TECHNICAL NOTE

Temporalis muscle reattachment by using transosseus running suture along superior temporal line: technical note

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Abstract

Introduction: After reattachment of the temporalis muscle, atrophy of the temporalis muscle may occur, which is associated with difficulty in chewing function. To prevent this, numerous surgical modifications have been made to allow reattachment of the temporalis muscle with minimal damage.

Methods: We describe the technical details of surgical modification for reattachment of the temporalis muscle in 12 cases treated surgically in our department.

Results: We used a transosseous continuous suture along the superior temporal line as a base for reattachment of the muscle. The temporalis muscle was successfully reattached in all observed cases. No infections, dislocations, muscle tears, or significant temporal atrophy with depression occurred in any of the observed cases. In the author's technique, the temporalis muscle is reconstructed anatomically at the level of the superior temporal line. At follow-up after approximately 24 months, all patients were satisfied with the cosmetic result.

Conclusions: The use of running sutures along the superior temporal line is a safe, simple, and successful alternative for reattachment of the temporal muscles in patients undergoing surgery for intracranial pathology. The surgery takes slightly longer but does not require additional costs. This technique minimizes the risk of atrophy of the temporal muscles. With this technique, muscle tension was maintained with good stabilization and the cosmetic result is also satisfactory.

Keywords: craniotomy; operative technique; temporalis muscle; superior temporal line

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Introduction

Temporal hollowing and cosmetic deformity often follow after the temporalis muscle has been reattached from the underlying skull[1]. Once the temporalis muscle is repositioned, bony remodeling at the deep surface aids its reattachment[2]. Because the temporalis muscle lifts the mandible when it contracts and closes the teeth when chewing, dysfunction of the temporalis muscle can affect the patient's quality of life.

A viable muscle flap can be obtained with subperiosteal dissection and elevation of the temporalis muscle[3]. Although the temporal fascia is divided into superficial and deep layers, the temporalis muscle must be elevated along with the fascia from the superior temporal line[4].

There are numerous different techniques for reattachment of the temporalis muscle after pterional and orbitozygomatic craniotomy[5-7]. In this article, the authors describe the technical aspect of modified reattachment of the temporalis muscle.

Methods

Operative technique

Recent advances in neurosurgery include satisfactory postoperative cosmetic results. To achieve this, bone, muscle, fascia and skin must be as close as possible to the ideal anatomical reconstruction.

Detachment of the temporalis muscle

The skin incision is made in the regular fashion for pterional or orbitozygomatic craniotomy in all patients. The skin flap is retracted with fishhooks. The pericranium is separated from the skull in the frontal region. The temporalis fascia and intact temporalis muscle are sharply incised along the anterior 2/3 of the superior temporal line and elevated using the retrograde dissection technique. A vertical incision is then made through the muscle toward the pina. To minimize muscle atrophy, we did not use monopolar cauterization for hemostasis or dissection. A standard pterional craniotomy is then performed with or without fronto-orbital extension.

Reattachment of the temporalis muscle

Once the intracranial surgery is completed, small drill holes are made along the superior temporal line on the bone flap, at 5-8 mm apart (***Figure 1***) or along the craniotomy margins if the craniotomy is performed along the superior temporal line (***Figure 2***). A running suture Vicryl 2-0 (Ethicon Inc., Raritan, NJ) is placed through these holes. At the time of closure, the bone flap was replaced and fixed with titanium miniplates and screws or the FlapFix system. The temporal muscle flap and temporalis fascia are rotated backward and reattached with interrupted single Vicryl 2-0 (Ethicon Inc., Raritan, NJ) sutures at the running suture along the superior temporal line (***Figure 1***). Thus, the transosseous running suture mimics the "muscular cuff" and serves as a base for muscle fascia reattachment.

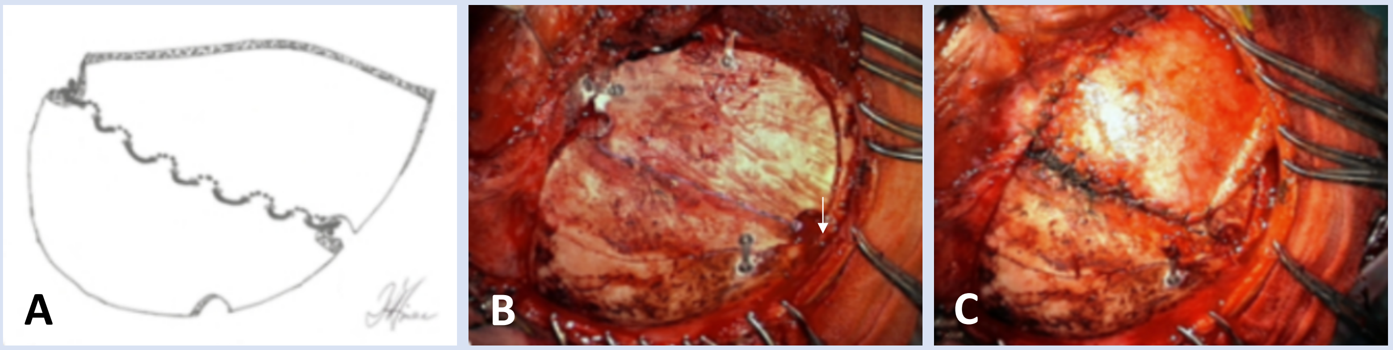

Figure 1. **A.** Artist's depiction shows a running stich alongside superior temporal line. **B.** After fixation of the bone flap with the microplate reattachment of the temporalis muscle can start. **C.** The temporalis muscle is tighty reattached to the running stich alongside superior temporal line (based on anatomical reconstruction).

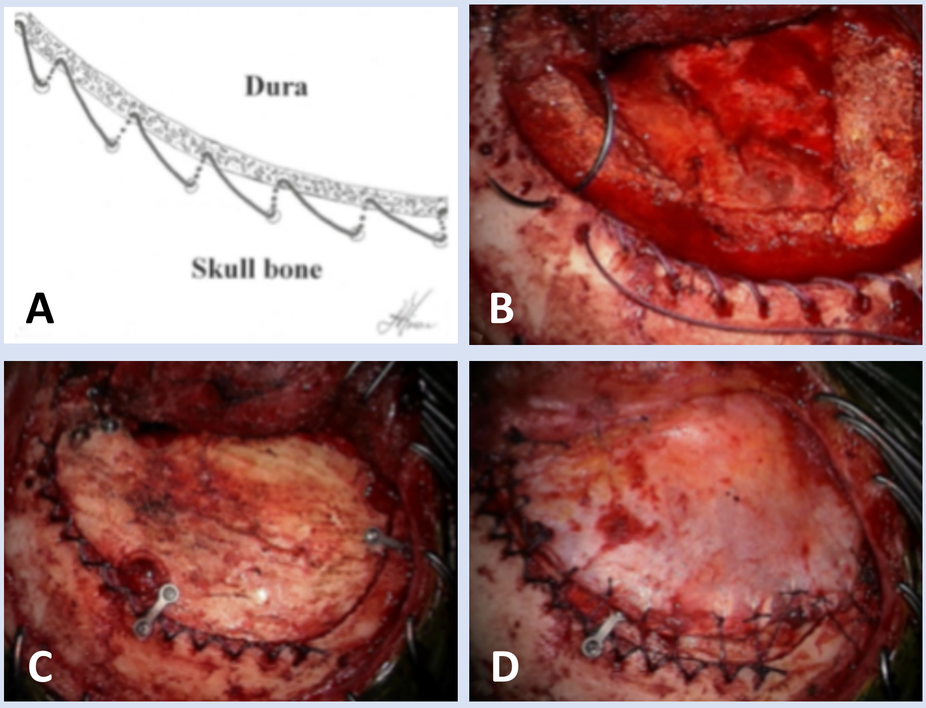

Figure 1. **A.** The drawing shows small holes through the bone edge which have been made by the high-speed drill **B**. Running stich through the small holes on the edge of the skull bone. **C.** Bone flap have been fixed with the 3 titanium microplates and screws. **D.** Temporalis muscle, fascial and galeal tissue have been tightly reattached to the running stich alongside craniotomy edge.

When a craniotomy is performed along the superior temporal line, a running suture can be made along the superior temporal line to reattach the temporalis muscle (***Figure 2***). The muscle incision perpendicular to the skull base is closed in the usual fashion. It is important to achieve the best possible anatomic reconstruction of the temporalis muscle and fascia toward the bony flap.

T1 sequences of brain MRI were used to measure the temporal muscle. Temporal muscle thickness was measured manually using DICOM Viewer (version 4.6.9). The baseline of the temporalis muscle was measured perpendicular to the long axis of the temporalis muscle at the level of the orbital roof. The Sylvian fissure was used as an anatomical reference point in the anterior-posterior direction. The temporalis muscle was measured on the side on which the surgery was performed, as shown in Figure 3. Measurements were performed by both authors (D.S. and D.J.), and discrepancies were resolved by consensus.

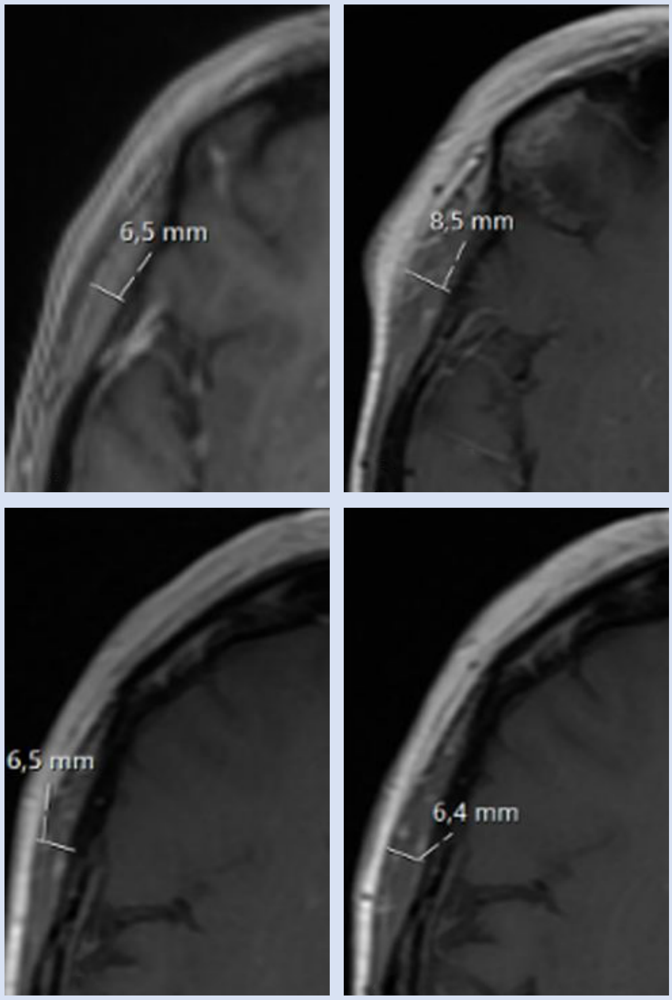

Figure 3. Temporal muscle thickness (TMT) measurement on cranial MRI. A. preoperatively, B. at 1 week postoperatively, C. at 3 months postoperatively, D. at 6 months postoperatively

Results

Table 1 shows the group of patients with all measurements. In 12 patients, the gender distribution is equal (6 men and 6 women). The median age was 52.5 years (range, 36 to 68). All patients underwent extended pterional craniotomy. Intracranial aneurysm was diagnosed in 6 patients (2 anterior communicating artery aneurysm, 2 ACI aneurysm, 1 anterior cerebral artery aneurysm, 1 posterior communicating artery aneurysm), whereas tumor was present in the other 6 patients. The most common tumor was a meningioma of the sphenoid wing (in 3 patients), followed by a meningioma of the tuberculum sellae (in 1 patient), a clinoidal meningioma (in 1 patient), and a suprasellar pituitary adenoma (in 1 patient).

Regarding temporal muscle measurements, the preoperative median of the temporal muscle measurement was 6.95 mm, whereas at follow-up it was 6.95 mm at 3 months and 6.92 mm at 6 months (***Table 1***)

Table 1. Patient characteristics

No.	Age/ Gender	Diagnosis	Measurement of Temporalis muscle thickness (TMT) (mm)			
			preoperatively	at 1 week postoperatively	at 3 months postoperatively	at 6 months postoperatively
1	54/F	Anterior communicating artery aneurysm	7,1	9,3	7,0	7,0
2	38/M	Sphenoid wing meningiomas	7,8	8,9	7,9	7,8
3	55/F	Clinoidal meningioma	6,5	8,5	6,5	6,4
4	56/F	Anterior communicating artery aneurysm	7,2	9,1	7,2	7,1
5	62/M	ACI aneurysm	6,6	7,9	6,6	6,6
6	45/M	Tuberculum sellae meningioma	7,8	9,6	7,7	7,6
7	42/M	Anterior cerebral artery aneurysm	7,3	8,9	7,4	7,4
8	35/F	Sphenoid wing meningioma	7,0	8,9	7,2	7,0
9	68/F	Suprasellar pituitary adenoma	5,6	7,8	5,7	5,7
10	57/M	ACI aneurysm	7,6	9,4	7,5	7,6
11	51/F	Posterior communicating artery aneurysm	7,0	8,9	6,8	6,8
12	67/M	Sphenoid wing meningioma	5,9	8,1	6,0	6,0

Discussion

Several methods have been described for the temporalis muscle reattachment to its site of origin. Wells and Kirn describe suturing the muscle to a cuff of the temporalis muscle left attached to the superior temporal line[8]. Frequently, suture tears the muscle cuff either during the suturing or soon after the surgery, because of the contractions of the temporalis muscle. Reattachment of the muscle to the aponeurotic galea frequently tears on the side of the galea, and the muscle becomes loosely attached and pulled down toward the zygomatic arch, with a subsequent bump on that region, and functional and cosmetic results far from the ideal.

Our study showed that after the postoperative swelling of the temporal muscle (measured one week after surgery), the muscle tissue gradually recovered to the preoperative condition.

In addition, the thickness of the temporal muscle decreased slightly at the 6-month follow-up (Table 1).

Hoenig et al. described a technique for anchoring the detached temporalis muscle[9]. Using the V-tunnel drill system, a V-shape tunnel is made through which suture is pulled and the temporal muscle is attached to the bone by consecutive stiches[10]. Thick drills can cause a sulcus instead of a tunnel, while thin drills create too narrow a tunnel for the suture needle to pass through.

There are several methods of positioning microscrews. In the technique described by Stechison, the microscrews were placed directly above the superior temporal line[7].

Webster et al. described a similar technique using microscrews, but in their technique, the microscrews are placed beneath the muscle[11]. The advantage of adsorbable plates and screws has led many authors to suggest that they should be a method of choice for muscle fixation in pediatric patients[12,13]. Another advantage of these plates and screws is avoiding complications with titanium plates, which may cause dose enhancement and shielding of the adjacent tissue[14].

In an animal study comparing self-reinforced polylevolactide and metal miniplates, it showed the same efficacy, while rapidly degradable self-reinforced polyglycolide showed less effective consolidation than on the contralateral side treated with titanium[15]. To minimize the risk of atrophy of the temporalis muscle before craniotomy, subperiosteal elevation of the muscle must be performed, avoiding monopolar cauterization[6].

Conclusion

Reconstruction of the temporalis muscle is a challenging task for neurosurgeons. The technique described achieves an almost anatomical approximation between the bony and muscular flaps. In addition to good stabilization, an excellent cosmetic result was also achieved. By attaching the temporalis muscle to the superior temporal line, a good, nearly ideal anatomic reattachment of the temporalis muscle is achieved. Further studies should focus on prolonged patient follow-up, with emphasis on measuring the thickness and surface area of the temporalis muscle.

Disclosures

Conflict of Interest: All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

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