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ORIGINAL ARTICLE

Pterional craniotomy-induced temporalis muscle dysfunction: A neurosurgical exploration and functional implications in Tertiary Care Hospitals.

Aurangzeb Kalhoro[1], Vashdev Khimani[2], Muhammad Hamid Ali[3], Mubarak Hussain[4], Mahesh Kumar Luhano[5]

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ABSTRACT… Objective: To highlight which surgical dissection of temporalis muscle is associated with temporalis muscle dysfunction. **Study Design:** Retrospective Comparative Cross-sectional Study. **Setting:** Liaquat University of Medical and Health Sciences, Jamshoro. **Period:** March 2018 to February 2023. **Methods:** All patients were included in study who came with complain of temporalis muscle dysfunction and previously had craniotomy. The patients those were included in this study were those who came for craniofacial pain or referred from maxillofacial department and had craniotomy done previously in our department or any other tertiary setup. **Results:** Total numbers of 54 patients were included in study with mean age 43.55 year with predominated male 55.6%. Cerebral tumor (50%) and trauma (42.6%) was the most common pathologies that were addressed. Submusclar technique was used in 50% of patients, the most common presentation was pain (74%) and most cases presented with in less than 3 months (51.8%). **Conclusion:** Subfacial technique is associated with less percentage of temporalis muscle dysfunction as compare to other surgical technique which is not statistical significant.

Key word: Temporalis Muscle Dysfunction, Submusclar, Subfacial, Interfascial, Post-craniontomy.

INTRODUCTION

Performing a craniotomy is a crucial surgical procedure for treating various intracranial conditions like tumors, hemorrhages, and aneurysms. This involves removing a portion of the skull to access the brain. However, it's crucial to consider potential repercussions, particularly concerning the temporalis muscle (TM), which plays a vital role in both masticatory function and facial aesthetics.[1]

TM dysfunction after craniotomy is a well-known complication, with studies indicating varying occurrence rates, possibly affecting 30% to 33% of patients. This dysfunction manifests with a range of signs and symptoms, including decreased muscle strength, pain, atrophy, and cosmetic deformity.[2,3] The craniotomy operation can be influenced by factors such as the incision technique, size of the removed bone flap, and surgery duration. These elements may affect the extent of muscle damage during the treatment.[4,5]

The adapted osteoplastic pterional craniotomy showed a significant advantage in reducing temporal muscle atrophy and causing comparatively less frontal muscle nerve damage compared to the conventional pterional craniotomy.[6] Various techniques have been suggested to address temporal hollowing post pterional craniotomy, such as the split myofascial bone flap, interfascial pterional craniotomy, or avoiding dissection beneath the superficial layer of deep temporal fascia or through the temporal fat pad. However, no clear-cut gold standard has been identified for the optimal surgical technique to prevent temporal hollowing.[7]

Our study aims to determine the frequency of TM dysfunction in various surgical approaches for patients who underwent craniotomy. Understanding the association between surgical

1. FCPS, FACS, MBA, FICS, MRCSP, CHPE, Assistant Professor Neuro Surgery, Liaquat University of Medical and Health Sciences, Jamshoro.
2. MBBS, FCPS, Associate Professor, Liaquat University of Medical and Health Sciences, Jamshoro.
3. MBBS, FCPS, Associate Professor Neurosurgery, Liaquat University of Medical and Health Sciences, Jamshoro.
4. MBBS, FCPS, Assistant Professor Neuro Surgery, Liaquat University of Medical and Health Sciences, Jamshoro.
5. MBBS, DCP, Ph.D, Assistant Professor Molecular Biology and Genetics, LUMHS, Jamshoro.

Correspondence Address:
Dr. Aurangzeb Kalhoro
Department of Neurosurgery,
Liaquat University of Medical and
Health Sciences, Jamshoro-Pakistan.
draurangzebkalhoro@gmail.com

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techniques and this dysfunction is crucial for developing effective preventive strategies.

METHODS

This is a Retrospective comparative Cross-sectional Study, between different surgical approaches of Temporalis Muscle dissection and retraction, conducted at Liaquat University of Medical and Health Sciences, Jamshoro. The study was conducted from March 2018 to February 2023. The study had ethical approval from the Review Board of the Liaquat University of Medical and Health Science, Jamhoro with IRB-LUMHS/REC/257 dated 1-03-2024. The patients those were included in this study were those who came for craniofacial pain or referred from maxillofacial department and had craniotomy done previously in our department or any other tertiary setup. The variables were recorded on questionnaire and previous data regarding surgery were explored for the patients that were operated in this setup and contact with primary surgeon was done via telephone regarding surgical aspects. Patient is being in follow up via telephonic or clinic visits.

Three surgical techniques were used mostly in craniotomies that are inter fascial

Inter-Fascial

The Inter-Fascial approach entails carefully separating and pulling back the temporalis muscle while ensuring that the muscle's fascial layers remain intact.[6,7]

The Subfacial Method

It is a technique that includes retracting the temporalis muscle beneath its fascial layer. This technique seeks to decrease muscle damage and postoperative atrophy by conserving the muscle's fascial integrity and reducing direct muscle manipulation.[8]

Submuscular Method

This technique entails retracting the temporalis muscle to provide access to the underlying temporal bone and cerebral structures. The approach is preferred due to its capacity to offer a broad surgical area while causing minimum muscle damage and postoperative cosmetic deformities.[9]

RESULTS

Total numbers of 54 patients were included in studies; see Table 1 for descriptive analysis. The mean age of presentation was 43.55 with standard deviation of 11.69. Most patients were male that is 55.6% as compare to female (44.4%). The majority of patients belong to lower middle (33.3%) and upper lower (33.3%). The operated pathologies were mostly cerebral tumor (50%) and trauma (42.6%).

Variable	Number (%)
Age (mean)	43.55 SD± 10.3
Gender	
• Male	30 (55.6%)
• Female	24 (44.4%)
Kuppuswamy scale	
• Upper	3 (5.6%)
• Upper middle	7 (13 %)
• Lower middle	18 (33.3%)
• Upper lower	18 (33.3%)
• Lower	8 (14.8%)
Operated for pathologies	
• Cerebral Tumor	27 (50%)
• Cerebrovascular lesion	04 (7.4%)
• Trauma	23 (42.6%)
Associated comorbidities	
• Yes	17 (31.5%)
• No	37 (68.5%)
Any management for TM dysfunction	
• Yes	34 (63.0%)
• No	20 (37.0%)

Table-I. Descriptive analysis

The surgical technique that was used to dissect temporalis muscle; See (Figure-1), the most common surgical dissection that was used was submuscular dissection (50%) as compare to other approached i.e., inter fascial (33.3%) and subfacial (16.7%).

The Clinical presentation of patient with temporalis muscles dysfunctions. (See Figure-2). Pain was the most common presentation (72.2%) as compare to others i.e., Trismus (44.4%), Chewing difficulty (50%) and Temporalis muscle hollowing (40.7%).

Time of clinical presentation after surgery was divided into three categories (see Figure-3). The

most common time duration of presentation was <3 months (42.6%) as compare to other .i.e. 3-6 months (40.7%) and >6 months (16.7%).

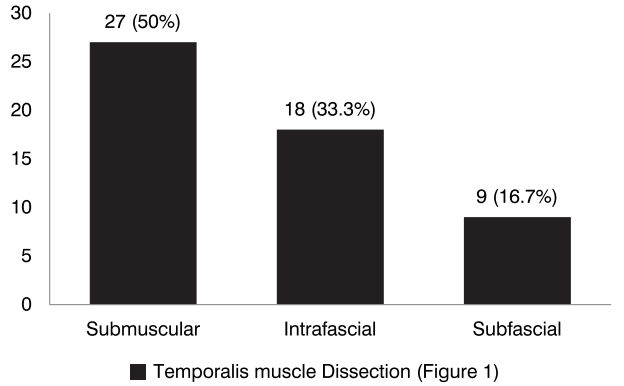

Figure-1: Temporalis muscle Dissection.

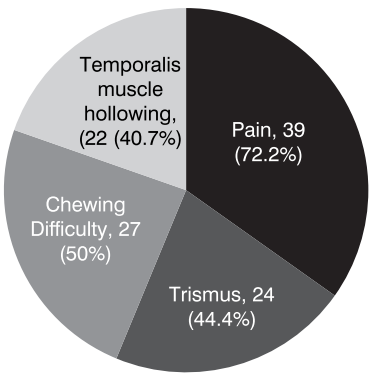

Figure-2: Temporalis muscle Dysfunctions.

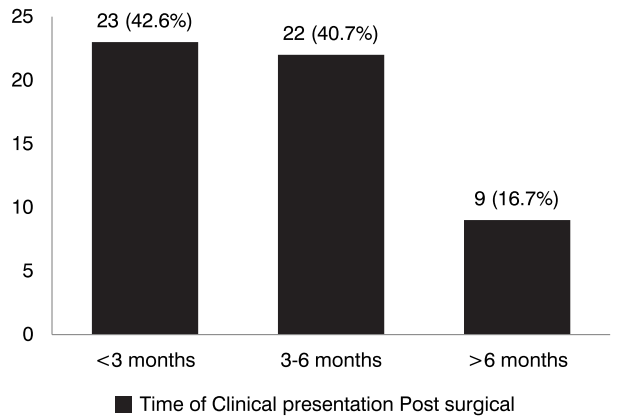

Figure-3: Time of Clinical presentaion post surgical.

Regarding the outcome of patient after medical and surgical management (see Figure-4). The outcome was, in most of the patients there was spontaneous relive of symptoms (46.3%) as compare to the patients with persistent complaint (22.2%) and patients are in follow up (31.5%).

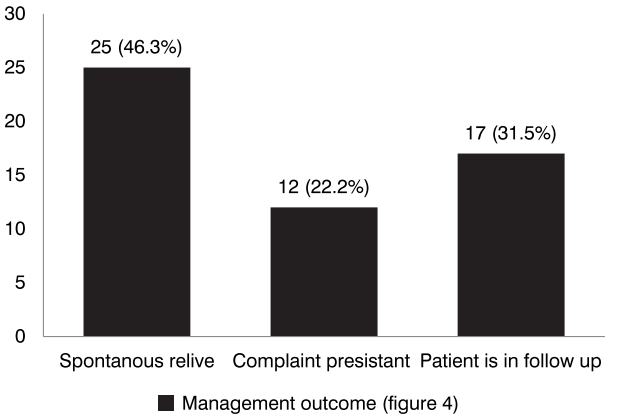

Figure-4: Management Outcome

The distribution of data in according to the surgical technique was used to dissect the Temporalis muscle. For the Sub muscular technique the mean age was 45.18 ± 10.96 with male 55.5% and mostly belongs to lower middle socioeconomical status (37%). The mostly operated pathologies were cerebral tumor (66.6%) in which sub muscular technique were used. The most common clinical presentation of temporalis muscle dysfunction was pain (74%) and Trismus (55.5%). The time of presentation with sub muscular approach was mostly < 3months (51.8%). 33.3% of patients had associated medical Co morbidities. The medical and surgical intervention was done in 62.7% and in 48.1% the symptoms resolve spontaneously. (Table-II)

For the interfascial technique the mean age was 39.44 ± 13.59 with male 55.5% and mostly belongs to upper lower socioeconomical status (33%). The mostly operated pathologies were trauma (72.2%) in which interfascial technique were used. The most common clinical presentation of temporalis muscle dysfunction was pain (61.1%) and chewing difficulties (61.1%). The time of presentation with interfascial approach was mostly 3-6 months (44%). 22.2% of patients had associated medical Co morbidities. The medical and surgical intervention was done in 55.5% and in 50% the symptoms resolve spontaneously. (Table-II)

For the subfacial technique the mean age was

46.88 ± 7.94 with male 55.5% and mostly belongs to lower middle socioeconomical status (44%). The mostly operated pathologies were cerebral tumor (66.6%) in which Sub-facial technique were used. The most common clinical presentation of temporalis muscle dysfunction was pain (88.8%) and chewing difficulties (77.7%). The time of presentation with Subfascial approach was mostly 3-6 months (44%). 22.2% of patients had associated medical Co morbidities. The medical and surgical intervention was done in 77.7% and in 55.5% the patients are still in follow up. (Table-II)

Variable (P-value)	Sub Muscular (N)	Inter-fasical (N)	Sub Facial (N)
Age (mean)	45.18	39.44	46.88
Gender (1.00) • Male • Female	 15 12	 10 08	 5 4
Operated for pathologies (0.013) • cerebrovascular • Trauma • Cerebral tumor	 2 7 18	 2 13 3	 0 3 6
Clinical presentation • Pain (0.301) • Trismus (0.185) • Chewing Difficulty (0.036) • Muscle hollowing (0.329)	 20 15 9 12	 11 7 11 5	 8 2 7 5
Time of presentation (0.686) • < 3 month • 3-6 months • >6 months	 14 10 3	 6 8 4	 3 4 2
Co morbidity (0.482)	9	4	4
Any intervention (0.530)	17	10	7
Outcome (0.505) • Resolve spontaneously • Compliant persistent • Still in followup	 13 6 8	 9 5 4	 3 1 5

Table-II. Analysis of patients with different muscular dissections

DISCUSSION

Several Neurosurgical procedures that require the access to Skull base lesions; may traumatize the masticatory muscle and can cause post-operative craniofacial pain and functional limitation of jaw.[4] The reported incidence of temporal muscle dysfunction is 30 to 33%.[2] As in our study, total number of 54 patients was included in study. All patients had temporalis muscle dysfunction. The average age of patients was 43.55 years, with a standard deviation of 11.69. Additionally, male patients make up the majority, comprising 55.6% of the total. The age reported in literature was 44.9 ± 16.3 years, which is almost same as in our study.[12]

Regarding the underlying conditions for craniotomy, our investigation identified cerebral tumors (50%) and trauma (42.6%) as the predominant diseases. As in literature, the craniotomies that was done mostly for cerebrovascular lesion 42% but in this study it was opposite because the trauma and tumor prevalence is more common as compare to cerebrovascular lesion or it could be the lack of surgical expertise to deal with this condition.[9] Regarding the clinical presentation of Temporalis muscle dysfunction, pain was the most common presenting feature in literature, which is aligned with this study (72.2%).[13] Other clinical presentation was Trismus (40%), chewing difficulty (70%) and temporal hollowing (35%) in literature is also align to this study in which chewing difficulty (50%) and trismus (44.4%) and temporal hollowing (40.7%).[2]

The most common time duration of clinical presentation was <3 months (42.6%) as compare to other .i.e. 3-6 months (40.7%) and >6 months (16.7%) with (31.5%) had associated co morbidities as compare to literature 92% presented within the three months of craniotomy with 65% has associated comorbidities like hypertension, diabetics and asthma.[2,11,14] The differences in associated morbidities are due to difference in underlying pathologies; as in this study Tumor and trauma was the most common pathologies that was addressed. The clinical manifestation resolves spontaneously (29%) and (40%) had gone through surgical intervention as shown in literature.[11] In our study 46.3% had spontaneous resolve of symptoms with 63% had to gone through proper medical and surgical intervention like consultation with oral

maxillofacial department.

Sub-Muscular Dissection

The most common surgical dissection that was used, it was sub-muscular dissection (50%) in this study. This is also a common surgical intervention used in literature (43%).[10] The mean age was 45.18 with male 55.5%. The cerebral tumor (66.6%) in which sub muscular technique were mostly used. The most common clinical presentation was pain (74%) and Trismus (55%) and chewing difficulty (33%) which is somewhat different with literature i.e. chewing difficulty (35%), pain (30%) and trismus (30%).[2] The time of presentation with was mostly < 3months (51.8%) and 33.3% of patients had associated medical Co morbidities. The medical and surgical intervention was done in 62.7% and in 48.1% the symptoms resolve spontaneously. The data regarding other variables are blurred in literature.

Inter Fascial Dissection

The second common approach was inter-fascial technique (33.3%), the mean age was 39.44 with male 55.5%. This is second most technique was inter- fascial approach 30% in literature.[12] The mostly operated pathologies were trauma (72.2%). The most common clinical presentation of temporalis muscle dysfunction was pain (61.1%) and chewing difficulties (61.1%) as in literature the chewing difficulty is common problem associated with this technique.[2] The time of presentation with interfascial approach was mostly 3-6 months (44%). 22.2% of patients had associated medical Co morbidities. The medical and surgical intervention was done in 55.5% and in 50% the symptoms resolve spontaneously. The other comparable data in literature is blurred.

Sub-facial Dissection

For the subfacial technique (16.7%), the approach used in literature (25%).[12] The mean age was 46.88 with male 55.5%. The mostly operated pathologies were cerebral tumor (66.6%) in which Sub-facial technique were used. The most common clinical presentation of temporalis muscle dysfunction was pain (88.8%) and chewing difficulties (77.7%). This symptoms is also present in literature.[2] The time of presentation with Subfascial approach was mostly 3-6 months (44%). 22.2% of patients had associated medical Co morbidities. The medical and surgical intervention was done in 77.7% and in 55.5% the patients are still in follow up. Other comparable data is blurred in literature.

By employing the interfascial-subpericranial flap and the subfascial-subpericranial flap, the need to open the layer of loose areolar tissue between the temporal fascia and galea in the lateral STL area, as well as between the galea and frontal pericranium in the medial STL area, is avoided. Additionally, this approach maintains the continuity of the nerve crossing the STL, enabling the preservation of nerves to the frontalis muscle throughout their entire trajectory, from the uppermost part of the parotid gland to the frontalis muscle.[15]

The results indicated that whether the temporalis muscle was reflected or not did not impact anesthetic outcomes. Both surgical approaches demonstrated an improvement in cerebral blood flow (CBF) and neuronal function. However, cranioplasty involving the reflection of the temporalis muscle showed a more significant enhancement in CBF and neuronal function.[16]

The prevailing perception of post-craniotomy pain is evolving, highlighting its significance as a challenging postoperative issue. Effectively managing this severe pain requires a comprehensive understanding of perioperative factors influencing its occurrence and intensity. Conducting well-designed studies in the future can unveil these factors in greater detail, contributing to improved patient management.[17]

Post craniotomy patients with a preoperative opioid history, younger age, or longer surgery duration face an elevated risk of needing opioid pain medications. Recognizing the early need for intravenous opioids postoperatively should signal physicians to consider additional or alternative pain control methods, preventing excessive reliance on opioid medications.[18]

LIMITATIONS

Prolonged dysfunction of the temporalis muscle can lead to atrophy, causing a decrease in

muscle mass and strength, as well as persistent pain and discomfort in the temporal region. This can significantly impact the overall quality of life for patients, necessitating ongoing management with pain medications. Additionally, cosmetic concerns may arise, including facial asymmetry or altered expressions, further contributing to distress for some individuals.

CONCLUSION

The sub facial technique is more safe procedure to prevent temporalis muscle dysfunction but this technique is associated with delayed recovery of symptoms. The presentation of symptoms is earlier after craniotomy done by submuscular approach. The type of underlying pathology is being addressed is significantly related to type of surgical technique being addressed.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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REFERENCES

1. Andrade JR FC, Andrade FC, Araujo Filho CE, Carcagnolo Filho JO. **Dysfunction of the temporalis muscle after pterional craniotomy for intracranial aneurysms: Comparative, prospective and randomized study of one flap versus two flaps dieresis.** Arquivos de neuro-psiquiatria. 1998; 56:200-5.

2. Khan MM, Khan FF, Idress M, Nawaz M, Jalal K, Jan I, Khan SD, et al. **Dysfunction of the temporalis muscle following pterional craniotomy: Analysis of 20 cases.** Pakistan Journal of Neurological Surgery. 2019 Jun 4; 23(2):93-100.

3. Missori P, Paolini S, Ciappetta P, Seferi A, Domenicucci M. **Preservation of the temporal muscle during the frontotemporoparietal approach for decompressive craniectomy.** Acta Neurochirurgica. 2013 Jul; 155:1335-9.

4. Rocha-Filho PA, Fujarra FJ, Gherpelli JL, Rabello GD, de Siqueira JT. **The long-term effect of craniotomy on temporalis muscle function.** Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2007 Nov 1; 104(5):e17-21.

5. Vaca EE, Purnell CA, Gosain AK, Alghoul MS. **Postoperative temporal hollowing: is there a surgical approach that prevents this complication? A systematic review and anatomic illustration.** Journal of Plastic, Reconstructive & Aesthetic Surgery. 2017 Mar 1; 70(3):401-15.

6. Seçer M, Çam İ, Gökbel A, Ulutaş M, Çakır Ö, Ergen A, et al. **Effects of modified osteoplastic pterional craniotomy on temporal muscle volume and frontal muscle nerve function.** Journal of Neurological Surgery Part B: Skull Base. 2021 Dec 29; 83(05):554-58.

7. Thiensri T, Limpoka A, Burusapat C. **Analysis of factors associated with temporal hollowing after pterional craniotomy.** Indian Journal of Plastic Surgery. 2020 Mar; 53(01):071-82.

8. Paglia F, Giammattei L, di Russo P, Froelich S. **Combined petrosal approach for resection of a large left petroclival meningioma.** Neurosurgical Focus: Video. 2022 Apr; 6(2):V6:1-3.

9. Baucher G, Bernard F, Graillon T, Dufour H. **Interfascial approach for pterional craniotomy: Technique and adjustments to prevent cosmetic complications.** Acta Neurochirurgica. 2019 Nov; 161:2353-57.

10. Finger G, Kaul VF, Adunka OF, Prevedello DM. **Subfascial dissection and extended temporal muscle detachment for middle fossa approach.** Acta Neurochirurgica. 2023 Jan; 10:1-5.

11. Abdulazim A, Filis A, Sadr-Eshkevari P, Schulte F, Sandu N, Schaller B. **Postcraniotomy function of the temporal muscle in skull base surgery: Technical note based on a preliminary study.** The Scientific World Journal. 2012:2012:427081.

12. Ajlan A, Basindwah S, Hawsawi A, Alsabbagh B, Alwadee R, Abdulqader SB, et al. **A prospective comparison between soft tissue dissection techniques in pterional craniotomy: Functional, radiological, and aesthetic outcomes.** Oper Neurosurg (Hagerstown). 2024 Mar 1; 26(3):256-267.

13. Brazoloto TM, de Siqueira SR, Rocha-Filho PA, Figueiredo EG, Teixeira MJ, de Siqueira JT. **Post-operative orofacial pain, temporomandibular dysfunction and trigeminal sensitivity after recent pterional craniotomy: Preliminary study.** Acta Neurochirurgica. 2017 May; 159:799-805.

14. Gligor MR, Cristache CM, Bucur MV, Burlibasa M, Matei C. **Questionnaire-based assessment of the masticatory function and facial nerve recovery post pterional approach in brain tumors surgery.** Journal of Clinical Medicine. 2021 Dec 23; 11(1):65.

15. Poblete T, Jiang X, Komune N, Matsushima K, Rhoton AL. **Preservation of the nerves to the frontalis muscle during pterional craniotomy.** Journal of neurosurgery. 2015 Jun 1; 122(6):1274-82.

16. Jin Y, Jiang J, Zhang X. **Effect of reflection of temporalis muscle during cranioplasty with titanium mesh after standard trauma craniectomy.** Journal of Craniofacial Surgery. 2016 Jan 1; 27(1):145-9.

17. Chowdhury T, Garg R, Sheshadri V, Venkatraghavan L, Bergese SD, Cappellani RB, et al. **Perioperative factors contributing the post-craniotomy pain: A synthesis of concepts.** Frontiers in Medicine. 2017 Mar 1; 4:23.

18. Wilson BR, Grogan TR, Schulman NJ, Kim W, Gabel E, Wang AC. **Early postoperative opioid requirement is associated with later pain control needs after supratentorial craniotomies.** Journal of Neurosurgical Anesthesiology. 2023 Jul 23; 35(3):307-12.

AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Aurangzeb Kalhoro	Proposal topics and Basic Study Design, Manuscript writing & data collection.	
2	Vashdev Khimani	Analysis of data, Study Design and methodology.	
3	Muhammad Hamid Ali	Role: Methodology, Study design, Data colelction.	
4	Mubarak Hussain	Role: Statistical analsis, Manuscript writing.	
5	Mahesh Kumar Luhano	Interpretation of results, final Literature review.	