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Functional Anatomy of the Premaxillary Area*

H.C. Hafkamp[1], Tj.D. Bruintjes[2], E.H. Huizing[1]

[1] Dept. of Otorhinolaryngology, Utrecht University, The Netherlands
[2] Dept. of Otorhinolaryngology, Hospital Centre Apeldoorn, The Netherlands

SUMMARY

Although the gross anatomy of the nasal septum is well-understood, the exact anatomy of its ventro-caudal or premaxillary area is not. More precisely, there is some confusion about the course of the perichondrial and periosteal fibers in this particular region. This paper considers the detailed anatomy of the chondro-spinal and chondro-premaxillary junction. Six cadaver noses were sectioned in the coronal (n=4) or the transverse (n=2) plane. The sections were stained according to the Mallory-Cason and the Haematoxylin-Eosine method and examined by light microscopy. At the chondro-spinal junction a relatively wide suture line filled with loose connective tissue fibers was found. The caudal margin of the cartilaginous septum is flanked by paraseptal cartilages. These broaden the septal base to fit onto the flat cranial surface of the anterior nasal spine. At the chondro-premaxillary junction a narrow suture with several crossing fibers between the perichondrium and periosteum was seen. Paraseptal cartilages, surrounded by their own perichondrium, cover the periphery of this area. It was concluded that the chondro-spinal junction provides stabilization while allowing some mobility of the septum, whereas the chondro-premaxillary complex stabilizes the septum without allowing mobility.

Key words: anterior nasal spine, premaxilla, septum

INTRODUCTION

The nasal septum plays a paramount role in nasal form and function. Surgery of septal pathology is challenging, even to the most skilled nasal surgeon. A thorough understanding of the anatomy and histology of the nasal septum will help the surgeon meet the special demands of functional corrective nasal surgery. Although the gross anatomy of the septum is well-known, there are still some gaps in knowledge about the exact anatomy of the premaxillary area.

The caudal margin of the cartilaginous septum rests, from ventral to dorsal, on the anterior nasal spine, the premaxilla, and the vomer. The connections between the cartilaginous plate and these bony structures are crucial to the stability of the cartilaginous part of the nasal pyramid. Any external nasal trauma may disrupt these connections and lead to a disturbance of nasal form and function.

There is some confusion in the literature concerning the course of the various perichondrial and periosteal fibers present at the sutures between the cartilaginous septum, the anterior nasal spine, and the premaxilla respectively. Lothrop (1910) found the deepest layer of the perichondrium and the periosteum passing through the suture line and fusing with each other. He claimed that both, the periosteum and perichondrium, adhere strongly to the bone, and not to the cartilage. Aymard (1917) found the perichondrial and periosteal fibers in a continuous band around the septal cartilage and the premaxilla respectively without actually touching each other. More recent studies (Cottle, 1958; Beeson, 1987; Oneal, 1996) describe a crossing-over of some of the perichondrial and periosteal fibers at the midline of the sutures.

The aim of the present study was to update and extend the knowledge of the anatomy of the anterocaudal part of the nasal septum by applying modern sectioning and staining techniques. Two areas were examined: the junction between the cartilaginous septum and the anterior nasal spine (chondro-spinal junction); and the junction between the cartilaginous septum and the premaxilla (chondro-premaxillary complex). The course of the various perichondrial and periosteal fibers was given special attention.

MATERIAL AND METHODS

Six noses from adult Caucasian cadavers were studied. The cadavers were fixed in 10% neutrally buffered formalin for about one year. The specimens were washed in buffered phosphate 0.1M at pH=7.4 for one day, decalcified in 5% HNO3 for 7 days, dehydrated in an accelerated concentration of alcohol for 5 days and put in xylene for 3 days. Finally, they were embedded in paraffin under a slowly rising vacuum of 200, 400, and 600 Torr

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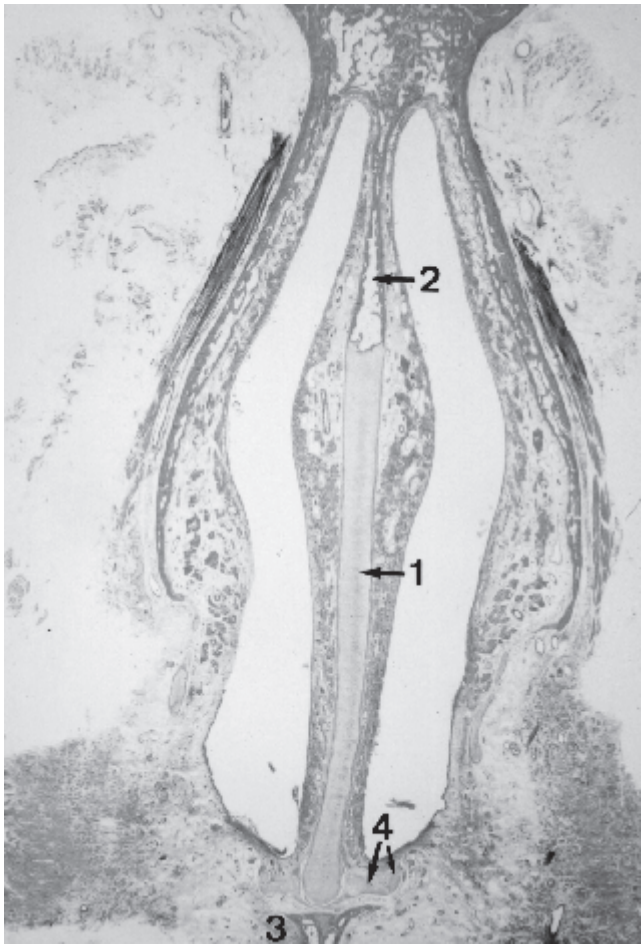

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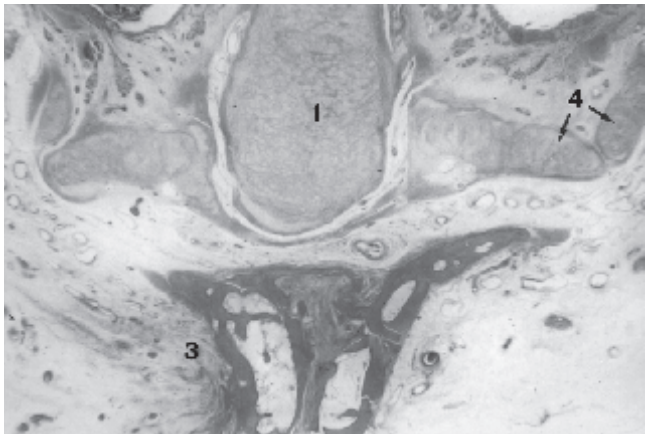

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Figure 1: Representative coronal section at the chondro-spinal junction (Mallory- Cason staining)

a: low magnification showing 1. cartilaginous septum, 2. lamina perpendicularis, 3. anterior nasal spine, 4. paraseptal cartilages.

b: high magnification showing a relatively wide suture filled with loose connective tissue fibers. The caudal base of the cartilaginous septum (1) is flanked by four paraseptal cartilages (4) that provides a broader septal base with extra support and stability. The cranial end of the anterior nasal spine (3) forms a corresponding flat surface. The perichondrial and periosteal fibers have a continuous course, the former around the septal cartilage and the latter around the anterior nasal spine. Connecting fibers cannot be seen.

at 60EC for 5 days. The blocks of paraffin with the embedded specimens were attached to microtome cutting tables by a mixture of 50 milliliter Technovit liquid 3040 with 50 grams of Technovit powder 3040.

Sections of 25 μm thickness were made in the coronal plane (n=4) or the transverse plane (n=2) by a microtome (type PMV 200). The distance between two sections was 150 μm. Prior to sectioning, an adhesive tape was fixed on the surface of the paraffin block. After sectioning, the thin sections of paraffin and tissue were stained according to a Haematoxylin-Eosine or a modified Mallory-Cason method (Mallory-Cason trichrome staining procedure modified by Van Leeuwen et al., 1990). The staining bath contained a solution of 0.5 g phosphotungstic acid, 0.1 g of orange G, 0.1 g of acid fuchsin in 100 ml of distilled water. Finally, the sections including the tape were mounted on glass slides with entellan. In each histological section, the relationships between the cartilaginous septum and its neighboring structures were studied by light microscopy. Special attention was given to the perichondrium, the periosteum, and the connecting fibers. Two of the specimens were also examined by Zhai et al. (1996) as part of their study of lobular anatomy.

RESULTS

The chondro-spinal junction

Microscopic examination of the junction between the cartilaginous septum and the anterior nasal spine shows a gap of about 0.5 mm filled with connective tissue fibers and relatively large blood vessels. The base of the septal cartilage is covered by a continuous perichondrial layer. The cranial end of the anterior nasal spine forms a flat surface covered by the periosteum. Connecting fibers between the periosteum and the perichondrium could not be found (Figure 1a,b).

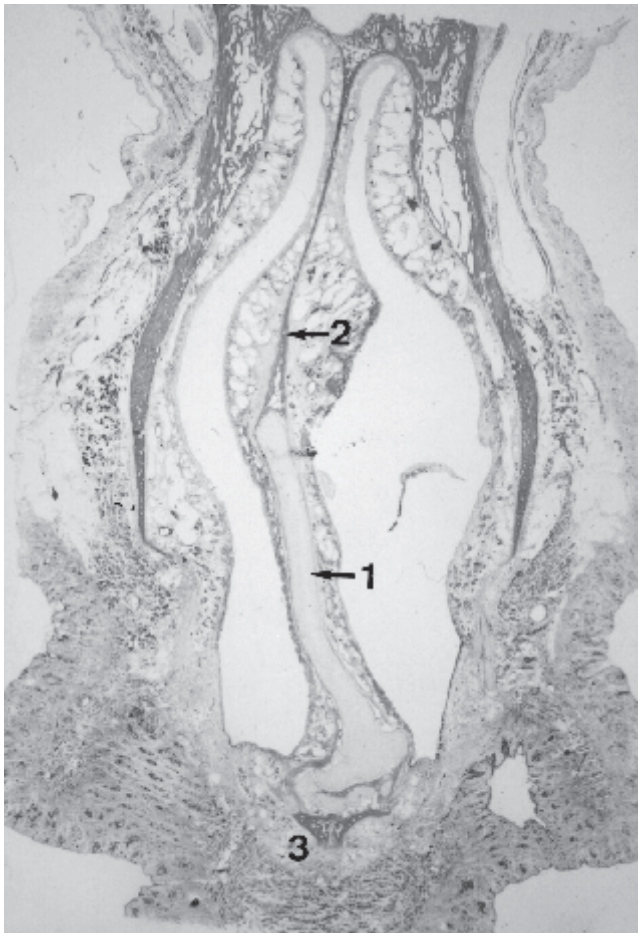
The caudal, pear-shaped base of the quadrangular cartilage was usually found to be flanked by one or two small pieces of cartilage on either side. These paraseptal cartilages were covered by their own envelope of perichondrial fibers. The form and position of the paraseptal cartilages provide the cartilaginous septum a broader base to rest on the wide, flat surface of the anterior nasal spine. Crossing fibers between the perichondrium of the cartilages and the periosteum could not be found.

Due to congenital abnormalities, infections, or trauma, the above anatomy may deviate somewhat from the above description. Figure 2a,b for example, shows a moderate deviation of the cartilaginous and bony septum to the right, with some broad ening of the cartilaginous base leading to a small basal crest on the left. Various separate small cartilages are present in the junction and also laterally from it.

Judging from these findings, the chondro-spinal junction apperently serves to stabilize the septum at its pedestal. At the same time, it seems to allow a limited mobility of the most prominent part of the external nasal pyramid.

The chondro-premaxillary complex

The chondro-premaxillary complex (Figure 3a,b) is characterized by a narrow gap of about 0.1 mm. This gap is considerably smaller than the one at the chondro-spinal junction. The caudal margin of the cartilaginous septum shows a bilateral broadening, the so-cal-



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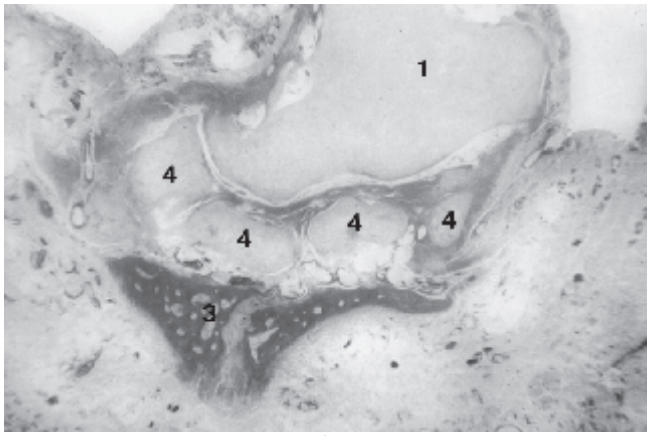

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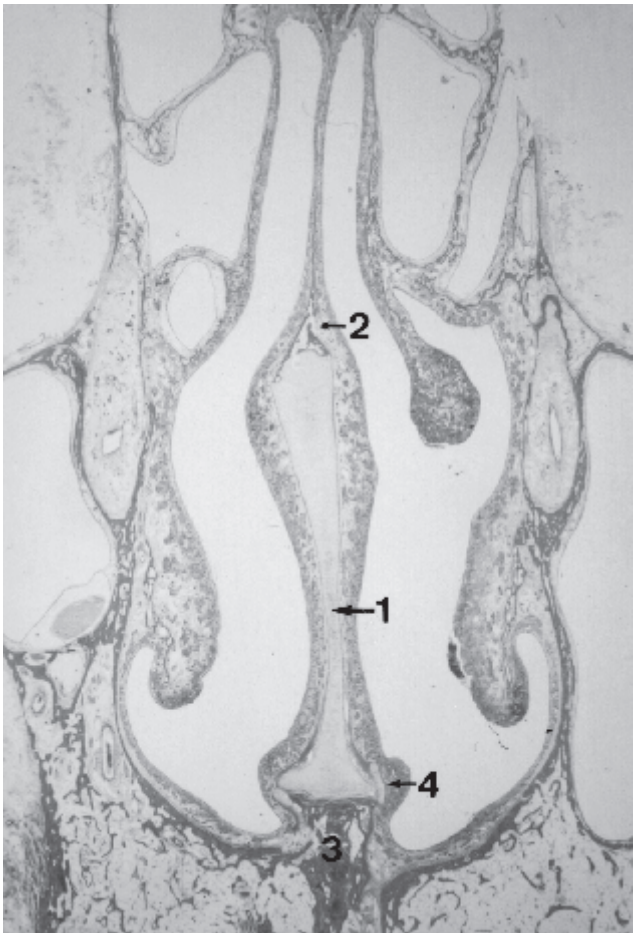
Figure 2: Coronal section at the chondro-spinal junction (Mallory-Cason staining).

a: low magnification showing a moderate deviation to the right of both the cartilaginous septum and the perpendicular plate. 1. cartilaginous septum, 2. lamina perpendicularis, 3. anterior nasal spine.

b: high magnification, showing a broadening of the cartilaginous base (1) and six small paraseptal cartilages (4) within and beside the suture.



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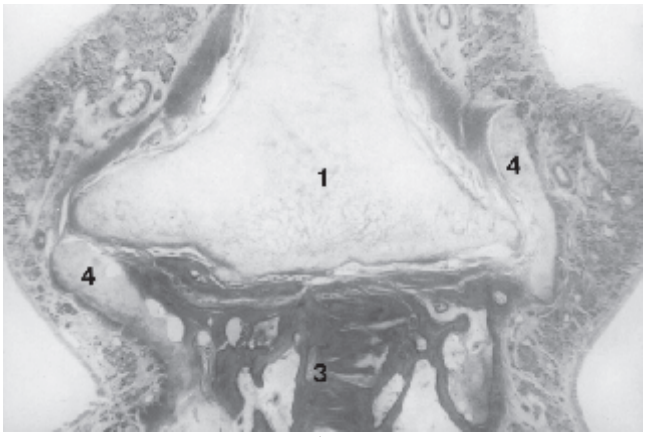

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Figure 3: Representative coronal section of the chondro-premaxillary complex (Mallory-Cason staining).

a: low magnification showing 1. cartilaginous septum, 2. lamina perpendicularis, 3. premaxilla, 4. paraseptal cartilages.

b: high magnification showing a narrow suture with a number of crossing fibers between the perichondrium and periosteum. The caudal margin of the cartilaginous septum (1) broadens laterally, forming the lateral process. The paraseptal cartilages (4) cover the periphery of the junction and are covered by their own envelope of perichondrium.

led lateral processes. This broadening is much more pronounced at this level than at the level of the anterior nasal spine. The cranial end of the premaxilla also shows a broadening, with premaxillary wings at both sides. Paraseptal cartilages kept in place by a tight perichondrium cover the lateral margin of the chondro-premaxillary complex.

The perichondrium overlaying the cartilaginous septum comprises an inner and an outer layer. The outer layer is continuous with the periosteum covering the lateral surface of the premaxilla. The inner layer either passes through the suture line to become continuous with the opposite perichondrium or crosses the suture line

to become continuous with the periosteum of the other side. The periosteum is adherent to the bone and has a similar crossing configuration around the superior edge of the premaxilla.
All anatomical details described above (narrow gap, connecting fibers, lateral processes, premaxillary wings, paraseptal cartilages) appear to serve the purpose of providing stability and rigidity.

DISCUSSION

The focus of this study is on the functional anatomy of the cartilaginous septum in relation to the premaxilla. The chondro-spinal and chondro-premaxillary area were studied as separate structures, whereas the anterior nasal spine is in fact the most ventral protrusion of the premaxilla (Ashley-Montagu, 1936). Special attention was devoted to the course of the periosteal and perichondrial fibers, since earlier investigations showed contradictory results.

The chondro-spinal junction

At the chondro-spinal junction, the caudal end of the quadrangular cartilage is supported by the anterior nasal spine. The cranial surface of the spine tends to be a rather flat bony plate. According to the literature, the septal cartilage also shows a lateral broadening (the lateral processes) that follows the configuration of the upper edge of the bone (Aymard, 1917; Klaff, 1956; Hollinshead, 1976). This study confirms that the cartilaginous part of the chondro-spinal junction has multiple components: the septal cartilage and a variable number paraseptal cartilages. This complex forms a broad articulating surface with the cranial edge of the anterior nasal spine, thus providing support and stability. Small pieces of cartilage in the junction between the septal cartilage and the anterior nasal spine (Figure 2a, b) were also found by Masing (1964). It is not clear whether these pieces are paraseptal cartilages or newly developed post-traumatic structures.
The present study could not demonstrate any crossing fibers in the chondor-spinal junction. This finding is in agreement with the outcome of studies by Klaff (1956) and Aymard (1917).

The chondro-premaxillary complex

Posterior to the anterior nasal spine, the septal cartilage is supported by the rest of the premaxilla. Our study reveals that the edges of the cranial surface of the premaxilla do not project as far later-ally as the processes extending from the anterior nasal spine. In contrast, the caudal end of the cartilaginous septum is broader at this level than at the chondro-spinal junction. This finding is in agreement with reports in the literature (Aymard, 1917; Hollinshead, 1976). The paraseptal cartilages that flank the chon-dro-premaxillary complex were found to be connected to it by a tight perichondrium.
The perichondrium overlaying the septal cartilages is divided into an inner and outer layer. We found the outer layer to be continuous with the periosteum covering the lateral surface of the premaxilla, whereas the inner layer was found to pass through the suture line. Neumann (1931) and Klaff (1956) previously described a similar feature at the chondro-vomeral junction. The present study confirms the existence of crossing fibers between the inner perichondrial layer and the periosteum, as described previously by Klaff (1956), Cottle (1958), Beeson (1987), and Oneal (1996).

CONCLUSIONS

1. At the chondro-spinal junction, the relatively wide suture line and the loose fibers of connective tissue between the cartilaginous septum and the anterior nasal spine allow a limited mobility of the protruding part of the septum in relation to the supporting bony structures. At the same time, the broadening of the caudal margin of the cartilaginous septum, the pre- sence of paraseptal cartilages, and the laterally projecting edges of the anterior nasal spine provide stability.
2. At the level of the chondro-premaxillary complex, the narrow suture line, the presence of crossing fibers, and the paraseptal cartilages that are connected to the lateral part of the junction by tight connective tissue serve stability without providing mobility of the chondro-premaxillary complex.
3. The lateral projections of the septal base, the wings of the premaxilla, and the strong mucoperichondrial and mucoperiosteal attachments make elevation of the mucoperichondrium and mucoperiosteum in this area particularly difficult during septal surgery.

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Prof. Dr. E.H. Huizing
Department of Otorhinolaryngology
University Hospital Utrecht
P.O. Box 85500
3508 GA Utrecht
The Netherlands