A New Classification Based on the Kaban's Modification for Surgical Management of Craniofacial Microsomia

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ABSTRACT

In medicine, classifications are designed to describe accurately and reliably all anatomic and structural components, establish a prognosis, and guide a given treatment. Classifications should be useful in a universal way to facilitate communication between health professionals and to formulate management protocols. In many situations and particularly with craniofacial microsomia, there have been many different classifications that do not achieve this goal. In fact, when there are so many classifications, one can conclude that there is not a clear one that accomplishes all these ends and defines a treatment protocol. It is our intent to present a new classification based on the Pruzansky's classification, later modified by Kaban, to determine treatment protocols based on the degree of osseous deficiency present in the body, ramus, and temporomandibular joint. Different mandibular defects are presented in two patients with craniofacial microsomia type III and IV according to our classification with the corresponding management proposed for each type and adequate functional results.

KEYWORDS: Craniofacial microsomia, classification, management, modification

In 1963, Longacre et al¹ proposed a descriptive classification based on the unilateral or bilateral involvement of the external ear alteration and the presence or absence of facial deformity. Two years later, Grabb² proposed an anatomic classification in which he established six groups based on the combination of external ear, middle ear, mandible, maxilla, zygoma, temporal bone, and oral involvement. Converse³ recognized a wide spectrum of anatomic alterations that he categorized into four groups. The first three groups were based on ear and mandible findings, whereas the fourth included facial soft tissue and bone involvement.

Edgerton and Marsh⁴ described four clinical groups based on the dominant pattern of dysplasia: I, mandibular; II, craniofacial soft tissue; III, auricular; and IV, composite deformity.

The first phenotypic classification, described by Tanconi and Hall,⁵ introduced and incorporated ocular and extracranial findings such as ocular dermoides, microphthalmos, limb deficiencies, and vertebral, heart, or renal abnormalities.

The most recent descriptive classification was devised by Vento et al⁶ in 1991, using an alphanumeric coding system to classify the patients based on the

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Craniofacial Trauma Reconstruction 2010;3:1-7. Copyright © 2010 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA. Tel: +1(212) 584-4662.

Received: May 10, 2009. Accepted: September 28, 2009. Published online: March 11, 2010.

DOI: <http://dx.doi.org/10.1055/s-0030-1249368>.

ISSN 1943-3875.

severity of deformity in the different anatomic structures. It used an acronym, OMENS—O, orbital alteration; M, mandibular deformity; E, ear deformity; N, nerve involvement; and S, soft tissue alterations.

Munro and Lauritzen^{7,8} described a surgical-anatomic classification scheme divided according to the skeletal deformity but based on treatment considerations. This classification is determined by whether the skeleton is complete (type I) or incomplete (types II to V), whether the occlusal plane is level (type Ia) or tilted (types Ib to V), and whether the orbit is involved (type IV and V).

David et al⁹ devised an alphanumeric coding classification called SAT, wherein S stands for skeletal grade of deformity, A for auricle alteration, and T for soft tissue anomalies.

Pruzansky¹⁰ reported a grading system of progressive mandibular deficiency: grade I, minimal hypoplasia of the mandible; grade II, functioning but deformed temporomandibular joint with anteriorly and medially displaced condyle; and grade III, absence of the ramus and glenoid fossa.

This classification was later modified by Kaban et al.¹¹ They established the following classification: type I, all mandibular and temporomandibular joint components are present and normal in shape but hypoplastic to a variable degree; type IIa, the mandibular ramus, condyle, and temporomandibular joint are present but hypoplastic and abnormal in shape; type IIb, the mandibular ramus is hypoplastic and markedly abnormal in form and location, being medial and anterior, and with no articulation with the temporal bone; and type III, the mandibular ramus, condyle, and temporomandibular joint are absent and the lateral pterygoid muscle and temporalis, if present, are not attached to the mandibular remnant.

Prahl-Andersen and colleagues¹² described a classification system, which incorporates the deformity of not just the mandible but also includes other craniofacial bony structures assessed using three-dimensional computed tomographic (3-D CT) imaging, called the Craniofacial Deformity Score. This was subdivided into a score for the mandible (Mandibular Deformity Score) and a score for the other craniofacial bones (Cranial Deformity Score).

On the basis of the mandibular anatomic involvement, the classification that fits best and has shown the most practical utility is the one described by Pruzansky

Table 1 New Classification

Type I	Hypoplastic temporomandibular joint
Type II	IIa—hypoplastic and abnormal shape of mandibular ramus, condyle, and temporomandibular joint IIb—mandibular ramus is hypoplastic and markedly abnormal in form and location, being medial and anterior
Type III	Absence of the mandibular ramus
Type IV	Mandibular body hypoplasia

and later modified by Kaban. It is important to determine the mandibular anatomic deformity to proceed with surgical treatment.

In our department, the treatment for craniofacial microsomia has been based on the Kaban's modified classification. In type I, the management we use is orthopedic treatment to stimulate maxillary and mandibular growth. In type IIa and IIb we use distraction osteogenesis of the mandible and practice orthopedic treatment management at the same time. In type III, we find two different situations: absence of ramus in which case the treatment is based on the utilization of iliac and costochondral bone grafts with later distraction osteogenesis on the integrated bone and absence of ramus with mandibular body hypoplasia in which case we reconstruct the mandible with fibular free flap.

According to Kaban's classification, the absence of the ramus with or without mandibular body hypoplasia is grouped in type III. This is a point of potential confusion because the management is different depending on whether the alteration or deformity of the mandibular body is present.

From a practical point of view, we propose a modification to Kaban's classification leaving type III for absence of the ramus and incorporating a type IV for presence of mandibular body hypoplasia associated with absence of the ramus (Table 1), because this requires a different management (Table 2).

PATIENTS AND METHODS

We presented a patient with Goldenhar syndrome and a deformity of type III craniofacial microsomia, based on our classification, who was managed with iliac bone graft, and another patient with craniofacial microsomia

Table 2 Management Protocol Based on New Classification

Type I	Type IIa	Type IIb	Type III	Type IV
Orthopedic management	Distraction osteogenesis + orthopedic management	Distraction osteogenesis + orthopedic management	Iliac or costochondral bone grafts + distraction osteogenesis (later)	Fibular-free flap + distraction osteogenesis (later if needed)

Figure 1 Preoperative pictures of the patient: (A) anterior view; (B) and (C) lateral view. Late postoperative pictures of the patient; (D) anterior view; (E) and (F) lateral view.

of type IV, according to our classification, who was managed with fibular free flap.

Case No. 1

An infant patient with craniofacial microsomia Goldenhar type, presented with left microtia, left mandibular hypoplasia, deviation of mandible and mandibular incisive teeth to the left, and restricted mouth opening. The left condilar head and ascending ramus of the

mandible were missing, and there was no functional temporomandibular joint but the mandibular body did not show hypoplasia. Therefore, mandibular defect on that side was classified as type III according to our classification, and reconstruction was planned to replace the missing bony segment of mandible (Fig. 1). A panoramic was obtained before the surgical treatment as baseline and after the surgical treatment to compare postoperative results (Fig. 2). Iliac bone graft was chosen as the method of reconstruction (Fig. 3).

Figure 2 Panoramic view of the patient: (A) preoperative view and (B) postoperative view.

Figure 3 Intraoperative picture of the patient: rigid fixation of bone graft with hypoplastic mandible.

Case No. 2

Another infant patient with craniofacial microsomia, presented with right microtia, right mandibular hypoplasia, and deviation of mandible and mandibular incisive teeth to the right. The right condilar head and ascending ramus of the mandible were missing, and there was no functional temporomandibular joint and the mandibular body was hypoplastic. Therefore, mandibular defect on that side was classified as type IV according to our classification, and reconstruction was

planned to replace the missing bony segment of mandible (Fig. 4). 3-D CT scans were obtained after the surgical treatment (Fig. 5). Fibular-free flap was chosen as the method of reconstruction (Fig. 6).

RESULTS

Plain radiographic evaluation with panoramic and 3-D CT showed that mandibular symmetry increased, and normoocclusive closure of incisive teeth was achieved after surgery and retained in the postoperative period with both surgical techniques (Figs. 1 and 4). Our classification guided us in the management of both patients in obtaining adequate functional results.

DISCUSSION

The modification made by Kaban added a subdivision based on whether the temporomandibular joint is functional (type IIa) or dysfunctional (type IIb). Although an important finding from a descriptive point of view, there is no difference in management between the groups. Our proposal differentiates the two groups based on an important anatomic finding that gives rise to different surgical management.

The importance of establishing this new classification with differentiation between the patients with

Figure 4 Preoperative pictures of the patient: (A) anterior view; (B) and (C) lateral view. Late postoperative pictures of the patient; (D) anterior view; (E) and (F) lateral view.

Figure 5 Three-dimensional computed tomographic views of the patient. Preoperative view: (A) anterior view and (B) lateral view. Postoperative view: (C) anterior view and (D) lateral view.

and without mandibular body hypoplasia is that the osseous requirements are not the same. A patient with mandibular body hypoplasia can achieve excellent functional results with iliac or costochondral bone grafts and

later if needed distraction osteogenesis, without the further morbidity of a free flap. On the other hand, a patient with mandibular body hypoplasia has a larger osseous deficiency that has to be managed with refined

Figure 6 Intraoperative pictures of the patient: (A) dissection of the vascularized free fibular flap; (B) elevated free fibular flap; and (C) rigid fixation of free fibular flap with hypoplastic mandible.

microvascular techniques. If a persisting structural deficit is observed after this treatment, distraction osteogenesis is a secure and safe option.

In patients classified in group IV, the results of using nonvascularized bone grafts have been disappointing because of variable resorption rates ranging from 30 to 80%¹³ and unpredictable growth rates. Graft failure has been attributed to poor vascularity of the recipient bed. Those grafts that survive have been poor candidates for distraction osteogenesis, with complication rates far higher than those in patients who were not grafted.

According to Stelnicki et al,¹⁴ distraction of costochondral grafts is prone to fail when the distraction advancement to bone width ratio is more than 1.5:1, as it is in patients classified in group IV. According to Li et al,¹⁵ free flaps have a low rate of resorption compared with nonvascularized bone grafts and are stable over time.

Ideally, we want to prevent the need for maxillo-mandibular distraction osteogenesis by performing free flap surgery before complete maxillary growth so that the maxillary alveolus has the opportunity to descend on its own to meet the neomandible. The upside to this approach is the free flap's ability to "unlock" maxillary growth, allowing a vertically deficient maxilla to "catch up" to its contralateral counterpart.¹³

In a study published by Cheung,¹⁶ during a 2-year period from January 1, 1995 to December 31, 1996, the success rate of free flap transfer was 94%. Thus, it is a safe option for patients classified in type IV. He affirmed that the advantages of free flaps were low failure rate, smaller number of surgical procedures to achieve good functional results, and the ability to transfer specific tissue according to the patient's needs. He demonstrated that with the free fibular flap, any component of a mandibular defect can be reconstructed. This procedure provides not only enough bone stock to achieve anatomic restoration, but also a reliable base on which to attach the osseo-integrated implants during dental rehabilitation.

The free fibular flap was described by Taylor in 1975 (as mentioned by Shenao¹⁷), and in addition to the advantages mentioned above in patients with craniofacial microsomia, it allows a restoration of the facial contour. It can incorporate a deepithelialized dermis, fat, and fascia, achieving a more favorable reconstruction of more severe soft tissue defects.

The free flap is the workhorse of mandibular reconstruction because of its abundant bone stock, ease of dissection, capacity for simultaneous dissection of the recipient and donor sites, low donor-site morbidity, and expectation of successful distraction osteogenesis. Additional benefits are the ability to perform multiple osteotomies without compromising blood supply and to use septocutaneous perforators to obtain soft tissue to remodel facial contour. But the major

advantage of using the free flap is the reliability of distraction osteogenesis thereafter, with its associated benefits.

Some might argue that the epiphyseal portion of the fibula can be included¹⁸ to form a neotemporomandibular joint because it contains a cartilaginous growth center. Because there is no glenoid fossa, the addition of a cartilaginous fibular head would still fall short of creating a neotemporomandibular joint. Furthermore, including the proximal epiphysis would compromise knee stability and alteration of growth in a pediatric patient, a risk we are not willing to take.

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