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Umit Kocaman,  
Hakan Yilmaz



# The effect of long-term subgaleal drain retention (for 14 days) in preventing Cerebro-Spinal Fluid (CSF) fistula development in cases with an insufficiently closed dural defect after craniotomy or craniectomy

Umit Kocaman<sup>1</sup>, Hakan Yilmaz<sup>2</sup>

<sup>1</sup> Izmir Cigli Region Education and Research Hospital, Department of Neurosurgery, Izmir, TURKEY

<sup>2</sup> University of Health Sciences, Izmir Bozyaka Education and Research Hospital, Department of Neurosurgery, Izmir, TURKEY

## ABSTRACT

**Purpose:** Our aim was to determine the effectiveness of long-term subgaleal drain retention in preventing CSF fistula development that may occur in the wound site when the dura cannot be completely closed after craniotomy or craniectomy.

**Material and method:** This study was planned to include the cases of craniotomy and craniectomy performed at Bakircay University Cigli Training and Research Hospital during 2017-2021. The study has been made in a retrospective manner to include a subgaleal drain group and a control group. Both groups were selected from Bakircay University Cigli Training and Research Hospital. A subgaleal drain was placed in 18 cases with a large or multiple defect after craniotomy or craniectomy where the defect could not be completely closed with grafts. It was planned to be kept in place for 14 days with free drainage. Patients were administered antibiotics for three days after the surgery. Patients were monitored for CSF fistula and infection development. On the other hand, 12 patients having large dural defect were included in the control group. Patients in the control group were determined by a random selection method. Patients were followed for 2 days under subgaleal drainage. The Control group was also monitored for CSF fistula and infection development. Both groups statistically were compared with each other in terms of CSF fistula and infection development.

**Results:** There were 18 cases where the dura was closed insufficiently, long-term subgaleal drainage was performed. The mean age was 66.6 (34-82) years. The surgery performed was craniotomy/craniectomy for cerebellar hematoma drainage in 3 cases, acute subdural hematoma drainage in 5 cases, supratentorial tumour resection in 5 cases, large depression fracture in 4 cases and debridement of cerebral tissue damaged by firearm injury in 1 case. The drain was withdrawn at the end of the 14th day in all patients. A CSF fistula did not occur in any of 18 patients (0%) included in the study. In all patients (100%), the wounds were healed without any problems and no signs of local or systemic infection were found. In the control group, the mean age is 62.2 (48-88) years. CSF fistula developed in 4 (33.3%) of 12 patients

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**Keywords**  
subgaleal drain,  
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Corresponding author:  
**Hakan Yilmaz**

University of Health Sciences, Izmir  
Bozyaka Education and Research  
Hospital, Department of  
Neurosurgery, Izmir, Turkey

dr\_hakanyilmaz@hotmail.com

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in the control group. We had to apply lumbar external drainage in 2(50) of 4 patients with CSF fistula. Central nervous system infection developed in one (% 8.33) patient.

**Conclusion:** Long-term subgaleal drainage can be used as an alternative to lumbar external drainage.

## INTRODUCTION

CSF leakage is an important risk factor in cranial surgeries where the dura is opened. This risk may increase even further in cases requiring dural patches, those with history of diabetes mellitus, during surgery for meningioma that has invaded the dura and bones, and according to craniotomy localization [1]. CSF leakage after craniotomy is directly related to intracranial infections [2].

Conventional methods are currently successfully used to minimize CSF fistula development. Primary tight closure of the dura and patching with galeal graft, lata graft or allograft when necessary and providing support to the dural repair site with biological tissue adhesives are certain precautions that can be taken during the surgery. The most important established method after the development of an CSF fistula is the resuturing of the wound area and simultaneous insertion of lumbar drainage [3,4,5]. External ventricular drainage can be used for CSF fistula treatment in selected cases and when lumbar drainage is contra-indicated.

We think that a subgaleal drain can be safely used as an alternative to lumbar drainage when the dura cannot be closed completely after craniotomy or when leak proof characteristics of the duraplasty are suspect. We share our results from the clinical experiences on this subject.

## MATERIAL AND METHOD

We included cases of craniotomy and craniectomy performed at Bakircay University Cigli Training and Research Hospital during 2017-2021 in this retrospective study. Cases in which the dura had a large defect and could not be closed were investigated in the study. Although duraplasty was performed with the aid of a galeal graft or dural patch, it had not been possible to ensure adequate closure. The subgaleal drain placed during surgery was therefore left for free drainage for 14 days. A 10 ch soft drain with a drainage bag was preferred as the subgaleal drain. The drain was always kept open and below the head level of the patient. Daily wound dressing and drain care was performed. Hemogram,

sedimentation and CRP were monitored every 3 days; daily 2x1g cefazolin was administered intravenously during 3 days. On the other hand, 12 patients having large dural defect were include to the control group. Patients in control grup were determined by random selection method. The control group was followed for 2 days under subgaleal dranaige. Control group was also monitered for CSF fistula and infection development. The both groups statistically was compared with each other in terms of CSF fistula and infection development. Statistical analysis was performed with Pearson's chi-square test.



**Figure 1.** A case where the defect dural to firearm injury is too large that duraplasty cannot be made.



**Figure 2.** Closure of the case using frontal flap and soft subgaleal drainage with 10 ch drainage bag.

## RESULTS

There were 18 cases where the dura had a large defect and could not be closed and where subgaleal drainage was planned. The surgery performed was craniotomy/craniectomy for cerebellar hematoma drainage in 3 cases, acute subdural hematoma drainage in 5 cases, supratentorial tumor resection in 5 cases, large depression fracture in 4 cases and debridement of cerebral tissue damaged by firearm injury in 1 cases, The mean age of 18 patients included in the evaluation was 66.6 (34-82) years. There were 11 males and 7 females. Duraplasty with a galeal graft had been attempted first, followed by a dural patch if that was not possible. However, adequate dura closure could not be ensured due to reasons such as dural tissue loss, dura maceration, cerebral edema, and damaged dura structure in traumatic cases. Long-term subgaleal drainage was planned during operation in these patients. The subgaleal drain was withdrawn and closed with a single suture at the end of 14 days. A CSF fistula did not develop in any patient (0%). Suture removal was at the 7-10 days on average. Local or systemic infection were not found in any of the cases (0%). In the control group, mean age is 62.2 (48-88) years. There were 7 males, 5 females. CSF fistula developed in 4(33.3%) of 12 patients in control group. We had to apply lumbar external drainage in 2(50%) of 4 patients with CSF fistula. Central nervous system infection developed in one (8.33%) patient.

The development of CSF fistula is statistically significant in patients with long-term subgaleal drain use compared to the control group (according to Pearson's chi-square test;  $p:0.018$ ).

Again, there is no statistically significant difference between the long-term subgaleal drain group and the control group in terms of preventing the development of central nervous system infection due to CSF fistula (according to Pearson's chi-square test;  $p:0.400$ ).

## DISCUSSION

Long-term subgaleal drainage provides time for wound site healing in cases where duraplasty is not possible due to a large dural defect. The drainage bag was kept just below the head level. We used long-term subgaleal drainage in 18 patients with a dural defect in this study. The lack of a CSF fistula in the patients indicates that this is an effective and practical method.

A study similar to ours was conducted in patients who underwent spinal surgery and had an iatrogenic dural tear. A subfascial drain was inserted for the patients who had CSF leakage despite dura repair and wound healing was allowed. The drain was left for 15 days. None of the patients developed long-term drainage-related complications and no permanent CSF fistula was observed [4].

Another study evaluated 24 patients who had undergone posterior fossa surgery with a CSF fistula. The CSF fistula was treated with conservative treatment that required resuturing in only 2 of the patients and lumbar external drainage was used in 20 patients. Two patients required ventriculo-peritoneal shunt insertion due to hydrocephalus. The importance of lumbar external drainage with resuturing of the wound site in the treatment of a CSF fistula was emphasized in that study [5].

We believe that subgaleal drainage could provide an alternative to lumbar external drainage. Placing a subgaleal drain during surgery and conducting the follow-up with drainage from the beginning reduces the risk of CSF fistula development while we are trying to treat a CSF fistula that has already developed with lumbar external drainage. This may be an advantage of subgaleal drainage. There may also be a period of a few days when CSF leakage is followed up with sutures while the flow continues after the CSF fistula develops in patients with lumbar external drainage. The patient can also suffer from infections during this time. There is no such period with subgaleal drainage.

Another study compared infection rates in terms of meningoventriculitis development in patients who required lumbar external drainage (LED) and external ventricular drainage (EVD). The infection rates for EVD and LED were reported as 7.5 and 24.7 per 1000 EVD and LED days respectively. The meningoventriculitis rate was highest between the 4th and 9th days. They found EVD not to be an important meningoventriculitis risk factor while LED was among the major risk factors [3]. Furthermore, subgaleal drainage may have a lower infection risk as it is less invasive than EVD. Since both lumbar external drainage and subgaleal drainage are placed under sterile conditions, a significant risk may not occur as long as drainage care is performed regularly. We did not find any significant findings in terms of infection. Some articles suggest replacement of external ventricular catheters every

10 days [6]. A similar study was also conducted in spinal durotomy cases. A subfascial epidural drain was placed after primary repair and left for a mean period of 5.3 days for draining in these patients. A CSF fistula did not develop in any patient and no excessive drainage occurred. It should be noted here that daily and careful monitoring of the drainage and wound dressing during long-term subfascial drainage follow-up is very important in terms of reducing the risk of infection. If signs of infection develop, the drain should be withdrawn, appropriate antibiotic treatment should be reviewed and repair with re-exploration considered.

Another study has reported that the prolonged subgaleal drainage and suture technique used to eliminate CSF leakage and wound problems after decompressive craniectomy significantly decreases wound problems [7].

We would like to emphasize that long-term subgaleal drainage may be less invasive and more practical than LED. LED has several disadvantages. It is contra-indicated in some cases. It cannot be performed following cranial surgery for tumor resection and if there is a residual mass that can cause tonsillar herniation. LED after surgery that may interrupt CSF flow creates a risk of tonsillar herniation [8]. These risks do not seem to be present with subgaleal drainage.

As the biggest disadvantage of the application is that we cannot know in advance whether a patient develops a CSF fistula. We decided to extend the subgaleal drainage period in patients with one criteria. This is large dural defect despite duraplasty.

Our experience has shown that complete dural closure is not possible in some cases. In these cases, prolonging the subgaleal drainage time can give us time for wound healing.

LED is an invasive procedure. Known complications that can develop during or after the procedure include spinal headache, spinal epidural hemorrhage, radiculopathy, epidermoid tumor formation, intracranial subdural hygroma or bleeding, vestibulo-cochlear dysfunction, ocular problems and dural sinus thrombosis [8]. These complications are not encountered with subgaleal drainage in practice. LED can also lead to problems during the follow-up. Too much drainage can result in serious morbidity and mortality. Experienced ancillary healthcare staff are therefore required to monitor the lumbar drainage.

The disadvantage of subgaleal drainage is the risk of CSF leakage from drain path after the drain itself is removed. We used a compressive dressing after the removal of the drain and no CSF fistula occurred in any of our cases. Biological tissue adhesive can be applied to the drain route as an alternative as mentioned in the Menovsky et al. study [9]. Another study has reported biological tissue adhesive applied to sutures after primary dura repair to reduce the risk of CSF fistula [1].

Our study can clarify the following issue: The development of CSF fistula is statistically significant in patients with long-term subgaleal drain use compared to the control group.

## CONCLUSION

Long-term subgaleal drainage in preventing CSF fistula development in cases with dural defect is a less invasive and more effective alternative to LED with practical application and follow-up. There is no risk of infection if the drain is cared for properly.

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