Subcranial Approach in Pediatric Craniofacial Surgery

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ABSTRACT

We report our experience with the subcranial approach, developed at the Plastic Surgery Unit of Hospital "Ricardo Gutiérrez," for the treatment of injuries in the frontoethmoidal orbital region in pediatric patients. The subcranial approach was described by Raveh et al for the treatment of fractures in the frontoethmoidal area. The subcranial approach was used later for surgery of tumors and deformities of the frontoethmoidal region. We have used this approach in nine cases of nontraumatic injuries (one meningioma, one orbital bone fibrous dysplasia, one vascular malformation, five nasal dermoid cysts, and one fronto-orbital mucocoele). One patient with vascular malformation died of a stroke 10 days after surgery. The patient with the meningioma had a recurrence. Another patient developed an infection that needed surgical resolution and hardware removal. A third patient suffered a mild infection that receded with medication. No other complications were registered. The surgical exposure obtained through this approach was always excellent and left no cosmetic defects. There was no evidence of facial growth disturbance in this group of patients, except in one patient who received radiotherapy after surgery. Operative time and hospitalization were lower in this group than in patients with conventional frontal craniotomy.

KEYWORDS: Subcranial approach, dermoid cysts, orbitoethmoidal approach

The traditional approach for injuries of the skull base in the frontoethmoidal area has been frontal craniotomy with retraction of the frontal lobe. To decrease the morbidity of this technique, Raveh et al described the subcranial approach for the treatment of nasoethmoidal trauma.^{1,2} The subcranial approach was used later by the same authors for the treatment of the anterior base cranial deformities³ and tumors.^{4,5} In the medical literature, there are few publications on this approach in pediatric patients.⁶⁻⁸

From January 1996 to October 2008 in the Plastic and Reconstructive Surgery Unit at a Children Hospital of Buenos Aires, we used the subcranial

approach in a limited number of pediatric patients with nontraumatic pathology. The purpose of this article is to communicate this experience.

METHODS

We retrospectively analyzed the medical records of nine patients treated in the Plastic and Reconstructive Surgery Unit at a Children Hospital of Buenos Aires from January 1996 to October 2008, with subcranial approach technique. This technique consisted of:

1. Bicoronal incision, elevation of the frontal flap up to the nasal dorsum, with visualization of the

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Figure 1 Dissection of the frontal flap up to the nasal dorsum. Carving a plaque that includes the frontal bone with outermost limits in the supraorbital nerve.

lower edge of the nasal bones, and release of the supraorbital nerves

2. Bone carving of a plaque that includes the central region of the frontal bone, with its external limits in the supraorbital nerves (Fig. 1)
3. Lifting bone plaque, leaving, if possible, the periosteum attached to the lower end of nasal bone (Fig. 2)
4. Treatment of tumor/trauma and eventual reconstruction of the orbital wall or floor of the anterior cranial fossa with a bone graft (Fig. 3)
5. Sealing of the surgical area with galea flap and fibrin glue (Fig. 4)
6. Repositioning and fixation of the bone plaque (we preferred bioabsorbable mesh) (Fig. 5)

Figure 2 Lifting of the frontonasal plaque leaving, if possible, soft tissues adhered to the nasal bone.

Figure 3 Treatment of the pathology and eventual reconstruction of the orbital wall or floor of the anterior cranial fossa with bone graft harvested from calvaria.

7. Repositioning and closure of the frontal flap

Nine patients were operated on using this procedure (six females, three males), with an age range from 10 months to 14 years and an average of 5 years and 3 months. Pathology results are detailed in Table 1.

The average follow-up was 3 years and 3 months. Two patients with dermoid cysts dropped out during the first and second year after operation, respectively. At that time, there were no signs of disease recurrence.

One patient died at 10 days postsurgery due to a thrombotic stroke. She had been operated on for a vascular tumor of the ethmoidal region.

Another patient had recurrence of an orbital meningioma, which was reoperated on and irradiated. The patient remains with no disease progression 12 years after treatment. At present, the patient shows slight changes in the frontal boundary (Fig. 6). One patient

Figure 4 Sealing the area with galea flap and fibrin glue.

Figure 5 Repositioning and fixation of bone plaque.

had local infection and required a new surgery to remove the mesh of absorbable osteosynthesis (Fig. 7), and another one with nasal pus discharge had spontaneous drainage, which resolved with medical treatment.

The other patients had no complications.

DISCUSSION

The congenital diseases, trauma or tumors of the orbitonasoethmoidal region in pediatric patients have required traditionally a major approach, through a frontal craniotomy with frontal lobe displacement backward to treat the injury. This surgical approach had severe complications such as encephalomalacia, anosmia, olfactory nerve injury, and other serious cosmetic and functional changes,^{9,10} and there were problems sealing the dura. The reconstruction of the bone defect created aesthetic flaws of paranasal incisions, anosmia, and potential damage to the frontal lobe due to prolonged retraction. Raveh and Vuillemin originally described a subcranial approach to treat fractures of the central region of the face. The easy implementation of this approach encouraged the

Figure 6 Recurrent meningioma sequel. The patient received radiotherapy.

Figure 7 Local infection. The patient needed reoperation to remove the reabsorbable mesh.

Table 1 Cases

Diagnosis	Age	Sex	Follow-up (y)	Complications
Naso-orbital meningioma	7 y	F	12	Orbital recurrence; frontal alteration
Nasal dermoid cyst	3 y, 6 mo	F	3	No complications
Nasal dermoid cyst	2 y, 3 mo	F	2	No complications
Nasal dermoid cyst	4 y	M	3	Local infection; reoperation
Nasal dermoid cyst	4 y, 2 mo	M	1	No complications
Vascular tumor (nonspecific)	9 y	F	—	Death at 10 d postsurgery (stroke)
Nasal dermoid cyst	20 m	F	5	Nasal discharge; medical treatment
Orbital fibrous dysplasia	3 y, 5 mo	F	3	No complications
Frontal mucocele	14 y	M	8	No complications

authors to use it for tumor treatment, and other groups published several articles on the subject.¹¹ A combination of the subcranial approach with an intraoral approach of the maxillary region (a technique known as “facial degloving”)¹² or with approaches to the temporal fossa and the treatment of tumors of the frontal region has also been published.¹³ Although the endoscopic technique has been proposed for resection of nasal dermoids in an attempt to minimize morbidity, the authors¹⁴ only dealt with cases of small size and small intracranial communication. The use of endoscopic approaches in pediatrics is limited by the small diameter of the nasal cavity and the need of very narrow instruments.

Moore et al,¹⁵ in a comparative analysis with traditional techniques, concluded that the operative time, need of intensive care, and hospital stay are significantly lower, without implying higher morbidity and mortality. In our patients, the average hospital stay was 3.5 postoperative days. Only the patient who suffered a stroke required intensive care.

Kellman et al⁶ in 2004 published their results of this approach in three patients with uncomplicated nasal dermoid cysts. In 2007, this group published another communication⁷ and concluded that the technique is effective in younger patients, provides excellent exposure, minimizes frontal lobe retraction and cerebrospinal fluid fistulas, and has excellent cosmetic results. Follow-up of these patients showed that their facial growth was not impaired. This opinion is shared by Shlomi et al¹⁶ in the discussion of their population of adolescents.

In our series, only one patient, operated on due to an orbitoethmoidal meningioma (now 22 years old), had a slight alteration at the frontal region; but it should be

Figure 9 Fibrous dysplasia. Two years after surgery.

noted that she is the only patient who had received local radiation therapy. In our follow-up, we have found no abnormalities of facial growth in patients who are still being followed.

We want to show our successful experience with the subcranial approach in pediatric patients. In a case of orbital bone fibrous dysplasia and meningioma, as well as in a frontal mucocoele with involvement of the inner wall of the orbit, bone grafts taken from the outer table of the calvaria skull, already exposed by the approach, were used to repair the bone defects. It was also easy to repair the medial canthus under direct vision. The facts mentioned above are considered advantages for the subcranial approach.

Figure 8 Fibrous dysplasia. Presurgical appearance.

Figure 10 Nasal dermoid cyst. Presurgical appearance.

Figure 11 Nasal dermoid cyst. Four years after surgery.

Moreover, we highlight the ease of sealing the anterior cranial fossa with a galea flap or with bone grafts, or both. This is a point that we share with other authors.^{17–20}

CONCLUSIONS

Based on the above and in coincidence with other published work,^{21,22} we conclude that the subcranial approach in the pediatric population minimizes morbidity. Surgical exposure was excellent. Cosmetic results were excellent in all cases followed (Figs. 8 and 9). There was no evidence of facial growth disturbance (Figs. 10 and 11), but a longer follow-up and larger series of patients are necessary to confirm that. Operative time and hospitalization were lower in this group than in patients with conventional frontal craniotomy, which added to the above-mentioned benefits.

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