Posterior Fossa Craniotomy: Retrospective Analysis of 85 Patients

Kadir Oktay[1], Ebru Güzel[2], Emre Unal[3],
Mansur Mammadov[1], Hakan Seckin[4], Aslan Güzel[3]

1 Department of Neurosurgery, Cukurova University Medicine School, Adana, Türkiye
2 Department of Radiology, Gaziantep Medical Point Hospital, Gaziantep, Türkiye
3 Department of Neurosurgery, Bahcesehir University Medicine School, Istanbul, Türkiye
4 Department of Neurosurgery, Medicana Bursa Hospital, Bursa, Türkiye

Abstract

Aim: Craniectomy procedures were traditionally performed in posterior fossa surgeries. However, craniotomy procedure has also been started to be performed routinely in recent years. In this study, we aimed to evaluate the patients who underwent posterior fossa craniotomy procedures.

Methods: The records of 85 patients who underwent posterior fossa craniotomy for various pathologies between 2016-2021 were retrospectively reviewed.

Results: The mean age of the patients was 36.1 (2-82 years interval). There were 43 female patients (50.5%) and 42 male patients (49.5%). The pathologies were tumoral in 63 patients and non-tumoral in 22 patients. The symptoms of the patients identified were headache (84.5%), cerebellar symptoms (68%), deterioration of consciousness (54%), nausea (48%), cranial nerve dysfunction (34%) and hemiparesis (18.5%). At admission, hydrocephaly was present in 22 patients. Ventriculoperitoneal shunt was applied to 12 of these patients. The duramater of the 68 patients were closed with primary suturation while 17 patients underwent duraplasty with fascia graft. Craniotomy flaps were fixed with only silk in 75 patients and miniplates in 10 patients. Two of the patients had pseudomeningocele and 1 had cerebrospinal fluid leak from the wound. The mortality rate was 3.5%. The mean duration of hospitalization was 7.6 days (2-54 days interval).

Conclusions: Posterior fossa craniotomy technique has recently become widespread and begun to replace traditional craniectomy technique. It was facilitated by using high-speed drill with the advancement in technology. Posterior fossa craniotomy is a prominent technique with the low complication rates and high patient comfort in the postoperative period.

Keywords: Posterior fossa, craniotomy, tumor, microvascular decompression, complication

1. Introduction

Posterior fossa surgery is one of the important applications of neurosurgical practice. It differentiates from other regions of the brain in terms of the path of intervention and comprises important anatomical and neurovascular structures. Posterior fossa surgery is a routine procedure in the surgeries such as tumor, hemorrhage, cystic lesions that are located in posterior fossa and microvascular decompression. Traditional craniectomy procedure was performed during posterior fossa surgery in the past while craniotomy procedure started to be routine procedure in the last three decades.

Preservation of the bone structure is useful in many ways for the patient. There are studies in the literature examining osteoblastic craniotomies performed in posterior fossa interventions and comparing craniotomy and craniectomy procedures.[1-4] Craniotomy is considered to be more advantageous. In this study, we aimed to evaluate 85 patients who underwent posterior fossa craniotomy for various pathologies.
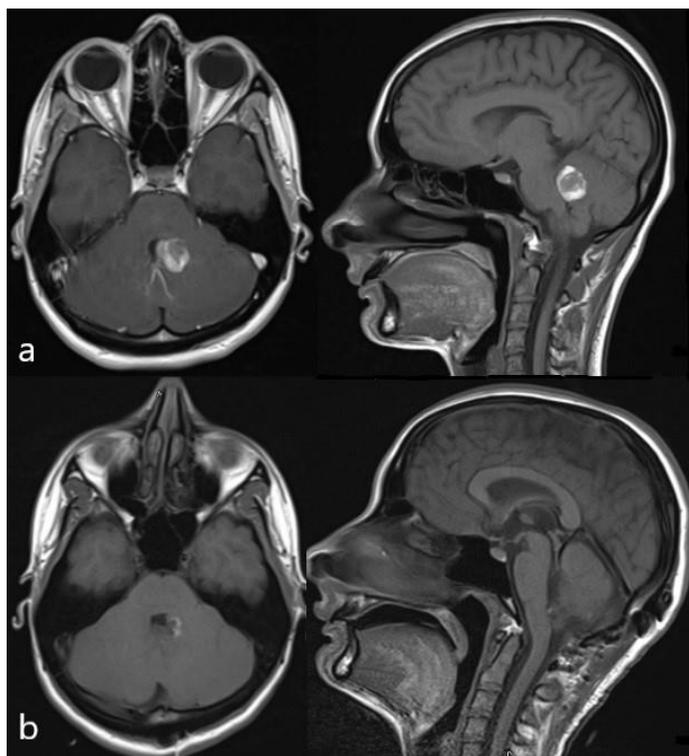
2. Materials and methods

The records of 85 patients who underwent posterior fossa craniotomy for various pathologies between 2016-2021 were retrospectively reviewed. Patient records including age, gender, preoperative and postoperative neurological conditions, type and radiographic localization of their pathologies, applied surgical positions, closure methods of duramater, fixation methods of bone flaps, drain applications, hospitalization periods and postoperative complications were gathered.

(a) Preoperative axial and sagittal contrast-enhanced magnetic resonance images of 17-year-old female patient with 4. ventricle localized cavernoma. **(b)** Postoperative axial and sagittal contrast-enhanced magnetic resonance images of the same patient revealing total resection of the lesion.

Postoperative axial cranial computed tomography images of the same patient demonstrating suboccipital craniotomy for posterior fossa cavernoma excision


Surgical planning was performed according to the location of the lesions. Contrast-enhanced magnetic resonance imaging of all of the patients was performed preoperatively (Figure 1). The patients were operated via sitting, prone and park bench positions. Duramater was closed with primary suturation in suitable patients while duraplasty with fascial graft was performed in inappropriate patients. However, watertight closure was ensured in all patients. Posterior fossa craniotomy procedures were applied to all patients (Figure 2). Craniotomy technique was applied to the patients with four burrholes from the safe areas and cutting with high-speed drill after dissection of the duramater under the bone. There was no dural or sinus injury in any of the patients except one. This patient had injury to the sigmoid sinus. However, the repair with the fascia graft and surgecell tamponade was performed and the patient was discharged without any problem. Bone flaps were fixed with silk in appropriate patients and by using miniplates in patients with defective or fragmented bone flaps. Jackson-pratt drains were placed in the required patients and drain was not placed in patients with good hemostasis. The patients were medicated with prophylactic antibiotherapy (ampicillin sulbactam) peroperatively and postoperatively for three days.

2.1. Statistical evaluation

SPSS software version 25.0 (IBM Corporation, Armonk, New York, USA) was used to analyze the variables. The Mann–Whitney U-test was applied with the Monte Carlo results to compare the categorical variables quantitatively. The quantitative variables were presented as the mean ± SD (standard deviation) and range (maximum-minimum) and the categorical variables as n (%). The variables were examined at a 95% confidence level, with $p < 0.05$ considered to indicate statistical significance.
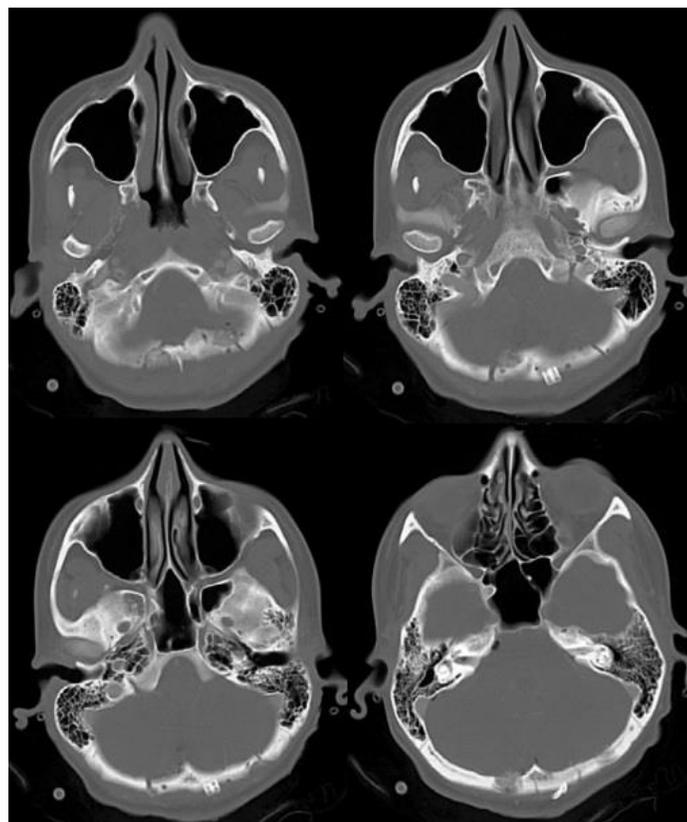
3. Results

3.1. Patient Profile

A total of 85 patients were included in the study. The mean age of the patients was 36.1 (2-82 years interval). 43 patients (50.5%) were female and 42 patients (49.5%) were male. 24 patients were in pediatric age group and 61 were adult. 63 patients had tumoral and 22 patients had non-tumoral pathologies. Of these 22 patients, 17 had trigeminal neuralgia, 2 had cerebellar abscess, 1 had hydatid cyst and 2 had traumatic epidural hematoma. In the tumoral group, 19 patients had medulloblastoma, 11 patients had epidermoid tumor, 8 patients had meningioma, 7 patients had schwannoma, 3 patients had hemangioblastoma, 4 patients had low grade glial tumor, 2 patients had high grade glial tumor, 2 patients had ependymoma and 1 patient had cavernoma (Table 1).

3.2. Patient Symptoms

The most common symptom was headache (84.5%). Other symptoms identified were cerebellar symptoms (68%), deterioration of consciousness (54%), nause (48%), cranial nerve dysfunction (34%) and hemiparesis (18.5%), respectively (Table 2).

3.3. Neuroimaging

The pathologies were extra-axial in 66 patients and intra-axial in 19 patients. Localization of the pathologies were; right cerebellopontine angle in 23 patients, left cerebellopontine angle in 21 patients, fourth ventricle in 20 patients, left cerebellum in 13 patients, right cerebellum in 6 patients and brainstem in 2 patients. According to the neuroimaging of the patients, hydrocephaly was detected in 22 patients. All patients with hydrocephalus had tumoral pathologies.

Table 1

Demographic data of the patients in the study group

Characteristics		Study group n=85 (%)
Age (Mean)		36.1 ± 5.5 (2 -82 years)
Gender (Male/Female)		42/43
	Tumoral	63 (75%)
	· Medulloblastoma	19 (23%)
	· Epidermoid tumor	11 (14%)
	· Menengioma	8 (9%)
	· Schwannoma	6 (7%)
	· Metastasis	7 (8%)
	· Hemangioblastoma	3 (4%)
Pathology	· Low grade glial tumor	4 (5%)
	· High grade glial tumor	2 (2%)
	· Ependymoma	2 (2%)
	· Cavernoma	1 (1%)
	Non-tumoral	22 (25%)
	· Trigeminal neuralgia	17 (20%)
	· Cerebellar abcess	2 (2%)
	· Hydatid cyst	1 (1%)
	· Epidural hematoma	2 (2%)

Table 2

Clinical symptoms of the patients

Symptoms	Study group n=85 (%)
· Headache	84.5%
· Cerebellar signs	68%
· Consciousness deterioration	54%
· Nausea-vomitting	48%
· Cranial nerve deficit	34%
· Hemiparesis	18.5%

Table 3

Surgical procedures performed to the patients and postoperative complications

Characteristics		Study group n=85 (%)
	· Sitting	48 (56%)
Position	· Lateral park-bench	33 (39%)
	· Prone	4 (5%)
Dural closure	· Primary suturation	68 (80%)
	· Fascia graft	17 (20%)
Bone fixation	· Silk only	75 (88%)
	· Miniplates	10 (12%)
Jackson-Pratt drainage	· +	74 (87%)
	· -	11 (13%)
Hydrocephalus treatment	· External ventricular drainage	16 (19%)*
	· Ventriculoperitoneal shunt	12 (14%)**
	· Pseudomeningocele (short term)	1 (1%)
	· Pseudomeningocele (long term)	1 (1%)
Complications	· CSF leak + meningitis	1 (1%)
	· Hematoma	1 (1%)
	· Vegetative state	1 (1%)
	· Exitus	3 (3.5%)

CSF: Cerebrospinal fluid, Ventriculoperitoneal shunt was applied in 6 of these patients, 10 patient did not need ventriculoperitoneal shunt after tumor resection,*

*** Ventriculoperitoneal shunt was applied in 6 patients before the surgery and in 6 patients after external ventricular drainage.*

3.4. Surgery

Posterior fossa craniotomies were applied to all patients. The operations of 48 patients was performed in the sitting position, 33 patients in the park bench position and 4 patients in the prone position. All craniotomies were performed using high speed drill. The duramater of the 68 patients were closed by primary suturation and the rest of the 17 patients underwent duraplasty with the fascia graft. Watertight closure was ensured with valsalva maneuver in all patients. Craniotomy flaps were fixed using only silk in 75 patients (Figure 3-4). In 10 patients, bone flaps were fixed with miniplates because they were fragmented or defective. During closure, Jackson-Pratt drains were placed in 74 patients. 11 patients did not have a drain due to good hemostasis (Table 3). The mean duration of hospitalization was 7.6 days (2-54 days interval).

At admission, hydrocephaly was present in 22 patients. Ventriculoperitoneal shunt was applied in 6 of these patients before tumor resection. The remaining 16 patients underwent external ventricular drainage. In 6 of these patients, ventriculoperitoneal shunt was needed and shunt was inserted after tumor resection. A total of 12 patients underwent ventriculoperitoneal shunting (Table 3).

Figure 3

Peroperative images of the same patient revealing suboccipital craniotomy fixation with silk sutures.

Figure 4

(a) Postoperative axial cranial computed tomography images of 32-year-old male patient who underwent microvascular decompression via left retrosigmoid craniotomy for trigeminal neuralgia. **(b)** Peroperative images of the same patient demonstrating left retrosigmoid craniotomy.
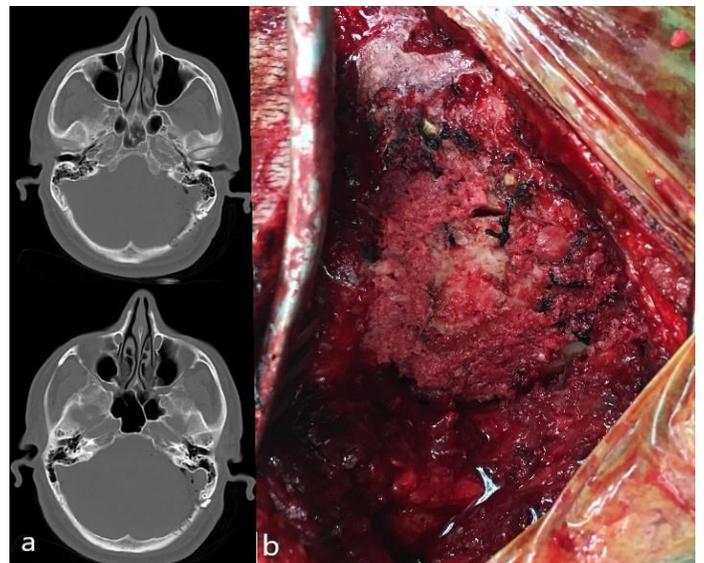
3.5. Complications

There were complications detected in 8 patients. During the fol-low-up, short term pseudomeningocele in 1 patient, long term pseu-domeningocele in 1 patient, hematoma in 1 patient and co-existence of cerebrospinal fluid (CSF) leak from the wound and meningitis in 1 patient were detected. 3 patients died and 1 patient had vegetative status. The mortality rate was 3.5%. The patients who developed pseudomeningocele were treated with external lumbar subarach-noid drainage. The patient who developed hematoma in the opera-tion region underwent re-operation and her hematoma was drained out. The patient who had co-existence of CSF leak from the wound and meningitis was treated with proper antibiotherapy and external lumbar subarachnoid drainage (Table 3).

4. Discussion

Traditionally, posterior fossa surgeries include craniectomy pro-cedures. However, craniotomy procedures have been widely ap-plied during the posterior fossa surgeries in the last three decades. This procedure was first described by Yaşargil and Fox[5] in 1974. This craniotomy procedure is a technique applied by several bur-rholes using gigli wires. Ogilvy and Ojemann[6] presented the craniot-omy technique by using high-speed drill to the literature in 1993. In the following years, other techniques that have been modified using high-speed drill are also described in the literature[7-10]. This tech-nique has been widely used in pediatric patients in previous periods and is currently used in both pediatric and adult age groups[3].

There are some advantages of osteoclastic craniectomy technique used in traditional posterior fossa interventions. It is a more familiar technique by neurosurgeons in terms of application, it is easier to apply and can provide a wide field of view and it is easier to preserve duramater and vital neurovascular structures such as transverse and sigmoid sinuses during the procedure[4]. However, anatomical plane is impaired after resection of the occipital bone and the vital neurovascular structures in the posterior fossa remain vulnerable as a result of this technique[1,4]. In addition, posterior fossa craniec-tomies have been associated with an increase in surgical complica-tions in the literature[1-4].

Craniectomy procedures are thought to increase especially CSF leak in posterior fossa surgeries[1-4]. In cases where the skin integrity does not deteriorate, pseudomeningocele formation occurs, and in cases of deterioration, CSF leak and infections such as meningitis oc-cur. In the study performed by Gnanalingham et al., three hypothe-ses were presented. The first one is the iatrogenic elimination of one of the anatomical layers to be breached before CSF can leak from the wound. The second is the bulging of the sutured duramater from the craniectomy defects with the increase in the intracranial pressure, such as coughs or strains, and dural sutures may tear out in these patients. The third is the formation of a dead space in the region where the muscles adhere together as a result of the resection of the bone, which is an adhesion area for the paravertebral muscles. Even in the small defects in the dura, this dead space is suitable for the formation of CSF collection and pseudomeningocele in the later stages[1].

CSF leak may also be seen after posterior fossa craniotomies. However, CSF leak rates were found to be much lower in craniot-omies in the studies presented in the literature[1-4]. In the study per-formed by Legnani et al.[4], pseudomeningocele rates were 4% in cra-niotomy and 19.2% in craniectomy. CSF fistula rates were found to be 11.5% in craniectomy and 2% in craniotomy. Gnanalingham et al.[1] presented similar results. In the craniotomy group, the rate of pseudomeningocele was 9% and CSF leak rate was 4%, while these

rates were 23% and 27% in the craniectomy group. Because of the high CSF leak rates, wound infection and meningitis rates also in-creased in the craniectomy patients. In the present study, the rates of CSF leak and pseudomeningocele were 1% and 2% in patients who underwent craniotomy. Meningitis occured in one patient who had risk factors including CSF leak from the wound and long-term stay in the intensive care unit. This patient was treated with appro-priate antibiotherapy and external lumbar subarachnoid drainage application and discharged with no problem.

Severe headache is another problem that may occur after craniec-tomy procedures in posterior fossa surgery. It is thought that this situation is caused by adhesion of the paravertebral muscles to the duramater and traction of the duramater during neck move-ments[1,9,11]. In accordance with this, we did not observe severe head-ache in the present craniotomy cohort. Another advantage of crani-otomy is the ease of reoperations in the long term. Since the ana-tomical plane is impaired in patients undergoing craniectomy, the risk of damage to the duramater and vital neurovascular structures increases in recurrent surgeries[1,4,9,12].

In previous periods, there was a thought that the craniectomy pro-cedure would save the patients in emergency cases such as sudden brain swelling. However, it was found that this situation was not sig-nificant. No significant difference was found in the studies pre-sented in the literature[2-4]. In order to avoid this situation, we think that total resection of the pathology in suitable patients, careful he-mostasis, proper opening of subarachnoid cisterns and drainage of CSF should be performed.

In the literature, there are also publications in which the craniec-tomy defect is closed by using the autologous bone particles. Missori et al.[13] presented a technique in which autologous bone fragments were covered with Surgicel (Ethicon, Johnson & Johnson) and the suboccipital craniectomy defect was reconstructed. In the study performed by Sheikh et al.[10], reconstruction of the craniectomy de-fect was described by adding tissue glue to the autologous bone par-ticles and covered with gel foam. There are also more studies about craniectomy defect reconstruction using tissue glue in the litera-ture[14-16]. However, in such techniques, a certain fusion period is re-quired for the bone flap and the strength of the bone in the early stages is not sufficient to be protective. In addition, we believe that craniotomy technique is more advantageous in terms of both sus-ceptibility to infection and cost because it is applied without using a foreign body. Foreign material such as cranioplastic kit may cause artifacts in the neuroimaging of patients at later stages.

There are certain limitations of the present study. The most im-portant limitation was the retrospective nature of the study. The ab-sence of a craniectomy cohort in which we can compare the craniot-omy group is another important limitation. The patient group was not classified as pediatric and adult, and a study group of total of 85 patients was composed.

5. Conclusion

Craniotomy procedure in posterior fossa surgery is a technique that has become widely used in recent years and replaces traditional craniectomy procedure. Although the application technique was thought to be more difficult in the early stages, it has been deter-mined that the neurosurgeons could apply craniotomy procedure without damaging the patient with their modified techniques. It was difficult to apply with gigli wires in the past, but with the technology advancement, it was facilitated with the use of high-speed drill. It can be applied without any problem as a result of a certain learning period. In the present study, we present patients who underwent posterior fossa craniotomy with various pathologies. Posterior fossa craniotomy is a prominent technique with the low complica-

tion rates and high patient comfort in the postoperative period.

Statement of ethics

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki and was approved by Cukurova University Clinical Research Ethics Committee (Date: 23/02/2024, decision number 22).

Conflict of interest statement

The authors declare that they have no financial conflict of interest with regard to the content of this report.

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Author Contributions

KO is the major contributor in writing the manuscript. KO, EG and AG are involved in the design and conception of the study. KO, EG, EU, MM, HS, and AG are involved in the collection of the data and the clinical follow-up of the patients. All authors read and approved the final version of the manuscript.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Originality Assertion

The authors have not submitted this article to another journal previously.

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