Histology of the Premaxillary-Vomerine Suture in a Bilateral Cleft Case

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Most plastic surgeons facing the challenging task of repairing the lip of a baby with a complete bilateral cleft lip and palate have been aware of, and have been able to localize the junction between the premaxilla and vomer. This anatomical structure has always been controversial. Its significance has also been interpreted differently not least because of its poor histological description.

From experience many surgeons have ascribed the suture an ability of overgrowth. Some (*2*) reported on the existence of a "prevomerine bone" causing the premaxillary protrusion characteristic for bilateral clefts. Others (*5*) mentioned a fibrocartilaginous structure between the premaxilla and vomer, but neither presented any histological proof. However, their opinion about a septal expansive growing structure guided their rehabilitation of these patients. Thus, the overgrowth was alleged as reason for a surgical septal resection combined with a premaxillary set-back at the time of lip closure.

More recently this concept of overgrowth of the suture in bilateral clefts was also demonstrated by Pruzansky (*9*) using roentgencephalometry in combination with metallic implants. His study included histological examination revealing a suture line which contained proliferating cartilage. This was interpreted as secondary to excess movement and pressure in the area.

A quite different view of the anatomy of the premaxillary-vomerine suture has also been presented. Monroe (*6, 7*), describing a histological specimen from a unilateral cleft case, noted no signs of overgrowth but rather a reduced osteoblastic activity in the suture if compared to a noncleft control case. This reduction was stated to cause the lacking maxillary growth, often seen postoperatively in cleft patients. Monroe also reported the suture to contain cartilage; yet without any comments.

Recently Burdi (*3*) presented a histological investigation of the premaxillary-vomerine junction in noncleft fetuses. He found exclusively an ordinary five layered suture, similar to that previously described by Pritchard et al. (*8*). No epiphyseal cartilaginous junction could be detected.

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However the author speculated, that in cleft cases the paraseptal cartilages might be rotated in the sagittal plane as is the premaxilla. This would then explain the cartilage in the sutural area between the premaxilla and vomer as described by Monroe (*6, 7*).

As more accurate knowledge about the suture might influence the rehabilitation of bilateral clefts, it was deemed important to describe the histology of the junction between the premaxilla and vomer. It was also felt that the use of serial sectioning would add further information about this structure than earlier available.

Materials and Method

A specimen was taken from the lateral part of the premaxillary-vomerine suture (Figure 1) from a patient with complete bilateral cleft lip and palate (age 9 months). Two months earlier, lip adhesion and closure of the anterior nasal floor by use of a vomer flap had been performed on the opposite side. After fixation (Bouin's fluid) and decalcification (formic acid 50% and sodium formiate 15%) the specimen was embedded (paraffin) and sectioned sagittally ($\approx$10 μm). Stainings used for routine histology were: Weigert's hematoxylin-van Gieson, Heidenhain's azan and he-

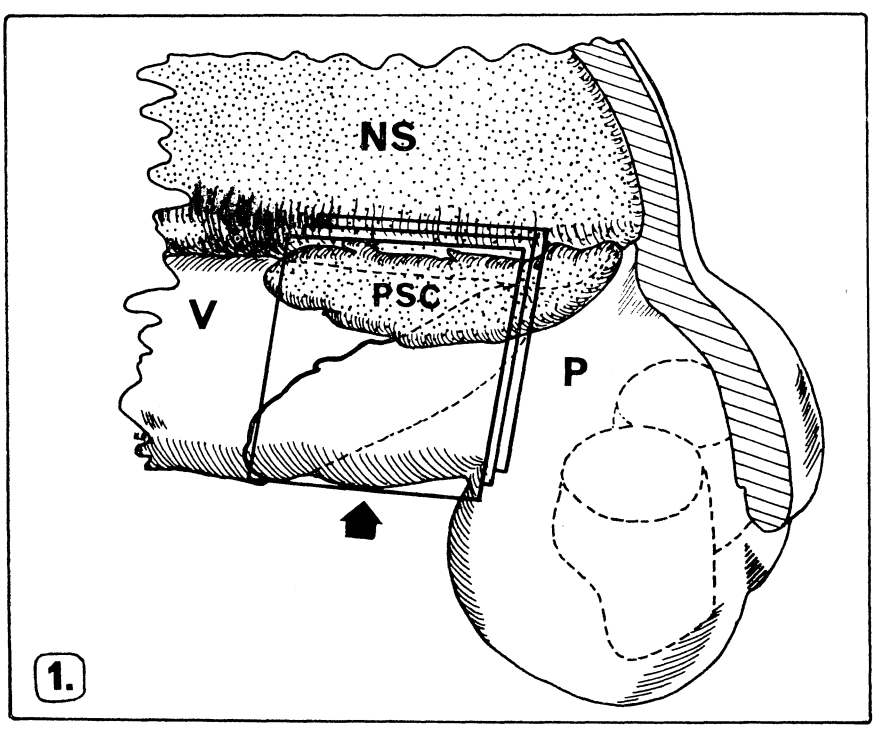


FIGURE 1. Schematic sideview of the septum and premaxilla with the other nasal soft tissue removed. Sectioned area indicated by arrow. NS = nasal septum, P = premaxilla, PSC = paraseptal cartilage, V = vomer.

matoxylin-eosin (*10*). For special study of the cartilage the stainings with toluidin blue at pH4 (*10*) and Astrablau (*1*) was selected.

Results

ANATOMY. The main direction of the suture was oblique from the inferior side of the septum running upward and forward (Figure 2). The front tip of the vomer, constituting the posterior surface of the junction, was not flat but rather convex. The suture, when passing through the cortical layer, was well-defined though slightly winding. These characteristics changed deeper into the junction to a more winding and also less well-defined extension (Figure 2). In this respect serial sections revealed a similarity between the sagittal and transverse plane. A paraseptal cartilage could be detected lateral to the suture but no cartilaginous extension into the junction was found.

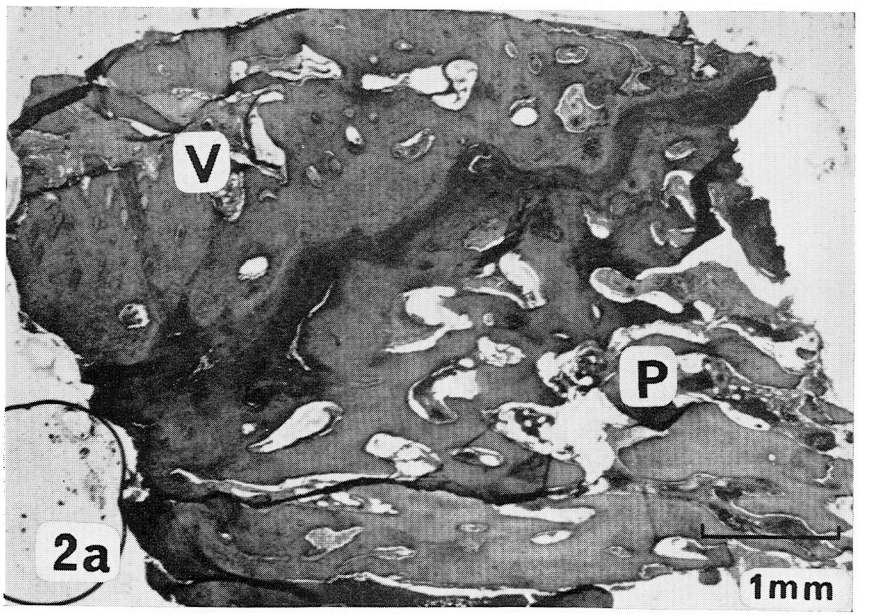
HISTOLOGY. In most sections of the suture five different zones could be distinguished (Figure 3). Closest to the sutural bone margins there was a *cambium* layer with osteoblasts, fibroblasts and undifferentiated mesenchymal cells. The collagen bundles in this zone were fine and their direction rather irregular while in the next layer, the *capsular* layer, they ran parallel to the bone edges. The fibres seemed markedly thicker, while the content of fibroblasts was less. The middle zone was most often very scanty and not as well defined as the other layers. When found, it contained vessels, both arteriols, sinusoids and venols while only few fibroblasts (Figure 4).

The margins of the suture in some areas exhibited irregular islands of large cartilage cells (Figure 5). The mitotic division seemed to be slow, indicated by only few lacunes with daughter cells. If compared to the neighboring bone tissue the matrix of the cartilage was rather sparse and not distinctly separated from the bone. Deeper into the sutural area more and larger cartilage islands were found than closer to the cortical bone. However in all instances the cartilage areas constituted but a limited part of the suture margins.

Discussion

This description of the premaxillary-vomerine suture centered on the existence of cartilage. An "epiphyseal line" (*6*) was looked for, because this structure is functioning as an active growth center in the long bones. If found, it might explain the protrusion of the premaxilla seen in complete bilateral clefts. However only small cartilaginous islands or conglomerates of cartilage cells were detected in the junction, and no "epiphyseal line" could be found what so ever.

This finding is in disagreement with Monroe (*6*), who noticed "the presence of cartilage between the premaxilla and vomer". He reported on *one* section of a unilateral cleft specimen with septal deviation in both the transverse and sagittal planes. A closer examination of his illustrations in-



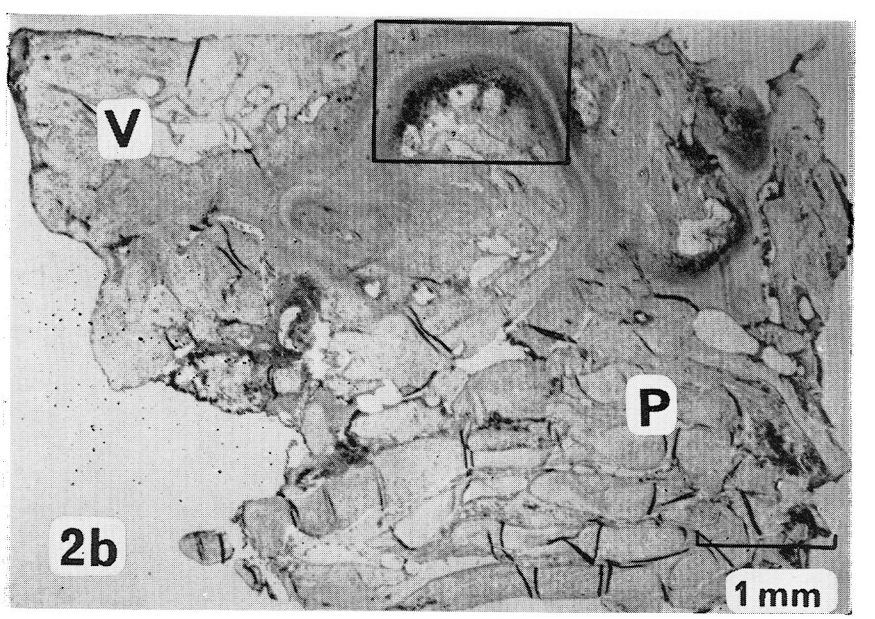


FIGURE 2. a) Well-defined extension of the premaxillary-vomerine suture close to the surface. Note the oblique direction. Htx-eosin. b) Winding extension of the suture in a deeper section. Conglomerates of cartilage cells outlined. Astrablau. V = vomer P = premaxilla.

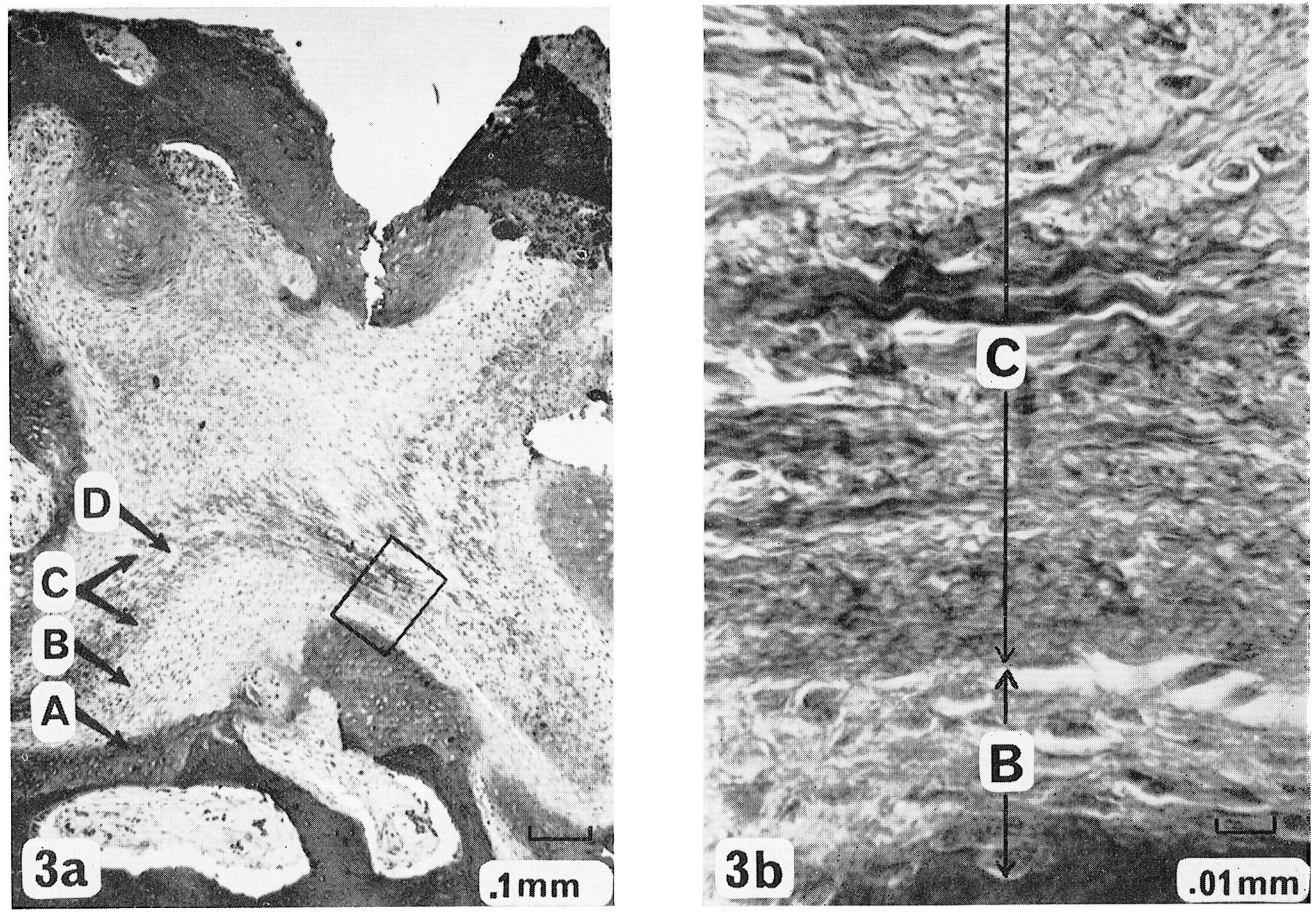


FIGURE 3. a) Part of a section of the suture showing the different zones. Weigert's htx-van Gieson. b) High power magnification of the area marked in figure 3a. Note the difference in the collagen fibres between the cambium and capsular layer. A = bone margin, B = Cambium layer, C = Capsular layer, D = Middle zone.

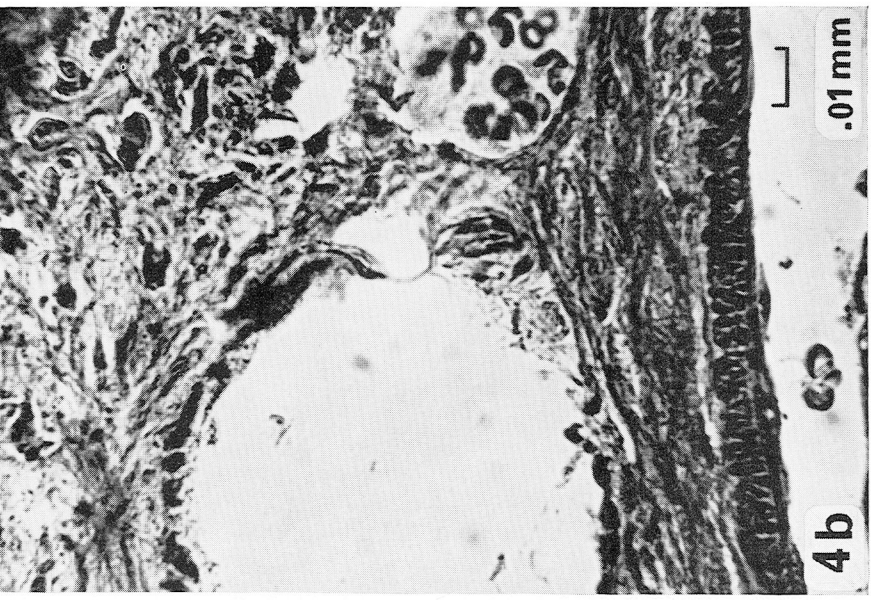
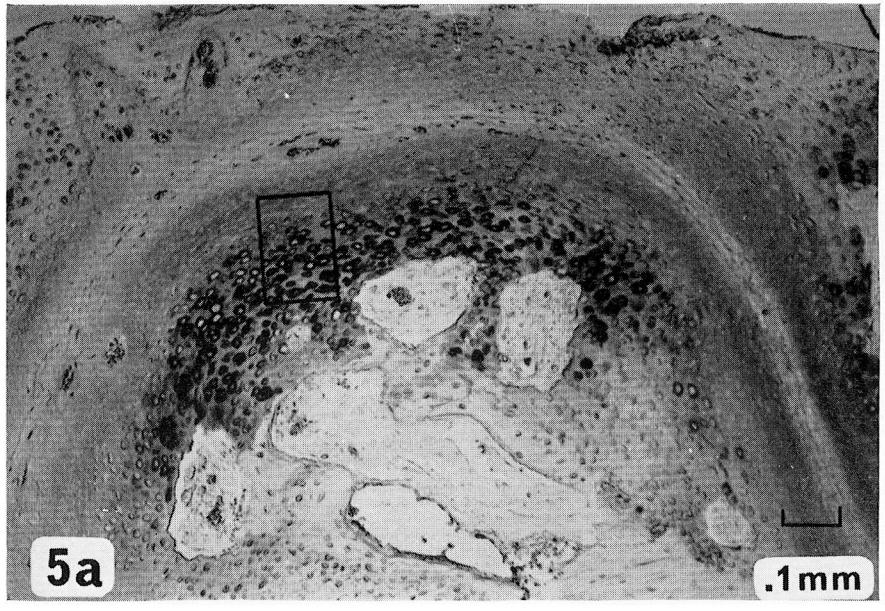


FIGURE 4. a) Arteriol and venol running parallel in the suture. Azan. b) High power magnification of the area indicated in figure 4a. A = bone margin. E = Arteriol. F = venol.



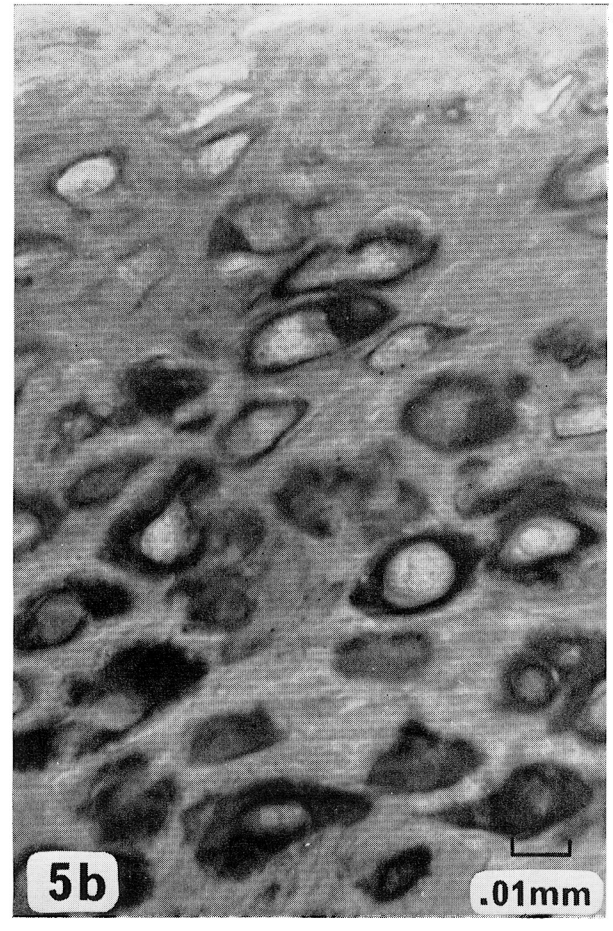


FIGURE 5. a) Medium power magnification of the section marked in figure 2b showing conglomerates of cartilage cells. Astrablau. b) High power magnification of the area indicated in figure 5a. Note sparse matrix and also sparse mitosis.

dicates, however, that he was describing the junction between the cartilaginous septum and the premaxilla. In a noncleft specimen this misconception would not likely be made, especially if using serial sectioning.

The explanation of Monroe's original description suggested by Burdi (*3*) could not be verified. The paraseptal cartilage was definitely separated from the suture by a perichondrium layer. It was also situated lateral to the septum similarly as in nonclefts.

The existence of cartilage cells in a suture was discussed earlier by Pritchard et al. (*8*) who considered these cells to be an alternative to bone formation. Referring to other authors (*4, 11*), they suggested different theories such as the cartilage cells being a result of strong pressure or having a protective function in the suture. They also mentioned the possibility that cartilage formation might be caused by "temporary ischaemic conditions associated with rapid growth".

Evidently the hard tissue forming cells have a potential for production of cartilage instead of bone tissue under certain circumstances. Some kind of mechanical, chemical or other type of stress may disturb the "normal" bone formation. Speculatively, the cartilage cells then develop under another type or degree of inductive influence. However the cartilage cells in the suture can hardly be taken as the cause for the premaxillary protrusion. Instead, the development of these cells must be considered as secondary to or perhaps simultaneous with the overgrowth. Also, the possibility cannot be overlooked that the previous surgery on the contrary side might have created a pressure in some part of the suture, even though the postoperative premaxillary deviation was only moderate. Studies on unoperated bilateral cleft cases and use of more specific histochemical techniques might shed further light on the function of these cells, usually not seen in human facial sutures.

Summary

The premaxillary-vomerine suture in a bilateral cleft case resembled an ordinary facial suture with five different zones discernible. The main sutural direction was oblique from the inferior side of the septum running upward and forward. Sparse conglomerates of cartilage cells were found on the bone edges but no "epiphyseal line" could be detected. The cartilage was interpreted as secondary to the overgrowth of the premaxillary-vomerine complex and not as causing the protrusion characteristic of an infant born with complete bilateral cleft lip and palate.

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