and of the pterygoalar bars between 1- 62.4%. Pterygospinous bar is reported to be more frequent in males (M - 7.09%, F - 3.74%); marginally more on left side (L - 3.63%, R- 2.65%, bilaterally 0.89%); more in whites 10.54% than in negroes 2.33%. The pterygoalar bar is more frequent in males (Males - 11.28%, Females - 7.22%); marginally more on left side (Left - 5.44%, Right- 4.86%, Bilaterally - 0.89%); more in negroes 9.85% than in whites 8.85%[4,5].

The reported incidence of these bars as shown by Chouké and also by other workers is shown in the table-1 Morphogenesis - The connective tissue between the pterygoid muscles, aponeurosis and ligaments starts ossifying[15] and presents as bony bars in different combinations. Therefore a plethora of variations are encountered in shape, size and number of these bars and foramina. Thus they appear as various extensions of the lateral pterygoid lamina. Their incidences increase with the increasing age[2,3].

Aetio-pathogenesis: The reason for the appearance of these ossifications is not clear.

Overuse reaction: Every individual has a tendency to chew the food on one particular side. It has been conjectured that these bones are formed on that particular side which is used more in chewing[4].

Infection: Some workers felt that the pathological origin was after an infection. Later on this reason was out rightly rejected because pathological bone formation is always irregular and never so smooth and regular as these bones are[4].

Atavistic regression: Perhaps these bars are

Author	Year	Pterygospinous Bars & Foramen of Civinini %		Pterygoalar Bars & Foramen of Hyrtl %	
		Partial	Complete	Partial	Complete
Wood- Jones	1931 [20]	8			
Chouké	1949[5]			14.79	7.72
Chouké & Hodes	1951[24]	10.3		7.05 - R- 2.3, L- 2.9, Bi lat- 0.89	
Priman & Etter	1959[8]	8	3	14.4	
Tebo	1968[16]	33	3.9		
Kapur et al	2000[9]	Uni lat R- 4.59 L- 6.22 Bi lat - 3.93	Uni lat R-1.31 L- 0.98 Bi lat - 1.31	Uni lat R-.60, L-5.24 Bi lat - 5.57	Uni lat R-0.98 L- 3.90 Bi lat - 0.97
Nayak et al	2007[18]	3.84	5.76		
Rosa et al	2010[14]	19.36	8.61	49.44	12.91
Suazo et al	2010[17]	1.6	13.14	3.84	22.43
Present Study				Bi lat 0.75	0

Table 1: The Incidence of Pterygospinous and Pterygoalar Bars. *Cited from Chouké (1946)

atavistic or theromorphic pithecoid regressions[4].

Associated anomalies: A high percentage of these ossifications were found in the lunatics and criminals.

Clinical Presentations: These bars can compress the mandibular nerve [4,5,7,9], and / or its motor branches, especially the nerve to the pterygoid and temporalis muscles, presenting as pain on chewing; may compress sensory branches like lingual nerve, with pain in the tongue[13] or can cause traction of branches like lingual and inferior alveolar nerves which, in the presence of these ossifications, are unduly stretched [10], producing anaesthesia or paraesthesia of the tongue, gums and teeth [11]. The chorda tympani nerve lying in close relation to these bars can be irritated or compressed producing loss of taste on anterior 2/3rd of tongue [7] or the auriculotemporal nerve [10] producing decrease of salivation and dryness of the mouth [11], and can also produce speech articulation deficits [13].

Clinical significance: These bars are important anatomically, anthropologically as well as clinically.

Anatomical significance of these bars is that exhibits a variable distribution in different ethnic groups, as shown in table I.

Racial predilection: These ossifications on the lateral side of the foramen ovale - the pterygoalar bars are more prevalent in other races than in Caucasians, in whom bars on the medial side of the foramen ovale are more common[4]

Sexual dimorphism: These are more common in males.

Side preference: These are marginally more on left side[4,17].

What should interest the anatomists is that the incidence of these bars is significantly high, pterygospinous bars (2% - 23%) and the pterygoalar bars (1% - 62%), as reported in different studies, so deserves further study.

Anthropologists find a lot of interest in these bars. In lemurs pterygospinous bar is present, while in pithecoids is absent. However in human and anthropoids the pterygospinous bar is present but usually not complete[20]. The bar is present in herbivora, rodentia, carnivora, and old world monkeys but not in new world monkeys and in humans so are phylogenetic remnants as shown in studies[2]. Probably, if present these bars are atavistic or theromorphic pithecoid regressions[1].

These bars are important from the standpoint of clinicians to diagnose if the bony anomalies are the root cause of this excruciating, paroxysmal highly annoying pain syndrome, the 'tic douloureux', which can be triggered by chewing[19].

Radiographically these bars can be best viewed in submento vertical axial, the Hirtz view; a position attained in supine position with the radiographic baseline as the auriculo-orbital (Frankfurt's plane) kept parallel to the film and the beam centered at midline between the angles of the jaw, tilting it headward by 100 – 200 and hyper extending the neck so that the vertex touches the sliding bucky, and shoulders well raised by pads.

Treatment options: When the pain of trigeminal neuralgia does not respond to any medical treatment then a surgical procedure becomes mandatory. One of the options for neurosurgeons

is to perform a neurectomy or microvascular decompression of the Gasserian ganglion by a transcranial skull base approach, which is an operation of considerable magnitude with associated hazards. Other safe alternatives are the balloon compression, radiofrequency thermal ablation of the trigeminal ganglion or glycerol injections into the trigeminal cistern [21]. Stereotactic gamma knife radio-surgery is the newest procedure. Most commonly neurolysis of the retrogasserian plexus is done by percutaneus transovale neurolysis taking supramandibular lateral or transzygomatic horizontal approach [1]. The needle is directed from skin to the lateral border of the foramen ovale. If present, the pterygoalar bar will obstruct the further passage of needle to the foramen ovale [22], especially in horizontal route [4], obligating to abort the procedure at hand. In contrast the pterygospinous bar always lying medial to the foramen ovale does not pose any hindrance anywhere throughout the passage of needle and thus in the treatment. With the advancement in technology, the above procedure if done under radiological surveillance, definitely has an edge over the intracranial approach. The results are more accurate and safe with total success and almost nil failure [23,22].

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Conflicts of Interests: None

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