VASCULARISED EPIPHYSIS AND HEMI-JOINT TRANSFER FOR RECONSTRUCTION OF TEMPOROMANDIBULAR JOINT AND RAMUS-CONDYLE UNIT IN CASES OF HEMIFACIAL MICROSPOMIA.

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SUMMARY: Epiphysis and hemi-joint transfer for reconstruction of the temporomandibular joint and ramus-condyle unit, using the proximal epiphyseal plate and proximal one third of the diaphyseal shaft of the fibula, has been successfully performed in cases of hemifacial microsomia. A total of 6 cases belonging to the type II and III of skeletal type of hemifacial microsomia in the age group of 3 to 8 years have undergone this procedure. All patients have a good range of painless movement at the temporomandibular joint with a proportionate growth at the neo ramus-condyle unit. Two cases with a follow up of 5 years have shown a growth of 0.4 cms and 0.5 cms per year respectively at the neo ramus-condyle unit and they have been illustrated.

INTRODUCTION

Hemi-facial microsomia occurs secondary to disturbances in development of various components of the first and the second branchial arches. The severity of skeletal aplasia/hypoplasia and its manifestation varies, depending upon the extent of tissue involvement. Clinical presentation of the deformity becomes progressively worse, as a result of continuous asymmetrical growth of the face, on the nonaffectected side. Three accepted programs in the management of hemi-facial microsomia are:

a) San Francisco Program,
b) Toronto Program, and
c) New York University Program.

All these programs aim:

i) To undertake mandibular and jaw corrective surgical procedures at an early stage of development, before an asymmetrical growth pattern has been established, thereby releasing the constricting effect caused by hypoplastic mandible and minimising secondary growth dependent soft tissue and bony deformities.

ii) To undertake massive facial bony and soft tissue reconstruction primarily in patients with severe grades of microsomia.

iii) Surgical correction of the secondary skeletal and soft tissue asymmetry after completion of facial growth.

Transfer of the vascularised head of the fibula on the anterior tibial artery pedicle is a good option for the correction of the bony hypoplasia, after excision of the hypoplastic condyle and ramus unit in young age. This satisfies the first objective.

Patients and Method:

6 Patients with hemi-facial microsomia in the age group between 3 and 8 have been operated by the authors with this technique. Two of these cases with a follow up of 5 years have been illustrated.

They have been typed according to the classification by Grabb and Lauritzen et al. (Table No.1)

TABLE - 1

CLASSIFICATION OF HEMI-FACIAL MICROSPOMIA

(A) GRABB(1965)

Group A - Underdevelopment of the external ear, middle ear, mandible, maxilla, zygoma, temporal bone, muscles of mastication, facial muscles and palatal muscles. (This group exhibits the greatest number of under developed structures). 

Group B - Underdevelopment of the external ear, middle ear and zygoma.

Group C - Underdevelopment of the external ear, middle ear and mandible.
Group D - Underdevelopment of the external ear and middle ear.

Group E - Unilateral macrostomia, under development of the mandible and absence of the parotid gland.

Group F - Anomalies of only one structure derived from the first and second branchial arches, intervening first pharyngeal pouch and first branchial cleft, and the primordia of the temporal bone. The first branchial cleft sinus is included in this group.

(B) LAURITZEN C., MUNRO I R and ROSS R B (1985)

Grade I - Hypoplasia affects the gonial angle.

Grade II - Less severe cases of hypoplasia of the angle and the ascending ramus.

Grade III - Complete absence of the ramus and condyle in more severe cases.

Case No. 1

A four years old male child belonging to the Group C of Grabb or Type III of Lauritzen presented with right sided deformity. The chin was deviated to the right side with secondary hypoplasia of the maxilla and the bony orbit. Dental models and bite plane were recorded during pre-operative planning and post-operative follow up assessment of growth. Assessment of the degree of hypoplasia of the vertical height of the mandible, as compared to the non-affected side, was performed using cephalometric studies and 3 dimensional C.T.Scan.

Through a curved sub-mandibular incision at the angle of the mandible, the hypoplastic ramus-condyle unit was dissected sub-periosteally, up to the temporo-mandibular joint/zygomatic arch. The hypoplastic ramus and condyle along with part of the angle of the mandible were resected. The space thus formed for insertion of the neo ramus-condyle unit was assessed for satisfactory placement of vascularized graft after pulling the angle of the mandible downwards and anteriorly. The facial artery and vein and anterior jugular vein were dissected as recipient vessels.

The head of the contralateral fibula was dissected using a 'S' shaped incision made along the upper end of the fibula. The common peroneal nerve was identified and retracted. The incision was deepened to the deep fascia, between muscles and intermuscular septi of the peroneal and posterior compartment. The anterior intermuscular septum was divided at the anterior border of the fibula and the anterior tibial artery and nerve were identified. Muscles attached to the proximal 4.0 cms of the shaft of the fibula were carefully dissected extra-periosteally. Perforating diaphyseal, muscular, epiphyseal and recurrent genicular branches arising from the anterior tibial artery were carefully dissected and preserved. The upper end of the fibula was made free by separating the upper tibio-fibular joint and ligaments. Osteotomy was performed at about 4.0 cms of the diaphyseal shaft of the fibula, thus harvesting proximal epiphysis and a diaphyseal segment of the fibula on the anterior tibial vessels. The vascular pedicle was dissected further, for about 3.0 cms, to facilitate a tension free anastomosis with the facial vessels.

The harvested bone graft was positioned into the space created earlier in the ramus-condyle area. Attempts were made to over correct the neo ramus-condyle unit by about 10% so as to get an anterior open bite. A step osteotomy was performed at the distal 1.0 cm of the diaphyseal end of the neo ramus-condyle unit, in order to override the angle of the mandible. Bone fixation was performed at the angle of the mandible, using No.24 stainless steel wire. The epiphyseal end with its articular cartilaginous coating was kept free but properly fitted into the space created at the diseased temporo mandibular joint area. The anterior tibial artery was anastomosed to the facial artery and one of the venae committantes to the facial vein. The wound was closed in layers, using a glove drain. Inter-maxillary fixation in over corrected position was maintained for three weeks.

The donor leg was provided with a foot drop splint for 6 to 8 weeks, to overcome the foot drop which invariably develops secondary to common peroneal nerve stretching and dissection of the muscular attachments, during harvesting of the fibular flap.

The patient was allowed soft diet and guarded movements of the jaw after three weeks and solid food was permitted after six weeks.

On follow up, the child has painless full range of up and down, lateral and antero-posterior movements of the mandible with a stable temporo-mandibular joint. The SS wire loop serves as the marker for assessment of the growth in the neo ramus-condyle unit, during follow up cephalometric studies. The patient has an observed growth in the neo-ramus-condyle unit of 1.9 cms in five years, averaging 0.4 cm/year. (Figs 1 to 6)

Case No. 2:

A five years old female child, presented with right sided hemi-facial microsomia with deviation of chin and hypoplasia of mandible with soft tissue deformity. It belonged to Group E of Grabb and Type III of Lauritzen.
(Fig. 1) Preoperative photograph of right side hemifacial microsomia belonging to Group C with dysplasia of the mandibular ramus-condyle unit.

(Fig. 2) Epiphysis with proximal shaft of the fibula harvested on the anterior tibial vessels with the resected specimen of hypoplastic ramus-condyle unit.

(Fig. 3) 4 Weeks post-operative lateral view X-ray to show neo ramus-condyle in position. IMF wires are also seen in the picture.

(Fig. 4) Postoperative 3-D C.T. scans of the patient. Showing fully integrated fibula as the neo ramus-condyle unit with the mandible.

(Fig. 5) Four years postoperative photograph. Front view showing satisfactory growth of the neo ramus-condyle unit, correcting the chin deviation.

(Fig. 6) Four years postoperative photograph. Side view shows growth of the neo ramus-condyle unit.
Free vascularized epiphyseal fibular transfer for temporomandibular joint reconstruction was performed as in Case No.1. At 5 years follow up, there is an observed total growth at the neo ramus-condyle unit of 2.4cms, averaging to 0.5cms per year. There has been a significant correction of chin deviation and the length of the horizontal and vertical rami of mandible on both sides have become comparable. Although, the neo ramus-condyle unit is still devoid of soft tissue padding and is lying at a subcutaneous plane, the secondary soft tissue correction required would definitely be of a lesser magnitude than otherwise. (Fig. 7, 8).

**DISCUSSION**

Mandibular hypoplasia occurs in all grades of hemifacial microsomia and may be associated with microtia, facial asymmetry, hypoplasia of soft tissue and abnormal position of the orbit. Ipsilateral maxilla and bony orbit are progressively deformed due to restriction of growth by the small hypoplastic mandible. Hence an early restoration of the vertical height of the mandible, using a cortical bone with an inherent growth potential, should result in symmetrical growth of the mid face, being physiologically supported by dentoalveolar adaptation and release of constricting effects of the small mandible. Increase in the vertical growth of the maxilla has been reported by Murray and Kaban following early surgery in children along with correction of secondary soft tissue deformities.

A number of clinical reports, reviewing the methods of mandibular reconstruction and long term results in cases of hemifacial microsomia, have shown an unpredictable growth pattern of the neo ramus-condyle unit with multiple secondary bony and soft tissue reconstructive surgeries. Use of costochondral graft, or free iliac crest bone graft for reconstruction of the vertical ramus of the hypoplastic mandible which are two of the popular methods of treatment of hemifacial microsomia, are often associated with failure of growth at the graft site. Guyuron et al have reviewed six patients with a mean follow up of 80 months, wherein costochondral graft was used for temporomandibular joint and ramus-condyle unit reconstruction. Overall results were unsatisfactory. Ware and Brown have stated that “costochondral grafts have shown growth potential in operated patients, but, it does not provide a rational treatment modality in temporomandibular joint reconstruction, where continued mandibular growth is desirable. Lack of predictability remains a problem”. Schellhas et al have reviewed the facial growth pattern and facial remodelling in cephalometric and imaging studies in patients of temporomandibular joint ankylosis treated early and have recommended an early restoration of the ramus-condyle unit to prevent secondary bony and soft tissue defects.

Wolfgang et al have tested in their experimental work, effectiveness of the new technique of tissue engineered growth of cartilage in temporomandibular joint disc replacements. They are created by seeding dissociated chondrocytes on synthetic, three dimensional bio-resorbable polymer constructs of a predetermined anatomical shape, incubating cell–polymer constructs in vitro and transplanting them into test animals. They have shown evidence of a histologically organized hyaline cartilage, which maintains its specific shape and resists deformation similar to that of the native donor cartilage.
Application of Ilizarov technique of bone distraction for mandibular elongation was done experimentally in dogs by Snyder and new bone formation at the elongated site was demonstrated by Karp et al. Molina and Ortiz-Monasterio have demonstrated mandibular elongation and remodelling by distraction in 87 patients with unilateral hemifacial microsomia. A great improvement of the facial asymmetry was achieved in all the patients. However, elongation was not considered in cases with agenesis of the ascending ramus (Type II & III hemifacial microsomia). Munro, Wray et al, Kaban et al, Goldsmith et al and Poole et al have used a variety of tissues for correction of bony and soft tissue deformities in relatively older patients of hemifacial microsomia, but with unsatisfactory and unpredictable results.

The epiphyseal plate is nourished by metaphyseal arteries and epiphyseal arteries. The metaphyseal artery supplies germinal cells and is responsible for growth, while the epiphyseal artery nourishes cartilaginous matrix which is responsible for ossification.

Epiphyseal growth plate, supported with metaphyseal segment has shown good survival and growth. Following vascularized transfer, growth in the transplanted epiphysis occurs up to 85% of the normal. Surgical intervention is better tolerated in very young patients. Epiphyseal transfer has provided an adequate mechanism for growth of the bone and prevention of associated secondary soft tissue deformities.

Transfer of a vascularized bone graft with an inherent growth potential, has been in clinical practice for over a decade. Inclusion of a growing epiphyseal plate along with a vascularized diaphyseal segment of the fibula, based on the epiphyseal branches coming from anterior tibial and peroneal arteries, is well described by Tsai. Following an exhaustive cadaveric dissection and dye injection studies, Taylor showed that the proximal epiphyseal plate of the fibula along with the proximal one third of the diaphyseal shaft of fibula, can be effectively harvested on branches arising from the anterior tibial artery alone. An average growth rate of 1.0cm/year has been recorded over a four year follow up period in two clinical cases by Taylor, following similar epiphyseal and diaphyseal transfer for defects of long bones in children.

The advantages of using a vascularized epiphysis and shaft of the fibula for ramus-condyle unit reconstruction in young patients are:

1) A more physiological reconstruction as the vascularized epiphysis provides a new growth centre. Due to its intrinsic growth potential, it corrects the secondary bony and soft tissue deformities and hence can minimize secondary corrective surgery in future. It provides a predictable growth pattern with an average growth of 0.5cms per year as shown in the two cases.

2) The fibular head simulates the normal ramus condyle unit arrangement more closely as well as provides a near normal temporomandibular joint.

All the cases that have been done in this series have shown encouraging results. The longest follow up of 5 years is only in two cases and further follow up is required of all these cases into adulthood.

References


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