

Sandwich wound closure reduces the risk of cerebrospinal fluid leaks in posterior fossa surgery

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Abstract

Posterior fossa surgery is demanding and hides a significant number of obstacles starting from the approach to the wound closure. The risk of cerebrospinal fluid (CSF) leakage in posterior fossa surgery given in the literature is around 8%. The present study aims to introduce a sandwich closure of the dura in posterior fossa surgery, which reduces significantly the number of CSF leaks (3.8%) in the patients treated in our department. Three hundred and ten patients treated in our hospital in the years 2009-2013 for posterior fossa pathologies were retrospectively evaluated. The dura closure method was as following: lyophilized dura put under the dura and sealed with fibrin glue and sutures, dura adapting stitches, TachoSil® (Takeda Pharma A/S, Roskilde, Denmark), Gelfoam® (Pfizer Inc., New York, NY, USA) and polymethylmethacrylate (osteoclastic craniotomy). The incidence of postsurgical complications associated with the dural closure like CSF leakage, infections, bleeding is evaluated. Only 3.8% of patients developed CSF leakage and only 0.5% needed a second surgery for CSF leakage closure. Two percent had a cerebellar bleeding with no need for re-operation and 3% had a wound infection treated with antibiotics. The sandwich wound closure we are applying for posterior fossa surgery in our patients correlates with a significant reduction of CSF leaks compared to the literature.

Introduction

Dura closure is a very important last step in the performance of the posterior fossa approach. Primary dural closure is often technically difficult and requires use of substitutes either autologous materials (fat graft,

pericranium) or dural sealant augmentation. Various techniques and products are used to ensure watertight dural closure-failure of which lead to dire consequences. Posterior fossa approaches are often accompanied with complications like cerebrospinal fluid (CSF) leakage, surgical site infection, meningitis, pseudomeningocele formation and delayed hydrocephalus.¹ CSF leakage is a potential life threatening complication with attending risk of infection. Treatment of CSF leaks leads to profound morbidity with increased hospital stay and its cost has been estimated to be one and half times greater than uncomplicated cases.² The two main techniques used in ensuring water tight dural closure in posterior fossa surgery are the use of autologous materials and dural substitutes with dural sealant augmentation. Dural substitutes like bovine collagen matrix are accompanied with a rate of 50% complications,³ whereas in general the risk is about 22%. Not only the differences in the material is described, but also the different suture techniques, which show no significant shift by comparison.⁴ Sealants increase the water tightness of suture significantly with variations in water tightness capacities of different sealants.⁵

This study presents our experience with the Sandwich technique of dural closure using a combination of autologous dura, dural substitute and fibrin glue.

Materials and Methods

This is a retrospective *technique* study. In accordance to the Chamber of Medical Doctors of North Rhine Westfalia, Germany, no Institutional Review Board (IRB) approval is needed for retrospective studies. All patients (N=310) were operated on the sitting position. The charts of patients >18 years old (mean age: 60.7 years) were analyzed, which were operated in our department from 2009-2013. No radiation treatment was performed on the posterior fosse before surgery.

The female to male ratio was 1.08:1. The follow up period was 6 months (until the second postsurgical control visit).

Technique

After removing the pathology in the posterior fossa, dural closure follows a sandwich closure with lyophilized dura, which is sutured on the dural edges, suturing the dura as tight as possible and placement of fibrin coated watertight sealant over the dura and under the edges of the craniotomy. In a next step the bone is replaced with polymethylmethacrylate, which is fixed as shown in Figure 1A-F. In almost all cases we placed bur

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holes on the lower edge of the transverse sinus and did not expose the whole sinus diameter. Post surgically the patients receive dexamethasone for 3 days.

For 2 weeks the patients wear a soft cervical collar. Figure 2 shows intraoperative images of the closure method and Figure 3 illustrates pre- and postoperative images.

Results

The patients were operated on variable pathologies with the greatest number representing astro-/oligodendroglial tumors (110), metastases (80), meningioma (30), glioblastoma (15) and acoustic neuroma (30). All other pathologies were represented by numbers <10 (arteriovenous malformation, meningocele, cavernoma, abscess, ependymoma, medulloblastoma, lymphoma, cyst, ganglioma, teratoma, amyloid angiopathy, Arnold-Chiari malformation, bone tumor).

The general health status (risk factors like hypertension, adipose patients, etc.) of the individuals was not significantly different compared to the general population.

Only 3.8% of patients developed CSF leakage and only 0.5% needed a second surgery for CSF leakage closure. By CSF leakage we mean a subcutaneous palpable mass, which is leaking outside the wound or not. Two percent had a cerebellar bleeding with no need for re-operation and 3% had a wound infection treated with antibiotics.

Five patients developed a hydrocephalus

and there was no significant difference between the CSF leakage rate in these patients and patients without hydrocephalus although the number of patients was too small to allow a statistical comparison.

There was also not a statistical difference between CSF leakage and patients with extended opening of the arachnoid.

Discussion and Conclusions

There are different dural closure techniques in use ranging from meticulous primary dural closure using interrupted or continuous stitches, use of dural substitutes-autologous (fat graft, fascia, pericranium) and synthetic. Many

neurosurgeons use autologous materials or dural substitutes due to the associated lesser complication rates.⁴ Complication rates following posterior fossa surgeries vary between 1 and 10%.^{1-3,6} Various aspects of the surgical approach and closure technique contribute to the complication rate. CSF leakages following posterior fossa surgery has remained an

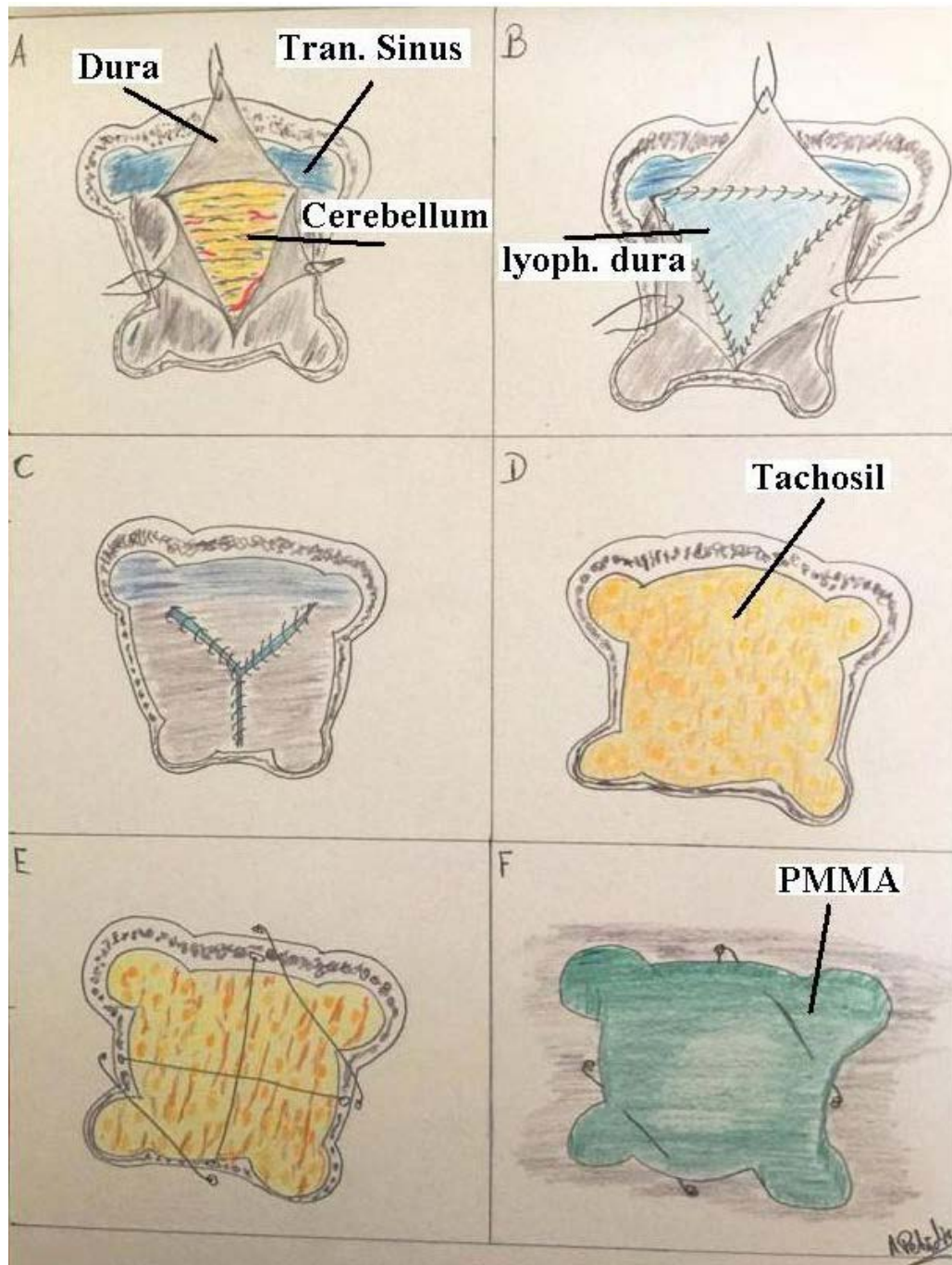


Figure 1. Illustration of the dural closure. A) Dura is opened in a Y shape; B) Lyophilized dura is opened and sutured on the dural edges; C) After suturing the lyophilized dura the dura is approximated; D) Fibrin coated dura seal is now applied epidurally; E) X-shaped suture is put over the closed dura through small hole in the calvaria; F) Polymethylmethacrylate (PMMA) is applied. The suture on the bone assists fixation of the PMMA to the defect.

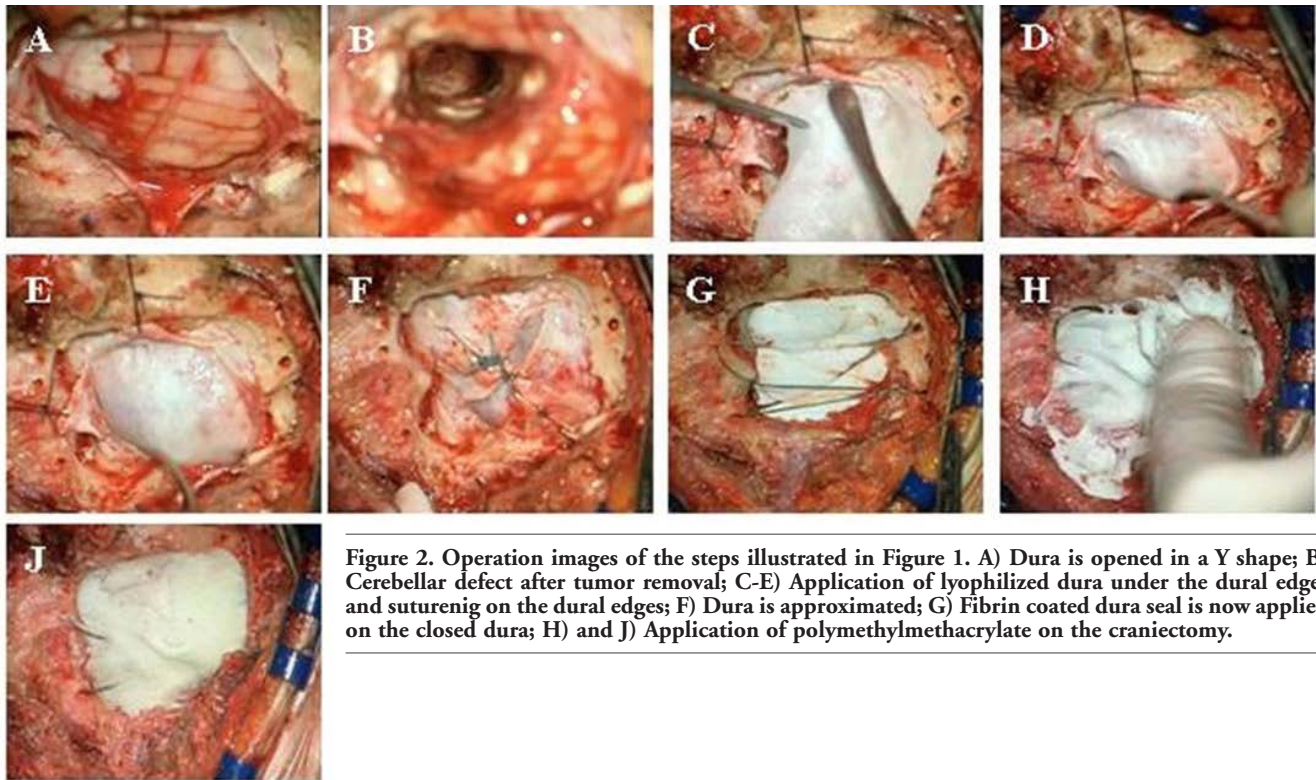


Figure 2. Operation images of the steps illustrated in Figure 1. A) Dura is opened in a Y shape; B) Cerebellar defect after tumor removal; C-E) Application of lyophilized dura under the dural edges and suturing on the dural edges; F) Dura is approximated; G) Fibrin coated dura seal is now applied on the closed dura; H) and J) Application of polymethylmethacrylate on the craniectomy.

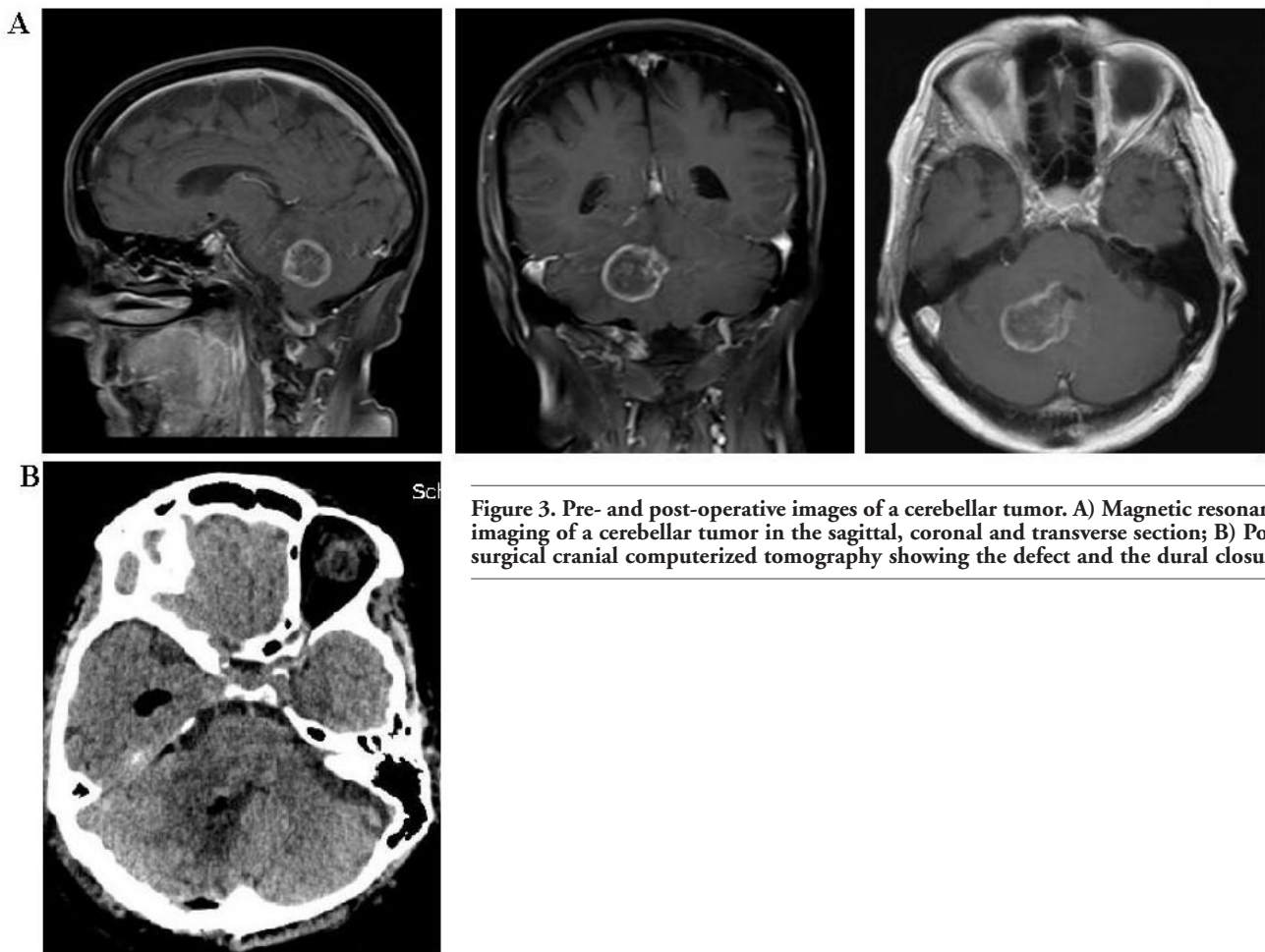


Figure 3. Pre- and post-operative images of a cerebellar tumor. A) Magnetic resonance imaging of a cerebellar tumor in the sagittal, coronal and transverse section; B) Post-surgical cranial computerized tomography showing the defect and the dural closure.

unsolved problem since the era of Cushing⁴ and constitute a major post operative complication due to potentially life threatening sequelae and delay beginning of adjuvant therapy in oncologic cases.⁶ It occurs in 2-17% following posterior fossa surgery.^{2,4,6}

In the present study the combination of those techniques, as it is in the sandwich technique, reduces the CSF leakage complication rate to 3.8% (only 0.5% needed a surgical revision) which is low compared to the complication rate described in the literature.^{3,6,7}

The 0.5% of patients needed a second surgery for CSF leakage closure which is better compared to 3.7% in a similar study.⁷ The rest of the patients with CSF leakage were managed by a lumbar drain for 5-7 days. The 2% of the patients had cerebellar bleeding with no need of re-operation and 3% had a wound infection treated with antibiotics to good effect. The sandwich wound closure we applied for posteri-

or fossa surgery in our patients, correlates with a significant reduction of CSF leaks compared to the literature and less need for surgical closure for the few who had CSF leaks.

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