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SURGICAL MEDICAL SCIENCES / CERRAHİ TIP BİLİMLERİ

Safe Retrosigmoid Oblique Craniotomy Technique: A Retrospective Single-Centre Experience

Güvenli Retrosigmoid Oblik Kraniyotomi Tekniği: Retrospektif Tek Merkezli Deneyim

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Abstract

Objectives: In neurosurgical practice, retrosigmoid craniotomy (RC) is mostly performed to gain access of the posterolateral skull base area. The close relationship of the sigmoid sinus (SS) and transverse sinus (TS) is critical for craniotomy related sinus injury. Previous studies have evaluated preoperative identification of TS and SS to provide appropriate surgical location and achieve a safe approach. We aimed to perform the safest and simplest craniotomy technique to avoid sinus injury and minimise bone removal. In this article, we described our modified RC technique.

Materials and Methods: Data of 27 patients who underwent a safe RC were retrospectively evaluated. All procedures were performed by the same senior and junior surgeons. Patient with recurrent surgery and craniofacial bone anomaly were excluded from the study.

Results: The mean age of the patients was 57.41±8.75 years, 15 (55.56%) patients were male and 12 (44.44%) were female. Moreover, 15 patients had vestibular schwannoma, nine had petrous ridge meningioma and three had an epidermoid tumour. The procedure was performed in 25 patients with cerebellopontine angle (CPA) lesions and in two patients with brainstem lesions. Cerebrospinal fluid leakage was found in 2 (7.41%) patients postoperatively, and all of them were treated conservatively. None of the patients had sinus injury, bone flattening or cosmetic failure related to RC technique.

Conclusion: We described our experience with the modified safe RC technique for CPA tumours. A 3×3 cm size safe oblique RC technique with exposure of the 1/4 medial border of the SS and transverse SS junction is satisfactory enough for all of our cases. Our modified RC technique is a safe and easily performed surgical approach that can be used in CPA, brainstem lesions and vascular pathologies. Nevertheless, this technique minimizes unnecessary bone removal and extra cerebellar retraction are not needed because of the small craniotomy sizes.

Key Words: Retrosigmoid Approach, Sigmoid Sinus, Landmark, Posterolateral Cranial Base Approaches, Cerebellopontine Angle

Öz

Amaç: Nöroşirürji pratiğinde retrosigmoid kraniyotomi (RK) posterolateral kafa tabanı bölgesine erişim sağlamak için yapılmaktadır. Sigmoid sinüs (SS) ve transvers sinüsün (TS) yakın ilişkisi nedeniyle cerrahi esnasında sinüs yaralanma ihtimali vardır. Önceki çalışmalarda, güvenli bir yaklaşım sağlamak için cerrahi öncesi TS ve SS'nin preoperatif tanımlaması yapıldı. Bizim amacımız, sinüs yaralanmasını önlemek ve kraniektomi en aza indirmek için en güvenli ve basit kraniyotomi tekniğini gerçekleştirmektir. Bu yazımızda modifiye RK tekniğimizi anlattık.

Gereç ve Yöntem: Yapılan retrospektif çalışmamızda güvenli kraniyotomi tekniği uygulanan 27 hasta verisi değerlendirildi. Hepsi aynı kıdemli ve uzman cerrah tarafından ameliyat edildi. Tekrarlayan cerrahisi ve kraniyofasiyal kemik anomalisi olan hastalar çalışma dışı bırakıldı.

Bulgular: Hastaların ortalama 57,41±8,75 yaş aralığında idi. Bu hastalardan 15'i erkek (%55,56), 12'si (%44,44) kadındı. Hastaların 15'inde vestibüler schwannom, 9 hastada petröz menenjiom ve 3 hastada epidermoid tümör tanısı kondu. Hastaların 25'inde bu yaklaşım serebellopontin açı alanı için ve 2 hastada beyin sapı lezyonları için uygulandı. Hastaların 2'sinde (%7,41) beyin omurilik sıvısı kaçağı görüldü. Hastaların hiçbirinde RK tekniğine bağlı sinüs yaralanması veya kozmetik şikayet olmadı.

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Öz

Sonuç: Bu yazıda köşe tümörleri ve beyin sapı lezyonlarında uyguladığımız modifiye güvenli retrosigmoid kraniotomi tekniğimiz ile ilgili deneyimimizi anlattık. SS 1/4 medial sınırını ve TSS bileşkesini cerrahi olarak hakim olmayı sağlayan 3x3 cm boyutunda güvenli bir oblik RK tekniğimiz, köşe tümörü ve beyin sapı lezyonları olan tüm olgularımızda yeterince güvenli ve daha fazla görüş alanı sağladı. Modifiye RK tekniğimiz, köşe tümörlerinde, beyin sapı lezyonlarında ve vasküler patolojilerde kullanılabilen hızlı, güvenli ve kolay uygulanabilen bir cerrahi yaklaşımdır. Bununla birlikte, bu teknik ile gereksiz kemik çıkarmayı en aza indiriyor, sınırlı kraniyotomi nedeniyle aşırı serebellar retraksiyona gerek kalmıyor.

Anahtar Kelimeler: Retrosigmoid Yaklaşım, Sigmoid Sinüs, Landmark, Posterolateral Kafa Kaidesi Yaklaşımları, Köşe

Introduction

In neurosurgical practice, retrosigmoid craniotomy (RC) is mostly performed to gain access of the posterolateral skull base area. This approach enables high exposure of the lateral cerebellomedullary cisterns and cerebellopontine area (CPA), which contain essential neurovascular structures including the facial and vestibulocochlear nerves, lower cranial nerves, anterior inferior cerebellar artery and posterior inferior cerebellar artery (1).

The close relationship of the sigmoid sinus (SS) and transverse sinus (TS) is critical in preventing sinus injury (2). Previous studies have evaluated the relationship within the sinus and anatomical landmarks to provide appropriate surgical location and achieve a safe approach (2,3). Our main surgical aim is to perform the safest and simplest craniotomy technique to avoid sinus injury and minimise bone removal. In this paper, we described our modified RC technique.

Materials and Methods

This retrospective study analysed data of 27 patients who underwent a modified RC technique in Ankara University Faculty of Medicine, İbni Sina Hospital between 2018 and 2020 years. All procedures were performed by the same senior and junior surgeons. Patients with recurrent surgery and craniofacial bone anomaly were excluded from the study. The mean age of the patients was 60±12 years, 55.56% were male and 44.44% were female. Of the patients, 15 had vestibular schwannoma, nine had petrous ridge meningioma and three had epidermoid tumours. The technique was performed in 25 patients with CPA lesions and in two patients with brainstem lesions. Intraoperative neuromonitoring was used in all patients. None of the patients had sinus injury. The craniectomy defect was minimal. None of the patients have bone flattening and cosmetic complaints. No mortality was recorded.

Surgical Technique

After positioning the patient, the TS and SS junction and SS are identified with the guidance of a navigation system. The approximate projection of these structures was marked by using anatomical landmarks. The ligamentum nuchae and trapezius muscle are attached to the midline bony prominence located in the occipital bone. This line connects the zygomatic arch to the inion, and it is usually located below the lower border of the TS. The posterior edge of the mastoid process could establish the trace of the SS. However, it could not be applied in all patients because of the anatomical variability of the bony prominence.

Several skin incisions are used in performing RC. We use a post-auricular C-shaped incision that included the transverse SS junction (TSSJ). The incision is located nearly 2 cm behind the pinna. The incision at the level of the pinna is extended beneath the mastoid tip. This incision prevents tension in the flap. To decrease bleeding from the subcutaneous tissue, the incision is infiltrated with bupivacaine. After the cutaneous flap was elevated, the suboccipital muscles are detached from their attachments and with electrocautery stripped from underneath the bone. The use of surface landmarks could localise the junction of the TS and SS. The most important landmark is the asterion, the junction of the parieto-mastoid, lambdoid and occipito-mastoid sutures. This landmark determined the TSSJ during craniotomy. However, it is not a safe and permanent landmark on the cranial surface because of the unstable location of the asterion relative to the sinuses (4). Its localisation has been reported in 60-78% of the cases (5). Additionally, it could be difficult to determine the asterion correctly during surgery (6).

After localising the TSSJ, a burr hole is made beneath the TS and SS junction. After unroofing the SS, the dura is meticulously stripped from the overlying bone. Then, a 3×3 cm RC was performed. After placing the burr hole to the TSSJ, the first 2/3 of craniotomy was performed until the SS inferior border. At this stage, the footing attached was replaced with a bone cutter, and the remaining 1/3 of the craniotomy was crossed obliquely with a bone cutter (Figures 1-3). This craniotomy technique exposes the TSSJ and about 1/4 of the medial border of the SS. If mastoid air cells are involved, which can be opened during drilling to prevent cerebrospinal fluid (CSF) leakage after surgery, they are carefully sealed with bone wax.

After surgery, the craniotomy defect is covered with 3×3 cm bone flap. Then, the suboccipital muscle, fascia and galea are closed in layers. The skin is closed by surgical titanium staples. Finally, a sterile dressing was applied on the wound.

Results

RC was performed in 25 patients with CPA lesions and in two patients with brainstem lesions. On histopathological examination, 15 (55.56%) patients had schwannoma, 9 (33.33%) had meningioma and 3 (11.11%) had epidermoid tumours.

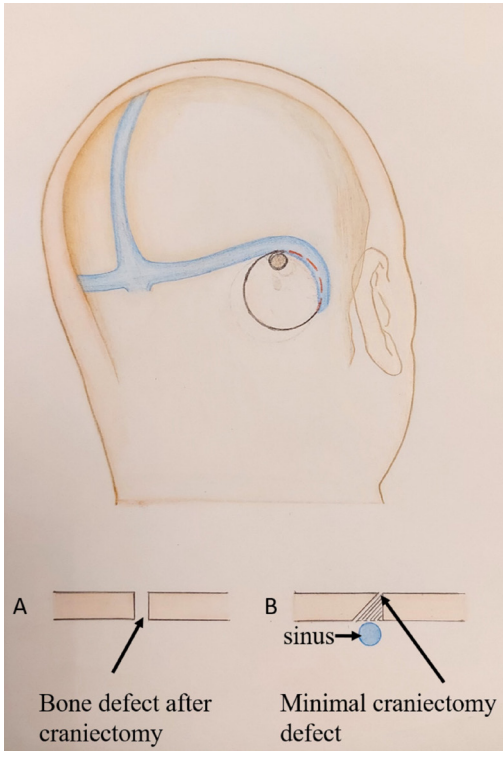

Figure 1. Schematic illustration of our safe retrosigmoid craniotomy. **A)** Defect between the bones after the standard craniectomy above the sinus, **B)** Minimal craniectomy defect between the bones after the safe retrosigmoid craniotomy

Red dotted lines - area of craniotomy performed with a bone cutter

Figure 2. Intraoperative illustration of our safe retrosigmoid craniotomy

Complications

CSF leakage was found in 2 (7.41%) of patients, and the patient was treated conservatively. Moreover, 16 (59.25%) patients experienced headache postoperatively. All patients respond well to non-steroidal anti-inflammatory drugs. No patients had bone flap mobility due to a large craniectomy defect. None of the patients had cosmetic complaints/failure (Figure 4). Sinus injury and mortality were recorded. All complications related with posterior fossa surgery and craniotomy are shown in Table 1.

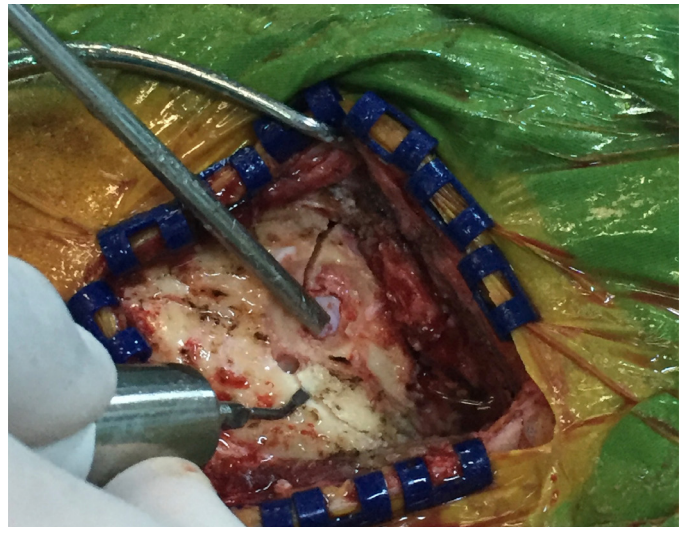

Figure 3. Remaining 13 of craniotomy (above sinus) crossed obliquely with a bone cutter

Figure 4. Postoperative image of a patient after suture removal. No sunken skin and no bone flattening due to the bone defect were noted

Table 1: All complications related with posterior fossa surgery and craniotomy

No	Age	Sex	Histopathology	Complication, (non related with craniotomy)	Bone flattening/cosmetic failure/sinus injury
1	60	M	Vestibular schwannoma	Headache	-
2	45	M	Epidermoid tumour		-
3	47	M	Vestibular schwannoma		-
4	65	F	Vestibular schwannoma	Headache	-
5	72	F	Petrous ridge meningioma	Headache	-
6	58	M	Vestibular schwannoma		-
7	56	F	Vestibular schwannoma	Headache	-
8	49	M	Petrous ridge meningioma	CSF leakage	-
9	40	F	Petrous ridge meningioma		-
10	55	F	Vestibular schwannoma		-
11	58	M	Petrous ridge meningioma	Headache	-
12	63	M	Petrous ridge meningioma	Headache	-
13	60	F	Vestibular schwannoma		-
14	67	F	Epidermoid tumour	Headache	-
15	68	M	Vestibular schwannoma		-
16	54	F	Vestibular schwannoma	Headache	-
17	48	F	Vestibular schwannoma		-
18	69	M	Petrous ridge meningioma	Headache	-
19	51	F	Petrous ridge meningioma	Headache	-
20	54	M	Vestibular schwannoma	Headache	-
21	72	M	Vestibular schwannoma		-
22	47	M	Petrous ridge meningioma	Headache	-
23	53	F	Petrous ridge meningioma		-
24	51	M	Vestibular schwannoma	Headache	-
25	64	M	Epidermoid tumour	CSF leakage, headache	-
26	68	F	Vestibular schwannoma	Headache	-
27	56	M	Vestibular schwannoma	Headache	-

Discussion

Our modified RC technique is a quick, safe and easily performed surgical approach that can be used in CPA lesions, brainstem lesions and vascular pathologies. In the traditional craniotomy technique, SS and bleeding-related complications are carefully prevented. Limited exposure of the SS resulted in the narrowed entry into the surgical corridor of the CPA. This condition causes a limited surgical area and thus requires additional cerebellar retraction. In the traditional method, after the craniotomy flap was elevated to expose the edge of the SS, the residual rim of the bone was removed, thereby increasing the free area between the bones (7). In our modified RC technique, initially, the burr hole was placed to the TSSJ, after the first 2/3 of the craniotomy was performed until the SS inferior border. At this stage, the footing attached was replaced with a bone cutter. To avoid sinus injury, oblique craniotomy is performed over the SS with a 45° inclination to the most medial dural surface near the SS. The remaining 1/3 of the craniotomy was performed by this technique. Compared with the traditional method, the modified technique allows for an extended craniotomy, provides increased exposure and requires minimal bone removal. Moreover, this technique reduces the gap between the nearby bones and bone surfaces become closer to each other. As a result, the gap between the adjacent bones was reduced, and the bone surfaces immobilised the bone flap, thereby contributing to the union (fusion) of bones postoperatively.

Our experience with 27 patients demonstrated that craniotomy performed above the "dangerous places" such as the SS and TSSJ with a bone cutter is safe. No haemorrhagic complications and sinus injuries occurred. This approach could avoid sinus injury, minimise bone removal and reach the CPA and brainstem lesions.

One of the patients (3.70%) had CSF leakage. In the literature, the incidence of CSF leakage was reported between

2% and 30% after surgery, and this rate depends on the closure method (8).

Headache is the most common complication of surgery to the CPA, with an incidence as high as 65% (9). Headache was related to discomfort caused by the incision, muscle spasms, dural irritation and decreased CSF pressure. In our retrospective study, 16 (59.25%) patients experienced headache postoperatively.

Strengths and Limitations

This retrospective study included a comparatively homogenous clinical series of successive brainstem and CPA lesions that were treated with our modified RC technique by a single surgeon. Data completeness was satisfactory. Clinical outcomes (bone flattening, cosmetic failure and SS damage) were assessed with varying postoperative follow-up periods.

Despite these strengths, the study has some limitations. Our technique should be used in a large group of patients. In addition, the use of a bone cutter (which sometimes could be missed in some clinics) in finishing the second part of the craniotomy is a relative disadvantage of this technique. However, prospective randomised controlled trials are warranted to confirm the encouraging results of this preliminary study.

Conclusion

We described our experience with the modified safe RC technique for CPA tumours. Moreover, this technique can be safely applied for vascular lesions of the posterior fossa and in vascular compression syndromes. Our modified RC technique is a simple and safe technique and increases the exposure of CPA lesions. Nevertheless, bone removal and extra cerebellar retraction are not needed because of the small craniotomy sizes.

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Ethics

Ethics Committee Approval: Ethical approval has not been obtained due to retrospective study.

Informed Consent: Informed consent was obtained from the patient.

Authorship Contributions

Concept: O.M., İ.D., Design: O.M., İ.D., Data Collection and Processing: O.M., İ.D., Analysis or Interpretation: O.M., İ.D., Literature Search: O.M., İ.D., Writing: O.M., İ.D.

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