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Closure of Large Cribriform Defects with a Forehead Flap

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Summary

The use of a forehead flap for closure of a large cribriform plate defect is described in conjunction with a case history. The follow-up of our six cases for periods of four to seven years is reviewed. These six cases are the result of infection (2 cases) and trauma (4 cases). The alternative treatments for closure of cribriform plate defects are reviewed.

Key-Words

Cribriform plate defects; Forehead flaps

Introduction

Cribriform plate defects are rare, generally small, and usually of no consequence. These bony defects usually occur due to infection, trauma, or tumours and in general, once the primary condition is treated, there is only a problem if there is a cerebro-spinal fluid leak. The dura is especially vulnerable in this area and without adequate protection from below, it may be impossible to prevent a cerebro-spinal fluid leak. For closure of small defects the technique of *McCabe* (1976) of using a small local osteo-mucoperiosteal flap can be very satisfactory. In a very rare case a large defect may result. *Ketchum* et al. (1964) have described the use of split thickness skin grafts applied directly to the dura to allow for epithelial coverage over the widely exposed area. In some cases, however, the use of a split thickness skin graft may not be advisable. The use of a narrow based forehead flap for the closure of a large cribriform plate defect with a cerebro-spinal fluid leak will be described.

Case History

The fifty-five-year-old patient (Figure 1) originally underwent a craniotomy in 1965 for closure of a saccular aneurysm on an anomalous anterior communicating artery. Approximately one year later, it was necessary to complete a sequestrectomy of an infected piece of bone at the apex of his bi-temporal craniotomy incision, seemingly healing without further problem. Unknown to his neurosurgeon, he developed, approximately once a year thereafter, a mid frontal swelling which spontaneously resolved each time without treatment. In the summer of 1973, however, the swelling did not disappear and after noting a clear nasal drainage he returned to his neurosurgeon who obtained radiographs which showed extensive frontal bone destruction (Figure 2). Tomograms confirmed that the entire forehead bone flap was infected with involvement of the cribriform plate causing the cerebral spinal fluid leak and with possible involvement of the orbital roofs.

At surgery, the bi-temporal incision was reopened and the original bone flap exposed, removed, and cultured; the anterior cranial fossa was developed back to the anterior clinoids. The entire cribiform plate was missing and the ethmoid air cells and sphenoid sinus mucosa showed obvious infection and therefore were completely removed as was the upper one-third of the nasal septum. The orbital roofs were not involved except for one 2 mm opening present after bur debridement of the right orbital roof. The dural leak was closed without difficulty with a periosteal graft.

The problem remaining was that of a large area of exposed dura at the site of the cribriform plate-ethmoid air cell defect in an area of possible residual infection even though the debridement was felt to be complete. Because of possible residual infection, it was felt that a split thickness skin graft could not be depended upon to cover the dura. Certainly a local osteo-mucoperiosteal flap would not be of sufficient size to cover the large defect present. Therefore a narrow based forehead flap (Figure 3) was developed which was approximately 3 × 9 cm. This was rotated through a window placed in the frontal bone at the level of the glabella after the frontal sinus mucosa was completely burred away from behind maintaining the anterior sinus wall bony structures. The forehead flap was de-epithelialized in that portion which would be completely buried in the canal between the nasal skin and the nasal cavity, i.e., its most proximal portion approximately 2 cm in length. When the flap was positioned, epithelial surface towards the nasal cavity, a few fine bur holes were placed along the margins of the anterior cranial base back to the sphenoid sinus. The flap was stabilized, after tailoring it to the defect, with 2-0 Dexon sutures. As there was the possibility of residual infection, it was felt best to defer reconstruction of the forehead until a later date. Because of his occupation as a glazier, we felt he needed some forehead protection. A helmet was constructed to be worn until such time as the bony reconstruction was completed on the forehead but we doubt whether he wore this football-like helmet for more than one week.

Bone cultures demonstrated Penicillin resistant Staphylococcus aureus. The patient was maintained on Dynapen for two months and then five months following this, i.e., seven months following the excision and flap transposition, the bony forehead was reconstructed with split rib grafts. It was felt that autogenous material was superior to any prosthetic material in the event that any infected bone might remain. While the final contour was not as smooth as desired (Figure 4), the contour was acceptable, the protection was complete, and the patient deferred further reconstruction. The only postoperative complication has been that of an epithelial inclusion cyst at the glabella which drained spontaneously. He is now six years post surgery.

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Fig. 1 Fifty-five-year-old patient prior to removal of the infected bone and mucosa.

Fig. 2 Lateral view of skull showing markedly infected and partial destruction of anterior skull.

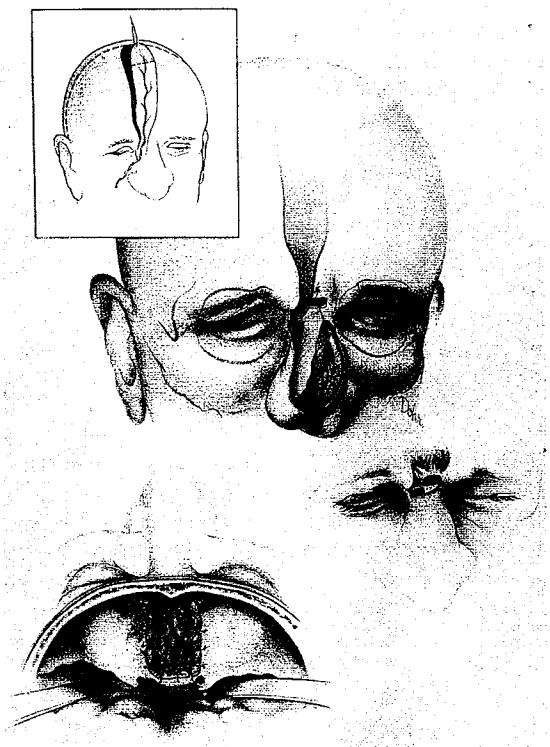

Fig. 3 Drawing representing the steps from creation to stabilization of the forehead flap into the cribriform plate defect.
Above left: design of the forehead flap
Middle: rotation of the flap into and through the window created in the glabellar area
Below left: stabilization of the flap into the area of the cribriform plate defect

Fig. 4 Lateral view of face following completion of skull reconstruc tion with split rib grafts

Results

Six patients, two in San Francisco and four in Paris have undergone cribiform plate reconstruction with this method with a follow-up period of four to seven years. Four of the defects have been the result of trauma while the other t have been secondary to infection. There has been no rec rence of infection. There have been no complications fr this technique and there have been no cases of recurr cerebro-spinal fluid leak.

Discussion

Major defects of the cribriform plate and the underlying dura are not a frequent problem. As previously described (*Ketchum* et al. 1964), an accepted method of protection of the dura following major loss of the anterior cranial base has been the placement of a split thickness skin graft directly onto the dura. As stated in the case history, it is our feeling that a skin graft is, however, generally more risky than a flap, particularly when compared to a flap as viable as a forehead flap. Perhaps of equal importance is the additional advantage of a well vascularized flap in an area where there may be some residual infected tissue. Certainly a viable flap, well contoured and stabilized in a defect, can be a comfort both to a concerned physician and the patient. In the six cases so treated, all have done very well, the closure has been complete, there are no instances of cerebrospinal fluid leak, and no recurrent infection has occurred.

In the inset drawing, the right angular artery is shown as the vessel supplying the forehead flap. The exact arterial supply will of course vary depending upon factors such as location of the base of the flap, previous trauma, local anatomical variations, etc. In the first case in which we raised this flap, there had been extensive tissue destruction in the glabellar area and the supporting artery and vein were probably the supra-orbital vessels. In the patient described in the case history, there was little question that the angular vessel was the nutrient vessel to the flap.

The original case was not done through an intracranial approach. It was possible to rotate the flap into the post traumatic, large, mid facial-glabella defect without an intracranial exposure and obtain the necessary stabilization of the flap. In general, however, the flap is more easily raised when an intracranial approach has been carried out.

The advances in craniofacial surgery over the coming years will perhaps have more to do with non-congenital than with congenital problems. The ease with which one can approach the mid facial bony and soft tissue structures from a bi-temporal incision and the orbits from above via a craniotomy are well known and appreciated by those doing craniofacial surgery, primarily at this time for congenital problems such as Telorbitism, Apert's and Crouzon Syndromes, Treacher-Collins, etc. It is our feeling that it will be imperative that during a plastic surgery residency, that craniofacial approaches be taught. For while there may never be enough congenital cases realistically to allow more than a few dozen craniofacial teams throughout the world, certainly there will be many patients with non-congenital problems who will benefit if these approaches are used by the reconstructive plastic surgeons of the future.

Conclusion

The use of a forehead flap in reconstruction of major cribriform plate defects is described. Six cases so treated have had excellent results with such a method.

References

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