



Original Article

A Comparative Study of Endoscopic Skull Base Repair Using Pedicled Flap, Fascia Lata Graft, and Fat Graft.

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ABSTRACT

Background: Endoscopic endonasal techniques have become the preferred approach for repair of skull base defects and cerebrospinal fluid (CSF) leaks. Various reconstruction methods including vascularized pedicled flaps, fascia grafts, and fat grafts are used to achieve watertight closure. The choice of material depends on defect size, CSF flow, and surgeon preference.

Objective: To compare the effectiveness and outcomes of pedicled flap, fascia lata graft, and autologous fat graft in endoscopic skull base defect repair.

Methods: A prospective comparative study was conducted on patients undergoing endoscopic skull base repair for CSF rhinorrhea. Patients were divided into three groups based on reconstruction technique: pedicled flap, fascia lata graft, and fat graft. Outcomes assessed included postoperative CSF leak, complications, operative time, and hospital stay.

Results: Pedicled flap reconstruction showed the highest success rate with the lowest postoperative CSF leak rate. Fascia lata graft provided reliable closure but had donor-site morbidity. Fat graft was effective for small defects but had slightly higher recurrence rates.

Conclusion: Pedicled vascularized flaps provide superior outcomes in large skull base defects, while fascia and fat grafts remain effective options for smaller defects. Selection of repair material should be individualized based on defect characteristics.

Keywords: Endoscopic skull base repair, CSF rhinorrhea, nasoseptal flap, fascia lata graft, fat graft, endoscopic endonasal surgery.

INTRODUCTION

Cerebrospinal fluid (CSF) rhinorrhea occurs when there is an abnormal communication between the subarachnoid space and the nasal cavity due to a defect in the skull base and dura mater. This condition is clinically significant because it allows the leakage of CSF into the nasal cavity and creates a potential pathway for microorganisms to enter the intracranial cavity, increasing the risk of serious complications such as meningitis, pneumocephalus, and intracranial infections. Early diagnosis and effective surgical repair are therefore essential to prevent these complications and improve patient outcomes.¹

The causes of CSF rhinorrhea include traumatic, iatrogenic, spontaneous, congenital, and neoplastic conditions. Traumatic skull base injuries account for the majority of cases, while iatrogenic leaks are increasingly encountered due to the growing number of endoscopic sinus and skull base surgeries. Spontaneous CSF leaks are also being reported more frequently, particularly in association with conditions such as idiopathic intracranial hypertension.²

Traditionally, skull base defects were repaired through intracranial approaches such as craniotomy, which allowed direct visualization and repair of the defect. However, these procedures were associated with significant morbidity, including brain retraction injury, anosmia, prolonged hospitalization, and cosmetic concerns. Over the past few decades, the development of endoscopic endonasal techniques has revolutionized the management of skull base defects. Endoscopic

repair provides excellent visualization, better localization of the defect, and minimal surgical trauma, resulting in high success rates and reduced postoperative complications.³

A critical factor in successful endoscopic skull base surgery is the selection of appropriate reconstruction material to achieve a watertight closure of the defect. Various graft materials have been used for this purpose, including autologous fat, fascia lata, and vascularized pedicled flaps. Each of these materials has unique advantages and limitations.

Autologous fat grafts are commonly used because they are easily available, simple to harvest, and effective in sealing small skull base defects. Fat is particularly useful for obliterating dead space and providing support during multilayer closure. However, fat grafts may undergo partial resorption and may not provide sufficient structural support for larger defects.

Fascia lata grafts harvested from the lateral thigh are widely used due to their strength, flexibility, and durability. Fascia provides a reliable barrier for skull base reconstruction and is often used as part of multilayer closure techniques. Nevertheless, harvesting fascia lata requires an additional surgical site, which may lead to donor-site morbidity such as postoperative pain or scarring.³

The introduction of vascularized pedicled flaps, especially the nasoseptal flap, has significantly improved the outcomes of endoscopic skull base reconstruction. Because these flaps maintain an intact blood supply, they promote better healing and reduce the risk of graft failure. Vascularized flaps are particularly useful in large skull base defects and high-flow CSF leaks. Despite the availability of multiple reconstruction techniques, the choice of repair material often depends on factors such as the size and location of the defect, the amount of CSF leakage, and surgeon preference. Comparative evaluation of these techniques is therefore important to determine their effectiveness and associated complications.⁴

The present study aims to compare the outcomes of endoscopic skull base repair using pedicled flap, fascia lata graft, and autologous fat graft. By analyzing surgical success rates, postoperative complications, and overall patient outcomes, this study seeks to identify the most effective reconstruction technique for the management of skull base defects.

MATERIALS AND METHODS

This prospective comparative study was conducted in the Department of Otorhinolaryngology at a tertiary care teaching hospital over a period of two years. The study included patients diagnosed with cerebrospinal fluid (CSF) rhinorrhea who underwent endoscopic skull base repair during the study period. Ethical approval was obtained from the institutional ethics committee prior to the commencement of the study, and informed consent was obtained from all participating patients.

A total of thirty patients fulfilling the inclusion criteria were enrolled in the study. Patients above 18 years of age with clinically and radiologically confirmed CSF rhinorrhea who were planned for endoscopic skull base repair were included in the study. Patients with recurrent CSF leak after previous surgical repair, patients with malignant skull base tumors, and those unfit for surgery were excluded from the study.

All patients underwent detailed clinical evaluation including history taking and complete otorhinolaryngological examination. Diagnostic nasal endoscopy was performed in all patients to identify the site of CSF leak. Radiological investigations including high-resolution computed tomography (CT) scan of the paranasal sinuses were performed to localize the skull base defect. Magnetic resonance imaging (MRI) of the brain and skull base was obtained in selected cases when further delineation of the defect or associated intracranial pathology was required.

The patients were divided into three groups based on the reconstruction material used for skull base repair: pedicled flap repair, fascia lata graft repair, and autologous fat graft repair. Each group consisted of ten patients. All surgeries were performed under general anesthesia using an endoscopic endonasal approach. The site of CSF leak was identified intraoperatively, and the surrounding mucosa was carefully elevated to expose the skull base defect.

In the pedicled flap group, a vascularized nasoseptal flap was harvested and used to cover the skull base defect after appropriate preparation of the recipient site. In the fascia lata group, fascia lata was harvested from the lateral aspect of the thigh through a small incision and placed as an underlay or overlay graft to reconstruct the defect. In the fat graft group, autologous fat was harvested from the abdomen or thigh and used to plug the skull base defect, either alone or as part of a multilayer closure technique. In all cases, meticulous care was taken to achieve a watertight closure.

Postoperatively, patients were monitored for complications such as persistent CSF leak, infection, and donor-site morbidity. Patients were advised bed rest with head elevation and avoidance of activities that could increase intracranial pressure, such as straining, coughing, or nose blowing. Nasal packing was removed after an appropriate postoperative period.

All patients were followed up regularly in the outpatient department for a minimum period of six months. Follow-up evaluation included clinical assessment and nasal endoscopic examination to detect any recurrence of CSF leak or postoperative complications.

The primary outcome measures assessed in this study included surgical success rate, recurrence of CSF leak, postoperative complications, operative time, and duration of hospital stay. The collected data were recorded and analyzed using appropriate statistical methods to compare the outcomes between the three reconstruction techniques.

RESULTS

The study included a total of 30 patients, of which 16 (53.3%) were male and 14 (46.7%) were female. The distribution shows a slight male predominance, although the gender representation was relatively balanced. Patients were equally distributed among the three reconstruction techniques evaluated in the study. Pedicled flap reconstruction, fascia lata graft, and fat graft reconstruction were each performed in 10 patients (33.3%), ensuring uniform group sizes for outcome comparison.

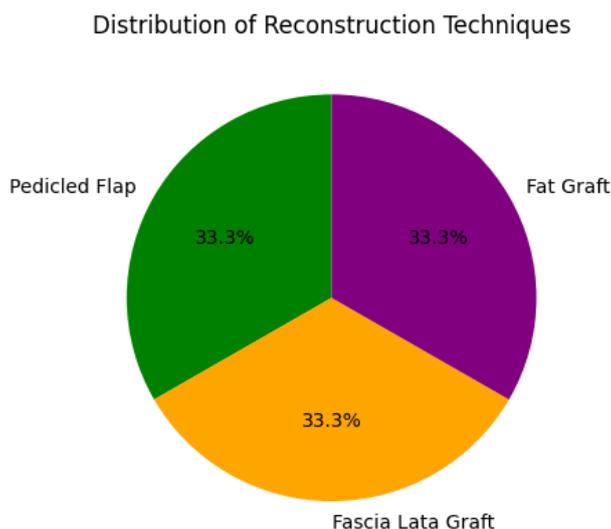


FIGURE 1: Distribution of Reconstruction Techniques

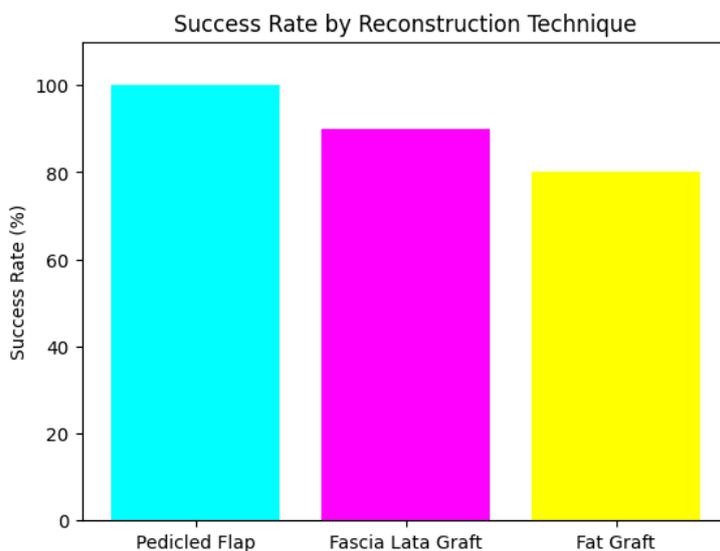


FIGURE 2: Success Rate by Reconstruction Technique

The pedicled flap technique demonstrated the highest success rate (100%), with successful reconstruction in all patients. The fascia lata graft showed a success rate of 90%, while the fat graft technique demonstrated a success rate of 80%. These findings suggest that pedicled flaps may provide the most reliable reconstruction among the techniques studied.

Surgical Outcomes			
Outcome	Pedicled Flap	Fascia Lata	Fat Graft
Success Rate	100%	90%	80%
Postoperative CSF Leak	0	1	2
Donor Site Complications	None	2	1
Mean Hospital Stay	4 days	5 days	4 days

FIGURE 3: Surgical outcomes

No postoperative CSF leak was observed in the pedicled flap group, whereas one case occurred in the fascia lata group and two cases in the fat graft group, suggesting a higher incidence with fat graft reconstruction. Donor site complications were absent in the pedicled flap group but occurred in two patients in the fascia lata group and one patient in the fat graft group. The mean hospital stay was 4 days in both the pedicled flap and fat graft groups and 5 days in the fascia lata group.

DISCUSSION

Endoscopic repair of skull base defects has become the preferred treatment for cerebrospinal fluid (CSF) rhinorrhea due to its minimally invasive nature, excellent visualization, and high success rates. The primary goal of surgical management is to achieve a secure and watertight closure of the skull base defect in order to prevent recurrence of CSF leak and avoid intracranial complications such as meningitis. Various reconstruction materials and techniques have been described in the literature, including autologous fat grafts, fascia lata grafts, and vascularized pedicled flaps. The present study aimed to compare the outcomes of these three commonly used reconstruction methods in patients undergoing endoscopic skull base repair.

In the present study, the pedicled flap group demonstrated the highest success rate with no postoperative CSF leak observed during the follow-up period. This finding highlights the advantages of vascularized reconstruction in skull base surgery. Pedicled flaps maintain an intact blood supply, which enhances graft survival, promotes rapid healing, and reduces the risk of postoperative failure. These characteristics make pedicled flaps particularly suitable for large skull base defects and high-flow CSF leaks.

The findings of the present study are consistent with the results reported in previous studies. Hadad et al¹ first described the vascularized nasoseptal flap and demonstrated its effectiveness in reconstructing skull base defects following endoscopic skull base surgery. Since its introduction, the nasoseptal flap has become the most widely used vascularized flap in endoscopic skull base reconstruction, with reported success rates exceeding 90–95%. Several studies have shown that the use of vascularized flaps significantly reduces the incidence of postoperative CSF leak compared with free graft techniques.

In the present study, fascia lata graft repair also demonstrated a high success rate, although one patient experienced a postoperative CSF leak. Fascia lata is widely used because it provides a strong and durable barrier for reconstruction of skull base defects. Its flexibility allows it to conform well to irregular defect margins, making it suitable for multilayer closure techniques. However, harvesting fascia lata requires an additional surgical incision at the donor site, which may lead to complications such as postoperative pain, scarring, or infection.

Previous studies have also reported favorable outcomes with fascia lata grafts in skull base reconstruction. Hegazy et al.² reported high success rates with fascia grafts when used as part of a multilayer closure technique during endoscopic CSF leak repair. Similarly, other authors have emphasized the reliability of fascia lata in repairing moderate-sized defects. However, these studies also note that donor-site morbidity remains a limitation associated with fascia lata harvesting.^{3,4}

In comparison, the fat graft group in the present study showed a slightly lower success rate with two cases of postoperative CSF leak. Although fat grafts are easy to harvest and provide effective sealing of small defects, they lack the structural strength required for larger defects. Fat may also undergo partial resorption over time, which can compromise the long-term stability of the repair. For this reason, fat grafts are often used in combination with other graft materials as part of multilayer reconstruction techniques rather than as a standalone repair material.^{5,6}

The results of the present study are comparable to those reported in previous literature, which suggests that fat grafts are most effective in small skull base defects or as supportive material in multilayer closure. Several authors have recommended combining fat with fascia or mucosal grafts to improve the overall strength and stability of the reconstruction.

In terms of complications, donor-site morbidity was observed more frequently in patients who underwent fascia lata harvesting compared with those in the pedicled flap group. This observation is consistent with findings from previous studies, which highlight that vascularized intranasal flaps eliminate the need for an additional surgical donor site and thereby reduce postoperative discomfort and complications.^{7,8}

The duration of hospital stay and operative time were also evaluated in the present study. Although pedicled flap reconstruction required slightly longer operative time due to the technical complexity of flap harvesting, it was associated with a lower rate of postoperative complications and recurrence. This trade-off between operative time and long-term success has also been noted in other studies evaluating skull base reconstruction techniques.^{9,10}

Overall, the findings of the present study support the growing body of evidence favoring vascularized pedicled flaps for the repair of skull base defects, particularly in cases involving large defects or high-flow CSF leaks. Nevertheless, free grafts such as fascia lata and fat remain valuable reconstruction options in appropriately selected cases, especially for small to moderate defects.

The present study has certain limitations that should be acknowledged. The sample size was relatively small, and the follow-up period was limited. Larger multicenter studies with longer follow-up durations would be beneficial in further evaluating the long-term outcomes of different skull base reconstruction techniques.

Despite these limitations, the study provides useful comparative data regarding the effectiveness of pedicled flap, fascia lata graft, and fat graft in endoscopic skull base repair. Careful selection of reconstruction material based on the size and location of the defect, the amount of CSF leakage, and surgeon expertise is essential for achieving optimal surgical outcomes.

CONCLUSION

Endoscopic skull base repair is a safe and effective method for managing cerebrospinal fluid rhinorrhea, with pedicled vascularized flaps demonstrating the highest success rate and lowest recurrence in the present study. Fascia lata and fat grafts remain useful alternatives for selected cases, particularly in small to moderate defects, depending on defect characteristics and surgeon preference.

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