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Reconstruction of Mid-Facial Defects Using Temporalis Muscle Flap

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ABSTRACT

Reconstruction of midfacial defects after tumor resection or trauma has evolved from skin graft to pedicled flaps and more recently, to free tissue transfer. Each of these reconstructive modalities has its specific indications, advantages and drawbacks. Temporalis muscle is one of the regional flaps that can be used to reconstruct midfacial defects. The muscle is available close to the surgical field and has a constant vascular supply. However, the flap has a limited arc of rotation and most of the muscle bulk is used in the pedicle. Therefore, various modifications of the surgical procedure were attempted in order to increase the arc of rotation of the flap. In this study, we describe the use of temporalis muscle flap in reconstruction of 9 cases of soft-tissue and/or bony midfacial defects. These defects resulted from resection of invasive periorbital skin tumors, maxillectomy and orbital exenteration. The study showed that temporalis muscle flap can provide a reliable, one-stage reconstructive alternative for more complicated surgical procedures for moderate-sized midfacial defects. Dimensions and arc of rotation of the flap may be increased by using temporalis muscle and deep temporal fascia as a myofascial unit.

INTRODUCTION

Midfacial defects represent a difficult reconstructive problem for the plastic surgeon. These defects result from tumor extirpation or severe trauma. They include composite soft tissue defects and defects following maxillectomy or orbital exenteration **[1]**. A variety of possible reconstructive techniques have been advocated to repair midfacial defects including skin graft, local and regional flaps, as well as free-tissue transfer **[2]**. However, each of these techniques has its advantages and limitations. Reconstructive methods for the bony component of midfacial defects range from the use of soft-tissue alone to vascularized bone **[3]**. Temporalis muscle flap has been used in facial reconstruction for more than a hundred years **[4]**. The muscle provides a large amount of well vascularized soft tissue, with minimal donor site morbidity **[5]**. However, the temporalis muscle flap can not reach the mid line, and most of the muscle bulk is used in the pedicle **[2]**. In this study, we report on our experience with temporalis muscle flap in the reconstruction of 9 cases of midfacial defects. The study aims at defining the role and verifying the reliability of temporalis muscle flap in reconstruction of midfacial defects.

PATIENTS AND METHODS

Patients:

Temporalis muscle flaps were used in 9 patients. Of these, 4 were males and 5 were females. Their ages ranged between 16 and 70 years (average 46.8 years). The indications for surgery were tumor extirpation in 7 cases, osteomyelitis of the orbital bones in one case, and necrosis of the orbital contents in 1 case. Reconstruction was done for various soft-tissue and/or bony midfacial defects, including orbital exenteration defects (3 cases), defects resulting from resection of invasive periorbital skin tumors (3 cases), and postmaxillectomy defects (3 cases). The data of these patients are summarized in Table (1).

Preoperative evaluation:

The patients were evaluated preoperatively by clinical examination and counseling other relevant specialty members as required. Tumor localization and metastatic workup were done by computerized tomography, magnetic resonance imaging and Technetium-99m scanning. Definitive diagnosis was attained after preoperative pathological examination of an incisional biopsy. Intraoperative pathological examination of the resection margins by frozen section was done before proceeding with definitive reconstruction.

Surgical technique:

The temporalis muscle was exposed through a coronal incision in cases of midfacial defects sparing the eyebrow where preservation of the frontal branch of the facial nerve was desirable. Otherwise, the muscle was exposed through an

incision extending from the defect into the temporal region. The technique of flap elevation and transposition is the same as described by Cordeiro and Wolfe **[6]**. The zygomatic arch and/or the coronoid process were divided when the flap was used to cover maxillectomy defects. Additional forehead flap was done in 2 cases. Rib graft was used to reconstruct the orbital floor in one case. The two laminas of the deep temporal fascia were separated from the zygomatic arch up to the area of fusion. Attachment of the deep temporal fascia to the muscle was reinforced by few absorbable sutures, and the musculofascial unit is transposed anteriorly to the orbit in one case (Fig. 1). The temporal fossa is drained and the muscle flap is covered by split-thickness skin graft.

RESULTS

The temporalis muscle was used to close mid-facial defects in 9 patients. In all cases, recovery was uneventful, with no infection, hemorrhage, partial or total flap loss (Figs. 2,3). The flap was insufficient to reconstruct extensive soft-tissue defect in 2 cases. Frontal branch of the 7th cranial nerve was sacrificed in 4 cases and preserved in the remaining 5 cases. Temporalis myofascial flap could reach the midline, providing enough well vascularized tissues to the medial part of the orbit, without resection of the lateral orbital rim or fenestration of the lateral orbital wall in one case. No attempt was made to reconstruct hollowness of the temporal fossa.

Table (1): Patients data and pathology.

Case #	Age (years)	Sex	Pathological diagnosis	Anatomical defect
1	16	Male	Rhabdomyosarcoma of the right orbit	Orbital exenteration defect
2	22	Female	Osteomyelitis of the exenterated orbit	Orbital exenteration defect
3	52	Female	Chemical necrosis of the right orbital contents.	Orbital exenteration defect
4	60	Female	Squamous cell carcinoma at the outer canthus of the right orbit	Composite soft tissue defect including the lateral parts of the eyelids and eyebrow
5	55	Female	Basal cell carcinoma lateral to the right outer canthus	Composite soft tissue defect lateral to the outer canthus
6	70	Male	Basal cell carcinoma infilterating the left zygoma	Composite soft tissue and maxillectomy defect
7	54	Male	Recurrent squamous cell carcinoma of the maxillary sinus	Hemimaxillectomy defect
8	65	Male	Sqamous cell carcinoma of the maxillary sinus	Hemimaxillectomy defect
9	27	Female	Osteosarcoma of the maxilla	Radical maxillectomy defect

Fig. (1): Temporalis muscle-deep temporal fascia myofascial unit in case # 3, reaching the medial side of the orbit.

Fig. (2-A): Preoperative view of rhabdomyosarcoma of the right orbit (case # 1).

Fig. (2-B): Postoperative view after coverage by temporalis muscle flap and split-thickness skin graft. A residual defect is seen in the upper part of the medial side of the orbit.

Fig. (3-A): Preoperative view of an invasive basal cell carcinoma in the right periorbital region (Case # 5).

Fig. (3-B): Postoperative view after reconstruction by temporalis muscle and split-thickness skin graft.

DISCUSSION

Soft-tissue and bone defects in the midface are associated with cosmetic deformity and functional disability. Reconstruction should obturate the nasal and orbital cavities, separating them from the oral cavity, and restore the facial contour **[3]**. Reconstruction of the bony component becomes necessary when the midfacial defect involves significant part of the palate or when the orbital floor is resected **[1]**. Causes of midfacial defects include extirpation of maxillary cancer, orbital exenteration or trauma **[1,2]**. Classification systems for midfacial defects were based on the extent of maxillectomy, the size of palatal defect and integrity of the orbital support **[3,7]**. However, these classifications did not consider isolated, composite soft tissue defects that may result from resection of invasive skin tumors. Foster et al., defined complex defect of the midface as a defect following extirpation that involves either skin covering and mucosal lining, or skin and soft tissue defect following maxillectomy or orbital exenteration **[1]**. Midfacial defects can be simply divided into soft-tissue and bone defects.

A large variety of techniques are available for reconstruction of midfacial defects. Each technique has its advantages and limitations. Traditional reconstruction included skin grafting and placement of a prosthesis for maxillary defect, and spontaneous granulation or epithelialization of orbital exenteration defect. However, the healing time is prolonged, the cosmetic outcome is poor, and there is a possibility of developing a fistula between the oral cavity or the orbit and the nasal cavity or the paranasal sinuses **[2,3]**.

Common regional flaps for reconstructing midfacial defects are cervicofacial rotation flap **[8]**, forehead flap **[9]**, facial artery musculomucosal flap **[10]**, and temporalis muscle flap **[11]**. These flaps can replace minor soft tissue defects, not involving the underlying bone **[3]**. They can cover only the anterior part of the orbit, leaving a potential dead space in the posterior orbital cavity **[2]**. Tissue expansion has been successfully attempted for reconstruction of head and neck defects but this was associated with a significant complication rate **[12,13]**.

Distant pedicled flaps that are used in reconstruction of midfacial defects include deltopectoral **[14]**, latissimus dorsi **[15]**, pectoralis major **[16]**, and trapezius flaps **[17]**. These flaps are based on the trunk and may not have sufficient pedicle to reach the maxilla and the orbit **[2]**. They may not provide adequate tissue volume, bone when required, or flexibility of flap inset **[1]**. The deltoid extension of medially-based deltopectoral flap is unreliable and incorporation of a random extension of pectoralis major myocutaneous flap over the rectus fascia may lead to ischemic necrosis of the flap tip **[3,18]**.

A variety of free tissue transfers have been advocated and favored by most of the surgeons to repair midfacial defects. The most popular are free omental flap **[19]**, latissmus dorsi flap **[20]**, rectus abdominis flap **[15]**, free scapular fasciocutaneous flap **[21]**, free fibular osteocutaneous flap **[22]**, and radial forearm flap **[1]**. Free flaps are reliable and flexible. They are specially required for extensive soft tissue and bone defects **[2,3]**. The main drawbacks of free tissue transfer are the long operative time, expensive cost, and the additional morbidity in another operative site **[3]**. The long distance from the midface to the neck for reliable donor vessels may necessitate vein grafting **[7]**. Latissimus dorsi and scapular flaps require position change to dissect the flap **[3]**. Rectus abdominis flap is bulky and may interfere with oral hygiene, dental rehabilitation, and tongue mobility. Radial forearm flap is thin with limited soft-tissue bulk **[1]**.

Temporalis muscle is one of the regional flaps that have been used in facial reconstruction. It has a constant vascular supply from the deep temporal and the middle temporal vessels that are located on the deep surface of muscle **[23,24]**. The temporalis muscle can be split safely in the coronal plane, since the blood supply travels in the same direction **[6]**. Temporalis muscle flap was employed in the obliteration of the dead space following orbital exenteration **[25,26]**, in augmentation of facial contour following major maxillofacial resection **[5,6,27]**, and in intraoral reconstruction **[6,28]**.

Temporalis muscle flap has been criticized because of its short arc of rotation. It can not reach the mid line and most of the muscle bulk is used in the pedicle **[2]**. Therefore, modifications of the surgical procedure were attempted in order to increase the arc of rotation of the flap. These included fenestration of the lateral orbital wall **[26]**, resection of the lateral orbital margin **[25]**, resection of the coronoid process and division of the zygomatic arch **[6]**, or the use of reverse temporalis muscle flap perfused by the superficial temporal vessels **[2]**. However, preservation of the lateral orbital margin is important for facial symmetry and projection **[26]**. Transposition of temporalis muscle through a window in the lateral orbital wall necessitates accurate measurements to avoid violation of the middle cranial fossa or ischemic loss of the distal part of the flap **[6,26]**.

We used temporalis muscle flap to reconstruct soft-tissue and bone midfacial defects in 9 cases. An anatomical study on cadavers indicated that the mean dimensions of the temporalis muscle are 8.45cm x 10.5cm **[26]**. This is why the flap can cover only moderate sized defects, measuring 4-8cm in the greatest dimension **[1]**. Larger soft-tissue defects require an additional regional forehead or cevicofacial flap **[6,29]**. We used forehead flap in combination with temporalis muscle flap in two cases. Alternatively, we used reverse deep temporal fascia flap in another case to reach the upper medial part of the orbit. This is based on the direct anastomosis between the fascial branch of the middle temporal artery and the deep temporal network and the sparse network of branches between the middle temporal and the deep temporal vessels where the two laminas fuse **[24]**.

Reconstruction of the bony component of midfacial defects has been debated in the literature. Numerous authors had success with soft tissue flaps while others have incorporated free or vascularized bone grafts **[3]**. Temporalis muscle flap can support immediate or delayed free bone graft **[6,30]**. It can also be used as a composite myofascial flap with cranial bone **[31]**. Bony midfacial defects that need reconstruction are alveolar ridge defects including or exceeding the hemi palate, and orbital floor defects **[1]**. In our study, the alveolar ridge defects were too small to require bone grafting and orbital floor reconstruction was needed in one case. There was no need for lining maxillectomy defects, since healing over exposed muscle occurs by mucosal growth and contraction **[6]**.

Summary:

This clinical study describes our experience in one-stage reconstruction of soft tissue and/or bony

midfacial defects with temporalis muscle flap. The flap is reliable as long as its vascular supply is preserved and the operative time is short compared with free-tissue transfer. Its dimensions and arc of rotation may be increased by using temporalis muscle and deep temporal fascia myofascial unit. Temporalis muscle flap should be taken into consideration before deciding on more extensive reconstructive procedures especially for moderate defects.

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