Abstract: Background: Postoperative headache is a major complaint after RS surgery. PH affected the patient’s quality of life. The role of craniotomy in the prevention of such headaches. We aimed to evaluate the role of craniectomy versus craniotomy via the retrosigmoid approach in reducing the incidence of postoperative headaches. Materials and methods: Patients who underwent surgery between January 2012 and December 2018 were retrospectively assessed and were classified into the craniectomy and craniotomy groups. Clinical data, such as those on age, sex, type of surgery, surgical repair technique, development of infection, postoperative cerebrospinal fluid leak, postoperative meningitis, size of the bone flap, and wound infection, were collected. The severity of headache in all patients was clinically assessed using the Catalano grading system.

Results: Overall, 95 patients underwent microsurgery via the retrosigmoid approach. Of these, 48 were men and 47 were women. In total, 34 patients underwent craniectomy, and 61 patients underwent craniotomy. On discharge, postoperative headache was observed in 47% (16/34) and 21% (13/61) of patients who underwent craniectomy and craniotomy, respectively ( P =.01). The incidence of headache decreased at follow-up. At 12 months after surgery, 15% of patients in the craniectomy group (5/34) and 2% of patients in the craniotomy group (2/61) experienced headache ( P =.01). Of the 61 patients in the craniotomy group, 2 (2%) had less severe headache at 12 months of follow-up.

Conclusion: The severity of headache after surgery and upon discharge significantly decreased in patients who underwent craniotomy than in those who underwent craniectomy.
### Table 1. Grading System Used for the Severity of Postoperative Headache

| Headache Severity | Description of Headache                                      |
|-------------------|-------------------------------------------------------------|
| Grade 0           | No headache                                                 |
| Grade 1           | Mild headache requiring no pain medication                   |
| Grade 2           | Moderate headache requiring nonprescription pain medication  |
| Grade 3           | Severe headache requiring prescription pain medication       |
| Grade 4           | Severe headache refractory to prescription medication        |
### Table 2. Demographic Characteristics of the Participants

| Patient Data                       | Craniectomy | Cranioplasty | P Value |
|------------------------------------|-------------|--------------|---------|
| Mean age (y)                       | 52          | 49           | >0.05   |
| Sex, n (%)                         |             |              | >0.05   |
| Female                             | 19          | 28           |         |
| Male                               | 15          | 33           |         |
| Type of surgery                    |             |              | >0.05   |
| Acoustic neuroma excision          | 27          | 49           |         |
| Microvascular decompression        | 5           | 6            |         |
| Others                             | 2           | 5            |         |
| Size of bone flap                  |             |              |         |
| <3 cm                              | 7           | 10           | 0.02    |
| 3–6 cm                             | 17          | 36           | 0.01    |
| >6 cm                              | 10          | 15           | 0.03    |
| Postoperative CSF leak             |             |              |         |
| Yes                                | 9           | 10           | 0.02    |
| No                                 | 25          | 51           |         |
| Postoperative meningitis           |             |              |         |
| Yes                                | 5           | 6            | 0.02    |
| No                                 | 18          | 55           |         |
| Postoperative wound infection      |             |              |         |
| Yes                                | 3           | 4            | 0.04    |
| No                                 | 31          | 57           |         |
Role of Craniectomy Versus Craniotomy via the Retrosigmoid Approach in Decreasing the Incidence of Postoperative Headache

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Running head: Craniectomy Versus Craniotomy via the Retrosigmoid Approach

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Abstract

**Background:** Postoperative headache is a major complaint after RS surgery. PH affected the patient’s quality of life. The role of craniotomy in the prevention of such headaches. We aimed to evaluate the role of craniectomy versus craniotomy via the retrosigmoid approach in reducing the incidence of postoperative headaches.

**Materials and methods:** Patients who underwent surgery between January 2012 and December 2018 were retrospectively assessed and were classified into the craniectomy and craniotomy groups. Clinical data, such as those on age, sex, type of surgery, surgical repair technique, development of infection, postoperative cerebrospinal fluid leak, postoperative meningitis, size of the bone flap, and wound infection, were collected. The severity of headache in all patients was clinically assessed using the Catalano grading system.

**Results:** Overall, 95 patients underwent microsurgery via the retrosigmoid approach. Of these, 48 were men and 47 were women. In total, 34 patients underwent craniectomy, and 61 patients underwent craniotomy. On discharge, postoperative headache was observed in 47% (16/34) and 21% (13/61) of patients who underwent craniectomy and craniotomy, respectively ($P=.01$). The incidence of headache decreased at follow-up. At 12 months after surgery, 15% of patients in the craniectomy group (5/34) and 2% of patients in the craniotomy group (2/61) experienced headache ($P=.01$). Of the 61 patients in the craniotomy group, 2 (2%) had less severe headache at 12 months of follow-up.

**Conclusion:** The severity of headache after surgery and upon discharge significantly decreased in patients who underwent craniotomy than in those who underwent craniectomy.

**Keywords:** retrosigmoid approach - craniectomy - craniotomy - postoperative headache
Introduction

Many authors advocate the retrosigmoid (RS) approach as the procedure of choice during resecting vestibular schwannoma as well as for microvascular decompression. However, complications such as facial or vestibulocochlear nerve damage, vascular result, cerebellum or brain system infarction, infection, cerebrospinal fluid (CSF) leak, and postoperative headache (PH) are observed after the RS approach is followed. PH is a common outcome of the retrosigmoid approach. Such a condition is a major complaint after surgery via the RS approach and affects a patient’s quality of life. Approximately 30%–80% of patients present with PH. Moreover, the incidence of PH varies across different surgical procedures. The occurrence of PH was indirectly proportional to the occurrence of perioperative complications. Uncontrolled PH is associated with tremor, vomiting, increased blood pressure and intracranial pressure, increased psychiatric disorders (anxiety or depression), and decreased quality of life.

The etiology and pathophysiology of PH is still controversial, and several theories on PH are available. Some authors have advocated that the cause of such condition is dural adhesion between the cervical musculature and dura. Another possible cause is occipital nerve damage directly or during retraction or scar formation and meningeal irritation owing to bone dust.

Infratentorial approach is associated with higher pain scores than the supratentorial approach and PH has a negative effect on mood. Despite the continuous developments and experience of the surgical technique, PH still remains the most frequent complication after this approach. The present study aimed to assess the incidence of and risk factors for headache after RS procedures to establish how to minimize their occurrence.

Materials and methods


The data of patients who underwent surgery via the RS technique at Gaziantep Dr. Ersin Arslan Training and Research Hospital between January 2012 and December 2018 were reviewed retrospectively. Patients were assigned to either surgery groups according to operative notes. We divided the patients into the craniectomy and craniotomy groups. There were not any cross overs. Clinical data, such as those on age, sex, type of surgery, and surgical repair technique, were collected. In terms of outcome indicators, we considered the following parameters: development of infection, postoperative CSF leak, postoperative meningitis, size of the bone flap, and wound infection.

The current study included 95 patients. The patients were followed-up at an average of 12 months. In total, 76, 12 and 7 patients underwent surgery with the RS technique due to acoustic neuroma, microvascular decompression (MVD), and other types of surgery (epidermoid and arachnoid cyst), respectively.

The severity of headache was clinically assessed using the Catalano grading system. As shown in Table 1, according to the Catalano grading system, patients with grades 0 and 1 headache did not take any medications, those with grades 2 and 3 headache. Treatment for PH routinely received nonopioid analgesics such as paracetamol and COX-2 inhibitors and antiepileptics such as gabapentin analgesics, and opioid analgesics such as tramadol. Those with grade four headache consulted a pain specialist.

In both patient groups, the outcomes were recorded prior to surgery; immediately after surgery; and at 1, 3, 6, and 12 months postoperatively. The patients underwent computer tomography (CT) scan and magnetic resonance imaging postoperatively during follow-up.

The patients who underwent MVD, corticosteroids and carbamazepine or gabapentin are also commonly administered preoperatively. MVD patients received for 5 days after surgery.
The retrosigmoid junction involves the transverse and sigmoid sinuses. For the retrosigmoid approach, both the transverse and sigmoid sinuses should be identified. Because of the adherent nature of the sinuses to the bone, craniotomy has increased risk of vascular injury and high morbidity and mortality. Based on this knowledge, all patients underwent craniectomy (Figures 1) rather than craniotomy. The craniectomy defect was closed with autograft. Autograft fixed with titanium plates. (Figures 2)

The head of the patients was fixed in Mayfield headholder and placed in the park-bench position, which is the standard approach. A postauricular curvilinear skin incision was made to prevent injury to the occipital nerves (2 cm inside the asterion and 2 cm medial to the mastoid) and musculoperiosteal flap elevation. After a single burr hole was made, bone dust was collected to prevent bone dust contamination in the subarachnoid space. Craniectomy was extended to the transverse and sigmoid sinuses. The dura mater was opened in a Y-shaped fashion. At the end of the operation, the dura mater was closed in a watertight fashion. The standard titanium plates were positioned in the cranium using titanium screws.

Statistical analyses were performed using the Statistical Package for the Social Sciences software version 22.0 (SPSS Inc., Chicago, IL, the USA). The Kruskal–Wallis and Mann–Whitney U tests were used.

Results

Ninety-five patients underwent microsurgery using the RS technique. All patients had similar clinical presentations. The PH were ipsilateral to the craniectomy (or craniotomy) area. Headaches were primarily somatic and originates from the scalp. The nature of PH was pulsating or usually burning. The preoperative, constant and continuous nature of pain was rarely seen.
The mean age of the patients who underwent craniectomy and craniotomy at the time of surgery was 50.3±9.3 (range: 29–68) years and 49.7±10.7 (range: 25–69) years, respectively. Of the patients, 48 were men and 47 were women. In total, 34 patients underwent craniectomy and 61 underwent craniotomy. In the craniectomy subgroup, 15 were men and 19 women, and in the craniotomy subgroup, 33 were men and 28 women. The RS approach was used to excise vestibular schwannoma in 76 patients, perform MVD in 12 patients, and resect other cerebellopontine angle lesions in seven patients (n=3, meningiomas; n=1, arachnoid cysts; and n=3, epidermoid cysts). The demographic characteristics of the patients are shown in Table 2.

In terms of age and sex, no statistically significant differences were observed between the craniectomy and craniotomy groups.

The size of the bone flap in the two groups was less than 3 cm in diameter in 16% (10/61) and 20% (7/34) of patients who underwent craniectomy and craniotomy, respectively (P=.02). The remaining bone flaps in 59% (36/61) of patients who underwent craniotomy and 50% (17/34) who underwent craniectomy measured 3–6 cm (P=.01). Approximately 25% (15/61) of patients who underwent craniotomy and 29% (10/34) who underwent craniectomy had a bone flap measuring greater than 6 cm in diameter (P=.03).

Wound CSF leakage was observed in 6.6% (9/61) and 20% (10/34) of patients who underwent craniectomy and craniotomy, respectively (P=.02).

Upon discharge, PH was observed in 47% (16/34) and 21% (13/61) of patients who underwent craniectomy and craniotomy, respectively (P=.01). The incidence of headache decreased during follow-up; at 12 months postoperatively, 15% (5/34) of patients in the craniectomy group and 2% (2/61) in the craniotomy group experienced headache (P=.01).
Upon discharge, in 16 patients with headache from the craniectomy subgroup, seven had severe (Catalano grading system, Grades 4 and 3) and nine had moderate and mild headache (Grades 2 and 1), respectively. At the 3- and 6-month follow-up, three patients still presented with severe headache and one had moderate headache; at the 12-month follow-up, one patient still presented with moderate headache, and the course of headache in four patients improved from moderate to mild. Upon discharge, in 13 patients with headache from the craniotomy subgroup, five had severe and eight had moderate and mild headache (Catalano grading system, Grades 2 and 1), respectively. At the 3- and 6-month follow-up, one patient had severe headache and one patient still presented with moderate headache; at the 12-month follow-up, the course of headache in two patients improved from moderate to mild. The assessment results using the Catalano grading system (Pain score 0-50) in the two groups are shown in Graphic (Figure 3).

Patients with craniectomy less than 3 cm in diameter had PH compared with those whose bone flap measured 3–6 cm in diameter, and the result was not significantly different (P=.17). However, craniectomy measuring greater than 6 cm was significantly associated with PH (P=.02). Similar to the results observed in patients with craniotomy, the incidence of postoperative CSF leak and wound infection in the two groups were significantly associated with PH.

Discussion

The RS approach is the main method used to reach structures in the cerebellopontine angle, particularly for vestibular schwannoma and MVD for trigeminal neuralgia. This approach has a lower incidence of CSF leakage than the retrolabyrinthine approach, which is considered its main advantage.16-20 The main disadvantage is the relatively high incidence of PH.1-6 Teo and Eljamel19 have reported that the incidence of headache decreases when cranial reconstruction
is performed. However, the incidence of CSF leak is lower in the craniectomy group than in the craniectomy group. Similar findings were observed in our patients.

Craniotomy may allow for support of cervical cervical musculature and scalp, early reattachment the dural closure, and serve as an additional anatomic barrier to CSF leak. So the craniotomy reduces the rate of wound related complications.\(^\text{19}\)

In the postoperative period, craniotomy was associated with a lower risk of CSF leak and subsequently wound or CSF sepsis, and significant risk factors for PH were also observed. The incidence of postoperative CSF leak, CSF infection, and wound infection was comparable to that reported in other series.\(^\text{6}\)

craniotomy reduces the occurrence of headaches due to dural scarring and adhesions. Soumekh et al.\(^\text{8}\) have reported that craniotomy decreases the incidence of PH. Ruckenstein et al.\(^\text{21}\) have found that craniotomy causes significantly less postoperative pain within the first postoperative year. However, 1 year after surgery, the difference was no longer significant.

In a recent literature review, patients with PH after craniectomy have reported the absence of or mild improvement in headache with pain medications.\(^\text{22}\)

Previous publications have described the use of craniotomy with calvarial bone grafts, methyl methacrylate, or titanium plates and acrylic. The benefit of such procedure has been questioned as clinical studies failed to show any decrease in the incidence of PH in these patients. However, there is currently a few of new studies demonstrating to decrease in the incidence of PH.\(^\text{23,24}\) Our findings support this hypothesis.

Patients who underwent MVD for trigeminal neuralgia took medications for 5 days after surgery. The use of carbamazepine, gabapentin, and steroids perioperatively might had decreased the incidence of headaches in the two groups by reducing edema and inflammation.
However, no change was observed in terms of the occurrence of long-term headache in these two groups.

Limitations of the current study being retrospective design and limited to somatic scalp pain. Therefore, all patients at follow up does not allow for exactly analysis of those responses. Our study was not randomized between craniectomy and craniotomy, and this was a limitation. Even so both procedures were used up between 2012 and 2018 (34 craniectomies and 61 craniotomy).

Conclusion

In this study, the incidence of headache significantly decreased in patients who underwent craniotomy via the RS approach. Postoperative CSF sepsis, CSF leak, size of craniotomy, and wound infection are important risk factors for PH. Thus, via the RS approach, craniotomy is considered a better technique than craniectomy. However, further randomized controlled trials must be conducted to validate such result.

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**Figure legends**

**Figure 1.** (a) Computed tomography (CT) scan 1 day after operation for vestibular schwannoma in the left posterior cranial fossa craniectomy. (b) Bone window CT scan image

**Figure 2.** (a) Calvarial bone prepared for the craniotomy. (b) and (c) Periop images of the same patient. Autograft fixed with titanium plates.
Figure 3. Assessment of the Outcomes of the Two Groups Using the Catalano Grading System

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