

Dentofacial Asymmetry: A Literature Review

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In the past, mild facial asymmetry was neglected because it was believed that normal craniofacial characteristic had some slight asymmetry. However, in recent times, the patients complain and concern increasingly even about minimal asymmetry. In addition, significant facial asymmetry results not only in functional, but also esthetic issues. Therefore, its etiology should be carefully investigated in order to achieve an adequate treatment plan. An assessment of dentofacial asymmetry consists of patient's interview, extra- and intraoral clinical examination, supplementary extra- and intraoral imaging examination, and radiographic evaluation. Subsequent treatments for the asymmetry depends on patient's age, etiology of the condition and on the degree of discrepancies, and may be based on asymmetrical orthodontic mechanics to orthognathic surgery. This present study aimed to provide an overview; etiology, diagnosis and management of dentofacial asymmetry for the orthodontist to achieve an accurate diagnosis and treatment plan of facial asymmetry.

Keywords: Dentofacial Asymmetry, Functional Appliances, Growth Modification, Orthognathic Surgery

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Perfect facial symmetry is extremely rare. In the past, a mild degree of asymmetry could be demonstrated by special techniques, but most patients did not concern themselves with this problem. However, recently, patients have been more concerned and increasingly complained even with mild asymmetry.

The prevalence of facial asymmetry in orthodontic patients is an important element for clinicians in their earlier detection of deviations prior to any orthodontic treatments. This may guide practitioners towards establishing the correct orthodontic treatment^(1,2).

Etiology of facial asymmetry

The etiology of facial asymmetry are divided into three main categories as shown in Table 1: 1) congenital: syndromic in nature; 2) developmental: idiopathic and non-syndromic in nature; and 3) acquired: resulting from injuries or diseases⁽³⁻⁷⁾.

Other etiologic factors related to facial asymmetry are dental characteristics. In 2007, Janson et al evaluated frontal photographs, submentovertex and posteroanterior radiographs of patients with 2 main

types of class II subdivision malocclusions. Type 1 is characterized by distal positioning of the mandibular first molar on the class II side, the maxillary dental midline was coincident with the facial midline and with a deviated mandibular dental midline. Meanwhile, type 2 is characterized by mesial positioning of the maxillary first molar on the Class II side, the mandibular dental midline was coincident with the facial midline with deviated maxillary dental midline. They suggested that type 1 Class II subdivision malocclusions have greater mandibular asymmetry than type 2⁽⁸⁾.

Classifications

There have been a few systematic classifications of facial asymmetry. In the past, the classifications were mostly for severe asymmetry. In 1994, Bishara et al classified facial asymmetry into dental, skeletal, muscular and functional dentofacial asymmetry. However, this classification did not provide adequate information for diagnosis and treatment planning⁽⁹⁾. Hwang et al in 2007 classified facial asymmetry into 5 groups according to cluster analysis. They claimed that this classification could provide proper diagnosis and treatment planning⁽¹⁰⁾.

Diagnostic characteristics

Clinical examination and radiography are necessary for diagnosis of dentofacial asymmetry. These tools are used to determine the extent of the soft

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tissue, skeletal, dental and functional participation.

A: Clinical examination

Facial asymmetry is a chief complaint from patients that can be revealed in the following directions. In addition to relationship in the transverse, anteroposterior and vertical planes of space used in traditional 3-D analysis, rotations around axes perpendicular to three planes also must be evaluated. It's a useful way to evaluate the relationship of the teeth to the soft tissues that frame their display.

1) Yaw: evaluation of dental midline in the following position: mouth open; in centric relation; at initial contact; in centric occlusion. True asymmetry exhibits similar midline discrepancies in centric relation (CR) and centric occlusion (CO). On the other hand, asymmetry due to occlusal interferences may result in a mandibular functional shift following initial contact. Lower dental midline and chin point should be compared to facial skeletal, dental and soft tissue midline. Unilateral posterior crossbite is an example.

2) Roll: description of the vertical position of the teeth when there is a difference on the right and left sides, viewing up-down deviations around the transverse axes. It is seen when lips relaxed and more clearly whilst smiling, in both frontal and oblique views. It is also applied in the evaluation of the vertical occlusal plane. The cant in the occlusal plane (bite on plate or tongue blade) is employed to determine how it relates to the inter-pupillary plane.

3) Pitch: the vertical relationship of the teeth to the lips and cheeks can be conventionally described as up-down deviations around the antero-posterior axes, in which can be clinically evaluated from cephalometric radiographs. For example: open bite.

B: Radiographic examination

A general approach to diagnosis and treatment planning relies on posteroanterior (PA) and other radiographs that offer better three-dimensional information. A careful clinical examination of facial proportions in all three planes of space is also important. Asymmetry due to trauma needs a careful history and assessment⁽⁵⁾. For example, condylar fracture may not be diagnosed at the time it occurred and the trauma may later be all but forgotten.

Changes in the form of the mandibular condyles can usually be seen on the panoramic radiograph, but it must be ensured that the patient's head is not even slightly rotated. Even so, the inherent characteristics of this projection make significant

geometric distortions⁽⁹⁾. Tomography gives a better view of condylar form. The presence of a clinically apparent asymmetry is the primary indication for obtaining a posteroanterior (PA) cephalometric film in addition to the lateral cephalometric film.

The location of landmarks on PA cephalometric films is unreliable enough that tracing errors may conceal small deviations or show minor deviations, when in fact they do not exist. The PA film is the most useful to better define a problem when a rather specific area of deformity exists clinically⁽¹¹⁾. The advantage of the PA cephalometric film is that the left and right structures are located at relatively equal distances from the film and source, which results in minimum distortion. The PA cephalometric film can be taken with the mouth open in order to help determine the extent of any functional deviation⁽⁹⁾.

In the lateral cephalometric film, vertical asymmetries can often be recognized by the failure of bilateral symmetric structures to superimpose. However, improper head positioning can also create this appearance due to significant differences in magnification of the right and left structures that are at different distances from the film and source. This may lead one to thinking that an apparent asymmetry exists when in fact it does not⁽⁹⁾. In standard cephalometric technique (PA or lateral), it is assumed that the ears are at the same vertical level, when the patient has their head in the natural position, unless, the patient has an ear deformity which accompanies the facial asymmetry, as often seen in hemifacial microsomia.

A submental vertex film, which adds an additional dimension, can be added to the radiographic examination. This is most useful when the mandibular ramus is severely deformed as well as the zygoma and zygomatic arches. It is possible to combine information from lateral, PA, and submental vertex films to allow a three-dimensional reconstruction of the mandibular ramus and with less accuracy, parts of the maxilla.

A three-dimensional reconstruction can also be obtained from computed tomography (CT) scans⁽¹²⁾. Although more radiation is significantly required, the multiple views available from CT scans make this a more versatile and generally preferred approach. The advent of computed tomography has greatly reduced magnification errors from geometric distortions that are common in conventional radiographs. Recently introduced 3-dimensional (3D) images are also useful in understanding asymmetrical structures⁽¹³⁾. This information tends to be more valuable for detailed surgical treatment planning than for diagnosis. It is

primarily indicated in patients who have missing or severely distorted skeletal areas because of congenital deformities or major trauma. For patients with less severe developmental deformities, who form the bulk of candidates for orthognathic surgery, neither a submental vertex film nor CT scan is necessary.

Management of dentofacial asymmetry

Skeletal asymmetry in preadolescent children and treatment

Hemifacial microsomia and mandibular ankylosis due to condylar fractures are the most common causes that primarily affect the mandible and cause deficient growth on the affected side. The maxilla is affected secondarily, as deficient vertical growth of the mandible leads to distortion of the alveolar portion of the maxilla. An important difference is that, in hemifacial microsomia, both hard and soft tissue elements are missing thus affecting growth potential. The magnitude of the effect depends on how much tissue is missing. Condylar fracture may produce partial (functional) ankylosis which restricts what otherwise would have been normal growth. The effect will depend upon the extent of soft-tissue scarring restricting translation.

The principle of treatment in growing children is to modify the expression of growth so that the child may grow out of their deformity. Nonetheless, this goal often cannot be reached, but it does clarify the role of early surgery. The major reason for early surgical intervention would be to improve the chances of subsequent favorable growth. This principle also places orthodontic growth-modification treatment into perspective. The effected patients will need to continue the treatment to guide growth as long as a deviant growth pattern might continue, and whether or not surgery is carried out at an early age⁽¹⁴⁾.

The Pruzansky-Kaban classification of Hemifacial microsomia⁽¹⁵⁾ describes 3 mandibular types based on the status of the condyle-ramus-glenoid fossa unit: type I (temporomandibular joint and ramus are well formed but smaller than normal), type II (temporomandibular joint, ramus, and glenoid fossa are hypoplastic and malformed, and sometimes malpositioned), and type III (temporomandibular joint, ramus, and glenoid fossa are absent).

In severely affected children, initial surgery takes place at the age between 5 to 8 years. Costochondral graft is considered the gold standard for temporomandibular joint reconstruction in growing patients. It can be used on its own or combined with

orthognathic surgery^(16,17). The goal is to replace missing skeletal elements and augment severely deficient areas via grafts to create a more favorable environment for subsequent growth of unaffected areas. After the adolescent growth spurt, orthognathic concerns are addressed. The third stage, in the late teens, is designed to enhance the contour of the skeleton and the soft tissues. The severity of the condition strongly influences both the timing and extent of surgery. Not all patients require all three stages of the surgery, and treatment at the second and third stages is strongly influenced by the success of earlier surgery.

It is important for a child, who has had early surgery for hemifacial microsomia, to have functional appliance treatment in the immediate post-surgical period to control eruption of the teeth, minimize the tendency for canting of the maxilla to develop, and stimulate normal jaw function⁽¹⁴⁾.

Gustavo et al in 2012⁽¹⁸⁾ reported a successful treatment for a patient with hemifacial microsomia that entailed orthodontic treatment and orthognathic surgery with temporomandibular joint reconstruction and a costochondral graft in the left temporomandibular joint to correct the asymmetry and correlated deformities.

Disadvantages of a costochondral bone graft are the unpredictability of its growth, excessive mandibular length production in some cases, inadequate growth in others, and no growth at all in some^(19,20). Other complications include infection or resorption and the potential for donor site morbidity, scarring and postoperative pain⁽²¹⁾.

Bone lengthening has become an accepted technique in the management of congenital deficiencies and post-traumatic deformities (nonunion and skeletal defects). Tehranchi and Behnia in 2000 reported 4 cases of mandibular asymmetry that were treated by Distraction Osteogenesis devices, followed by hybrid functional appliance therapy and fixed orthodontic appliance therapy. They suggested that gradual lengthening of the mandible, performed at an early age, can result in lengthening not only of the jaw but also of the attached muscles of mastication and soft tissues. Hybrid functional appliances are used to correct the cant of the occlusal plane by extrusion of teeth on the affected side and can be applied to continue the process in order to improve neuromuscular function. This treatment protocol (gradual distraction plus functional orthodontic therapy) enhances facial symmetry and minimizes relapse. Fixed orthodontic therapy is

Table 1. Etiology of facial asymmetry

Congenital	Developmental	Acquired
Cleft lip and palate	Unknown cause	Temporomandibular ankylosis
Hemifacialmicrosomia	Habitual chewing on one side	Facial trauma
Neurofibromatosis	Persistent sleep on one side	Unilateral condylar hyperplasia
Torticollis	Dental compensation	Fibrous dysplasia
Craniosynostosis	Prepubertal trauma to the mandible	Childhood radiotherapy
Vascular disorders		Condylar hyperplasia or hypoplasia
		Condylar fractures
		Inflammatory arthritis
		Mandibular asymmetries (often associated with lateral malocclusions, and lateral crossbite)
		Osteochondroma
Classification	Meaning	
Group A	Shows severe typical type of asymmetry that shows a distinct difference of right and left ramus length. Mental and mandibular apical base are deviated to the side of shorter ramus. Its etiology is believed to be asymmetric condyle and mandibular growth.	
Group B	Shows a distinct difference of right and left ramus length, but mental apical base is deviated to the opposite direction of the shorter ramus, indicating that the etiology of group B is related to muscular activity, including unilateral mastication, missing teeth, scissors-bite, occlusal interference, and faulty restorations on one side. Unilateral mastication leads to a low angle at the chewing side.	
Group C	Shows no differences in ramus length between the right and left sides but mental and lower apical base midline deviate to one side. The etiology of this asymmetry is a functional shift of the mandible resulting from various types of occlusal interference and abnormal tooth contact. These interference and abnormal contact cause the subsequent mandibular displacement in maximum intercuspation and lead to this type of functional asymmetry.	
Group D	Similar to Group A but less severe. Group E is within normal limits	

employed for final occlusal adjustments⁽²²⁾.

Functional appliances for asymmetric growth modification

The fabrication of a functional appliance requires consideration in all three planes of space. The construction bites not only bring the mandible forward and to the midline, but also open the affected side more vertically. This is accomplished by softening the bite wax more on the unaffected side so that the ramus is torqued downward on the short side. Asymmetric transverse expansion will require modification of the appliance design, but not the construction bite.

When there is doubt about the growth potential, attempting growth modification before the initial surgical reconstruction is the conservative approach. The more severe the deformity is and the more it appears to be getting worse rather than better with subsequent growth, the greater the indication for

early surgical intervention. The success of pre-surgical functional appliance therapy must be carefully monitored. It should be continued only as long as it is effective in producing skeletal changes⁽¹⁴⁾.

Melson et al in 1986⁽²³⁾ revealed two possible benefits from functional appliance treatment at an early age. First, to the extent that a favorable growth response occurs, the surgical result will be better than it might have been. Second, the surgical reconstruction is almost entirely a reconstruction of the missing hard-tissue elements. In hemifacial microsomia, the problem is that not only skeletal but also muscle and other soft-tissue elements are missing. The stimulation provided by a functional appliance allows the development of soft tissue or at least allows stretching of the soft tissues, so that a better surgical field can exist at the time of surgery. In some mildly affected children, such favorable growth can be obtained so that ultimate surgery is not necessary.

Table 2. Summary of treatment protocols used in the patients with condylar hyperplasia using single photon emission computed tomography result for treatment decision

Patient	SPECT	Treatment options
Patient under 18 years	1 st -positive 2 nd -positive	Follow-up to a 3 rd SPECT High condylectomy High condylectomy + compensatory orthodontics + surgical cosmetic camouflage after 18 years of age. High condylectomy and wait until 18 years of age to perform orthognathic surgery.
Patient over 18 years	1 st -positive	High condylectomy + compensatory orthodontics + surgical cosmetic camouflage
	2 nd -positive	High condylectomy + orthognathic surgery
Patient over 18 years	Negative	Compensatory orthodontics + surgical cosmetic camouflage Orthognathic surgery

Note. The treatment options were considered based on the patient's motivation, level of facial asymmetry, alterations in dental function and functional alterations and psychological condition.

* Patients are those who have facial asymmetry

Table 3. Surgico-orthodontic Treatment Protocols for HFM Patients

	Pruzansky Type I/II-A	Pruzansky Type II-B/III
Deciduous dentition	Growth surveillance/functional appliance	Costochondral graft
Mixed and early permanent dentition	Functional appliance	Growth surveillance/distraction osteogenesis
Late permanent dentition	Fixed orthodontic appliance with dentoalveolar compensation/distraction osteogenesis	Orthognathic surgery/distraction osteogenesis

Meliha and Ozge in 2010⁽²⁴⁾ reported a case that employed functional appliance therapy in which the patient achieved satisfactory improvements in facial esthetics and symmetry in a short period of time, which were maintained after 2 years of follow-ups. With this improved function and growth, the patient also experienced markedly positive psychosocial changes.

Condylar fractures: asymmetry due to trauma

The most frequent cause of mandibular asymmetry in children is functional ankylosis, secondary to trauma to the mandible at an early age⁽²⁵⁾. Unilateral fracture of the condylar process is easily produced with a blow to the anterior lower border of the mandible. This injury can occur readily as the result of a fall or contact during sport. A condylar fracture may lead to asymmetry and it occurs because there is more growth on the normal side than on the affected side. The facial morphology among these patients can become very similar to those with a congenital problem. When the ramus is short and the condylar process is

distorted, but the ear and adjacent soft tissues are normal, an old fracture is usually the problem⁽¹⁴⁾.

As the ramus grows more on the normal side, the chin deviates toward the affected side. Less tooth eruption takes place there and this distorts dentoalveolar development of the maxilla and the mandible, so that a three-dimensional asymmetry affecting both jaws develops. The problem is caused by a relative lack of translation of the mandible on the affected side, which is termed functional ankylosis, because jaw movement and function occur, though impaired. The greater the degree of restricted motion, the more rapidly asymmetry develops and the more severe it will become through periods of active growth⁽¹⁴⁾.

Management of condylar fractures in children

Condylar fractures are the most controversial fractures regarding classifications, diagnosis and treatment. There are 2 types of fracture-intracapsular and extracapsular, the anatomic level of the fracture is

divided into 3 sites: condylar head (intracapsular), condylar neck (extracapsular), and the subcondylar region. Treatment planning depends on patients, varying from conservative treatments comprising of observation to maxillomandibular fixation or functional appliance therapy, and surgical intervention⁽²⁶⁾. Both surgical and non-surgical treatments of condylar fractures have been discussed. The principle of treatment should focus on obtaining the best possible growth subsequent to the injury.

The recommended management for a child with a recent condylar fracture is closed management with or without immobilization of the jaw for a few days to allow initial soft-tissue healing, followed by physiotherapy (open-close movements) to maximize jaw movement and function into the previous occlusal relationships. Theologie-Lygidakis et al in 2016⁽²⁷⁾ concluded that younger children have a greater possibility of undergoing closed treatment and lesser need for intermaxillary fixation (IMF) than older children. Moreover, the closer the function of the mandible is to normal, the less the possibility of IMF at all, or IMF of short duration is needed. The IMF duration is suggested to be a maximum of 2 weeks because the use of IMF for a longer period carries an increased risk for ankylosis. Difficulty in coming into normal occlusion may indicate that a functional appliance is needed to guide the patient into the proper position. A child with an old fracture and asymmetry, who can bring the mandible to a normal symmetric position in the midline, requires a functional appliance. Treatment using the functional appliance should be attempted prior to any treatment. Tavares and Allgayer in 2012⁽²⁸⁾ reported on a pediatric patient with a unilateral condylar fracture who was treated conservatively with an asymmetric bionator and fixed appliances, which proved to be an efficient method for mandibular repositioning, avoiding vertical collapse, stimulating favorable condylar and soft-tissue remodeling, and allowing growth compensation in their pediatric patients. An adequate esthetic and functional result was subsequently obtained. The key to full recovery and normal growth is normal jaw movement and function in addition to the maintaining of proper occlusion^(5,14,29).

The indication for early surgery is that the deformity is progressive due to functional ankylosis, relating to the importance of the condylar fragment^(30,31). The more unfavorable the degree of displacement/dislocation of the condylar fragment, the greater the possibility of open reduction being required⁽²⁷⁾. Open reduction of condylar fractures in children is reserved

for selected cases with severe dislocation of the condylar fragment and restricted mouth opening. Therefore, it is not necessary to obtain normal growth after the injury. Some scarring is inevitable after any surgery and the effect of the surgical intervention can be growth inhibition, meaning that the mandible cannot be pulled forward on one side. A child who cannot bring the jaw to a position in which the asymmetry has been corrected requires surgery. Open reduction, hence, may do more harm than good and should be avoided as a routine procedure for managing condylar fractures in children^(29,32).

Closed manipulation to free the segment, therefore, should be attempted first. If this fails and mandibular motion is still restricted, an open approach must follow to free the mandible, remove the condylar head or reposition it^(30,33). Post-surgical orthodontic management with a functional appliance is necessary for these patients.

Annual follow-up care is required until the child's growth is complete. The patient can be followed-up by a knowledgeable general dentist who can refer the patient to the orthodontist at the earliest sign of developing asymmetry⁽²⁷⁾.

Skeletal Asymmetry in Adolescents and Treatment

Even if a condylar fracture restricts translation, there is not enough growth remaining to cause more than moderate mandibular asymmetry. An adolescent with a growth problem following a condylar fracture is managed best with a functional appliance until growth is complete. This is followed by corrective surgery as necessary^(14,29,34).

After the adolescent growth spurt has ended, severe asymmetry is more likely to arise because of excessive rather than deficient growth. This condition formerly was called condylar hyperplasia (CH), but because the body of the mandible as well as the condyle and ramus are affected by the overgrowth, hemimandibular hypertrophy and hemimandibular elongation are more accurate and descriptive terms⁽³⁵⁾. CH has an unknown etiology and is characterized by a progressive and independent growth, causing greater bone volume of one condyle over the other side. It generally appears in subjects in the growth phase, mainly in adolescence⁽³⁶⁾. Asymmetric facial deformities (AFD) and malocclusion are a clear consequence of CH. There is generally a deviation of the chin towards the contralateral side of the condyle with CH⁽³⁷⁾.

The problem becomes apparent after the adolescent growth spurt, when one side of the mandible

continues to grow after the other has stopped. The condition can occur before or during the adolescent growth spurt but it is extremely rare to occur before the late teens. Although the excessive growth tends to be self-limiting, it may continue until an extremely severe deformity has been created.

Excessive unilateral growth of the mandible can be an indication for surgical intervention in adolescents. The key question when hemimandibular hypertrophy is first discovered is whether the deformity is progressive. If asymmetric growth stops and the condition stabilizes, it is preferable to delay surgery. If the asymmetry is already severe enough to cause a problem and is becoming progressively worse, there is no option but to remove the growth site at the head of the affected condyle⁽¹⁴⁾.

Technetium-99m is administered with methylene diphosphonate, which is absorbed by hydroxyapatite crystals and calcium from the bone tissue so that the fixation intensity is proportional to the degree of osteoblast activity; the examination that obtains the scanned bone is called "single photon emission computed tomography" (SPECT) and it determines the percentage of absorption by the condyle quantitatively, by comparing it with the contralateral side. Therefore, a Tc-99 bone scan is the most direct way to determine whether asymmetric growth is still occurring. More uptake of the isotope on the affected side than the non-affected one is an evidence that it is occurring. Unfortunately, false negatives do occur with this diagnostic approach. Clinical findings may demonstrate continuing growth and clinical judgment ultimately may indicate surgery to remove the affected condyle, even though repeated bone scans do not demonstrate continued isotope uptakes⁽³⁸⁾.

If progressive deformity requires the removal of the condylar growth site, then two surgical options for the affected side exist. The first option is to excise bone at the head of the condyle, followed by recontouring or repositioning the bony stump. The second option is to remove the condyle and condylar process and reconstruct the area, either with a costochondral junction transplant as described above or with a free graft^(37,39). In addition, a sagittal split osteotomy on the unaffected side is almost always needed to allow proper positioning of the mandible. In an adult, if the maxilla is canted because of excessive vertical growth on the affected side, maxillary surgery is also required (using LeFort I osteotomy)⁽⁴⁰⁾. In younger patients, surgery in the maxilla should be avoided if possible. When post-surgical growth can

be anticipated, the maxillary cant can be corrected post-surgically by blocking further eruption of teeth on the affected side and allowing teeth to erupt on the non-affected side⁽¹⁴⁾.

Olate et al in 2013⁽⁴⁰⁾ summarized treatment protocols used in patients with CH using single photon emission computed tomography (SPECT) result for treatment decision as shown in Table 2.

Skeletal asymmetry in adults and treatment

Skeletal asymmetry in adults cannot be managed orthodontically and the only question is the type of surgical intervention. The general approach is the same as any other type of surgical-orthodontic treatment. Fixed orthodontic appliances are placed a few months prior to surgery for initial alignment, with jaw surgery performed as necessary to correct asymmetry. Appliances are then used to finish orthodontic treatment.

The major treatment planning decision is the extent to which surgery will be used to correct the deformity at its point of origin, as opposed to compensating for deformity and camouflaging its existence. An asymmetric mandible can be approached by surgery in the ramus, correcting the unequal ramus length, or it can be managed by inferior border osteotomy. This technique is applied to slide the chin sideways, correct the obvious asymmetry inferiorly and leave the gonial angles as they were. Another successful surgical approach for asymmetric mandible is bilateral sagittal split ramus osteotomy associated with a basilar osteotomy in the form of an "L" on the affected side⁽⁴¹⁾. An asymmetric maxilla can be approached via rotating, inferior positioning or camouflaged by asymmetric onlay grafts.

Choi et al in 2014⁽⁴²⁾ reported an adult patient that had Pruzansky-Kaban type I left hemifacial microsomia. The patient's left mandibular ramus was lengthened with distraction osteogenesis, and mini screw-assisted rapid palatal expansion was used to correct the maxillary transverse deficiency. These therapeutic treatments subsequently improved the patient's facial appearance.

Kim et al in 2012⁽⁴³⁾ created a new approach for the surgico-orthodontic treatment of hemifacial microsomia called unilateral distraction osteogenesis (UDOG) of the mandible. This technique has been used for the correction of facial asymmetry (FA) in hemifacial microsomia (HFM) patients. In addition, transarch elastic traction from the orthodontic mini-implants on the unaffected side of the mandible to the affected side

of the maxillary posterior teeth can produce a plastic molding of the regenerated bone in the distraction area of the mandible, and induce compensatory dentoalveolar downward development of the maxillary posterior teeth.

Baek and Nahm in 2006 suggested surgico-orthodontic treatment protocols for HFM patients as shown in Table 3.

General guidelines for treatment planning⁽¹⁴⁾

1) Patients are much more aware of transverse, than of vertical distortions of facial symmetry, and are much more concerned about the position of the chin, than of the mandibular angles. For this reason, it can be quite acceptable to leave a vertical asymmetry of the angles uncorrected, and to correct the chin position that is off to one side by using an inferior border osteotomy to reposition the chin transversely. This assumes that dental occlusion and jaw function would be satisfactory if the entire mandible were not repositioned.

2) The transverse position of the maxillary teeth is obvious and, therefore, aesthetically important. The easiest way to correct this in many instances is to rotate the maxilla surgically. When the mandibular dental midline is not obvious and patients have acceptable occlusion, there is no reason to go to extraordinary lengths to correct dental midline deviation. Moreover, for some patients, an asymmetry can be corrected with a maxillary osteotomy and repositioning of the chin without concomitant mandibular ramus surgery.

3) When an asymmetry of the jaws develops, the nose may deviate in the same direction as the chin. Hence, rhinoplasty is recommended to correct the nose in addition to jaw surgery. Moving the jaw to a more symmetric position magnifies the deviation of the nose, and the patient is likely to be more conscious of it and dissatisfied with it. The jaws may deviate in one direction and the nose in the other. In this case, orthognathic surgery has the effect of improving overall facial symmetry, and residual deviation of the nose is often aesthetically acceptable. The orthognathic surgery should be carried out first and rhinoplasty should be deferred for a few months post jaw surgery. This approach ensures that the final soft-tissue contours can be observed when the rhinoplasty is done.

4) Asymmetry may affect the higher structures of the maxilla (infraorbital rims and zygomatic arch). In this circumstance the use of onlay grafts to reposition the deficient bony areas, alone or in combination with osteotomies, is particularly advantageous. The grafts

provide a way to augment the midface without the increased risk and morbidity of a LeFort II or III osteotomy.

Dental asymmetry

The most frequent cause of mandibular asymmetry due to dental asymmetry is class II subdivision malocclusion. There are 2 types of class II subdivision malocclusion. Type 1 is characterized by distal positioning of the mandibular first molar on the Class II side, when the maxillary dental midline is coincident to the facial midline and the mandibular dental midline is deviated. Type 2 is characterized by mesial positioning of the maxillary first molar on the Class II side, when the mandibular dental midline is coincident to the facial midline and the maxillary dental midline is deviated. Janson et al in 2007 suggested slightly greater mandibular skeletal asymmetries in type 1 than in type 2 class II subdivision malocclusions. Further large scale studies, especially of type 2 class II subdivision malocclusions, are necessary to confirm these tendencies⁽⁸⁾.

Orthodontic considerations

1) Neither the pre-surgical nor post-surgical orthodontic treatment for adults with asymmetry differs significantly from the orthodontics in other types of problems.

2) One of the goals of pre-surgical orthodontics is to remove dental compensations for the skeletal deformity. Dental compensation means that the dental midlines are not off as much as the skeletal midlines. For instance, if the chin deviates to the left, the maxillary dental midline often is also to the left, but the mandibular dental midline relative to the chin is usually to the right. It is better to decompensate the dentition pre-surgically as much as possible.

3) The two approaches to transverse decompensation are (1) asymmetric extraction, so that the incisors are retracted more on one side than on the other and the midline shifts to the desired direction, and (2) asymmetric elastics (usually anterior diagonal elastics). With appropriate extractions, the midline can be shifted several millimeters. Without extraction or the presence of spaces in the arches, only small changes can be made with elastics alone.

4) For acceptable aesthetics, the maxillary dental midline must be close to the midline of the face. If only mandibular surgery is planned, the orthodontist must make the maxillary midline correction. If maxillary surgery is necessary anyway, the surgeon can rotate

the jaw enough to change the midline 3 to 4 mm without great difficulty. Such a rotation will produce some occlusal interference posteriorly, but these are not great enough to prevent orthodontic tooth alignment during post-surgical orthodontics. It is best to minimize the pre-surgical orthodontics for patients who require maxillary osteotomy and to let the surgeon correct the maxillary midline, accepting that somewhat more extensive post-surgical orthodontics will be required.

5) The mandibular dental midline must be considered from two perspectives: (1) its relationship to the facial and maxillary dental midlines; and (2) its relationship to the chin.

At the completion of treatment, everything should line up, though the critical elements are the chin and the maxillary teeth. It is an error to correct the dental midlines and leave the chin asymmetric. This will occur unless the transverse relationship of the lower teeth to the chin is corrected pre-surgically, or an inferior border osteotomy to reposition the chin is planned, in addition to surgery to bring the dental midlines together.

Conclusion

Asymmetry in the face and dentition is a naturally occurring phenomenon. The point at which “normal” asymmetry becomes “abnormal” cannot be easily defined. It is known that the patients are much more aware of a transverse than vertical distortion of facial symmetry. Dental and functional asymmetries may be treated orthodontically but significant structural facial asymmetries may require orthopedic correction during the growth period and/or surgical management at a later point.

What is already known on this topic?

It is worth noting that accurate facial asymmetry correction is a major challenge. Furthermore, some asymmetrical craniofacial regions oftentimes cannot be corrected by means of conventional surgical techniques. Thus, the patients should be informed that in spite of successful correction of bone deviation, some asymmetrical contour might remain after orthognathic surgery.

What this study adds?

Distraction osteogenesis has become a popular and reliable technique for the correction of craniomaxillo-mandibular deformities. The study of the efficacy of simultaneous maxillary-mandibular distraction to correct facial asymmetry in the patients with compensated occlusion and a canted occlusal

plane should be performed in further study.

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Potential conflicts of interest

None.

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บททวนวรรณกรรมเรื่องความไม่สมมาตรของใบหน้าและช่องปาก

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ในสมัยก่อนความไม่สมมาตรกันของใบหน้าที่ไม่เล็กน้อยได้ถูกมองข้ามเนื่องจากเชื่อกันว่าใบหน้าของคนเราจะไม่เท่าเล็กน้อยอยู่แล้วแต่อย่างไรก็ตามในยุคปัจจุบันผู้คนหันมาให้ความสำคัญกับความสวยงามของใบหน้ามากขึ้น ทำให้มีผู้ป่วยที่อยากแก้ไขความไม่สมมาตรกันของใบหน้ามากขึ้นแม้จะเป็นความไม่สมมาตรกันเพียงเล็กน้อยก็ตาม และยิ่งไปกว่านั้นในคนที่มีความไม่สมมาตรกันของใบหน้าที่มาจากการจะมีปัญหาเกี่ยวกับการทำงานแล้วยังมีผลต่อความสวยงามอย่างเห็นได้ชัด ดังนั้นการหาสาเหตุที่แท้จริงของปัญหาเหล่านี้จะสามารถทำให้วางแผนการรักษาได้อย่างเหมาะสม ซึ่งก่อนจะทำการวินิจฉัยเราจะต้องมีการเก็บรวบรวมข้อมูลตั้งแต่การซักประวัติ, ตรวจลักษณะที่พบทางคลินิก ทั้งภายในและภายนอกช่องปาก อีกทั้งภาพถ่ายใบหน้าและภายในช่องปาก รวมไปถึงภาพถ่ายรังสีด้วย ซึ่งการรักษาความไม่สมมาตรกันของใบหน้าจะขึ้นอยู่กับอายุของผู้ป่วยว่ายังจะมีการเจริญเติบโตอยู่หรือไม่, สาเหตุและระดับความรุนแรงของความไม่สมมาตรกันของใบหน้า ซึ่งการรักษาผู้ป่วยในกลุ่มนี้มีตั้งแต่การรักษาทางทันตกรรมจัดฟันแบบไม่สมมาตรไปจนถึงการจัดฟันร่วมกับการผ่าตัด