Morbidity Profile and Functional Outcome of Modified Facial Translocation Approaches for Skull Base Tumors

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ABSTRACT

The primary objective of this study was to evaluate morbidity associated with facial translocation approaches for skull base and results of various technical modifications. Forty consecutive patients who underwent facial translocation approaches for accessing skull base tumors from July 2005 to June 2010 were included in this study. There were 25 patients who underwent standard facial translocation, 4 patients medial mini, and 11 patients underwent extended facial translocation. Thirteen patients had benign disease and 27 patients had malignant disease. Resection was R0 in 36 and R1 in 4 patients. Most patients had acceptable cosmetic results. None of the patients had problems related to occlusion or speech and swallowing. The commonest complication observed was nasal crusting in 16 patients. Grade 2 trismus and exposure of mini plate was seen in three patients. Two patients developed necrosis of translocated bone. Three patients developed palatal fistula before modification of palatal incision. Facial translocation provides a satisfactory access for adequate clearance of skull base tumors with satisfactory aesthetic and functional results. With modifications of the surgical technique and implementation of new surgical tools, the morbidity of facial translocation approaches will continue to decrease.

KEYWORDS: Facial translocation approach, morbidity, skull base, infratemporal fossa

Tumors located within the nasopharynx, posterior maxilla, infratemporal fossa, and central skull base pose a significant challenge with regard to access and exposure. Successful treatment of these tumors depends upon adequacy of exposure and complete resection of the lesion. Several approaches such as the facial transloca-

tion,¹ the maxillary swing,² the infratemporal fossa,³ the transpalatal⁴ as well as the transmandibular⁵ and endoscopic approaches⁶ have been described to provide exposure for resection of these tumors. Most of these approaches are traditionally associated with significant functional and cosmetic consequences.

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The facial translocation approach first described by Janecka et al¹ is based on principle of modular disassembly of facial aesthetic and functional subunits. This approach provides direct access for tumors involving the nasopharynx, posterior maxilla, and infratemporal fossa. This approach can be combined with subcranial and transcranial approaches to provide direct access and wide exposure of the anterior and anterolateral skull base. Postoperative necrosis of the translocated bone, palatal fistula formation, and palsy of the frontal branch of facial nerve are the common complications of the facial translocation approach. Various modifications of the surgical technique have been described to reduce the associated morbidity associated with this approach. In this study, we evaluated the morbidity associated with facial translocation approaches for skull base resections. We further analyzed the results of various technical modifications to reduce the morbidity.

PATIENTS AND METHODS

Patients

A retrospective chart review of consecutive patients treated with facial translocation approaches from July 2005 to June 2010 was undertaken using a predefined datasheet. Forty patients who underwent various facial translocations for tumors involving the posterior maxilla, the infratemporal fossa, and/or the nasopharyngeal region were included in the study. Average follow-up was 6 months. The facial translocations were classified as described by Janecka.⁷ In our series, there were 28 male patients and 12 female patients with an age range of 12 to 69 years. Variables such as patient and tumor factors, indications and approaches utilized, pathology, and morbidity associated with the surgical technique were evaluated.

Operative Technique

The basic surgical procedure as described by Janecka et al was followed. However, with a goal of reducing morbidity, the modifications incorporated in the technique are described.

INCISION AND EXPOSURE

The facial incision is modified as described earlier.⁸ Briefly, the incision consists of upper lip-split incision, extending into the anterior nares, curving around the alar cartilage, superiorly between the dorsal and lateral nasal subunits. To preserve the integrity of medial canthus and the lacrimal system, the incision is extended just inferior to the medial canthus and continued as subciliary incision to the lateral canthus. This is followed by a preauricular hemicoronal incision to expose the zygomatic arch. To preserve the integrity of frontal branches

of the facial nerve, the extension of the incision lateral to the lateral canthus is limited to ~1 cm long (Fig. 1). The intraoral, interdental incision is placed from the ipsilateral tuberosity of the maxilla along the palatal interdental papillae to the contralateral molar region.

The skin flap elevation is limited to the areas of proposed osteotomies to retain vascularity to the translocated bone. Midpalatal incisions are avoided to prevent wound dehiscence (Figs. 2A and 2B).

OSTEOTOMY

To ensure perfect occlusion and to restore facial form, bone plates are preadapted at the zygomatico-temporal and premaxillary region (Fig. 2C). In addition, an occlusal splint is used for precise reposition of the maxilla at the time of reassembly. The osteotomy is performed at the Lefort III level as described previously.⁹ The modifications included placing the nasal osteotomy over the nasolacrimal duct (NLD) to preserve the integrity of the lacrimal system. The palatal cut is made at the ipsilateral paramedian plane to protect nasal septum.

RESULTS

Clinical and demographic characteristics of 40 patients who underwent facial translocation are listed in Table 1. There were 27 patients who presented with primary disease while 13 patients had recurrent or residual disease at the time of presentation. The details of tumor extent are summarized in Table 1. The facial translocation approach provided adequate access for complete resection in the majority of tumors. R0 resection was achieved in 36 (90%) patients and R1 in 4 patients (10%). A total of 32 patients underwent radiotherapy, 15 patients received radiation before surgery while remaining 17 patients received postoperative radiation. There was no perioperative mortality in this series.

Table 2 lists the surgical procedures performed in this series of patients. The facial translocations were classified according to Janecka's classification. There were 25 patients (63%) who underwent standard facial translocation, while 4 (10%) patients had medial mini, and 11 (27%) patients required extended facial translocation. Craniofacial resection was required in 14 (34%) patients. In patients with intracranial extension of tumor, facial translocation was combined with various craniotomies. Five patients with tumor extension to anterior skull base underwent a frontal craniotomy. Five patients with disease extending to cavernous sinus underwent a frontotemporal craniotomy. Two patients each underwent a temporal craniotomy and a subcranial approach.

The defect in three patients was reconstructed with a rotated temporalis muscle flap. Microvascular free flap reconstruction was performed in 10 patients, out of these 7 patients were reconstructed using a rectus

Figure 1 (A) Incision placed between the dorsal and lateral nasal aesthetic subunits. The incision is then extended just inferior to the medial canthus and continuing as subciliary incision to lateral canthus. (B) A separate small 1-cm preauricular incision. (C) Assess following standard facial translocation. (D) Well-healed scar at follow-up.

abdominis, the remainder were reconstructed using an anterolateral thigh or a latissimus dorsi free flap.

Pathological characteristics of the tumors are listed in Table 3. Thirteen (34%) patients had a benign pathology while remaining 27 patients (66%) had malignant disease. The most common benign pathology was the juvenile nasopharyngeal angiofibroma with nine cases, followed by three cases of inverted papilloma and one case of an inflammatory pseudotumor. Among the malignant pathologies there were six cases with squamous cell carcinoma, six cases with sinonasal undifferentiated carcinoma, five cases with nasopharyngeal carcinoma, and one case of a chondrosarcoma.

The morbidity and complications associated are listed in Table 4. The most common problems were nasal crusting and associated foul nasal smell reported by 16 (42%) patients. The nasal symptoms were only present in the patients who had received pre- or postoperative radiotherapy. Five patients developed symptoms of NLD obstruction. Early in our series, three patients developed a palatal fistula following a midline palatal incision. After above-mentioned modification of the palatal incision no further palatal fistula formation was observed in the cohort. Exposure of the miniplates at the frontomaxillary osteotomy site occurred in three patients within 6 months of completion of postoperative

Figure 2 (A) Palatal interdentary incision and flap elevation. (B) No palatal fistula at 1-month follow-up. (C) Good occlusion at follow-up.

radiotherapy. Three patients developed grade 2 trismus. Two patients after a medial mini translocation developed partial necrosis of underlying maxilla. One of the two patients had received postoperative radiation, in both the patients there was associated miniplate extrusion. Postoperative ectropion was noted in two patients. Following the modification of incision, none of the cases developed facial nerve (frontal branch) palsy except one case with transient paresis. One patient with craniofacial resection developed cerebrospinal fluid leak which was managed conservatively. Dehiscence of wound was noted in one patient. None of the patients had malocclusion and there was no peri- or postoperative mortality.

Table 1 Patient and Tumor Characteristics

Age range (<i>n</i> = 40)	12–69 years
Gender (<i>n</i> = 40)	
Male	28
Female	12
Presentation (<i>n</i> = 40)	
Primary	27
Recurrent	13
Tumor extent (<i>n</i> = 40)	
Nasopharynx	2
Extension to infratemporal fossa	35
Extension to anterior skull base	7
Extension to lateral skull base	7
Resection (<i>n</i> = 40)	
R0	36
R1	4
R2	0
Radiotherapy	
Preop	13
Postop	19

DISCUSSION

The surgical access for an oncologic resection of tumors located in the nasopharynx, posterior maxilla, and infratemporal fossa remains challenging. Several anterior and lateral approaches have been described such as the lateral infratemporal approaches type C and D,^{3,10} the maxillary swing approach,² the facial translocation approach,¹ the transpalatal approach, the maxillotomy approach,¹¹ and the Le fort I osteotomy approach.¹² Each of these approaches has its own distinct advantages and limitations. The facial translocation approach is based on the principle of modular disassembly of the facial subunits. The subunits are separated to provide access for an oncologic resection, following which the subunits are reassembled and fixed back into position. The advantage of this approach is its versatility to be tailored to the extent of resection required. This helps in limiting the functional and cosmetic sequelae. Accordingly, Janecka developed a classification system reflecting the various types of facial translocation approaches.⁷ The

Table 2 Surgical Procedures

Facial translocation (<i>n</i> = 40)	
Standard	25
Medial mini	4
Extended	11
Extended approach (<i>n</i> = 13)	
Frontal craniotomy	5
Frontotemporal craniotomy	5
Temporal craniotomy	2
Subcranial approach	2
Mandibulotomy	1
Additional procedure	
Free flap reconstruction	10
Neck dissection	11

Table 3 Pathology

Pathology (n = 40)	
Benign	13
Malignant	27
Juvenile nasopharyngeal angiofibroma	9
Undifferentiated carcinoma	6
Squamous cell carcinoma	6
Nasopharyngeal carcinoma	5
Inverted papilloma	3
Olfactory neuroblastoma	2
Giant cell tumor	2
Sinonasal melanoma	2
Inflammatory pseudotumor	1
Transitional cell carcinoma	1
Mucoepidermoid carcinoma	1
Spindle cell sarcoma	1
Chondrosarcoma	1

indications and access provided by the approach modifications have been standardized.¹³ In appropriately selected cases, complete resection of tumor can be achieved using the facial translocation and its modifications. In our series, R0 resections were achieved in 90% of patients.

Although the facial translocation provides adequate exposure, there are concerns regarding the associated morbidity with the originally described technique. Since then several technical modifications have been introduced to reduce this morbidity which are discussed in the following. Necrosis and osteomyelitis of the bone subunits is a major complication after a facial translocation approach. This problem is pronounced in patients undergoing postoperative radiotherapy. Sequestrotomy rates as high as 61% following radiation therapy have been previously reported.¹⁴ In our series, bone necrosis was seen in two patients (6%). The possibility of bone necrosis is markedly reduced if the translocated bone is left attached to cheek flap with

minimal elevation of periosteum around the osteotomy sites. Performing the osteotomies with the piezosurgical tools further reduces damage to the bone edges and promotes osteogenesis and osteoconduction. Bone healing can additionally be supported by providing a vascularized tissue cover with local flaps such as the temporalis muscle, the lateral nasal flap, or various free-flap reconstructions.¹⁵ Exposure of the reconstruction plates is commonly associated with bone necrosis and radiation therapy.¹⁶ In our series, three patients developed plate exposure. This can be prevented by preserving the viability of the underlying bone and providing vascular tissue cover as described above.

A midface degloving approach has been suggested to avoid a facial scar.¹⁷ In our series, facial incisions placed over the dorsal and lateral subunits of the nose provided excellent cosmetic results. The aesthetic and anatomical basis of this modification has been previously reported.⁸ Other sequelae, such as lower lid ectropion and epiphora can be avoided by the degloving approach, but is associated with a higher incidence of bone necrosis, particularly after postoperative radiation.¹⁵

Palatal fistula formation at the junction of the soft and hard palate is common following a standard mid-palatal incision.¹⁸ Persistent palatal fistula is associated with speech and swallowing issues, adversely affecting quality of life.¹⁹ The incision can be modified to raise a posteriorly based palatal flap from an interdental incision; this flap can be sutured back after repositioning of the maxilla. This modification has significantly helped reduce the incidence of palatal fistulas.

A small preauricular incision or extension is sufficient to perform the osteotomy of the zygomatic arch and translocating the maxilla based on cheek flap. This avoids the need to transect the frontal branches of the facial nerve as described originally by Janecka.

Telecanthus resulting from improper fixation of medial canthal tendon is a rare but significant problem for the patients when it occurs. A technique to prevent this is by tagging the tendon ligament before detachment to ensure adequate reapproximation at the time of closure. The NLD obstruction is another problem that can occur postoperatively due to the scarring of the NLD system at the nasomaxillary osteotomy site.¹⁷ Although repair of NLD has been described, we do not perform a routine repair, but try and prevent NLD obstruction by placing the osteotomy at level of the lacrimal sac with the concept that the sac heals in a transected open fashion. In our series before modification of incision, five patients developed NLD obstruction, for which duct repair was attempted. As previously reported, most patients complaint of nasal crusting and associated foul smell. This problem is aggravated in patients undergoing radiotherapy. Regular nasal irrigation with warm saline several times a day helps reduce these symptoms and prevent secondary infections.

Table 4 Morbidity Profile

Crust in nose/foul smell	16
NLD obstruction	5
Telecanthus	3
Palatal fistula	3
Plate exposure	3
Trismus	3
Bone necrosis	2
Ectropion	2
Frontal branch paresis	1
CSF leak	1
Wound dehiscence	1
Malocclusion	0
Perioperative mortality	0

CSF, cerebrospinal fluid; NLD, nasolacrimal duct.

Recently, endoscopic approaches have been described for tumors extending to infratemporal fossa and anterior skull base.²⁰ Many of the complications of facial translocation approaches can be avoided by endoscopic approach, but this is an evolving technique and its use for malignant conditions will require long-term follow-up data. Also special instrumentation and expertise are required for the endoscopic approaches particularly for tumors extending to infratemporal fossa. Facial translocation approach is technically simple and provides adequate access to infratemporal fossa. Until the expertises for endoscopic surgery are universally available and technique is standardized, facial translocation approach should be recommended for tumors involving infratemporal fossa and anterolateral skull base.

In conclusion, the facial translocation approach with its modifications provides adequate access for oncologic resections of tumors located in the infratemporal fossa and nasopharynx. Various modifications and implementation of new surgical techniques have led to a significant reduction of associated morbidity.

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