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REVIEW ARTICLE

FACIAL ASYMMETRY: DIAGNOSIS & TREATMENT PLANNING IN ORTHODONTICS - A REVIEW

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ABSTRACT

Bilateral symmetry is a most manifest morphological characteristic of the human body and especially that of the head. Due to large biological variations, either inherent in the developmental process or caused by environmental disturbances, such symmetry is rarely encountered. A number of causal factors have been highlighted in the development of facial asymmetries. The diagnosis of functional asymmetry should be accomplished by a thorough clinical examination and an analysis of various diagnostic records to determine the extent of involvement of dental, skeletal, soft tissue and functional components. Determination of the underlying cause of the asymmetry must be an important ingredient in the process of formulation of an appropriate treatment plan. Cases of facial asymmetry may be managed by orthodontic or surgical means depending upon the degree of severity and the patient's expectations regarding their treatment. A detailed clinical examination and formulation of the correct diagnosis would help the clinicians to achieve the desired treatment goals.

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INTRODUCTION

In 1907 Angle said, The study of orthodontia is indissolubly connected with that of art as related to the human face and Berendt (1952) considered that Aesthetic problems are of decisive importance in orthodontics. Therefore the subject of the symmetry or lack of symmetry of the human face is of considerable interest, particularly in the field of orthodontics.
Right-left differences occur everywhere in nature where two bilateral congruent parts present in an entity. Asymmetry in craniofacial morphology can be recognized as differences in the size or relationship of the right and left sides. This may be the result of imbalances in the individual position and form of teeth, variation in the position of bones of the craniofacial complex, and it may also be limited to the overlying soft tissues.

Prevalence: According to Severt and Proffit, frequencies of facial laterality are 5%, 36% and 74% in the upper, middle, and lower thirds of the face (Severt and Proffit, 1997). Peck *et al.,* 1991 observed that orbital region exhibited the least asymmetry (0.87 mm), mandibular region the most (3.54 mm) and the zygomatic region exhibiting a moderate asymmetry of 2.25 mm. It was suggested that as the facial structures farther from the cranium are observed there was an increase in asymmetry.

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History: Asymmetry of the craniofacial region was first recorded by an artist 'Hasse (Hasse, 1887). Human craniofacial investigations carried out by anthropologists Leibrick (1908), Harrower (1928), Woo (1931) and Hellmann (1931) showed varying degrees of asymmetry within the material studied. Cephalometric radiographic studies of Harvold (1951), Shore (1959), Mulick (1965), Letzer and Kronman (1967), and Vig and Hewitt (1975) have also shown presence of asymmetry in the normal facial features.

Etiology: Cheong and Lo (2011) reported that the causes of facial asymmetry can be grouped into three main categories: (I) congenital, of prenatal origin; (II) acquired, resulting from injury or disease; and (III) developmental, arising during development and of unknown etiology Facial asymmetry can be summarized and divided into three main categories;

Classification: Types of Facial asymmetries or transverse discrepancies can be broadly grouped into following categories: (Ashok Karad, 2014)

- Dental asymmetries in one or both arches
- Skeletal asymmetries involving maxilla and/or mandible
- Functional mandibular shifts causing asymmetric maxillomandibular relationships
- Muscular asymmetries

Table 1. Etiology of Facial Asymmetry (You-Wei Cheong *et al.*, 1993; Cohen, 1995; Reyneke *et al.*, 1997)

Congenital	Developmental	Acquired
Cleft lip and palate	Cause unknown	Temporomandibularjoint ankylosis
Tessier craniofacial cleft		Facial trauma
Hemifacial microsomia		Childhood radiotherapy
Neurofibromatosis		Fibrous dysplasia
Torticollis		Other facial tumors
Craniosynostosis		Unilateral condylar hyperplasia
Vascular disorders		Romberg's disease
Others		Others

Diagnosis

The diagnosis of functional asymmetry should be accomplished by a thorough clinical examination and an analysis of various diagnostic records to determine the extent of involvement of dental, skeletal, soft tissue and functional components. The goal of these diagnostic procedures is to identify the causative factor and determine the location and extent of the skeletal or soft tissue problem. The differential diagnosis of facial asymmetries is critical to formulate proper treatment plan. Minor asymmetries that are often neglected, or underlying asymmetries that are masked by dental compensations, if undiagnosed at the beginning of treatment, usually become apparent as treatment progresses, especially during the finishing stage.

Clinical examination (Ashok Karad, 2014; Varghese Mani, 2010)

It involves:

- Visual inspection of the entire face
- Palpation to differentiate soft tissue and bony defects
- Comparison of the dental midline with the facial midline
- Inspection of symmetry between the bilateral gonial angle and mandibular body lower border
- Determination of the amount of gingival show per side
- Evaluation of malocclusion
- Occlusal canting
- Inclination of the anterior teeth
- Open bites
- Maximal inter incisal opening
- Mandibular deviation
- The temporomandibular joint.

These examinations have to be combined with radiographic evaluation. Clinical examination remains the most important diagnostic tool in the evaluation of facial asymmetry. Clinical assessment starts with ascertaining the patients chief complaint and evaluating the medical history.

Medical history (Maheshwari *et al.*, 2015): A thorough medical history of the patient would aid in diagnosing the exact cause of the asymmetry. The patient should be asked for any prolonged illness or infections during childhood. Any history of trauma to the craniofacial region should be noted.

Dental history: The necessary information regarding any trauma to the dentition, history of previous extractions, caries, and premature loss of teeth or presence of supernumerary teeth should be recorded.

Extra-oral Examination: Extra oral assessment comprehends visual inspection of facial morphology, associated with soft, hard tissues and TMJ palpation. A thorough facial analysis must be conducted, giving special attention to the center of the chin, leveling of lip commissures, and bilateral symmetry of gonial angles and mandibular body contours. At smiling, analysis should assess whether dental midlines coincide with facial midline, inclination of the occlusal plane and the amount of bilateral gingival exposure.

Frontal evaluation (Maheshwari *et al.*, 2015); The patient should be evaluated from the frontal view. A gross evaluation of the facial proportions can be done by dividing the face into equal fifths (Farkas and Munro 1980). Along with this an inspection of symmetry between the bilateral gonial angles should be made. The lower border of the body of the mandible should also be assessed for bilateral symmetry

Evaluation of facial and dental midline: In order to have asymmetry assessed, patients must be in upright position, looking forward, with teeth in normal occlusion and relaxed lips. Additionally, having patients upper and lower views often aids in determining asymmetry (Maheshwari *et al*., 2015). A common procedure is the use of a piece of dental floss stretched from the region of the glabella to the lower chin, passing through the philtrum. The midline of the face should pass through the point between the eyebrows, the dorsum and tip of the nose, the philtrum and the chin point. Facial midline can be assessed by extending a wire from the forehead to the chin. The dental midline should coincide within both the arches and with the facial midline. The evaluation of the concordance between the midlines should be made in various positions of the mandible such as mouth open, centric relation, initial contact and in centric relation. A true facial asymmetry due to a skeletal cause maintains the same relation both in centric relation and centric occlusion (Farkas and Munro 1980). Another approach is to observe the distance between the canine or first premolar and the corner of the mouth. In the presence of midline deviation, the patient will notice unequal amount of tooth exposure on the right and left side. In clinical examination, the clinician must record the extent to which the maxillary midline is deviated from the facial soft tissue midline, since the orthodontic treatment goal is to position the two midlines and the mandibular midline so they are aligned with each other.

Evaluation of the vertical relations: The cant of both the maxillary and mandibular planes should be evaluated. The patient is made to bite on a tongue blade and is assessed for a parallelism with the interpupillary plane. According to Padwa *et al*, an inclination of the occlusal plane higher than four degrees tend to cause remarkable asymmetry on patients face (Padwa *et al*., 1997). The patient should also be evaluated for the amount of gingival display on both sides of the midline as the patient is made to smile.

Evaluation of the transverse relations: The chin point is compared with the lower dental midline indicating the shift of the mandible leading to asymmetry. Furthermore, the patient is made to recline the head backwards, and the lower borders of the mandibular body are evaluated from an inferior view.

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. A note of the maximum inter-incisal opening is made along with the inter-occlusal gap. Temporomandibular joint evaluation is done to check any symptoms of clicking, popping or tenderness to rule out any temporomandibular joint dysfunction disorder. An accurate registration of the centric relation must be made. The use of diagnostic splints has been recommended by Joondeph 2000 to deprogram the muscle memory and correct recording of the centric relation.

Intraoral clinical examination: Intraoral clinical examination should focus on assessing malocclusion, tipping of posterior and anterior teeth, crossbite and the presence of functional deviation of the mandible. Dental arch asymmetries could occur because of local factors such as early loss of a deciduous tooth or they could be associated with the rotation of the entire dental arch and its supporting skeletal base. Assessment of the overall shape of the maxillary and mandibular arches from an occlusal view may disclose not only side to side asymmetries but also differences in the bucco-lingual angulation of the teeth. In summary, to best diagnose and treat asymmetries, the clinician should consider several guidelines:

- Thoroughly evaluate the initial history and diagnostic records.
- Always check for a functional component to the malocclusion and take the appropriate records in centric relation.
- Recognize the early signs of a progressive asymmetry.
- Understand the dentoalveolar compensations associated with the various types of asymmetries.
- Take progress records and reevaluate if there is reason to suspect that the patient has an underlying progressive asymmetry.

Study models: 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. The articulated study models give a comprehensive three-dimensional view of dental relations. Bilateral symmetry can be established by using oriented occlusograms on the dental casts. 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 (Maheshwari *et al.,* 2015).

Photographic Assessment: Photographic assessment the routine frontal-relaxed and smiling, profile view and oblique view photographs of the patient are taken. The photographs are assessed for any gross asymmetry between the two sides of the face. An asymmetry analysis by digitizing standard photographs was proposed by Edler *et al*. in 2002. The four ratios to be measured are the area (relative size of right and left mandibular segments), perimeter or length of outlines, compactness (shape), and moment on each side of lower half of the face to assess the asymmetry.

Radiographic examination: A number of radiographic projections are available for accurate identification of the location and etiopathology of transverse problems.

Orthopantomogram (OPG): A panoramic radiograph gives the details of the mandibular ramus and body along with the entire dentition. An analysis to calculate the asymmetry index based on the values of ramus height and the condylar height was proposed by Habets *et al*. (1988). This index helps in the assessment of the morphological asymmetry between the two sides of the mandible. The limitations of an orthopantomographic analysis are that such radiographs are prone to distortion thus might give an impression of false asymmetry between the two sides (Fig. 1).

Figure 1. Orthopantomogram evaluation for asymmetry (Maheshwari *et al.,* 2015)

Lateral cephalogram: The lateral cephalogram, usually, suggests an antero-posterior or vertical discrepancy and cannot be used to assess a transverse discrepancy. Although, such radiographs might prove to be useful in cases of hemimandibular hyperplasia where there is no overlapping of the two sides of the mandible.

Postero-anterior cephalogram (Ashok Karad *et al.,* 2014): The cephalometric postero-anterior projection is a valuable tool in the study of the right and left structures since they are located at equal distance from the film and x-ray source. The postero-anterior view gives an assessment between the transverse dimensions of the skeletal and dental structures. The postero-anterior view can be obtained at the centric occlusion and open mouth positions to determine the extent of functional deviation. Three basic approaches for a postero-anterior analysis have been proposed anatomic approach, triangulation approach and bisection approach. Hwang *et al.* 2006 measured variables in the postero-anterior radiograph of patients and classified them into five major groups on the basis of three major parameters - Menton deviation, apical base midline discrepancy, vertical difference of ante-gonial notch between the right and left sides. According to Trpkova 2003 lines constructed as perpendiculars through midpoints between pairs of orbital landmarks showed excellent validity for measuring asymmetry using postero-anterior cephalogram. The use of postero-anterior cephalogram is fraught with inherent problems: difficulty in reproducing head posture; difficulty in identifying landmarks because of superimposed structures or poor radiographic technique; and concern about exposure to radiation (1987). Despite these disadvantages, numerous frontal cephalometric analyses have been used for several decades for surgical application as well as orthodontic use.

Submento-vertex radiograph: The coordinates of the submental radiographic view were proposed by Ritucci and Burnstone. The analysis of a submento-vertex radiograph was suggested by Forsberg *et al*. (1984). This analysis helps an investigator in calculation of asymmetry on the cranial base, zygomatic complex and mandible.

CT scans: CT scans both in 2-dimensional and 3-dimensional views can provide excellent details necessary for proper

diagnosis and treatment. In addition, three dimensional CT images can also provide information for the fabrication of three-dimensional acrylic skeletal models to facilitate evaluation and surgical planning.

Cone beam CT scanning: Three dimensional CT scans are excellent in assessing the facial asymmetry and in developing a treatment plan. The three-dimensional radiography Cone beam computed tomography (CBCT) images can be used to localize the exact position of the skeletal asymmetry.

Figure 2. Three-dimensional CT of facial asymmetry due to ankylosis of the temporomandibular joint (Left side) (Varghese Mani, 2010)

CBCT images have been measured for the following parameters to localize facial asymmetry.

a) Maxillary height
b) Ramus length
c) Ramal inclination from a frontal view
d) Ramal inclination from a lateral view
e) Mandibular body length and
f) Mandibular body height.

Single positron emission computed tomography: Single positron emission computed tomography is an essential diagnostic tool for visualizing hyperactivity in condyle. The radioactive isotope technetium 99 methylene bisphosphonate is injected into the patient and evaluated on a computed tomogram for signs of increased unilateral condylar activity in the form of hot spots. The difference in activity of 10% or more between the two condyles is indicative of condylar hyperplasia.

Three dimensional MRI: Three dimensional MRI is an excellent tool in assessing the soft tissue deformities.Technetium-99 is a radioactive isotope which localizes in areas of greatest bone turnover. Technetium-99 bone scans are frequently used to determine the condylar growth activity in progressive asymmetry. After injecting the isotope intravenously the radiation emission is assessed using gamma counter. If the activity is pronounced in one joint, condylar resection or high condylectomy is warranted.

Stereophotogrammety: The three-dimensional photographic imaging can act as an aid in evaluating the degree of asymmetry between the two sides of the face. Stereophotogrammetry uses two or more cameras, configured as a stereo pair to generate a three-dimensional image of the face. This provides a useful three-dimensional assessment of facial soft tissue asymmetry before and after orthognathic surgery. The images can be used for comparison and quantitative measurement. Stereophotogrammetry using two or more cameras, configured as a stereopair to generate a 3-dimensional image of the face by triangulation, has been reported. This provides a useful three-dimensional assessment of facial soft tissue asymmetry before and after orthognathic surgery. More recent devices for 3-dimensional photography have been used (Fig. 3).

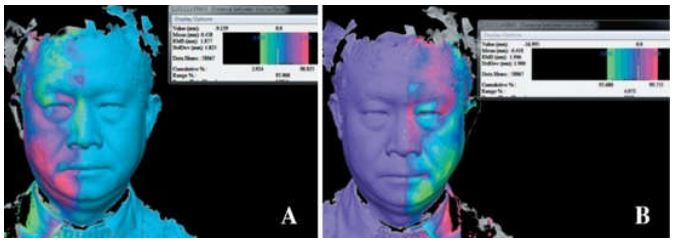

Figure 3. The 3-dimensional photograph shown in Fig. 1 was used to overlap the mirror image of the left side of face on the right side of the face (A). A color map illustrates the differences in depth, showing asymmetry or deformity of the facial contour on both sides. Quantitative differences are shown on the right upper inset scale map. 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)

The image can be used for comparison and quantitative measurement. The precision and accuracy of the 3-dimensional photographs have been validated. The soft tissue images captured from 3-dimensional photogrammetry are comparable to those obtained from traditional cephalogrammetry.

Treatment planning: Determination of the underlying cause of the asymmetric or symmetric transverse problem must be an important ingredient in the process of formulation of an appropriate treatment plan. It is equally important to determine the relationship of the transverse discrepancy with the sagittal and vertical problems, which often have a significant impact on designing a treatment strategy. The management of transverse discrepancies has been universally recognized as one of the most challenging aspects of orthodontic therapy.

Treatment of facial asymmetry: Once the diagnosis of transverse discrepancies is established, specific goals of treatment are defined and a final treatment plan is formulated. Patients with transverse problems may present with some of the most biomechanically challenging situations to the clinician. Whenever coming up with an orthodontic or surgical treatment plan, great emphasis should be given not only to the diagnosis of asymmetry, but also to patients final facial balance, as well as whether dental midlines coincide and proper occlusion has been achieved.

Conclusion

A detailed clinical examination and formulation of the correct diagnosis would help the clinicians achieve the desired treatment goals. Cases of facial asymmetry may be managed by orthodontic or surgical means depending upon the degree of severity and the patients expectations regarding their treatment. The clinician must be aware of the patient's expectations while treating such cases and evaluate the cost to benefits ratio of the

various treatment modalities to achieve the best possible outcomes.

REFERENCES

Angle, E.H. 1907. Treatment of malocclusion of the teeth. 7th ed. Philadelphia, S.S. White., P.60.

Ashok Karad. 2014. Clinical Orthodontics-Current Concepts, Goals and Mechanics. Elsevier India.

Berendt, N.C. 1952. Orthodontics and the study of ant. Malformations in art history. *Int Dent J.,* 3: 216-19.

Cheong, Y.W., Lo, L.J. 2011. Facial asymmetry: etiology, evaluation, and management. *Chang Gung Med J.,* Jul-Aug; 34(4):341-51.

Cohen, M.M. Jr. 1995. Perspectives of craniofacial asymmetry. Part III. Common and/or well known0/ causes of asymmetry. *Int J Oral Maxillofac Surg.,* 24: 127-33.

Edler, R., Wertheim, D., Greenhill, D. 2004. Outcome measurement in the correction of mandibular asymmetry. *Am J Orthod Dentofacial Orthop.,* 125:435-43.

Farkas, L.G., Munro, I.R. 1987. Anthropometric Facial Proportions in Medicine. Illinois: Charles C Thomas; 1987.

Forsberg, C.T., Burstone, C.J., Hanley, K.J. 1984. Diagnosis and treatment planning of skeletal asymmetry with the submental-vertical radiograph. *Am J Orthod.,* 85(3): 224-37.

Grummons, D.C., Kappeyne Van De Coppello, M.A. 1987. A frontal asymmetry analysis. *JCO*, 21(7):448–465.

Habets, L.L., Bezuur, J.N., Naeiji, M., Hansson, T.L. 1988. The Orthopantomogram, an aid in diagnosis of temporomandibular joint problems. II. The vertical symmetry. *J Oral Rehabil.,* 15:465-71.

Harrower, G. 1928. A biometric study of 170 Asiatic mandibles. Biometrika., 20: 279 quoted from Mulick.

Harvold, E.P. 1951. The asymmetries of upper facial skeleton and their morphological significance. *Tr Euro Ortho Soc.,* 1951; 63-69 cited from Letzer and Kronman.

Hasse, C. 1887. Uber Gesichtasymmetrien, Arch. Anat. V. Physical Anat. Abtail; pp.119-25 cited from Mulick.

Hellman, M. Some facial features and their orthodontic implication quoted from Shah and Joshi.

Hwang, H.S., Hwang, C.H., Lee, K.H., Kang, B.C. 2006. Maxillofacial 3-dimensional image analysis for the diagnosis of facial asymmetry. *Am J Orthod Dentofacial Orthop.,* 130: 779-85.

Joondeph, D.R. 2000. Mysteries of asymmetries. *Am J Orthod Dentofacial Orthop.,* 117: 577-9.

Leibrich, Die asymmetric des Gesichtes and pre Entsichung. Munich: Bergman; 1908 quoted from Shah and Joshi.

Letzer, G.M., Kronman, J.H. 1967. A posteroanterior cephalometric evaluation of craniofacial asymmetry. *Angle Orthod.,* 37: 205-11.

Maheshwari, *et al*. 2015. Diagnosis and management of facial asymmetries; *Journal of Orthodontic Research,* May-Aug | Vol 3 | Issue 2

Nanda, R., Margolis, M.J. 1996. Treatment strategies for midline discrepancies. *Semin Orthod.,* 2: 84-9.

Padwa, B.L., Kaiser, M.O., Kaban, L.B. 1997. Occlusal cant in the frontal plane as a reflection of facial asymmetry. *J Oral Maxillofac Surg,* 55: 811-6.

Peck, S, Peck, L., Kataja, M. 1991. Skeletal asymmetry in esthetically pleasing faces. *Angle Orthod.,* 6: 43-8.

Reyneke, J.P., Tsakiris, P., Kienle, F. 1997. A simple classification for surgical planning of maxillomandibular asymmetry. *Br J Oral Maxillofac Surg.,* 35:349-51

Severt, T.R., Proffit, W.R. 1997. The prevalence of facial asymmetry in the Dentofacial deformities population at the University of North Carolina. *Int J Adult Orthodon Orthognath Surg.,* 12: 171-6.

Shore, I.L. A cephalometric study of facial symmetry cited from Letzer and Kronman.

Trpkova, B., Prasad, N.G., Lam, E.W., Raboud, D., Glover, K.E., Major, P.W. 2003. Assessment of facial asymmetries from posteroanterior cephalograms: Validity of reference lines. *Am J Orthod Dentofacial Orthop.,* 123:512-20.

Varghese Mani. 2010. Facial Asymmetry. Surgical Correction of Facial Deformities, 186-190

Vig, P.S., Hewitt, A.B. Asymmetry of the human facial skeleton. *Angle Orthod.,* 1975;45:125-29

Woo, T.L. 1931. On the asymmetry of the human skull. Biometrika 22: 324 quoted from Shah and Joshi.

You-Wei Cheong, *et al.* 1993. Facial asymmetry Philadelphia: Lippincott, 1400-14.

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