Effects of Cruciate Embedding Fascia-Bone Flap Technique on Grade II–III Cerebral Spinal Fluid Leak in Endoscopic Endonasal Surgery

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Abstract

Leakage of Cerebral Spinal Fluid (CSF) is still a significant problem in Endoscopic Endonasal Surgery (EES). The use of stiff buttress has not received enough attention, and there is no defined standard methodology for skull base closure. We introduced the Cruciate Embedding Fascia-Bone Flap (CEFB) technique using autologous bone graft to buttress the fascia lata attachment to the partially sutured skull base dural defect and evaluated its effectiveness in a subsequent case series of grade II-III CSF leaks in EES to highlight the functions of support and fixation from rigid buttress in reconstruction. According to this study, the novel CEFB approach may be able to stop postoperative CSF leak in EES. The outcomes showed that it can be utilized successfully without PNSF in appropriate situations or added to a PNSF with high compatibility when required. The following stage should involve a larger cohort and a better design to confirm its efficacy.

Keywords: Endoscopic endonasal surgery • CSF leak • Bone flap • Skull base reconstruction • Pedicle vascularized nasoseptal flap

Introduction

With little invasiveness and high visualization, Endoscopic Endonasal Surgery (EES) has gained popularity as a technique for removing tumours from the ventral skull base [1]. However, the difficulty in maintaining a watertight closure of the skull base means that the possibility of postoperative Cerebral Spinal Fluid (CSF) leakage still exists. The prevalence of CSF leak following EES has been found to range from 1.6% to 40%. The prognosis of patients is significantly impacted by complications including meningitis, pneumocephalus, and others. A common procedure has not yet been created, despite the emergence of numerous skull base rebuilding techniques. Since 2006, the Pedicle Vascularized Nasoseptal Flap (PNSF) has been widely used to significantly enhance the success of skull base restorations [2]. For high-flow CSF leaks in EES, it has become a widely accepted and even standard procedure. However, the PNSF involves anatomical transposition of the nasal mucosa that is distinct, and it can lead to problems including perforation, epistaxis, dysosmia, and nasal discomforts that can lower quality of life. While the soft (membranous) repair is highlighted, the hard support of the skull base is absent. With regards to reducing postoperative CSF leaks, In Situ Bone Flap (ISBF) has proposed solid buttress in addition to soft repair. However, in these applications, artificial grafts, PNSF, Lumbar Drainage (LD), and iodoform gauze nasal packing remain essential. Since 2015, we have been using the Cruciate Embedding Fascia Bone Flap(CEFB) approach to integrate soft ti--ssue healing, stiff buttress, and multilayer reconstruction in appropriate patients with intraoperative grade II–III CSF leak. With reduced nasal intrusion and autologous material, we sought to restore the natural anatomical layers of the skull base. The independent usage of the CEFB flap without routine PNSF, iodoform gauze, and LD is another aspect we've focused on, though it can also be fully PNSF-compatible when necessary [3].

Discussion

Benefits of inlay and partial dural suturing in the CEFB technique

By removing dead space, absorbing the force of CSF pulsation, and lowering CSF pooling or soaking, the inlay materials help to lessen leak size and CSF flow. The most important step in the CEFB inlay method is to precisely regulate the volume of the fat graft to achieve the ideal subdural tension that matches the buttress pressure of the wedged bone graft, resulting in the proper tightness of the attachment between the fascia and dura. Deep suturing and knotting are no longer significant problems in EES, but technically difficult suturing that is literally "watertight" due to dural dehydration, fragility, or electro cauterization [4]. Although partial suturing is insufficient to stop CSF leaks, the following advantages are still considered to exist:

1. The rigid buttress's center contains and reduces the dural defect.
2. To prevent direct contact between the fascia and inlay grafts, the dural interface is made accessible for onlay fascia attachment.
3. The fat and ADM are secured in position.
4. There is an increase in intrasellar tension and compactness.

Comparison between the CEFB procedure and gasket-seal

With some substantial changes, the CEFB technique adheres to the same strict reconstruction principle as the gasket seal. Gasket-seal concentrates on the watertight sealing of the defect, as the name indicated. The shape of the material utilized in the gasket-seal, which is circumferentially wedged, must be closely matched to the geometry of the bone defect. Due to the fact that the autologous bone transplant does not always fit completely, artificial material is usually employed. The buttress pressure that tightly holds the fascia lata to the dura to encourage a tight attachment and mutual adhesion is the foundation of the CEFB technique. First, the CEFB design merely embeds the bone flap at two sides of the bone defect rather than all the way around. The bone flap's size is determined by a sufficient length on just one axis, which encourages the use of autologous bone and results in lower costs and rejection- or infection-related hazards.The bone flap's two-sided embedding enables the fascia lata to spread out through the spaces on the sides that aren't wedged and to be paved smoothly onto the skull base. The fascia lata, however, takes on the appearance of a "cauliflower leaf" when gasket-seals are applied because of the little depression in the center. Smooth attachment is challenging because of the fascia's slanted or curled edge.Partial dural suturing prevents unintentional misplacement of the bone flap into the subdural space by ensuring proper epidural embedding. The dura and fascia are firmly in touch, which aids in the production of adhesions. In circumstances when faults cross two geometric planes, the gasket-seal is not optimal. We wedged two separate bone flaps at distinct defect planes in our EEEA instances with enough bone graft harvest. The fascia lata could thus be held in place and supported equally on angled planes [5].

Resistance of the CEFB construct against counteracting forces

In skull base restoration, forces such brain gravity, CSF pulsation, and intracranial pressure are major issues. These downward pressures have a tendency to undermine the repair. Therefore, countermeasures such intranasal balloons, lumbar drainage, and iodoform gauze packing are utilized. Due to the rigidity of the securely wedged bone flap, the

CEFB construct is strong enough to withstand these stresses. Even without iodoform gauze packing or lumbar drainage, we never saw a bone flap dislocate or break in any of our instances. Hypothetically speaking, these downward forces might even contribute to cause a more solid compression of the CEFB structure, which would then increase the water tightness and attachment. This technique may have helped preoperative hydrocephalus patients prevent CSF leaks and reduced the length of time spent in bed in the CEFB group [6].

Considerations regarding the application of PNSF

The PNSF's quick healing and long-term security of closure made it a turning point in the evolution of skull base repair. However, in order to mobilize a sizable piece of mucosa for the PNSF harvest, a lengthy incision must be made on the nasal septum. This mucosa is then moved to cover the skull base. Re-epithelialization of the exposed donor location requires six to twelve weeks. Nasal problems resulting from this significant mucosal change are not uncommon [7]. Due to intranasal pressure and stimulation, the nasal packing of iodoform gauze or a balloon frequently employed in conjunction with PNSF affects mucosa regeneration and the patients' subjective experience. Garcia-Navarro said that the PNSF had little to no impact on their gasket-seal procedure, raising the question of whether the PNSF was actually necessary. In our study, nasal problems were even less common in the CEFB group, and we found similar results in terms of postoperative CSF leak and infection between the CEFB and PNSF groups. The efficiency of CEFB is comparable to previous authoritative reports on postoperative CSF leaks in this regard. Our findings imply that the PNSF may not be the only required choice with proper CEFB utilization and multilayer reconstruction. The PNSF's benefits and drawbacks should each be considered separately. We did not try to use the CEFB in place of the PNSF. Contrarily, the PNSF and the CEFB method work very well together and are not mutually exclusive [8].

Limitations of the CEFB and the present study

First, anatomical variances or tumor invasion make it difficult or impossible to always harvest the bone flap, especially when the defect is large and extends laterally. Second, only a small portion of the fascia beneath the defect's wedging edges is covered. There are several steps that could be performed to overcome these restrictions:

1. Any possibly salvageable bone structures should be preserved during surgery by avoiding over-grinding the micro drill.

2. The bone transplant might be cut into thin strips and inserted into the defect in intervals.

3. Carefully enlarging the defect's wedging edges would expose more dural area for fascia attachment.

4. By optimizing the dural incision design and suturing, the dural defect might be reduced. In the worst-case scenario, if all other measures prove to be ineffective, the PNSF is still a reliable final resort [9].

Our research was retrospective, and we only included a few patients. A randomized control trial's setup is challenging. Additionally, the 6-month follow-up period already in place was insufficient for long-term evaluation. We must admit that our group set, baseline control, and outcomes comparison may be underpowered due to the presence of type II error given the variety of clinical situations.

The statistical analysis in our study should only be used as a source of reference and should be viewed with caution. The descriptive information and experience from our surgical practice are highlighted in this paper. For a more thorough evaluation of the CEFB approach, a more rigorous study design and an accumulation of cases are needed [10].

Conclusion

The study revealed that by offering a hard buttress coupled with multilayer soft-tissue regeneration, the innovative CEFB technique may be able to prevent postoperative CSF leak in EES. Our data show that independent use of the CEFB technique had comparable reconstruction efficacy to the conventional PNSF in appropriate cases of grade II and even grade III intraoperative CSF leaks and resulted in fewer nasal complications, a shorter length of stay in bed, and a better patient subjective experience. The CEFB could be properly paired with the PNSF for grade III leaks with several high-risk characteristics or oversized flaws to assure successful reconstruction.

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