Republic of Iraq
Ministry of Higher Education
and Scientific Research
University of Baghdad
College of Dentistry

Facial Asymmetry

A Project Submitted to

The College of Dentistry, University of Baghdad, Department of Orthodontics in Partial Fulfillment for the Bachelor of Dental Surgery

By

Hiba Ammar Yehya

Supervised by

Dr. Sara M. Al-Mashhadany

BDS, MSc. Orthodontics

Certification of the Supervisor

I certify that this project entitled "Facial asymmetry" was prepared by the fifth-year student **Hiba Ammar Yehya** under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Supervisor's name: **Dr. Sara M. Al-Mashhadany**

Dedication

This graduation project is dedicated with gratitude to God who has been with me through my lifetime. To my parents who always motivate and support me to achieve success, you mean the world to me.

Acknowledgment

First of all I would like to present my thanks to "Allah" for inspiring me with energy and strength to accomplish this work, and I pray upon his great prophet Mohammad (peace be upon him).

I would like to thank **Prof. Dr. Raghad A. Al-Hashimi,** dean of college of dentistry, university of Baghdad, for offering me the opportunity to perform my study.

Grateful thanks are expressed to **Assist. Prof. Dr. Yassir A. Yassir,** chairman of orthodontic department, for his scientific support and encouragement.

My special thanks and apperciation to my supervisor **Dr. Sara M. Al-Mashhadany,** for her cooperation and scientific care.

Finally, I would like to thank my lovely family for support and encouragement.

List of Contents

List of Figures

Introduction

The word symmetry is derived from the Greek word *'symmetria'* which means ‘common measure’. Symmetry is defined as correspondence in size, shape and relative position of parts on opposite sides of a dividing line or median plane. Asymmetry is described as a lack or absence of symmetry. When applying this to the human face, it illustrates an imbalance or disproportionality between the right and left sides **(Chia *et al.*, 2008).**

Normal faces are not completely symmetric, they consists of a multitude of minor asymmetric components **(Edler *et al.*, 2001).** Perfectly symmetric faces, constructed in computer software, are unnatural and are not as beautiful as the natural asymmetric ones **(Haraguchi *et al.*, 2008).**

It is known that a certain degree of asymmetry is beautiful, but the border line between normal asymmetry and asymmetry that requires treatment is subjective **(Lee *et al.*, 2010).** Slight facial asymmetry can be found in normal individuals, even in those with aesthetically attractive faces. This minor facial asymmetry is common, usually indiscernible and does not require any treatment **(Bishara *et al.*, 1994).**

The appearance of facial asymmetry as abnormal depends on individual perception. Mild to moderate facial asymmetry can be managed by camouflage orthodontic treatment. Severe skeletal asymmetry most often requires a surgical management protocol **(Ko *et al.*, 2009).** Not all adult facial asymmetry patients are candidates for surgical correction; therefore, patient assessment and selection remain major issues in diagnosis and treatment planning **(Jung and kim, 2015).**

Aim of the study

The aim of our study is to illustrate the methods that are beneficial for examining facial asymmetry and collect diagnostic data and management of patients with facial asymmetry according to the degree of asymmetries.

Chapter one
Review of literature

1.1 Facial Asymmetry

Facial symmetry refers to a complete match in size, location, shape and arrangement of each facial component about the sagittal plane. That is, asymmetry refers to the bilateral difference between such components. A perfect bilateral symmetry almost never exists in the human body **(Ko *et al.*, 2009)**.
Facial asymmetry refers to the deviation from the regular mirror image (Fig 1.1) or difference in the proportion of two sides of the face **(Maheshwari *et al.*, 2015).**

Symmetrical appearances frequently show variations, owing to embryonic tissue development and environmental factors. Embryonic development of the face is initiated at the third week of intrauterine life, largely by the organization of the frontonasal, maxillary, and mandibular prominences. Relative or subclinical asymmetry is often encountered due to the failure in coordinated development and maturation of the craniofacial structures originating from these prominences **(Thiesen *et al.*, 2015).**

Fig 1.1: Extraoral photograph in frontal view. Patient with relative symmetry (A) in which the median sagittal plane was determined and used to create mirror images on the right and left sides (B and C, respectively). Note that the original and mirror images differ from one another (Thiesen *et al.*, 2015).

Acquired facial asymmetries are not only manifest during the developmental and growing stages of life, but also in adulthood. They are

predisposed by certain traumatic events, infections, or pathologies**(Cheong and Lo, 2011)**.

1.2 Etiology of facial asymmetries

Chia *et al.* in **2008** divided the etiology of facial asymmetry into

1.2.1 Congenital

1- Cleft lip and palate

Cleft lip and palate, the pathology more often occurs unilaterally on the left side and this phenomenon probably has a genetic basis **(Haraguchie *et al.*, 2002).** Cleft lip and palate patients generally present anterior and posterior crossbites and mid-face deficiency with a tendency towards a Class III malocclusion **(Shetye and Evans, 2006).**

2- Hemifacial microsomia

Hemifacial microsomia is a congenital craniofacial malformation caused by hypoplasia of anatomical structures deriving from the first and second branchial arches. As a result, hemifacial microsomia involves facial skeleton, soft tissues, ear, and cranial nerves as shown in Fig 1.2 **(Ongkosuwito *et al*,. 2013).** The occlusion may be affected with crowding and a unilateral crossbite on the affected side. Tooth development can also be disturbed on the affected side and the prevalence of hypodontia is five times more common in these patients than the normal population **(Monahan *et al.*, 2001).**

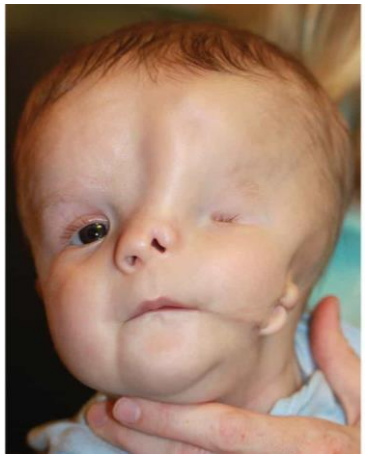

Fig 1.2 Patient with hemifacial microsomia (Keogh *et al.*, 2007).

1.2.2 Developmental

1- Hemimandibular elongation

Hemimandibular elongation is a developmental deformity of unknown etiology affecting the mandible unilaterally. It commonly presents with a progressively increasing transverse displacement of the chin point in young adulthood. The occlusion follows the displaced skeletal pattern so that the mandibular dental centreline does not coincide with the midfacial line. There will also be a crossbite observed on the unaffected side and possibly a scissor bite on the affected side **(Obwegeser and Makek, 1986).**

2- Hemimandibular hyperplasia

Hemimandibular hyperplasia is a three-dimensional developmental enlargement of one side of the mandible including the condyle, condylar neck, ramus and body. It typically only affects one side of the mandible. There is an increase in the height of the affected side, giving the face a rotated appearance and The condition usually commences in puberty and hence the maxillary dentition on the affected side will over erupt to compensate for the excessive vertical mandibular growth, which results in a characteristic transverse cant of the maxillary occlusal plane **(Obwegeser and Makek, 1986).**

3- Torticollis

Torticollis is a condition of unknown cause, consist of a unilateral tilt of the neck to one side caused by developmental condition and it is usually unilateral and results in the development of a cervicofacial asymmetry with the interpupillary plane slanted downward and the chin deviated to the side of the affected sternocleidomastoid muscle **(Pirttiniem *et al.*, 1989).**

4- Hemifacial atrophy (Parry-Romberg syndrome)

Parry-Romberg syndrome is a disorder that is characterized by progressive atrophy of underlying soft tissues and bones on one side of the face. It is more common on the left side and in females. The facial changes include the tissues around the nose and nasolabial fold and later progresses to the angle

of the mouth, eyes, ears and neck. It follows the distribution of the trigeminal nerve. It may also cause muscle and facial bone atrophy. This can lead to the development of a mandibular asymmetry **(Pinheiro *et al.*, 2006).**

5- Condylar hyperplasia

Condylar hyperplasia of mandible is over development of condyle unilaterally or bilaterally leading to facial asymmetry, mandibular deviation, malocclusion and articular dysfunction. Prominent features include an enlarged mandibular condyle, elongated condylar neck, outward bowing and downward growth of body and ramus of mandible on affected side, causing fullness of face on that side **(Mehrotra *et al.*, 2011).**

6- Intra uterine pressure

Intra uterine pressure on the fetus head, as well as pressure in the birth canal during parturition can cause molding of the skull bones and facial bones, causing observable craniofacial asymmetry. However this problem is usually transient and the skull and facial bones return to their normal shape within a few weeks to few months **(Noordhoff and Chen, 2006).**

1.2.3 Pathological

1- Temporomandibular joint ankylosis

Temporomandibular joint ankylosis is a pathological condition, in which the mandible fuses to the fossa. It may result from a number of factors such as arthritis, infection, trauma, congenital deformities, or idiopathic factors **(Movahed and Mercury, 2015).** In a growing child, this condition can lead to unilateral mandibular under development on the affected side **(Zhi *et al.*, 2009).**

2- Cysts and tumors

Tumours of the orofacial region may affect the soft tissues, salivary glands, nerves and bones . The ameloblastoma is a common odontogenic tumour that may occur in the childhood. It is a locally aggressive benign tumour that develops from the remnants of the odontogenic epithelium and may present in the mandible asymmetrically. Dentigerous cysts, keratocysts and fibrous

dysplasia have asymmetric presentations in the mandibular region **(Frunza *et al.*, 2014).**

3- Infection

Various infections can present a mandibular asymmetry include dento-alveolar abcess and acute parotitis. These are characterized by their rapidity of onset, pain, pyrexia, malaise and associated regional lymph node involvement **(Dhanvanth *et al.*, 2018).**

4- Condylar resorption

There are a number of conditions that may cause resorption of the mandibular condyles include juvenile rheumatoid arthritis, post-steroid therapy and orthognathic surgery. Rheumatoid arthritis as a child can affect the temporomandibular joint unilaterally or bilaterally, causing changes in mandibular function and structure. Destruction of the joint and disc can be seen as the condition affects bone and cartilage. If unilateral condylar resorption occurs, then this may result in a mandibular asymmetry **(Hwang *et al.*, 2004).**

1.2.4 Traumatic

1- Condylar fracture

Trauma to the condylar region during childhood may result in growth arrest and impaired function. If growth arrest does occur, this may produce a chin asymmetry towards the side of the affected condyle. The loss of function is usually caused by an ankylosis in the temporomandibular region. This is initiated by the intra-articular bleeding and resulting haematoma formation that follows traumatic episodes in children **(Proffit *et al.*, 1980).**

2- Facial trauma

Traumatic events that occur at a young age usually interrupt the process of growth in the facial regions. This leads to detrimental influences on the development of the cranio-facial skeleton, resulting in asymmetric changes of the face and causing long-term aesthetic, physical, and psychological distress **(Morris *et al.*, 2012).**

3- Mandibular displacement

A buccal crossbite occurs when the buccal cusp of a mandibular molar occludes buccal to the buccal cusp of the corresponding maxillary tooth. Slight transverse narrowing of the maxilla or associated dentition may result in mandibular to maxillary cusp to-cusp occlusal interferences, resulting in a lateral displacement of the mandible as the patient tries to achieve maximam intercusption on closure. Some authors have suggested that mandibular growth is restricted on the side of the crossbite and may result in shortening of the ramal height on that side and contribute to the development of a mandibular asymmetry. However, there is not yet any firm evidence to support this theory **(Schmid *et al.*, 1991).**

1.3 Classification of facial asymmetry

Facial asymmetries are classified based on the craniofacial structures involved into:

1.3.1 Dental asymmetry

Early loss of deciduous teeth, a congenital missing tooth or teeth, and habits such as thumb sucking . Tooth asymmetry generally does not involve the entire arch. On the other hand, teeth in the same morphologic class tend to have the same direction asymmetry. For example, if the maxillary first premolar is larger on the right side, the maxillary second premolar will also tend to be larger on the right side but the molars need not be larger on that side. In addition, asymmetry tends to be greater for the more distal tooth in each morphologic class (i.e., the lateral incisors, second premolars, and third molars) **(Garn *et al.*, 1966).**

1.3.2 Skeletal asymmetry

Skeletal asymmetry may involve one bone such as the maxilla or mandible, or it may affect a number of skeletal structures on one side of the face, as in hemifacial microsomia. When one side of osseous development is

affected, the contralateral side will most inevitably be influenced resulting in compensational or distorted growth **(Bart and Kopf, 1978).**

1.3.3 Muscular asymmetry

Muscular asymmetry can occur in conditions such as hemifacial microsomia and cerebral palsy. Abnormal muscle function, as in masseter hypertrophy, can itself cause an asymmetrical appearance of the face. Fibrosis of the sternocleidomastoid muscle as seen in torticollis may create evident craniofacial deformation if left untreated for a period of time **(Yu *et al.*, 2004).**

1.3.4 Functional asymmetry

Functional asymmetry may result from the mandible being deflected laterally if occlusal interferences prevent proper intercuspation in the centric position. These functional deviations may be caused by a constricted maxillary arch or a local factor such as a malpositioned tooth. In some cases, temporomandibular joint derangement, such as an anteriorly displaced disc, may result in a midline shift during mouth opening caused by interference in mandibular translation on the affected side **(Reyneke *et al.*, 1997).**

1.4 Diagnosis of facial asymmetry

Not all adult facial asymmetry patients are candidates for surgical correction; therefore, patient assessment and selection remain major issues indiagnosis and treatment planning **(Jung and Kim, 2015).**

1.4.1 Medical and dental history

Following the patient's chief complaint and evaluation of their medical and dental history helps clinicians identify the precise cause of the asymmetry. Childhood traumas or infections related to the craniofacial area and records of dental history, such as abnormal eruption or premature loss of the dentition, should also be taken into account **(Maheshwari *et al.*, 2015).**

1.4.2 Extra-oral examination

1- Evaluation of facial midline

The first step in examining facial symmetry is determining the reference midlines of the face. The reference upper midline is often established by the line connecting through soft tissue Glabella (G'—the center point of the eyebrows) and Subnasale (Sn—the central point of the nasal septum and the upper lip) points. Following this reference line, clinicians can assess the upper facial symmetry, and any remarkable deviations from this line should be noted and examined carefully. Regarding the lower midline, some authors consider a reference line through Sn and Pogonion (Pg'—the most projecting median point on the anterior surface of the chin). If the reference lower midline is aligned with the upper midline, the chin is centered, otherwise, the mandible is considered shifted and further investigation should be made to determine whether the mandibular deviation is functional or not. Note Fig 1.3 **(Haraguchi *et al.*,2008).**

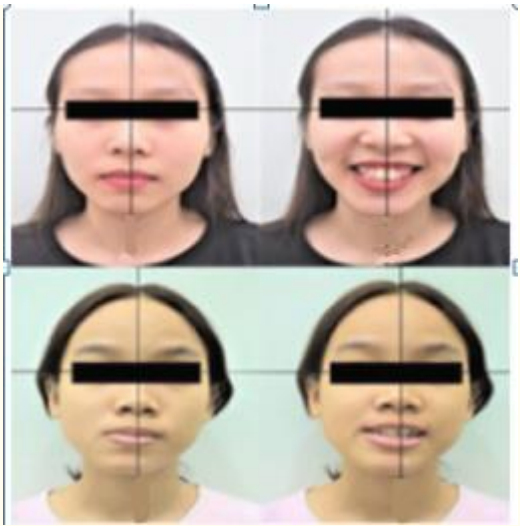

Fig 1.3: Frontal view photographs of two patients at rest and at smiling. An imaginary mid-pupillary line and a facial median line are dividing the face into four parts for asymmetric evaluation. Both patients are diagnosed with facial asymmetry with regard to these two reference lines (Iyer *et al.*, 2021).

2- Evaluation of vertical relation

The occlusal plane canting is performed in extra-oral examination. Patients are requested to hold a tongue blade between their canines to compare the vertical and transverse relation of the occlusal plane to the interpupillary plane (Fig 1.4). In asymmetric cases, the occlusal plane has an inclination of more than 4° from the reference plane **(Srivastava *et al.*, 2018).** The exact cause of occlusal canting can be either due to an uneven dental eruption, a functional shift of the mandible, or the rotation of the entire maxilla and mandible arches, and should be accurately identified **(Cheong and Lo, 2011).**

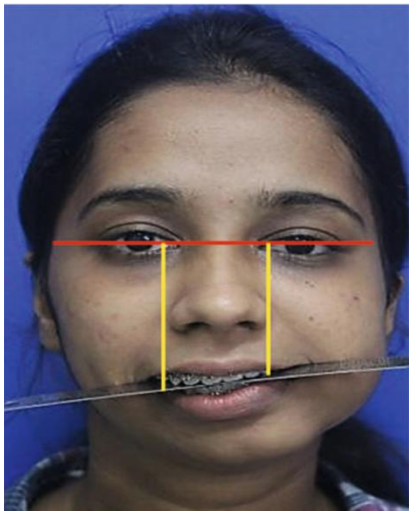

Fig 1.4: Occlusal cant in relation to the pupillary plane and asymmetry marked from medial canthi to the oral commissure (Andrade et al., 2021).

3-Evaluation of transverse relation

Andrade *et al.* in **2021** suggests that submental [worm's-eye] and superior [bird's-eye] views are very useful in assessing deviation of the assessment of midline structures such as nasal bridge, nasal tip, philtrum, and the chin point as shown in Fig 1.5.

(A) **(B)**

Fig 1.5: (A) shows submental(worm's-eye) view and (B) shows superior (bird's-eye)view. Note the discrepancy in the midline of both pictures. (Andrade *et al.*, 2021).

4- Functional evaluation

The patient is made to perform the various functional movements such as opening of the mouth, protrusive movements and the lateral movements of the mandible and any imbalance between the two sides is recorded. Temporomandibular joint evaluation is done to check any symptoms of clicking, popping or tenderness to rule out any temporomandibular joint dysfunction **(Joondeph, 2000).**

1.4.3 Intra-oral evaluation

Various occlusal traits, such as impacted or ankylosed teeth, congenital deformities, dental discrepancy, deep bite, open bite, unilateral/bilateral crossbite, the curve of Spee, the curve of Wilson, and periodontal tissue conditions, are recorded in this step. The upper and lower dental midline are evaluated at rest, in centric relation, centric occlusion, at smiling, and other functional positions of the jaw **(Maheshwari *et al.*, 2015).**

1.4.4 Dignostic records

1- Photographs

The routine frontal-relaxed and smiling, profile view and oblique view photographs of the patient are taken (Fig 1.6). The photographs are assessed for any gross asymmetry between the two sides of the face **(Edler *et al.*, 2004).**

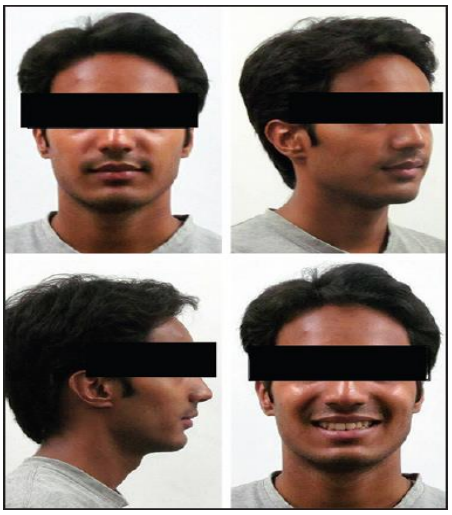

Fig 1.6: Facial photographs (Maheshwari *et al.*, 2015).

2- Study models

The articulated study models give a comprehensive three-dimensional view of dental relations. The study models can be used to assess the presence of constricted arches and crossbites, which might be the cause of functional asymmetry in the patient. Three-dimensional models can be assessed for various parameters using software to indicate the position of dental asymmetry. Characteristic dental anomalies have been reported in the facial asymmetry group, including asymmetry of the curve of Spee, molar inclination, dental arch form, lateral overjet, and slanting of the occlusal plane **(Kusayama *et al.*, 2003).**

3- Radiographs

Andrade *et al.* in **2021**suggests the use of Radiographic diagnostic aids such as :

A- Orthopantomographs

Orthopantomograph is a tool to evaluate mandibular asymmetry and dental status. The anatomy of the condyle-ramus unit, body, and inferior border of the mandible is readily discernible (Fig 1.7). Increase or decrease in dimensions or changes in mandibular morphology can be studied. In cases of unilateral asymmetry, the affected side can be compared to the normal side. It is also an excellent tool for the screening of maxillofacial pathology that may cause facial asymmetry, e.g., tumors and fibro-osseous lesions.

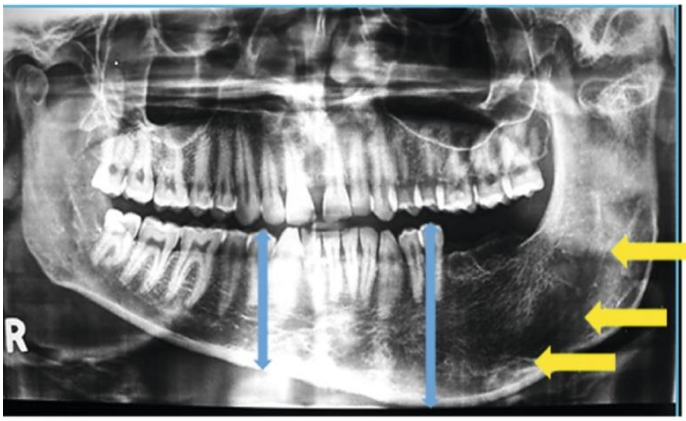

Fig 1.7: Orthopantomograph demonstrates the difference in height of the mandibular body and displacement of the inferior alveolar nerve canal toward the inferior border (Andrade *et al.*, 2021).

B- Postero-anterior cephalometry:

The postero-anterior cephalogram allows a comparative study of the symmetry between the structures of the right and left sides. Projections can be obtained in both open mouth position and centric occlusion with head oriented in natural head position to identify the full extent of static and dynamic [functional] asymmetry. The horizontal reference plane is represented by a line passing through the bilateral zygomatico-frontal sutures. The vertical reference plane is a line perpendicular to the horizontal plane passing through crista galli. Also, any shift in the dental midlines can be assessed by comparing them to the skeletal midline. The Grummons and Ricketts analyses are commonly used PA cephalometric analyses for the evaluation of facial asymmetry as shown in Fig 1.8.

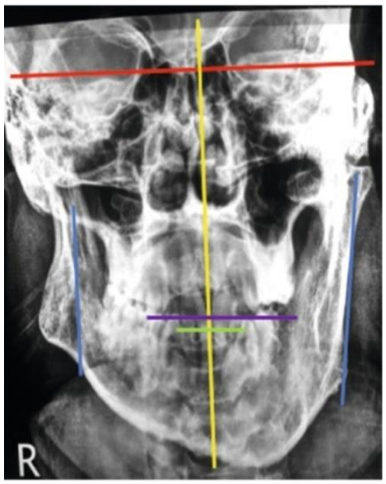

Fig 1.8: Grummons and Ricketts analysis using PA Cephalogram (Andrade *et al.*, 2021).

C- Computed tomography/Cone Beam CT with 3D Reconstruction

The main advantage of the 3D CT scan is that it helps in visualization and treatment planning of complex facial asymmetry in cases like hemifacial microsomia (Fig 1.9), temporomandibular ankylosis, and unilateral condylar hyperplasia . Unlike cephalometric and panoramic radiographs, there is no superimposition of structures, the absolute position of anatomical landmarks can be defined, and viewing is possible from any angle. It is also an excellent tool for patient education. The disadvantage of the CT scan is the exposure to a high radiation dose; with the introduction of the CBCT, the amount of radiation exposure has been greatly reduced.

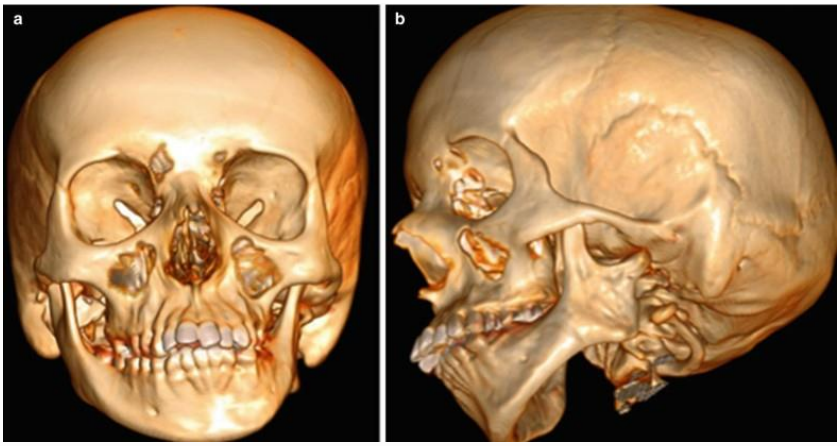

Fig 1.9: CT scan of patient with Hemifacial microsomia disorder (Andrade et al., 2021).

4- Stereophotogrammetry

Stereophotogrammetry using two or more cameras, configured as a stereopair to generate a 3-dimensional image of the face by triangulation. This provides a useful three-dimensional assessment of facial soft tissue asymmetry before and after orthognathic surgery as seen in Fig 1.10 **(Hajeer *et al.*, 2004).**

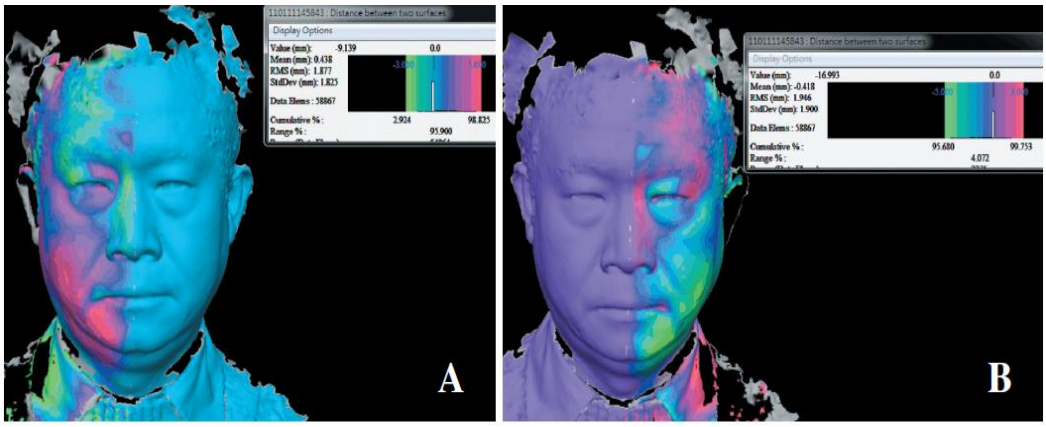

Fig 1.10: Stereophotograph shown in Figure A was used to overlap the mirror image of the left side of face on the right sides. A mirror image of the right side of the face overlapping the left side of the face and the differences are shown in (B) (Cheong and Lo, 2011).

5- Stereolithographic Models

3-D models have been successfully utilized for correction of complicated facial asymmetry cases when compared to similar treatments without its use. The models facilitate direct visualization of complex 3D facial asymmetry, decrease operating time due to better treatment planning, and can also be used as an educational tool for patients (Fig 1.11) **(Wong et al., 2005).**

Fig 1.11: Facial asymmetry demonstrated on stereolithographic model involving both the midface and mandible with hyperplasia involving the right side (Andrade et al., 2021).

1.5 Management of facial asymmetry

Decisions about intervention for dentofacial deformities depend on patient awareness of the aesthetic problem, the extent of the occlusal deformity, and concomitant sagittal or vertical jaw imbalance **(ko *et al.*, 2009).**

Facial asymmetry may involve dental, skeletal and soft tissue components and a combination of orthodontic treatment and orthognathic surgery may be indicated.

1.5.1 Orthodontic treatment

1- Growth modification

In cases where a mandibular asymmetry or deficiency is identified at a young age, growth modification may be attempted by using hybrid functional appliances which act by components causing eruption of teeth (bite planes), altering the linguo-facial muscle balance and mandibular repositioning through construction bites. Such appliances allow selective dento-alveolar eruption and encourage normal mandibular growth to compensate for asymmetrical deficiencies as seen in Fig 1.12 **(Peter and Katherine, 1986).**

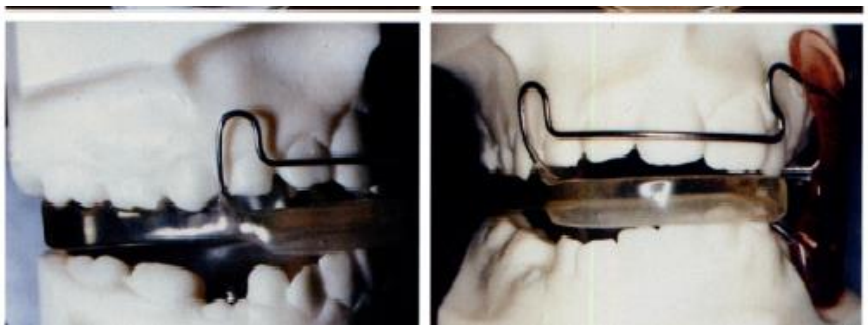

Fig 1.12: Hybrid appliance (Peter and Katherine, 1986).

2- Orthodontic camouflage

If the mandibular skeletal asymmetry is acceptable, and any abnormal growth has ceased, but a dental midline shift still exists, then this may be camouflaged orthodontically. A number of techniques can be used in conjunction with fixed appliances to correct dental midline discrepancies including asymmetric extraction patterns, asymmetric lace backs, push-pull mechanics and asymmetric elastics **(Chia *et al.*, 2008).**

1.5.2 Surgical treatment

1- Pre and post surgical orthodontics

Andrade *et al.* in **2021** suggests the Pre-surgical orthodontic treatment in patients with facial asymmetry must include the following:

A- The presence of a dental and facial midline shift is best corrected at the time of orthognathic surgery provides the best results.

B- Any occlusal cant correction should not be attempted orthodontically. Cant is evidently skeletal in nature and should be corrected surgically.

C- Levelling and alignment of the dental arches should be done.

D- Post-operative position of the upper incisor and the upper lip-maxillary incisor relationship is the most important factor determining surgical result. This should be checked intra-operatively before fixation of the maxilla.

E-Position of the symphysis similarly is another important determinant of a satisfactory post surgical correction in cases of asymmetry; thus the anatomical position and surgical limits of symphysis correction should be determined pre-surgically.

F- The facial midline reference should be taken from the unaffected jaw.

G- In cases of hemifacial microsomia and temporomandibular joint ankylosis, a unilateral open bite is created after increasing the ramus height. This is done to correct the skeletal cant by allowing the vertical alveolar growth of maxilla.

H- Based on the severity of crowding, the amount of retraction and uprighting needed; upper second premplar extraction [minimal decompensation] or upper first premolar extraction [greater decompensation] is indicated.

2- Single jaw surgery

Single jaw surgery is usually done in cases of uncomplicated asymmetries affecting mandible only, such as in deviant prognathism. Bilateral ramal osteotomies. Sagittal split ramus osteotomy and intraoral vertical ramus osteotomy are routinely used orthognathic mandibular procedures for correction of asymmetric dentofacial deformities. Sagittal split ramus osteotomy is usually employed for cases having mild to moderate magnitude of asymmetry (up to 7–8 mm). Intraoral vertical ramus osteotomy is usually preferred for correction of larger asymmetries (magnitude more than 8 mm) with associated temporo-mandibular joint disorder's symptoms. it offers the advantages of short

rehabilitation time (being quick and safe operation in cases of asymmetric mandibular prognathism), easy and rapid correction of early occlusal instability and lower risk of permanent inferior alveolar nerve injury, when compared to sagittal split ramus osteotomy **(Fonseca *et al.*, 2000).**

3- Two jaw surgery

The various orthognathic surgical procedures, which are routinely used are bone grafting, Le fort I maxillary osteotomy and intra-oral vertical ramus osteotomy. Most of the skeletal asymmetries require two-jaw surgeries for complete correction. Surgical planning of two-jaw orthognathic surgery requires three-dimensional consideration in the sagittal, coronal and horizontal planes. Ideally, the dental midline and skeletal midline are aligned to the facial midline. The intercommissural plane should be parallel to the inter exocanthal plane. Orthognathic surgeries are often supplemented with additional surgical procedures involving bone contouring such as mandibular angle reduction, mandibular inferior border ostectomy, bony augmentation and soft tissue contouring such as buccal fat pad reduction, masseter muscle reduction, fat graft injection and subcutaneous liposuction **(Tai *et al.*, 2012).**

4- Distraction osteogenesis

Multiplanar distraction osteogenesis can be used to correct mandibular hypoplasia. The treatment planning using distraction osteogenesis involves osteotomy, distraction device placement, vector planning and selection of a distractor. Only a single osteotomy and two pin sites are required for mandibular distraction. Distraction for lengthening mandibular ramus also increases soft tissue by increasing the volume of medial pterygoid muscle **(McCarthy *et al.*, 1992).**

5- Genioplasty

The lower border osteotomy (genioplasty) of the mandible can reposition the chin point transversely or vertically in order to address the asymmetry. It is one of the most stable movements compared with managing mandibular asymmetries by other orthognathic movements. It is reported that a minimum of 6 mm between the inferior border of the mental nerve canal and the proximal osteotomy during sliding genioplasty can greatly reduce the chance of inferior alveolar nerve damage, although it does not completely eliminate the risk. Thus, keeping at least 6 mm of space should be a goal during surgery to protect the patient **(Ousterhout, 1996).**

1.6 Case report

A 25 years old Iraqi male patient came to the oral and maxillofacial surgery department at Al-Shaheed Ghazi Al-Hariri Hospital, suffering from facial asymmetry. The patient was dignosed with CT scan (Fig 1.13) that shows presence of osteoma on the left condylar head causing shifting of occlusion and chin deviation to the right side.

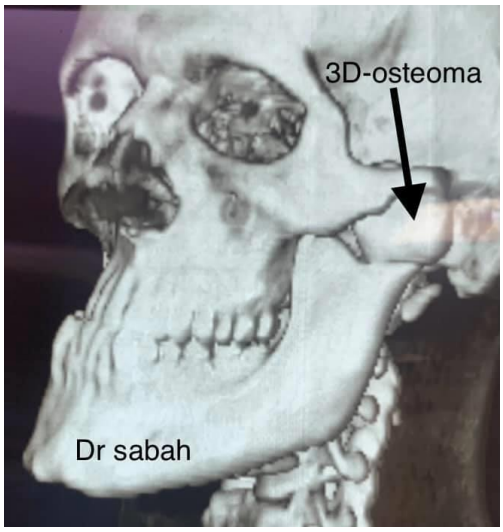

Fig 1.13: CT scan of the patient showing the osteoma

The first step in the surgical treatment steps was condylectomy with removal of large osteoma through preauricular approach as shown in Fig 1.14

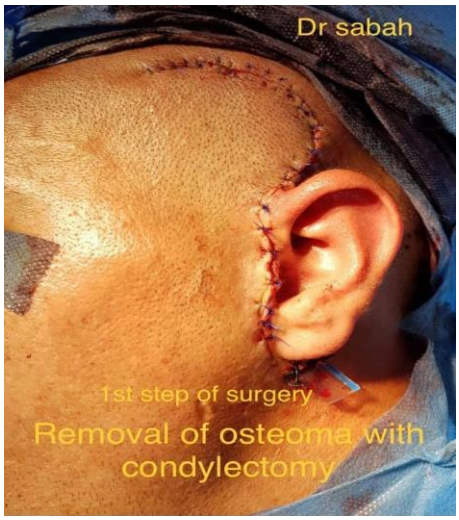

Fig 1.14: Condylectomy for removal of osteoma

The second step of surgery was unilateral sagittal split osteotomy of right side with rotation of the mandible to the left side to correct occlusion and chin deviation. Surgery done by using 3D virtual planning as shown in Fig 1.15.

The surgical steps was operated by Dr. Sabah Abdulaziz Issa.

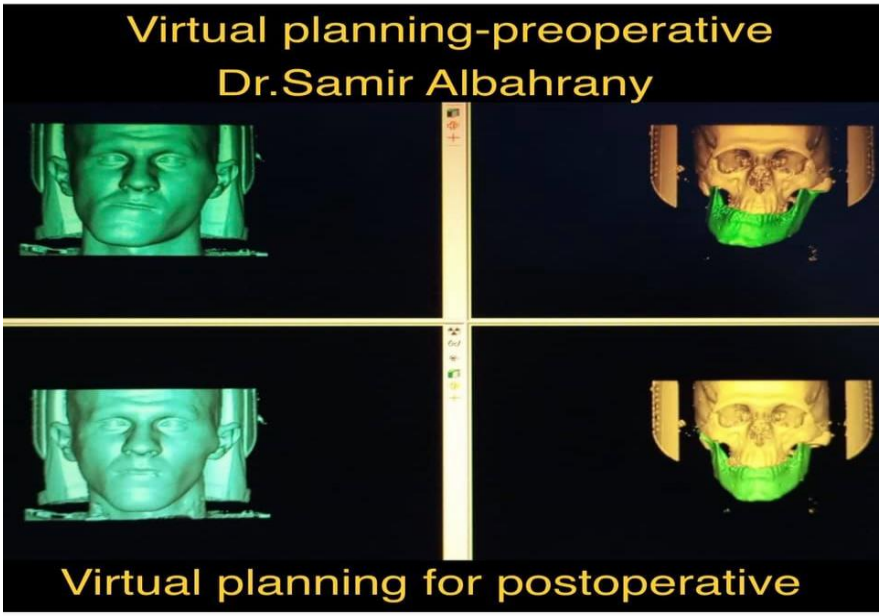

Fig 1.15: 3D preoperative and postoperative virtual surgical planning

Fig 1.16 pre-operative and postoperative follow up photograph of the patient

Fig 1.17: Photographs showing the pre-operative and post-oprative follow up occlusion of the patient after 6 months

Chapter Two

Discussion

Facial asymmetry is common in humans. Significant facial asymmetry causes both functional as well as esthetic problems. When patients complain of facial asymmetry, the underlying cause should be investigated. The etiology includes a combination of genetic and environmental factors, such as syndromes, hypoplasia or hyperplasia of the condyle, fracture and trauma, infection, inflammatory arthritis or unilateral functional cross bite **(Pirttiniemi, 1994).**

Facial asymmetry affects lower half of the face more than upper face. Clinically apparent facial asymmetries were most often recorded at the level of the chin in 74% of patients and midface asymmetries were documented in roughly a third 36% **(Severt and Proffit, 1997).** A possible explanation would be the longer mandibular growth periods, in addition to the maxilla being rigidly attached to the stable region of synchondroses at the cranial base **(Haraguchi *et al.*, 2002).**

Assessment of facial asymmetry consists of a patient history, physical examination, and medical imaging. Medical imaging is helpful for objective diagnosis and measurement of the asymmetry, as well as for treatment planning. Components of soft tissue, dental and skeletal differences contributing to facial asymmetry are evaluated. Frequently dental malocclusion, canting of the occlusal level and midline shift are found. Posterior-anterior cephalometric radiographs using Grummons and Ricketts analyses allow the comparison of left and right hard tissue structures**.** The lateral view on cephalometry provides limited useful information for asymmetries in the ramal height, mandibular length and gonial angle. The right and left structures are superimposed on each other and resulting in significant differences in magnification. **(Cheong *et al.*, 2011).**

Currently, there are several available methods for capturing and quantifying craniofacial surface morphology. These include direct anthropometry and digital photography as well as newer three-dimensional surface imaging systems which assist in reducing the magnification errors produced from geometric distortions that commonly affect conventional 2D-acquisition methods **(Hajeer *et al.*, 2004).**

Chapter Three

Conclusion and Suggestion

Conclusion

- Over the years, technology and advanced imaging techniques have aided in the accurate detection of facial disproportion. These diagnostic tools allow the clinicians to better understand the etiological and triggering factors leading to facial asymmetries.
- An orthodontic consultation is required if there are dental or occlusal problem.
- Skeletal problems may require surgical treatment planning which include staged procedures. The first stage comprises orthognathic surgery, facial bone contouring surgery, genioplasty, and contouring of soft tissues such as the masseter muscle and buccal fat pads.

Suggestion

Further studies can be done to provide more information of facial asymmetry by 3-dimensional assessment using stereophotogrammetry and stereolithographic models.

References

- Andrade, N.N., Aggarwal, N. and Mathai, P. (2021) Facial Asymmetry. In *Oral and Maxillofacial Surgery for the Clinician*, 1549-1576.
- Bart, R.S. and Kopf, A.W. (1978) Tumor conference# 20: hemifacial atrophy. *Dermatologic Surgery*, 4(12), 908-909.
- Bishara, S.E., Burkey, P.S. and Kharouf, J.G. (1994) Dental and facial asymmetries: a review. *Angle Orthodontist,* 64, 89-98.
- Cheong, Y.W. and Lo, L.J. (2011) Facial asymmetry: Etiology, evaluation, and management. *Chang Gung Medical Journal*, 34, 341–351.
- Chia, M.S., Gill, D.S. and Naini, F.B. (2008) The aetiology, diagnosis and management of mandibular asymmetry. *Orthodontic Update,* 1(2), 44–52.
- Dhanvanth, M., Ganapathy, D. and Jain, A. (2018) Choice of Antibiotics in the Management of Dentoalveolar Abscess among Dental 766 Practitioners. *Drug Invent*, 10, 2390–2394.
- Edler, R., Greenhill, D. and Wertheim, D. (2001) Clinical and computerized assessment of mandibular asymmetry. *European Journal of Orthodontics,* 23, 485-494.
- Edler, R., Greenhill, D. and Wertheim, D. (2004) Outcome measurement in the correction of mandibular asymmetry. *American Journal of Orthodontics and Dentofacial Orthopaedics,* 125, 435-443.
- Fonseca, R.J. and Penn, W.B. (2000) *Oral and Maxillofacial Surgery-Orthognathic Surgery,*Vol.2., 297–323.
- Frunza, A., Lascar, I. and Slavescu, D. (2014) Aggressive tumor of the midface. *Eplasty*, 14, ic26.
- Garn, S.M., Kerewsky, R.S. and Lewis, A.B. (1966) The meaning of bilateral asymmetry in the permanent dentition, *Angle Orthodontist,* 36, 55-62.

- Hajeer, M.J., Ayoub, A.F. and Millet, D.T. (2004) Three-dimensional assessment of facial soft tissue asymmetry before and after orthognathic surgery. *British Journal of Oral and Maxillo-Facial Surgery*, 42, 396-404.
- Haraguchi, S., Takada, K. and Yasuda,Y. (2002) Facial asymmetry in subjects with class III deformity. *Angle Orthodontist,* 72, 28-35.
- Haraguchi, S., Iguchi, Y. and Takada, K. (2008) Asymmetry of the face in orthodontic patients. *The Angle Orthodontist*, 78(3), 421-426.
- Hwang, S.J., Haers, P.E., Seifert, B. and Sailer, H.F. (2004) Non-surgical risk factors for condylar resorption after orthognathic surgery. *Journal of Cranio-Maxillo-Facial Surgery*, 32, 103−111.
- Iyer, J., Cao, U.M.N., Hariharan, A. and Tran, S.D. (2021) Acquired Facial, Maxillofacial, and Oral Asymmetries--A Review Highlighting Diagnosis and Management. *Symmetry*, 13(9), 1661.
- Joondeph, D.R. (2000) Mysteries of asymmetries. *American Journal of Orthodontics and Dentofacial Orthopaedics*, 117, 577-579.
- Jung, S.K. and Kim, T.W. (2015) Treatment of unilateral posterior crossbite with facial asymmetry in a female patient with transverse discrepancy. *American Journal of Orthodontics and Dentofacial Orthopaedics,* 148, 154-164.
- Keogh, I.J., Eavey, R.D., Kaban, L.B.,Monroy, A.A. and Troulis, M.J. (2007) Isolated Microtia as a Marker for Unsuspected Hemifacial Microsomia. *Archives of Otolaryngology–Head & Neck Surgery,* 133(10), 997.
- Ko, E.W., Chen, Y.R. and Huang, C.S. (2009) Characteristics and corrective outcome of face asymmetry by orthognathic surgery. *Journal of Oral and Maxillofacial Surgery,* 67, 2201-2209.
- Kusayama, M., Kuroda, T. and Motohashi, N. (2003) Relationship between transverse dental anomalies and skeletal asymmetry. *American Journal of Orthodontics and Dentofacial Orthopaedics*, 123, 329-37.

- Lee, M.S., Cha, K.S., Chung, D.H. and Lee, J.W. (2010) Assessing soft-tissue characteristics of facial asymmetry with photographs. *American Journal of Orthodontics and Dentofacial Orthopaedics*, 138, 23-31.
- Maheshwari, S., Dhiman, S., Gaur, A. and Verma, S.K. (2015) Diagnosis and management of facial asymmetries. *Journal of Orthodontic Research,* 3, 81 - 87.
- McCarthy, J.G., Grayson, B.H., Karp, N., Schreiber, J. and Thorne, C.H. (1992) Lengthening the human mandible by gradual distraction. *Plastic Reconstructive Surgery*, 89, 1-8.
- Mehrotra, D., Dhasmana, S., Gambhir, G. and Kamboj, M. (2011) Condylar hyperplasia and facial asymmetry: report of five cases. *Journal of maxillofacial and oral surgery*, 10(1), 50-56.
- Monahan, R., Alder, M., Grud, S., O'Gara, M., Patel, P. and Seder, K. (2001) Hemifacial microsomia. *Journal of American Dental Association,* 132, 1402−1408.
- Morris, C., Kushner, G.M. and Tiwana, P.S. (2012) Facial skeletal trauma in the growing patient. *Oral and Maxillofacial Surgery Clinics*, 24, 351–364.
- Movahed, R. and Mercuri, L.G. (2015) Management of temporomandibular joint ankylosis. *Oral and Maxillofacial Surgery*, 27(1), 27–35.
- Noordhoff, M.S. and Chen, P.K.T. (2006) Unilateral chieloplasty. In: Mathes, S. Mathes plastic surgery. 2nd ed. *Philadelphia, Saunders- Elsevier*, 4, 165-215.
- Obwegeser, H.L. and Makek, M.S. (1986) Hemimandibular hyperplasia−hemimandibular elongation. *Journal of Maxillofac*ial *Surgery,* 14, 183−208.
- Ongkosuwito, E.M., Adrichem, L.N., Kuijpers-Jagtman, A.M., Neck, J.W. and Wattel, E. (2013) Craniofacial morphology in unilateral hemifacial microsomia. *British Journal of Oral and Maxillofacial Surgery*, 51(8), 902–907.
- Ousterhout, D.K. (1996) Sliding genioplasty, avoiding mental nerve injuries. Journal of Craniofacial Surgery, 7, 297-298.

- Peter, S. and Katherine, W.L. (1986) Hybrid appliances: A component approach to dentofacial orthopedics. *American Journal of Orthodontics and Dentofacial Orthopaedics*, 90, 273-285.
- Pinheiro, T.P., Camarinha da Silva, C., Ereno Botelho, P.C., Limeira da Silveira, C.S., Rodrigues Pinheiro, M.D.G. and Viana Pinheiro, J.D.J. (2006) Progressive hemifacial atrophy: case report. *Medicina Oral, Patología Oral y Cirugía Bucal*, 11(2), 112-114.
- Pirttiniemi, P.M. (1994) Associations of mandibular and facial asymmetries--a review. *American Journal of Orthodontics and Dentofacial Orthopaedics*, 106, 191-200.
- Pirttiniemi, P.M., Huggare, J. and Lahtela, P. (1989) Head posture and dentofacial asymmetries in surgically treated muscular torticollis patients. *Acta Odontologica Scandinavica*, 47(4), 193–197.
- Proffit, W.R., Turvey, T.A. and Vig, W.L. (1980) Early fracture of the mandibular condyles: frequently an unsuspected cause of growth disturbances. *American Journal of Orthodontics*, 78, 1−24.
- Reyneke, J.P., Kienle, F. and Tsakiris, P. (1997) A simple classification for surgical planning of maxilla-mandibular asymmetry. *Journal of Oral and Maxillofacial Surg*ery, 35, 349-351.
- Schmid, W., Felisio, A. and Mongini, F. (1991) A computer based assessment of structural and displacement asymmetries of the mandible. *American J*ournal of *Orthodontics and Dentofacial Orthopaedics*, 100, 19−34.
- Severt, T.R. and Proffit, W.R. (1997) The prevalence of facial asymmetry in the dentofacial deformities population at the University of North Carolina. *International Journal of Adult Orthodontic and Orthognathic Surg*ery, 12, 171-176.

- Shetye, P.R. and Evans, C.A. (2006) Midfacial morphology in adult unoperated complete unilateral cleft lip and palate patients. *Angle Orthodontist*, 76, 810-816.
- Srivastava, D., Chandra, L., Kapoor, P., Mishra, S., Sharma, P. and Singh, H. (2018) Facial asymmetry revisited: Part I-diagnosis and treatment planning. *Journal of oral biology and craniofacial research*, 8(1), 7-14.
- Tai, K., Ikeda, K., Nishiyama, A., Park, J.H. and Sato, Y. (2012) Severe facial asymmetry and unilateral lingual crossbite treated with orthodontics and 2-jaw surgery: 5-year follow-up. *American Journal of Orthodontics and Dentofacial Orthopaedics*, 142, 509-523.
- Thiesen, G., Freitas, M.P. and Gribel, B.F. (2015) Facial asymmetry: a current review. *Dental press journal of orthodontics*, 20(6), 110–125.
- Wong, T.Y., Chung, C.H., Fang, J.J., Huang, J.S. and Lee, J.W. (2005) Comparison of 2 methods of making surgical models for correction of facial asymmetry. *Journal of oral and maxillofacial surgery*, 63(2), 200-208.
- Yu, C.C., Chen, Y.R., Lo, L.J. and Wong, F.H. (2004) Craniofacial deformity in patients with uncorrected congenital muscular torticollis: an assessment from 3-dimensional CT imaging. *Plastic Reconstructive Surg*ery, 113, 24-33.
- Zhi, K., Gao, L., Hou, C., Ren, W., Zhang, Y., Zhao, L. and Zhou, H. (2009) Management of temporomandibular joint ankylosis: 11 years' clinical experience. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontics*, 108, 687-692.