

## Original Article

## The incidence of Civinini's bar in adult Anatolian dry skulls: An anatomical study

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## ABSTRACT

**Introduction:** Civinini's ligament is among the intrinsic ligaments of sphenoid bone that may occasionally ossify. The ossification may be complete or incomplete and unilateral or bilateral. It may lead entrapment of neighboring neurovascular structures and may cause difficulties during surgical procedures through infratemporal fossa. Therefore, the aim of the present study was to demonstrate the incidence and types of Civinini's bar and discuss its clinical relevance.

**Methods:** Sixty-six adult human Anatolian dry skulls with unknown age and sex were obtained from the Department of Anatomy. All skulls were examined and classified with regard to presence or absence, side and ossification degree of Civinini's bar.

**Results:** A total incidence of 31.81% of different types of Civinini's bars was observed, out of which 1.51% were Type I, 18.18% Type II, 1.51% Type III, 0% Type IV and 10.60% were of Type V variety.

**Discussion:** Complete or incomplete ossification of Civinini's ligament have significant relation with blockage and entrapment of important neurovascular structures. A thorough knowledge of the anatomy and incidence of Civinini's bar and related clinical situations could be important for radiologists, neurosurgeons, maxillofacial surgeons, anaesthetists, anatomists and anthropologists.

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## 1. Introduction

Sphenoid bone involves several intrinsic ligaments such as interclinoid, pterygospinous and caroticoclinoid that may occasionally ossify.<sup>1</sup> Among them, Civinini's ligament (pterygospinous ligament) extends from the upper part of the posterior border of the lateral pterygoid plate to the spinous process of the sphenoid bone.<sup>2</sup> Complete or incomplete ossification of this ligament forms a bony bridge (Civinini's bar), which creates the Civinini's foramen (pterygospinous foramen) just medially to the foramen ovale.<sup>3</sup> Complete ossification of the ligament forms a foramen called Civinini which varies between 2 and 12 mm in size.<sup>4</sup>

The ossified Civinini's ligament may lead to the entrapment of neurovascular structures in the exocranial region of the foramen ovale and cause difficulties during surgical procedures through infratemporal fossa.<sup>2,5–7</sup> Such entrapments may produce various clinical symptoms such as pain during the mandibular function and trigeminal neuralgia.<sup>4,8</sup> Furthermore, entrapment of the

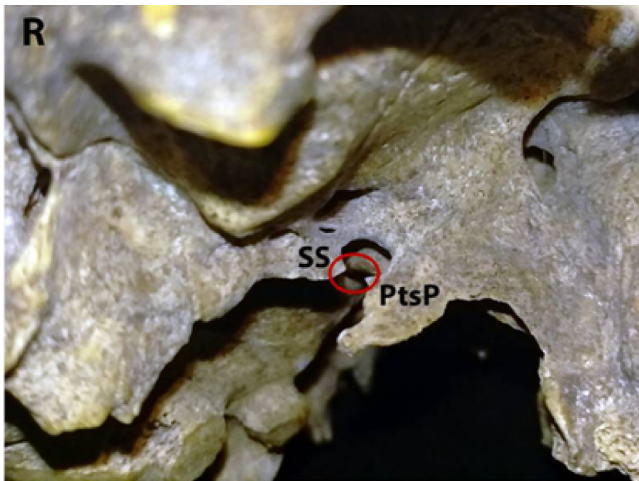
lingual nerve may cause numbness in its area of distribution or pain associated with speech impairment.<sup>2,9,10</sup> On the other hand, mandibular nerve block may be challenging due to the presence of the Civinini's bar acting as a barrier to the passage of needle through the foramen ovale.<sup>6,11</sup>

A good knowledge of the anatomy and the incidence of Civinini's bar is important for clinicians, especially for maxillofacial surgeons.<sup>9</sup> Therefore, the aim of the present study was to demonstrate the incidence and types of Civinini's bar and discuss its clinical relevance.

## 2. Material and methods

A total of 66 adult Anatolian dry skulls of unknown sex were obtained from the Akdeniz University Department of Anatomy. The study was approved by the Ethics Committee on Human Research of the Akdeniz University. Skulls with abnormalities such as fractures or morphological asymmetries were excluded from the study. Both sides of the skull bases were examined meticulously for the presence or absence of Civinini's bar. As previously described, Civinini's bars were classified into five types based on the side and complete or incomplete ossification of the bar.<sup>7</sup> Unilateral complete ossification was evaluated as Type I, unilateral

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**Fig. 1.** Type II Civinini's bar- circle shows unilateral partially ossified pterygospinous ligament (R: Right, SS: Sphenoid spine, PtsP: Pterygospinous process).

incomplete ossification as type II, unilateral complete ossification on one side and incomplete ossification on other side as Type III (mixed type), bilateral complete ossification as type IV and bilateral incomplete ossification as Type V.<sup>7</sup>

### 3. Results

Presence of complete or incomplete Civinini's bar was observed in twenty-one (31.81%) dried skulls. Ossification was incomplete in 19 skulls (28.78%), in 12 (18.18%) unilaterally and in 7 (10.60%) bilaterally. Unilateral complete Civinini's bar (Type I) was observed in one skull on left side. Unilateral incomplete Civinini's bar (Type II) was found in 12 skulls, 4 of them were right and 8 of them were left sided (Fig. 1). In one skull (1.51%), unilateral complete ossified Civinini's bar on one side and partially ossified on the other side (Type III) was observed (Fig. 2). Type IV was not observed in any skull. Bilateral partial ossification (Type V) was found in 7 skulls, as well (Table 1) (Fig. 3).

### 4. Discussion

#### 4.1. Anatomy and classification

Civinini's ligament is one of the intrinsic ligaments of sphenoid bone which connects the posterior margin of the lateral pterygoid plate with the base of the spine of sphenoidal bone. In 1837, Italian anatomist Civinini described the Civinini's bar which formed as a result of the ossification of this ligament in varying degrees.

**Table 1**

The distribution of the types I, II, III, IV and V of Civinini's bar.

|                  | Type I    | Type II     | Type III  | Type IV | Type V     | Total       |
|------------------|-----------|-------------|-----------|---------|------------|-------------|
| <b>Right</b>     | 0         | 4 (6.06%)   | 0         | 0       | 0          | 11 (16.66%) |
| <b>Left</b>      | 1(1.51%)  | 8 (12.12%)  | 0         | 0       | 0          | 9 (13.63%)  |
| <b>Bilateral</b> | 0         | 0           | 1(1.51%)  | 0       | 7 (10.60%) | 1(1.51%)    |
| <b>Total</b>     | 1 (1.51%) | 12 (18.18%) | 1 (1.51%) | 0       | 7 (10.60%) | 21 (31.81%) |

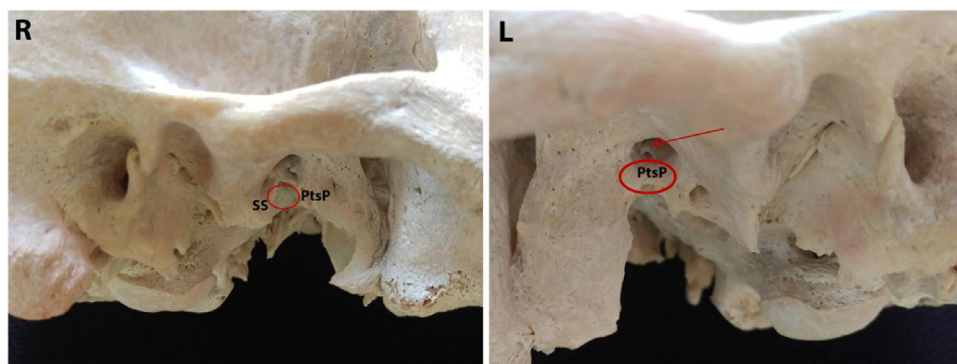
Civinini's bar may be located medial or lateral to the foramen ovale.<sup>4,9</sup>

Several classifications have been made for the ossified Civinini's ligament based on the degree of the ossification.<sup>3,9,12,13</sup> In most studies, Civinini's bars were classified into two types as complete and incomplete,<sup>9–12</sup> while some did not include any classification system.<sup>14,15</sup> In the present study, Civinini's bars were classified into 5 types regarding both the side and degree of ossification as previously described by Verma et al.<sup>7</sup> The proposed classification allows to define the mixed type (unilateral complete ossification on one side and incomplete ossification on other side) of the Civinini's bar which has not been mentioned in majority of the studies.<sup>3,5,9,12,13,16</sup>

#### 4.2. Etiology and incidence

The existence of Civinini's bar in human is considered as a phylogenic remnant because it was found in all the skulls of herbivora, rodentia, carnivore, and old world monkeys, but not in new world monkeys.<sup>4,5,17</sup> The etiology of the ossification of the Civinini's ligament remains unclear. There were studies reporting that it was secondary ossification of intrinsic ligaments of the sphenoid bone,<sup>2</sup> as well as the ossification was genetically controlled and showed a racial variation in frequency.<sup>4,18</sup>

Due to its close relationship with the foramen ovale and diverse clinical relevance, the incidence of the ossification of Civinini's ligament have been extensively studied.<sup>4,17,19–22</sup> Variable incidence rates for Civinini's bar have been reported between and within populations ranging from 0.95% to 38% (Table 2). Different studies revealed a total incidence of 38% on Greek population,<sup>10</sup> 6% for Japanese population,<sup>17</sup> 14.64% on Brazilian population,<sup>13</sup> 1.3%–6.28% on American population,<sup>20,21,23</sup> 9.61%–18.10% on Indian population,<sup>5,7,9,12,24,25</sup> and 35.6% on Anatolian population.<sup>3</sup> (See Table 2) Current study revealed a total of 31.81% incidence rate which was within the reported range in the literature. Our findings were very much similar to that Peker et al.,<sup>3</sup> which was the only study carried out on Anatolian population, however, they did not mention the mixed type that we observed to be 1.51% in Anatolian population.



**Fig. 2.** Type III Civinini's bar- circle shows unilateral complete ossified pterygospinous ligament on one side and incomplete on other side. Arrow shows foramen Civinini (R: Right, L:Left, SS: Sphenoid spine, PtsP: Pterygospinous process).

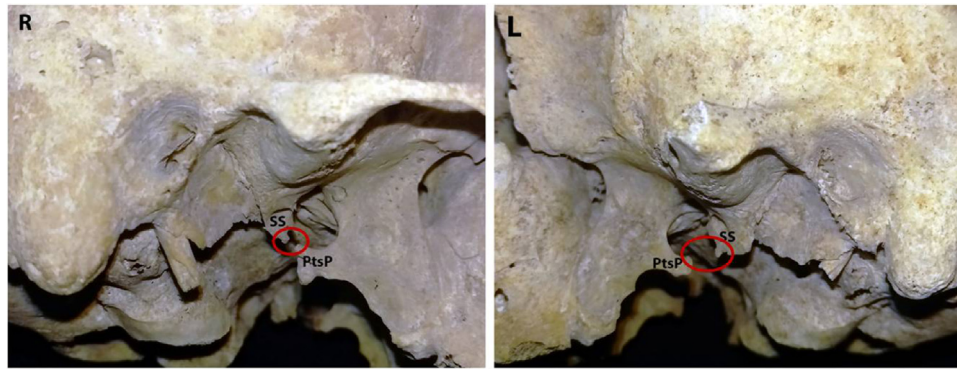


Fig. 3. Type V Civinini's bar- circle shows bilateral partially ossified pterygospinous ligament (R: Right, L:Left, SS:Sphenoid spine,PtsP: Pterygospinous process).

Table 2

Incidence of Civinini's bar types in various studies. (UI: unilateral incomplete, BI: bilateral incomplete, UC: unilateral complete, BI: bilateral incomplete).

| Study                                   | Number of skulls | Civinini's Bar (%) |       |       |      |      | Mixed | Population |
|---|------------------|--------------------|-------|-------|------|------|-------|------------|
|   |                  | Presence           | UI    | BI    | UC   | BC   |       |            |
| (Antonopoulou et al.; 2008)             | 50               | 38                 | 22    | 14    |      | 2    |       | Greek      |
| (Chouke; 1946)                          | 1544             | 6.28               |       |       | 4.99 | 1.29 |       | American   |
| (Chouke; 1947)                          | 2745             | 5.45               |       |       | 2.25 | 3.20 |       | American   |
| (Das&Paul; 2007)                        | 50               | 2                  | 2     |       |      |      |       | Unstated   |
| (Ebenraj; 2014)                         | 90               | 70                 | 30    | 34.44 | 5.55 |      |       | Unstated   |
| (Galdames et al.; 2010)                 | 312              | 14.64              | 13.05 |       | 1.59 |      |       | Brazilian  |
| (Kavitha Kamath&Vasanth; 2014)          | 100              | 17                 | 15    | 1     | 1    |      |       | Indian     |
| (Goyal&Jain; 2016)                      | 75               | 17.34              | 4     | 10.67 | 1.33 | 1.33 |       | Indian     |
| (Krupanidhi et al.; 2014)               | 105              | 0.95               |       |       |      | 0.95 |       | Unstated   |
| (Nayak et al.; 2007)                    | 416              | 9.61               | 1.92  | 1.92  | 5.76 |      |       | Indian     |
| (Rosa et al.; 2010)                     | 93               | 31.20              | 9.68  | 9.68  | 3.23 | 5.38 | 3.23  | Unstated   |
| (Saran et al.; 2013)                    | 80               | 11.25              | 5     | 3.75  |      |      | 2.5   | Unstated   |
| (Vijaykumar Shankar Shinde&Patil; 2011) | 65               | 3.07               | 3.07  |       |      |      |       | Unstated   |
| (Tebo; 1968)                            | 516              | 36.9               | 28.6  |       | 8.3  |      |       | Indian     |
| (Tubbs et al.; 2009)                    | 154              | 1.3                | 0.65  |       | 0.65 |      |       | American   |
| (Verma et al.; 2013)                    | 116              | 18.10              | 8.62  | 4.31  | 1.72 |      | 3.45  | Indian     |
| (von Ludinghausen et al.; 2006)         | 100              | 6                  |       |       | 6    |      |       | Japanese   |
| (Yadav et al.; 2014)                    | 500              | 10.20              | 5     | 1.20  | 4    |      |       | Unstated   |
| (Chakravarthi; 2013)                    | 100              | 4                  | 1     |       | 3    |      |       | Unstated   |
| (Krpmotic-Nemanic et al.; 1999)         | 100              | 5                  |       |       | 3    | 2    |       | Unstated   |
| (Devi et al.; 2012)                     | 204              | 11.78              | 9.31  |       | 0.99 | 1.47 |       | Indian     |
| (Peker et al.; 2002)                    | 452              | 35.6               | 24.55 |       | 5.75 | 3.1  |       | Anatolian  |
| (Aggarwal et al.; 2012)                 | 134              | 9.7                | 6.7   |       | 3    |      |       | Unknown    |
| (Kapur et al.; 2000)                    | 305              | 18.34              | 10.82 | 3.93  | 2.29 | 1.31 |       | Unstated   |
| Present study                           | 66               | 31.81              | 18.18 | 10.60 | 1.51 |      | 1.51  | Anatolian  |

#### 4.3. Clinical aspects

The importance of the osseous structures in the infratemporal fossa is not only an anatomic concern. Ossification of Civinini's ligament may cause entrapment of the lingual branch of mandibular nerve which travels between this ligament and the medial pterygoid muscle.<sup>10, 12, 13</sup> This entrapment of the lingual nerve may have significant implications leading to numbness, hypoesthesia or anaesthesia of all supplied regions such as mucosa of the floor of the mouth, the presulcal part of the tongue and lingual gingiva, and pain during mandibular movements.<sup>2, 14, 19, 22</sup> The other branches of mandibular nerve, that innervate the muscles of mastication, also may get compressed resulting in numbness or associated pain with movement of the mandible.<sup>23, 26</sup> Furthermore, Peucker et al. reported that ossification of Civinini's ligament might interfere with salivation owing to the compression of the auriculotemporal nerve.<sup>2</sup>

Another possible clinical concern related to the ossification of Civinini's ligament is the compression of chorda tympani branch of facial nerve which may result in impairment of taste sensation to

the anterior two thirds of tongue.<sup>26</sup> It has been also reported that the Civinini's bar could hinder the blood supply of trigeminal ganglion by occluding the vessels and lead to trigeminal neuralgia.<sup>27–29</sup>

On the other hand, the presence of an ossified Civinini's ligament may cause difficulties in performing anaesthesia for trigeminal neuralgia and surgical approach to the para- and retro-pharyngeal space via the lateral transzygomatic infratemporal fossa.<sup>4, 10, 17, 23</sup>

#### 5. Conclusion

Complete or incomplete ossification of Civinini's ligament have significant relation with blockages and entrapments of important neurovascular structures. Such variable osseous formations should be kept in mind while performing invasive procedures in or near the infratemporal fossa. A thorough knowledge of the anatomy and incidence of Civinini's bar and related clinical situations could be important for radiologists, neurosurgeons, maxillofacial surgeons, anaesthetists, anatomists and anthropologists.

## Conflicts of interests

The authors declare no conflict of interests.

## Acknowledgements

None declared.

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