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Original Article

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Modified Pterional Approach for the Management of Infratemporal Fossa Tumors

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ABSTRACT

Introduction: The pterional approach (fronto–temporo–sphenoidal craniotomy) is the most common procedure used for the exposure of Sylvian fissure,frontal and temporal opercula. The tumors of the floor of middle cranial fossa and infra temporal fossa pose a difficulty in access through this approach. Modification of pterional approach, the transzygomatic access osteotomy is one of the core routes to approach infratemporal region. Transzygomatic osteotomy provides enhanced visualization of infratemporal fossa and floor of the middle cranial fossa. The infratemporal tumors may originate from tissues in the region or extending from surrounding tissues.

Method: A series of 5 tumors were treated by author in which 2 were primary in origin and 3 were extension of tumors from mandible. All the cases were approached through hemicoronaltranszygomatic osteotomy except in one case where rhytidectomy incision was given as the tumor was originating from mandibular angle extending to infratemporal region.

Result: The purpose of this article is to access the surgical outcome of the modified pterional approach for the infra temporal fossa tumors. The surgical exposure created by the modified pterional approach was excellent to individuate the tumor margins in all the cases. The depression created by the zygomatic arch osteotomy is aesthetically and functionally accepted by all the patients. Recurrence was noticed in 1case, following chemotherapy and radiotherapy the patient was deceased.

Conclusion: The management of infra temporal lesions using the modified pterional approach gave an outcome which was both functional and aesthetically established and merely accepted by the patients.

Key Words: *Modified pterional approach, Transzygomatic access osteotomy, Infratemporal tumors*

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INTRODUCTION

Pterional approach also called as frontotemporosphenoidal craniotomy is the gold standard technique for the micro neurosurgical procedures. This technique is also called as yasargil highway in neurosurgery which was named after the pioneer work done by the yasargil in 1975. This approach gives a wide exposure of frontal and temporal opercula and sylvian fissure however it creates a difficulty in accessing the floor of the middle cranial fossa and infratemporal fossa as the zygomatic arch acts as an anatomical obstacle. To increase the exposure of the infra temporal tumors modification was done to the pterional approach by hamylnet al by placing an osteotomy to the zygomatic arch [1].

Tumors of infratemporal region spreads from surrounding tissues like paranasal sinuses, middle cranial fossa, nasopharynx, parotid gland, mandible, and external auditory meatus. About 25 to 30% of infratemporal tumors are primary in origin. Majority of Infra temporal tumors are usually benign and illustrate slow growth pattern which lead to late diagnosis. Clinical symptoms are insidious in onset and attention is drawn unless there is impairment of function and/or aesthetics.

The tumors which were extensive and the tumors which were situated superior to the position of the zygomatic arch were not ideal candidates for this approach, the decision of the surgery is individualised for each patient based on the site and extension of the lesion. Here by we performed this approach in a series of 5 cases which were treated by one surgeon in which two patients showed primary origin in the infratemporal fossa and three patients reported tumors extending from the mandible. The procedures were done hand in hand by the help of the neurosurgeons of our institution.

MATERIALS AND METHODS

Infratemporal tumors though not pervasive, five cases were reported to our department. In a span of three years, five patients were treated by one surgeon in which two patients showed primary origin in the infratemporal fossa and three patients reported tumors extending from the mandible. Two out of three ameloblastoma's were found to be extending from the angle of the mandible and the other commencing from the ramus of the mandible. Out of 5 cases 3were male and the rest were female patients. The age ranges from 6 to 38 years. In the present series the infra temporal tumors were recorded more in 2nd decade of the life.

Routine investigations along with supplementary CT scan and MRI were incorporated for all the 5 cases. (Fig 2 and Fig 7). The scan revealed no annexe of tumors to the skull base. Fine needle aspiration cytology (FNAC) was done for all the cases. Histopathological diagnoses for two patients were spindle cell variant of rabdomyosarcoma. Three patients reported ameloblastoma of the mandible extending to the infratemporal fossa. All the cases were treated by surgical excision of tumor through transzygomatic osteotomy. As per the oncologist advice, the two cases of rhabdomyosarcoma were planned for debulking followed by chemotherapy and radiotherapy.

The surgical approach for all the cases was combination of hemicoronal incision and transzygomatic osteotomy. Hemicoronal combination with extended rhytidectomy incision was used in cases of ameloblastoma originating from mandibular angle and ramus extending into infratemporal region. All the cases were followed for a period of 2 years with 6 months timely interval.

Table no.1 showing clinical history, diagnosis and treatment plan

SURGICAL TECHNIQUE

Under all aseptic precautions general anaesthesia was induced to the patients. Nasotracheal intubation was done for all the five cases. The plane of dissection varies for the tumors originating from the infra temporal area and the tumors extending from the mandible.

Tumors with the infra temporal origin:

In these caseshemicoronal skin incision with preauricular extension was planned. The initial incision was given along the premarked line. Scalpel and blade were used in all the cases for the skin incision. Subcutaneous and aponeurotic layer was incised using diathermy. The superficial layer of temporal fascia was incised at the root of zygomatic arch and the incision was continued anterosuperiorly till the pericranium. Dissection was carried out relieving the subgaleal plane from pericranium this was done superiorly till the temporal line and inferiorly till the zygomatic arch, the dissection always lied above the temporal fascia. Dissection was done in the plane deep to the facial nerve to protect the branches of facial nerve (frontal and zygomatic branches) which lie in the superficial layer of temporal fascia. Osteotomy of zygomatic arch was done by giving an oblique cut anteriorly at the level of lateral orbital rim and posteriorly at root of the zygomatic arch anterior to Temporomandibular joint. The arch was unchained and removed. Anteriorly flap was reflected till the level of lateral wall of orbit and inferiorly reflected till the level of zygomatic arch. The reflected flap exposes the condyle, coronoid process and the ascending ramus of the mandible. As two of the tumors were originating from coronoid process, preauricular approach provided a sufficient exposure of the tumor.

The tumor in the infra temporal region was identified, based up on the extent of spread and with the involvement of muscular and bony structures. The neurovascular structures mainly the facial nerve and its branches were protected and internal maxillary artery was recognized and ligated. In all of the cases the inner facet of zygomatic arch was resorbed with tumor expansion and hence part of the arch was removed and was not replaced.

Extended rhytidectomy approach:

This incision was used for two of the cases to access the tumor related to the angle and ramus of the mandible. (Fig 8) The incision was given along the premarked line. In this approach dissection was done in subplatysmal plane. The main vital structures in this area were the facial artery and the marginal mandibular branch of the facial nerve. The incision begins 1.5 to 2cm superior to the zygomatic arch behind the hair line and in front of the ear. The incision curves inferiorly under the ear lobe and then curves onto the posterior surface of the auricle. The skin incision is followed by placing the incision over the platysma and the musculo-aponeuratic layer. The marginal mandibular nerve is identified and retracted superiorly; Pterygomassetric sling is identified and incised to expose the angle and ascending ramus of the mandible. The perisoteum lining is incised to expose the superior fraction of the ramus of the mandible. Along with facial nerve branch the tissues are retracted anteriorly and superiorly to expose the tumor. Identification of facial nerve branches was done with the help of nerve stimulator. Segmental resection of mandible along with tumor was done in cases of ameloblastoma and debulking was done in cases of rhabdomyosarcoma. Once the tumor is completely resected, haemostasis is achieved.

The region is well irrigated and suction drain (redivac) is placed for the evacuation of the hematoma. Always a three layer closure should be followed which includes the parotid layer, musculo-aponeuratic layer, pteregomassetric sling and

the final skin closure. The capsule of the parotid gland should be closed in an airtight manner using resorbable sutures to prevent the parotid fistula formation. The subcutaneous planes are closed using vicyryl 3-0 sutures and the skin is closed using 3-0 silk sutures.

RESULTS

The access to the infra temporal fossa was adequately achieved by the osteotomy of the zygomatic arch. The margins of the lesions were well visualised and the lesion was able to be removed in toto. In the case of rhabdomyosarcoma the margins were not well defined and found to be infiltrating, for this reason through debulking was done and post operatively the patients were subjected to chemotherapy and radiotherapy. In all the cases zygomatic arch was eroded so the arch was removed and was not replaced in its original position, which gave a decreased aesthetics to the patient.

All the patients showed a satisfactory recovery in the post op days. The section drain was removed for 2 patients on their 2nd post operative day as the drain collection was insignificant (less than 30ml). In the 3 cases the drain was replaced on 3rd post operative day as the collection was significant and the drain was removed on 7th post operative day. Extra oral sutures were removed alternatively on 5th post operative day and the residual sutures were removed on 7th post operative day. All the patients were discharged on the 7th post operative day once the patient general condition reached a stable point.

Post operative CT scan was taken for the ameloblastoma (fig 10) cases and bone scan was taken for the case of rhabdomyosarcoma, to rule out the distinct metastasis. (fig 4) The bone scan showed negative results for metastasis.

Post operative chemotherapy and radiotherapy was advised for cases of rabdomyosarcoma subsequent to tumor debulking. Out of 2 patients of rhabdomyosarcoma, there was recurrence in one case and the patient deceased after nine months .The chemotherapy regime followed for the cases of rhabdomyosarcoma was 3 cycles VIE + IMRT + 1cycle VIE (Vincristine, Epidophyllotoxin and Ifosfamide). Radiation dose of 40Gy for 45 days was given according to radiotherapist advice. Regular follow up was done every one month for 6 months and every 3 months after the patient was asymptomatic with acceptable post operative facial asymmetry.

The patients of mandibular tumors were completely asymptomatic without any recurrence of tumor. Mild facial asymmetry is observed in all the patients after tumor resection. Post operative facial nerve function was evaluated for all the patients using House-Brackmann facial nerve grading system (HBFNGS). All the branches of facial nerve were well preserved. There was mild weakness of frontal and zygomatic branches of facial nerve in all the cases, which were improved and become normal soon after by period of 4weeks to 3months post operatively. Mouth opening and jaw movements were normal with normal masticatory function in all the patients. All the patients were contented both functionally and aesthetically. (fig 9)

Table no.2: Results showing treatment done and follow up

Fig 1: Pre Operative Profile View.

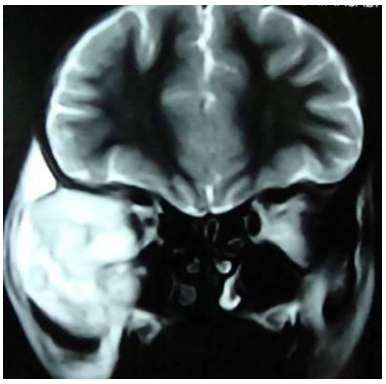

Fig 2: Pre Operative Mri

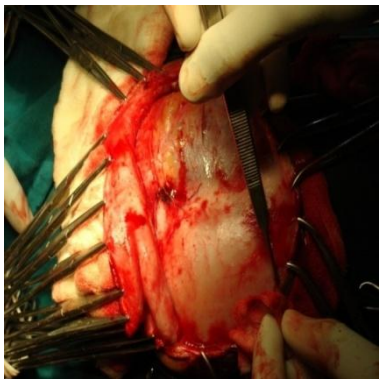

Fig 3: Intra Operative Picture.

Fig 4: Bone Scan of the Patient

Fig 5: 3 Year Post Operative Picture.

Fig 6: Pre Operative Views of the Patient

Fig 7: Pre Operative Mri.

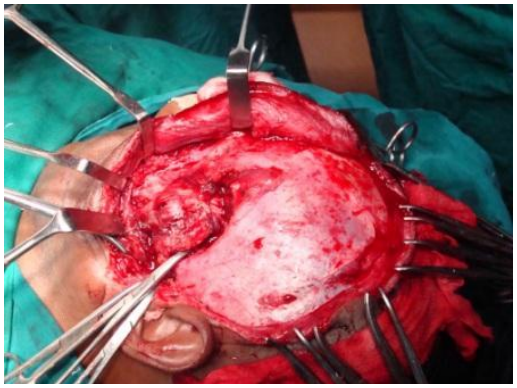

Fig 8: Intra Operatvie Picture:

Figure 9: 6 Years Post Operative Picture of the Patient

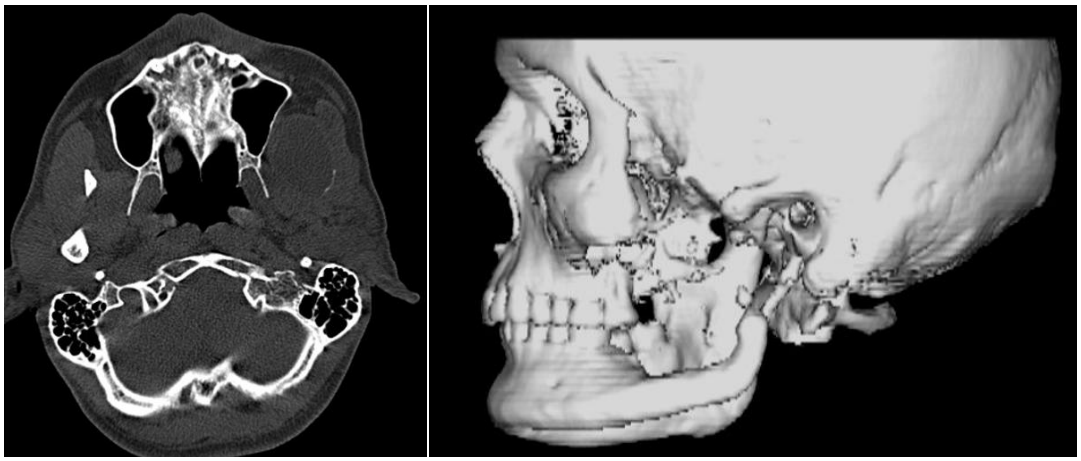

Figure 10: Post Operative Ct Scan of the Patient:

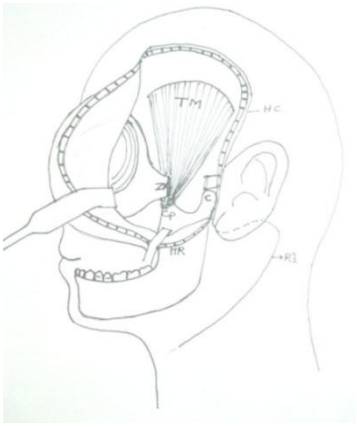

FIG 11:

DISCUSSION

Yasargil in 1975 first described frontotemporosphenoidal craniotomy also called as pterional approach which was found to be the milestone for the micro neurosurgery procedures. This approach exposed the entire frontotemporal operculum, sylvian fissure which made this approach the best for the neurosurgeons in the present days.

Wide ranges of modifications were made to the pterional approach. Haim Ezer et al modified the pterional craniotomy by preserving the temporalis muscle and its fascia and named it as agnes fast craniotomy [2]. Necmettin et al modified the pterional approach and named it as orbitopterional temporal approach, in this approach roof of the orbit, lateral wall of the orbit and fronto zygomatic bone were removed placing the zygomatic arch inact [3]. Floor of the middle cranial fossa and infra temporal fossa poses a difficulty to access from the pterional approach as the zygomatic arch act as an obstacle. Hamylnet al first described the osteotomy of the zygoma as a route for the exposure of the infra temporal fossa. The osteotomy of the zygomatic arch was found to be mandatory by Al-Meftly, Uttley et al [1]. The osteotomy of the zygoma followed by inferior displacement of the arch along with its muscular attachments were found to preserve anatomical as well as early functional recovery of the patient. Terasaka et al followed the procedure of dissecting the muscle completely from the zygomatic arch. The osteotomy should be done in a manner which creates a gap of at least 3cm through which the temporalis muscle was displaced in downward direction. Krisht and Kadri followed the procedure of osteoplasty of the superior surface of the zygomatic arch and preserving the inferior part of the arch intact which helps in maintaining the proper facial counter [4]. Technically some authors preserve the arch at the area of orbital edge. The temporal bone is removed in a U shaped manner in such a way that the vessels are preserved on either side. The fractured zygomatic arch was replaced in the novel position during the final closure, in cases where the erosion of the medial aspect of arch was identified the arch was not replaced. In all the cases of our study the zygomatic arch was eroded and the arch was not replaced, this lead to the compromised aesthetics.

The main advantages of the trans zygomatic osteotomy are 1.Simplicity. 2. Direct exposure of the infra temporal region the elevation of the temporal lobe is minimal. 3. It is effective only in conditions where the arch is placed superior to the floor of the middle cranial fossa. On the other hand demerits of present surgical procedure are, 1. Atrophy of the temporalis muscle due to excessive stripping. 2. Facial nerve palsy. 3. Injury to the temporomandibular joint. 4. Exposure of the middle cranial fossa is minimal. The decision of the type of osteotomy depends on the extent of the tumor involvement, before planning the osteotomy it is indicated to individuate the tumor margins [5].

Infratemporal fossa is an irregular shaped retro maxillary space bounded laterally by zygomatic arch and ramus of mandible, medially by lateral pterygoid plate, posterior by tympanic plate, mastoid & styloid process, superiorly by inferior surface of greater wing of sphenoid, inferiorly related to attachment of medial pterygoid muscle. The contents of the infratemporal fossa are muscles of mastication, maxillary artery, pterygoid venous plexus, mandibular nerve and autonomic fibers of maxillary nerve. The infratemporal region communicates with temporal fossa, pterygopalatine fossa, nasopharynx, orbit and middle cranial fossa. Temporalis muscle and zygomatic arch are the key anatomic structures that cover the infratemporal region. The tumors from the mandible can approach the infra temporal area along the path of pterygopalatine fossa, which were noted in 2 of our cases. Identification of route of tumor spread plays an important role in planning the incision.

Bailey in 1941 first described the rhytidectomy incision. In this procedure the parotid gland in toto is displaced anteriorly thus making the field clear, the scar is aesthetically placed along the hair line. In our procedure we have given extended rhytidectomy incision in the cases where the tumor origin was from the posterior mandible.

Rhabdomyosarcomas constitute for 50% of the sarcomas in children and teenagers. The head and neck area is found to be the common site of occurrence. Histologically they are classified into embryonic, alveolar and pleomorphic variants. The embryonic is further divided into botryoid and spindle cell tumor. 60% of the rhabdomyosarcomas in children were of embryonic variant. The embryonic variants were found to have a good prognosis [3]. A multi modality treatment was indicated based on different stages of tumor by Intergroup Rhabdomyosarcoma Study (IRS). Prognosis depends up on size of tumor and age of patient. Management of rhabdomyosarcomas is a team effort, the treatment included are surgery, chemotherapy, radiotherapy and rarely stem cell transplant. The tumor first should be removed surgically without much of facial disfigurement. If the lesion is found to be extensive then chemotherapy precedes the surgery so as it helps in shrinkage of the tumor. If there is any left outtumors cells and to prevent distinct metastasis the surgery is always preceded by cycles of chemotherapy and radiotherapy [6]. C.B. Pratt et al in their study about treatment of childhood Rhabdomyosarcoma, stated that coordinated therapy of Rhabdomyosarcoma by surgery, radiotherapy and triple drug chemotherapy resulted in prolonged tumor free survival [7]. The survival rate of embryonic rhabdomyosarcomas was found to be 82 to 86.8%. The alveolar variant has a survival rate of 48%. It was found that the survival rate is increased in the patients who underwent chemotherapy and radiotherapy after the surgical management [8]. Hence by taking the stage of tumor into consideration and consultation with oncologist we planned for surgical debulking primarily followed by chemotherapy and radiotherapy. Two out of five cases in the present study were of rhabdomyosarcomas, even after thorough debulking there was recurrence in one case were the recurrent lesion was found to be extending into the middle cranial fossa .Both the patients were subjected to chemotherapy and radiotherapy but one patient was deceased.

The asymmetry following resection of these tumors depends on depth of tumor extension. Due to resection of tumor along with muscles of mastication there was noticeable deformity seen in lateral middle third of the face which was acceptable. There was no occlusal derangement seen in any of the cases. The customary function was achieved post operatively in all the cases. The outcome with the modified pterional approach was found to be satisfactory for the management of the infra temporal fossa tumors.

CONCLUSION

Modified pterional approach gave an opportunity to access a wide range of pathologies involving the skull base and the hidden areas of the middle cranial fossa. The complexity of this approach can only be simplified by understanding the surgical anatomy of the area. The modification which was done to the standard pterional approach gave an additional advantage of easy access to the infra temporal fossa and floor of middle cranial fossa with an osteotomy to the zygomatic arch. The simplicity of this procedure made a safe route for the surgeons to manage the lesions which are otherwise inaccessible.

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COMPETING INTERESTS: None declared
ETHICAL APPROVAL: Consent of surgery was cleared by the patient and the patient's bystander. Ethical clearance was given by the ethical committee of our institution.

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FIGURE LEGENDS:

Figure 1: Pre operative clinical photo showing swelling in right temporal region extending to lateral orbit and zygomatic bones.

Figure 2: MRI of patient with rhabdomyosarcoma showing the tumor extension into the infratemporal region.

Figure 3: intra operative picture showing the exposure of the tumor.

Figure 4: post operative bone scan of the patient, no metastasis identified.

Figure 5: 3 year post operative picture of the patient whose diagnosis was rhabdomyosarcoma.

Figure 6: pre operative clinical photo of the patient showing swelling in the mandible region which was extending superiorly.

Figure 7: pre operative MRI of the patient with ameloblastoma showing the tumor extension in to the infra temporal region.

Figure 8: intra operative picture showing the exposure of the tumor.

Figure 9: 3 years post operative picture of the patient whose diagnosis was ameloblastoma.

Figure 10: post operative CT scan of the patient.

Figure 11: Schematic diagram demonstrating skin incision, anatomical structures that can be accessible through hemicoronal preauricular approach. Extended Hemicoronal incision (HI), Rhytidectomy incision (RI), Temporalis muscle(TM), Zygomatic arch (ZA), Coronoid process (CP), Condyle (C), Mandibular ramus (MR).