The Evolution in Surgical Technique for Frontoethmoidal Encephalocele

Drew Thibault, DO; Ahmad Chehab, MD; Pradeep Setty, DO

Corewell Health William Beaumont University Hospital, Department of Neurosurgery

Background

Frontoethmoidal encephaloceles are rare birth defects that disproportionately impact individuals from low-income and remote countries. Although these malformations are surgically repairable, many resource-limited countries face a shortage of trained surgeons and support staff. Additionally, those with expertise are often constrained by limited access to modern technology, perioperative care, postoperative follow up, and resources such as ventilators and blood products. A point of emphasis in neurosurgical mission work in the last two decades has been the development and improvement of relatively safe, simple, and low complication techniques for treating such malformations. Several physician-led groups have successfully refined a combination of extracranial and transcranial approaches to frontoethmoidal encephaloceles with limited long-term complications. Additionally, these European or American groups have proven the reproducibility of these techniques by local surgeons trained either prior to, or during these mission trips.

Operative Technique

Previously we have described our experience with such cases utilizing a bicoronal incision with a bifrontal craniotomy and orbital osteotomies. However, this technique requires a large incision, significant dissection and has the potential for blood loss, infection and other complications that are difficult to manage in rural and low-income settings. As a result, we have modified our approach to a midline incision over the encephalocele to minimize blood loss and tissue dissection without compromising cranial reconstruction and cosmesis. After the midline incision is made, a pericranial flap is dissected and elevated from the cranium then reflected inferiorly, preserving its vascular supply (**Figure 1,2**). The edges of the skull defect are also defined, and the dura is dissected from the skull base circumferentially around the encephalocele which is at the foramen cecum (**Figure 3**). Once this is completed, the dura is opened and the encephalocele is truncated (**Figure 4**). The dura is then repaired in a watertight fashion with the pedicled pericranial flap laid on the skull base beneath the repaired dura. The nasal reconstruction is then completed by Plastic Surgery, and a single midline incision is closed.

Figures

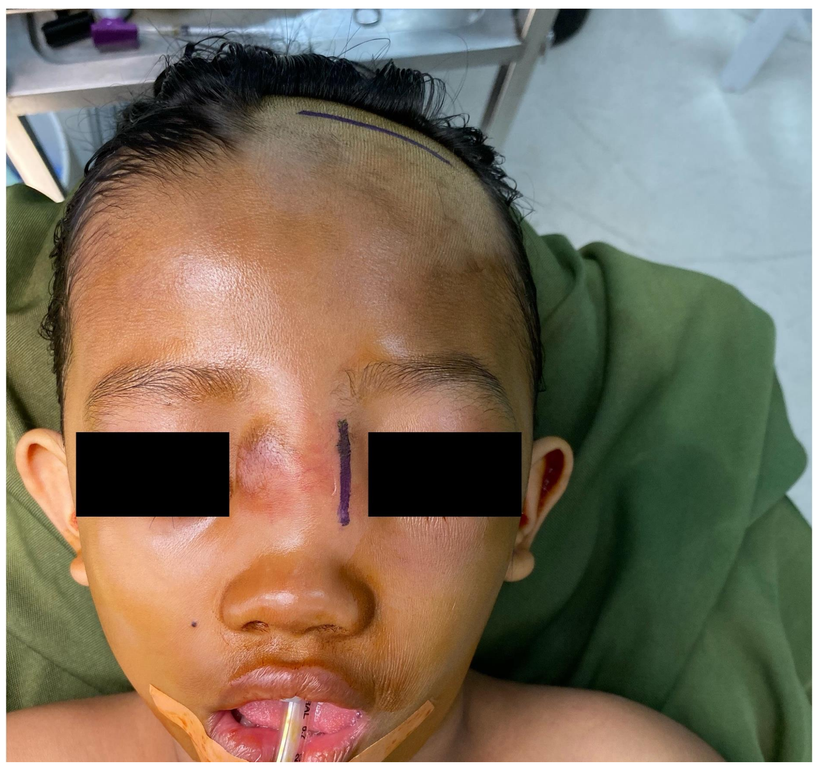

Figure 1. Pre-operative positioning demonstrating patient supine with vertical paramedian incision marked.

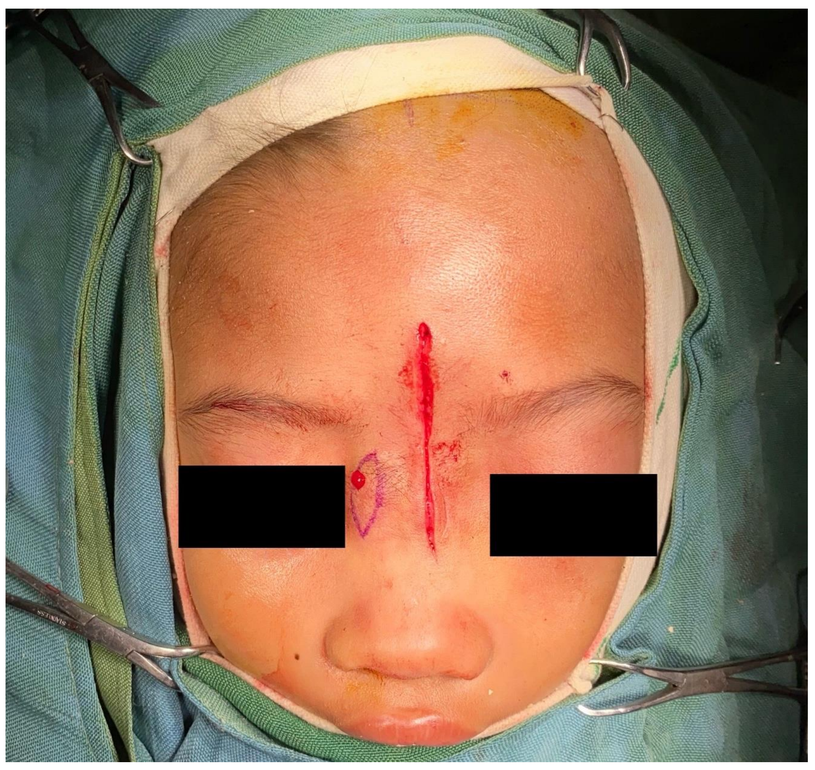

Figure 2. Vertical paramedian incision approximately 6-7cm in length.

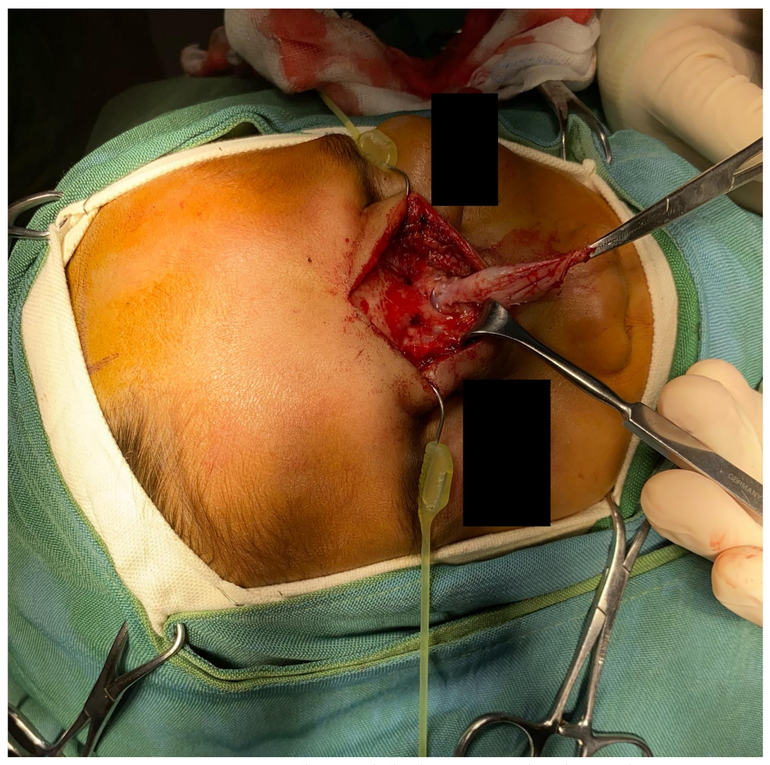

Figure 3. Frontoethmoidal encephalocele dissected and with boundaries of bony cranial defect defined.

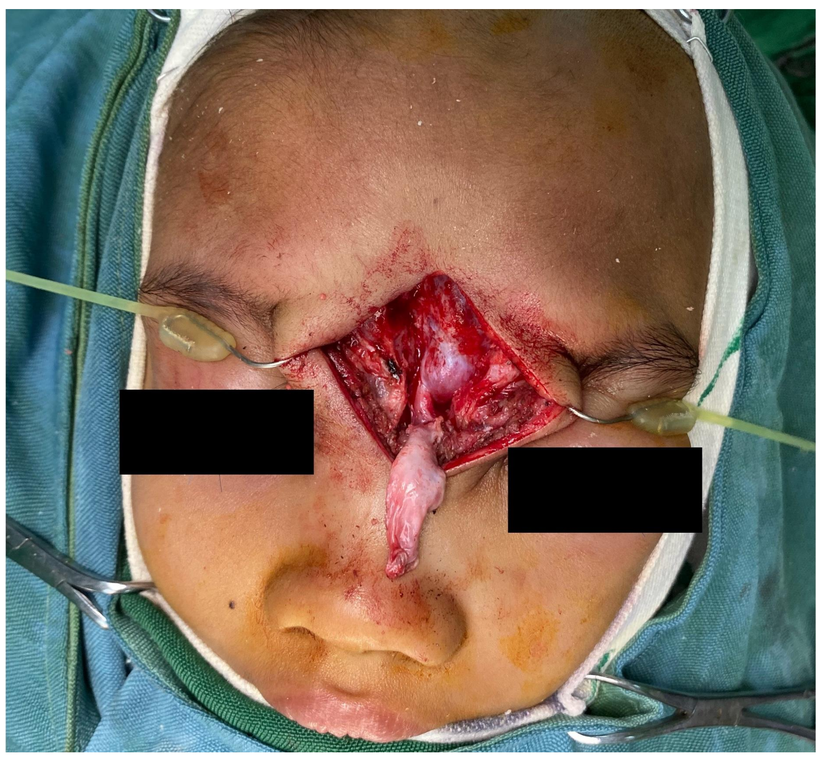

Figure 4. Bony defect further dissected and encephalocele obliterated.

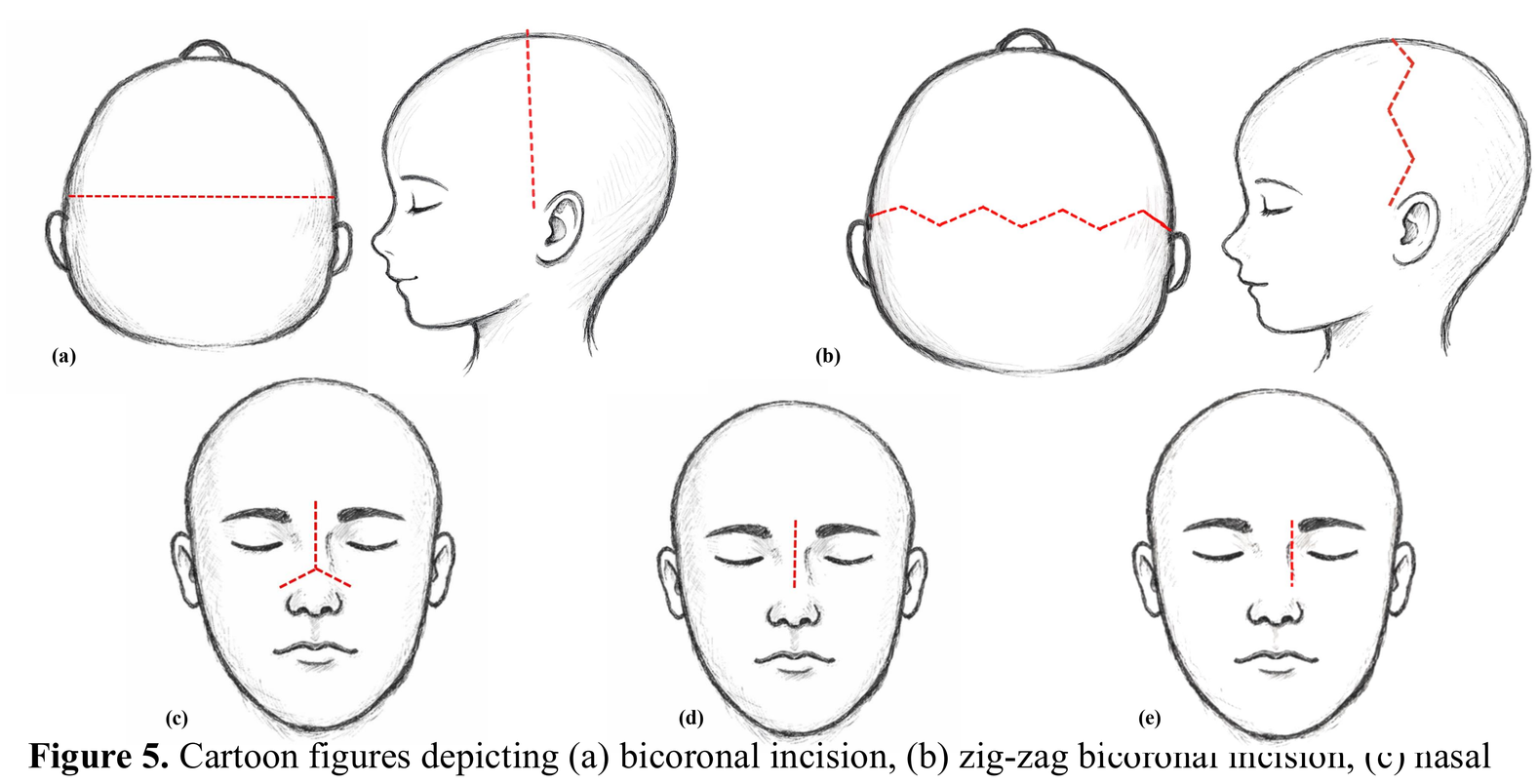

Figure 5. Cartoon figures depicting (a) bicoronal incision, (b) zig-zag bicoronal incision, (c) nasal lambda incision, (d) midline nasal incision, and (e) paramedian nasal incision.

Lessons

Utilizing this midline incision, surgical times were reduced, allowing for more operations to be completed in the limited time available on overseas mission trips. Additionally, reduced operative time is associated with a reduction in surgical blood loss and the need for transfusions, as well as minimizing anesthesia related complications. This reduction in complication rate allows patients to return home faster with shorter hospital stays, eliminating a significant burden on families coming from rural areas with limited resources. Furthermore, the described midline incision is a simple and manageable approach in which local surgeons can be successfully trained during these short interdisciplinary mission trips. Training local surgeons to independently manage these developmental abnormalities following the departure of visiting surgical teams, allows for future patients to have access to life-changing care previously unavailable to them.

Lessons (cont.)

Various skin incisions have been utilized for resection of frontoethmoidal encephaloceles (FE) and craniofacial reconstruction. Those utilized in various mission works are depicted in **Figure 5**. Bicoronal and bicoronal zig-zag incisions allow for excellent exposure of FE and dural reconstruction. However, they are significantly more invasive and more difficult to manage in the peri-operative period in resource-challenged areas when compared to extracranial approaches through nasal incisions, of which there are several excellent options (**Figure 5**).

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References

1. Heidekrueger PI, Schantz JT, Fansa H, Bannasch H, Lampert F. Safe and sustainable: the extracranial approach for frontoethmoidal meningoencephalocele repair in 246 patients in Myanmar. *J Neurosurg Pediatr.* 2017;20(2):175-181. doi:10.3171/2017.3.PEDS16558
2. Ahanogbe KM, Aguemon AR, Anjorin A, Assogba GF, Mensah A. Frontoethmoidal meningoencephalocele: a report of four cases in Benin. *World Neurosurg.* 2021;151:54-59. doi:10.1016/j.wneu.2021.04.093
3. Marshall AL, Fernandez J, Laborde A, et al. Surgical repair of frontoethmoidal encephaloceles in a multidisciplinary craniofacial program in the Philippines. *J Neurosurg Pediatr.* 2017;19(5):529-536. doi:10.3171/2016.11.PEDS16270
4. Wondimu B, Obaid H, Hailu A, et al. Long-term outcomes following head and neck reconstructive surgeries performed during short-term surgical missions in Ethiopia: a retrospective cohort study. *BMJ Open.* 2021;11(9):e048653. doi:10.1136/bmjopen-2021-048653
5. Roux FE, Merle M, Lzic M, Choudhury AR, Mertens P. A low-cost procedure for developing countries: treatment of frontoethmoidal meningoencephaloceles. *Neurosurgery.* 2007;60(5):924-931. doi:10.1227/01.NEU.0000255421.98816.71
6. Suryaningtyas W, Sidabutar R, Prasetyono TOH, et al. Extracranial versus intracranial surgical approach in frontoethmoidal encephalocele: a systematic review and meta-analysis. *World Neurosurg.* 2022;164:e552-e563. doi:10.1016/j.wneu.2022.05.016
7. Oucheng N, Rozeik C, Kheng C, Roux FE. A low-cost management protocol for frontoethmoidal meningoencephaloceles in developing countries: appraisal of 200 consecutive cases. *J Neurosurg Pediatr.* 2010;6(4):385-390. doi:10.3171/2010.6.PEDS09505
8. Mainthia R, Tye GW, Lorenz RR, et al. A model for humanitarian neurosurgical aid based on 15 years of experience in Guatemala. *J Neurosurg Pediatr.* 2009;4(2):133-137. doi:10.3171/2009.3.PEDS08530