

Reconstructive Surgery of the Dura Mater and Literature Review

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Abstract

Case Report

Reconstructive surgery of the dura mater is a constantly evolving field, with significant advances in substitute materials and minimally invasive techniques. Although classic suturing remains a reliable method, the use of products such as fibrin glue and synthetic membranes like Redura® offers significant advantages in managing dural tears, particularly for large defects and minimally invasive procedures. However, further research is needed to refine treatment protocols and better understand the long-term implications of these materials.

Keywords: Dura mater, reconstructive surgery, dural tear, cerebrospinal fluid leak, basal cell carcinoma, subdural empyema.

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I. INTRODUCTION

The dura mater is the outermost and toughest of the three layers of tissue surrounding the brain and spinal cord. It is part of the protective system of the central nervous system (CNS), along with the arachnoid and pia mater. It can be damaged by several causes, including cranial trauma, infections, neurosurgical interventions, or underlying pathologies such as cutaneous tumors with bone infiltration. The primary goal of dura mater repair surgery is to restore the membrane's integrity to prevent infections and cerebrospinal fluid (CSF) leaks. This can be achieved by closing tears or perforations using sutures, tissue grafts, or biocompatible materials. We present two cases of dura mater reconstruction.

II. CASE REPORTS

Case 1

A 64-year-old male, married and father of 10, former farmer covered by national insurance (AMO).

History of wide tumor excision in the right peri-auricular region with lymph node dissection (zone 1) and pectoralis major flap on 12/24/2020. Operated again on 04/06/2021 for basal cell carcinoma of the scalp with cranial flap and coverage using a rotation flap and skin graft. He was admitted for infected tissue loss with subdural empyema in a tumoral context of the scalp. Progression showed worsening of functional symptoms, including facial paralysis with infiltration of adjacent soft tissues. On admission, there was extensive scalp ulceration with exposure of the parietal bone and dura mater, right retroauricular ulceration with pus discharge, and a general state of fatigue without fever. Imaging (CT scan): cerebral empyema with heterogeneous, lytic cranial vault, mainly at the vertex. Treatment: tumor excision, dura mater reconstruction, and post-excision defect coverage with rotation flap and split-thickness skin graft. Outcome: uncomplicated postoperative course; referred to oncology for adjuvant radiotherapy.



Figure 1: Appearance of bone remodeling and dura mater involvement following a basal cell carcinoma of the scalp (preoperative)



Figure 2 : Tumor excision with empyema drainage and dural reconstruction using graft material, followed by coverage with a rotation flap (intraoperative)



Figure 3: Three-month postoperative follow-up

Case 2

A 76-year-old male, married, father of three, farmer, presented with a 3-year history of a recurrent mid-parietal scalp lesion — ulcerative, crusted, exophytic, corresponding to a follicular and sclerodermiform basal cell carcinoma gradually increasing in size (8×6 cm), fixed to deep planes, painless, with seropurulent discharge and multiple facial lesions but no palpable lymphadenopathy. CT scan: $5 \times$

7.5 cm lesion infiltrating the musculoaponeurotic plane and skull vault, with bone erosion and demineralization up to 8 mm. Treatment: tumor excision, dura mater reconstruction, and post-excision defect coverage with a rotation flap and split-thickness skin graft. Outcome: uncomplicated postoperative course; referred to oncology for adjuvant radiotherapy. Dead after 31 seance of chemotherapy.



Figure 1: Appearance of a sclerodermiform basal cell carcinoma infiltrating the cranial vault



Figure 2: Tumor excision with dural reconstruction and coverage using a rotation flap and split-thickness skin graft (intraoperative)



Figure 3: One-month postoperative follow-up

III. DISCUSSION

The scalp is anatomically characterized by rich vascularization, relative thickness, and low elasticity. It may host malignant tumors, which represent only 2% of all skin cancers. Dural invasion is particularly serious in infiltrating tumors. Repair of the dura mater is an essential step in managing these infiltrative scalp tumors. Several techniques have been developed:

- 1. Direct Suturing:** The edges of the dural lesion are brought together with absorbable or non-absorbable sutures. However, some studies suggest avoiding suturing in certain cases, such as when the arachnoid is intact, in minimally invasive procedures, or when the tear is inaccessible. In such cases, tissue adhesive and collagen may be used.
- 2. Dural Grafts:** For extensive lesions or when suturing is impossible, dural grafts can be used—either allografts or synthetic substitutes—to restore dural integrity and prevent CSF leakage. RESODURA® (resorbable biological equine collagen) and BIOMESH A2 (non-resorbable synthetic patch) are commonly used materials.
- 3. Electrosurgical Welding:** This method uses electrosurgical energy to seal dural defects and is particularly useful in radical surgery of intracranial tumor extensions. It provides effective repair while minimizing CSF leakage.
- 4. Sealants:** Sealants are used to patch, fill dead spaces, and adhere to tear edges to prevent CSF leaks. No single product perfectly fulfills all requirements. NeuroFilm (Obex®) is suitable for small tears (<2 cm). The combination of collagen and fibrin provides sealing, space-filling, and hemostatic effects. Fibrin glue (Tissucol®) remains the most widely used product for dural sealing.

IV. CONCLUSION

Dural plasty is a specialized surgical procedure aimed at repairing or restoring the integrity of the dura mater — the protective membrane surrounding the brain and spinal cord. It is essential for preventing complications such as cerebrospinal fluid leaks, infections, and cerebral herniations.

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