

An anatomical study of the pterygoalar bar and the pterygoalar foramen

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The paper presents anatomical considerations on the pterygoalar bar and the pterygoalar foramen of the human skull. The pterygoalar bar is a bony bridge that stretches between the lateral pterygoid lamina and the greater wing of the sphenoid bone, while the space under this bar is termed the pterygoalar foramen. These structures were noted in 5 out of 70 investigated skulls. The length of the pterygoalar bar ranged from 4 to 8 mm, while the diameter of the pterygoalar foramen ranged from 7 to 11 mm. The presence of the pterygoalar bar is clinically important because it may disturb access to the foramen ovale during anaesthesia of the trigeminal nerve.

Key words: pterygospinous ligament, pterygospinous foramen, foramen *crotaphitico-buccinatorium*, pterygoid process, sphenoid bone

INTRODUCTION

The term “pterygoalar bar” applies to bony formations (osseous bridges or laminae) which result from ossification of the ligaments that are stretched between the lateral pterygoid plate and the greater wing of the sphenoid bone in the outer aspect of the skull base, running closely to the foramen ovale (Fig. 1). These structures are also known as *laminae pterygospinosae*, the pterygospinous process and the limited spaces by these structures are termed the foramen pterygospinale, pterygoalar foramen or *foramen crotaphitico-buccinatorium* [3, 4, 9, 10]. The bony bar which projects from the posterior border of the lateral pterygoid plate to the sphenoid spine is termed the *lamina pterygospinosae* and the limited space above it the pterygospinous foramen. Hence, similar lamina may extend from the root of the lateral pterygoid plate (passing over the groove which runs from the foramen ovale outwards) to the inferior surface of the greater wing of the sphenoid bone, than it limits the *foramen crotaphitico-buccinatorium* [3, 10].

Occasionally foramen pterygospinale may transmit the nerves and vessels for the pterygoid muscles, particularly to the medial pterygoid. The *foramen crotaphitico-buccinatorium* provides passage for some of the motor fibres of the trigeminal nerve (i.e. the masseter nerve) and deep temporal nerves [1]. The pterygoalar bar and pterygoalar foramen are rare cranial features but their presence may be of clinical importance in the event of trigeminal nerve injection or anaesthesia. Little is known of the incidence of these anatomical formations in the human population and there is only scarce information on their morphology in the literature [11, 12]. A complete unilateral pterygoalar bar has been found in about 5% of Anatolian skulls and with greater frequency in Negro, while the incidence of the bilateral pterygoalar bar is very low (1%). Thus, the occurrence of the pterygoalar bar and foramen may vary from 1% to 10% [5, 6, 8]. A similar incidence has been calculated by Kapur et al. [8] for the pterygoalar foramen (*foramen crotaphitico-buccinatorium*, foramen pterygospinale).

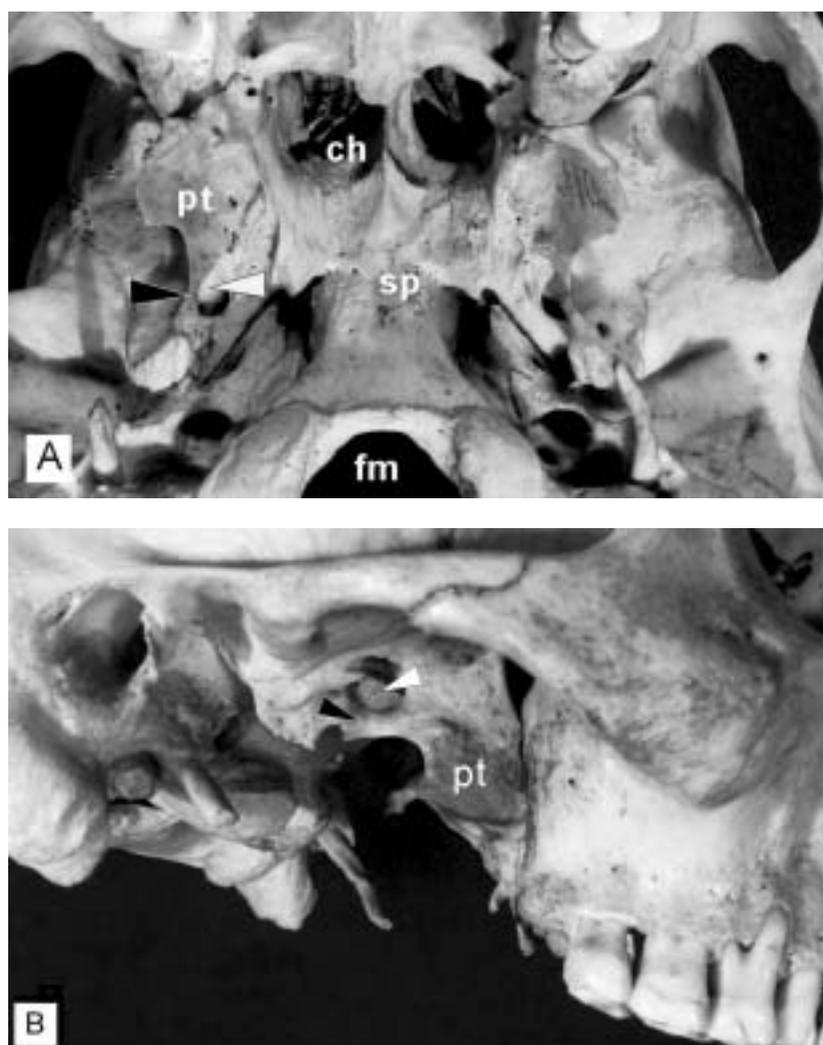


Figure 1. Inferior (A) and lateral (B) view of the pterygoalar bar (black arrow) and the pterygoalar foramen (white arrow); pt — lateral plate of the pterygoid process, ch — choana, sp — sphenoid bone, fm — *foramen magnum*.

The aim of this study was to investigate the morphological appearance of the pterygoalar bar and the pterygoalar foramen in the human skull and to evaluate their topography in the basicranium (Fig. 1).

MATERIAL AND METHOD

Examination of the pterygoalar bar and the pterygoalar foramen was performed on 70 non-deformed dry skulls, which are housed in the Department of Anatomy of the Collegium Medicum of the Jagiellonian University. The examined skulls show a varied craniofacial morphology but they are not identified with any particular populations. Thus the results of our study do not provide information on the incidence of the pterygoalar bar and the pterygoalar foramen but focus on morphological considerations only.

The external appearance of the pterygoalar bar and its location towards the foramen ovale was visually inspected. It was recorded whether the pterygoalar bar was unilateral or bilateral and whether it was complete or incomplete. In addition, the length of the pterygoalar bar and the maximum diameter of the pterygoalar foramen were measured with a digital sliding calliper.

RESULTS

Visual inspection of the basicranium of the 70 skulls revealed the presence of a pterygoalar bar and the pterygoalar foramen in 5 cases. The pterygoalar bar was located medially or laterally to the foramen ovale, while in one case it crossed the foramen ovale (Fig. 2). Thus, we confirm that the position of the pterygoalar bar differs towards the foramen ovale

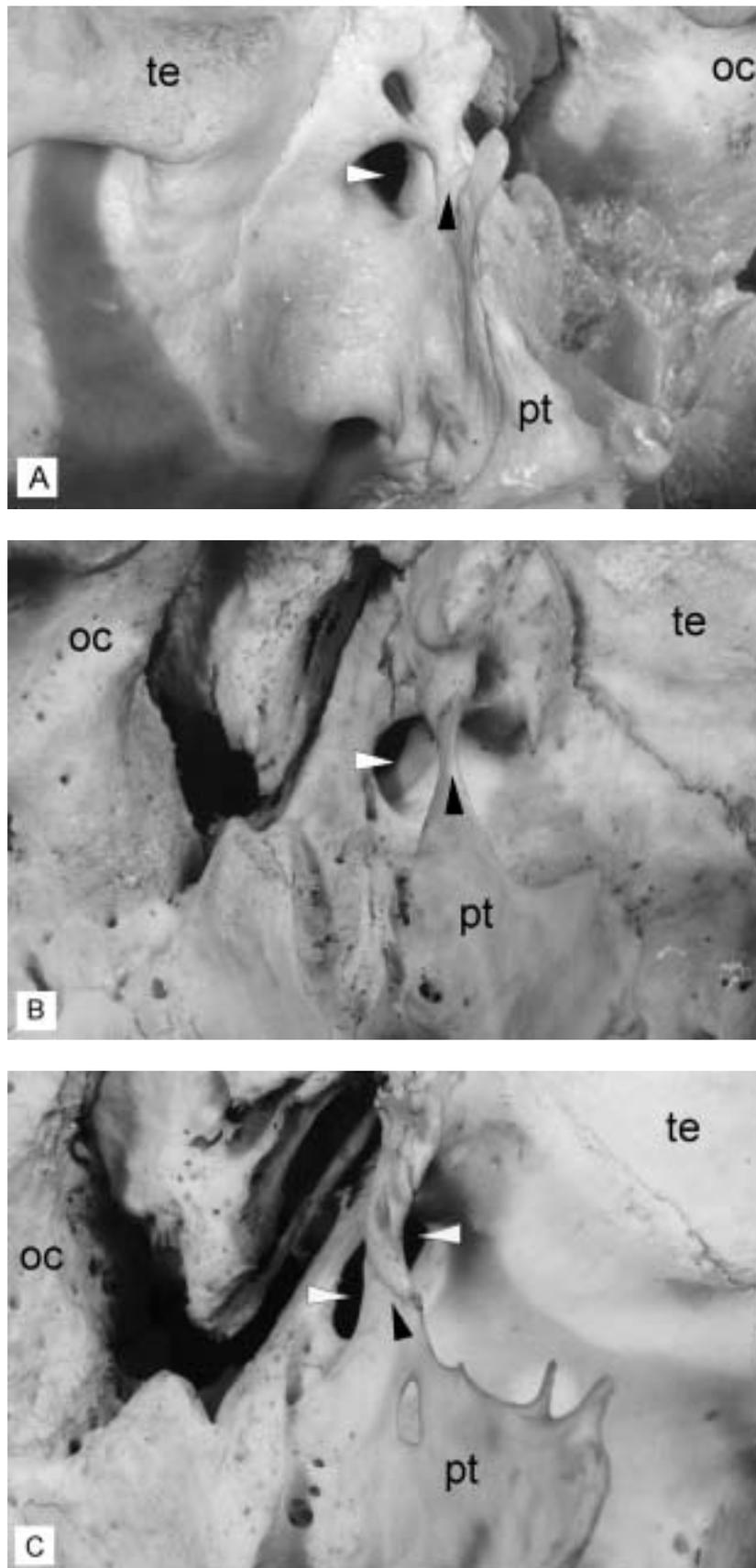


Figure 2. Position of the pterygoalar bar (ossified pterygospinous ligament — black arrow) to the foramen ovale (white arrow); **A.** Medial; **B.** Lateral; **C.** Across the lumen of the foramen ovale; oc — occipital bone, te — temporal bone, pt — pterygoid process.

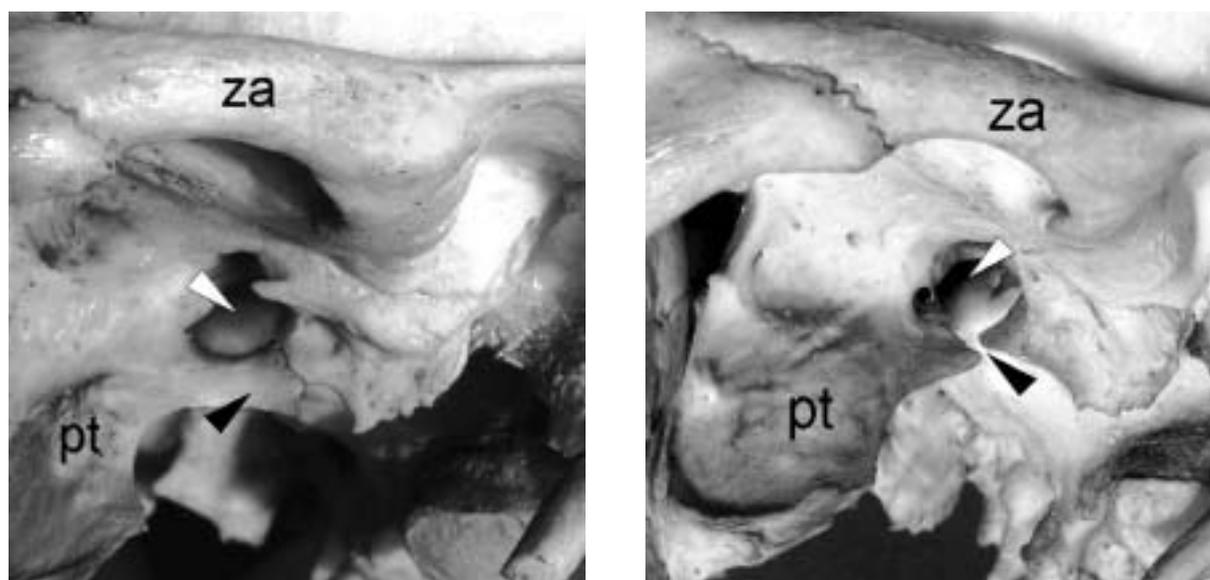


Figure 3. Complete and incomplete form of the pterygoalar bar (black arrow). Pterygoalar foramen indicated by white arrow; za — zygomatic arch, pt — lateral pterygoid plate.

and its size may vary from short and narrow bony trabeculae to wider laminae. Hence, we noted that the extension of these structures had three variants. First — the bar of bone arising from the posterior border of the lateral pterygoid plate was longer than that growing from the greater wing of the sphenoid bone. Second — a short bony process of the lateral pterygoid plate unites with a longer bony extension of the infra-temporal surface of the sphenoid bone. Third — the bony extensions contribute equally to the formation of the entire pterygoalar bar.

The complete pterygoalar bar and the pterygoalar foramen were found in both the female and the male skulls. An incomplete pterygoalar bar was observed in one case out of all the skulls observed (Fig. 3). We did not find any skull with a complete bilateral pterygoalar bar. However, one skull had a complete pterygoalar bar on the right side and an incomplete one on the left side. Measurements of the complete pterygoalar bar and of the pterygoalar foramen are given in Table 1.

DISCUSSION

The pterygoalar bar and the pterygoalar foramen are rarely described in anatomical literature and even papers on morphological variants and books of gross anatomy do not always mention of these structures [2, 4, 9, 15]. Hence, there is inconsistency in the usage of descriptive terms for osseous structures, which are ossified ligaments of the inferior surface of the sphenoid bone and exist close to the foramen ovale. In our material we found different variants of the accessory osseous trabeculae that exist close to the foramen ovale. They always arise from the posterior border of the lateral pterygoid plate but project to different regions of the inferior surface of the greater wing of the sphenoid bone. If the osseous bridge extended from posterior edge of the lateral pterygoid plate to the sphenoid spine, it could be recognised as the ossified pterygospinous ligament, which limited the foramen pterygospinale.

The osseous bridge, which arose from the root of the lateral pterygoid lamina to the infra-temporal

Table 1. Statistics for the length of the pterygoalar bar and the diameter of the pterygoalar foramen (measurements in millimetres)

| Feature | No. obs. | Mean value | Min. value | Max. value | Stand. dev. |
|---------------------------------|----------|------------|------------|------------|-------------|
| Length of pterygoalar bar | 5 | 6.2 | 4 | 8 | 1.67 |
| Diameter of pterygoalar foramen | 5 | 8.4 | 7 | 11 | 1.79 |

surface of the greater wing of the sphenoid bone, limited the space termed the *foramen crotaphitico-buccinatorium*.

In cases where the bony bridge was formed between the lateral pterygoid plate and the infra-temporal surface of the sphenoid bone or its greater wing and was not connected to the sphenoid spine, it was decided to name these osseous structures "pterygoalar bars" and "the pterygoalar foramen", respectively.

Our cranial material presented a rather low incidence of the accessory bony bars that exist along the foramen ovale. We did not therefore analyse separately the morphology of the ossified ligaments (e.g. the pterygospinous or pterygopetrosal) and the corresponding foramina (the *foramen crotaphitico-buccinatorium* and pterygospinale) but they were described collectively as pterygoalar bars and pterygoalar foramina.

Patnaik and colleagues discovered a pterygoalar bar arising from the upper posterior border of the lateral pterygoid plate and growing backwards and laterally towards the greater wing of sphenoid bone. They termed the foramen thus constituted *porus crotaphitico-buccinatorius*. The vertical and horizontal diameters of this foramen were 4.7 mm and 4.45 mm respectively [11]. In contrast, the diameters of the pterygoalar foramina of our investigated skulls ranged from 7 to 11 mm.

Either the caudal extension of the lateral pterygoid plate or the entire pterygoalar bar passing laterally to the foramen ovale may interrupt the injection of the trigeminal ganglion or mandibular nerve by blocking it [14]. In the case of anaesthesia within the foramen ovale, one should, in access to these neural structures, be aware of anatomical obstacles because of the possible presence of the complete or incomplete form of the pterygoalar bar. Percutaneous procedures for the treatment of trigeminal neuralgia involve the penetration of the foramen ovale [7]. This approach to the trigeminal ganglion may be difficult when the pterygoalar bar covers the foramen ovale. Radiological guidance is thus required to visualise the foramen ovale and its related structures, which makes puncture easier and more precise [8]. Otherwise, a higher dosage of the anaesthetic agent is recommended to influence effectively the trigeminal nerve or its branch.

Although the incidence of the pterygoalar bar and the pterygoalar foramen is low in the human

population, it would seem important to extend our knowledge of the morphology and topography of these structures. To improve therapeutic performance medical progress currently needs more accurate knowledge concerning the variability of human morphology [13].

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