

Condylar Hyperactivity – A Review

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Abstract

Facial symmetry is often associated with attractiveness. Mandibular growth anomalies can lead to facial asymmetry. The change in the pattern of mandibular growth, manifesting during the growth period of an individual can present with two classical hemi-mandibular anomalies namely Hemi-Mandibular Hyperplasia (H.H.) and Hemi-Mandibular Elongation (H.E.). The secondary growth centre (viz. the condylar cartilage) becomes hyperactive and plays an important role in the development of the two anomalies. Therefore they are grouped under condylar hyperactivity (CH). The two entities present with striking classical features which can be differentiated with each other. A combination of the two is also another common occurrence. The treatment however varies for the two anomalies. This article reviews the two classical presentations – H.H. and H.E., combination and Hybrid forms of hemi-mandibular growth anomalies.

Keywords: hemi-mandibular growth anomalies, hemi-mandibular hyperplasia, hemi-mandibular elongation, condylar hyperplasia, condylar hyperactivity, mandibular growth anomalies

INTRODUCTION

Symmetry refers to a sense of harmony, proportion and balance.¹ The relationship between aesthetics and symmetry is of a complex nature. Humans perceive bilateral symmetry of the face to be physically attractive as it is taken as an indication of sound health and superior genes.² The facial proportions are a direct result of the size and proportions of the various facial bones and the soft tissues draping them. Being the only movable bone of the face, the mandible plays an important role in facial aesthetics. Any asymmetry of the mandible as a result of an abnormal growth can negatively influence the facial proportions and in turn the facial symmetry.

MANDIBULAR ANOMALIES

The mandible is the only bone of the human skeleton which can produce many different typical growth anomalies. The anomalies of the mandible, in particular the growth and developmental anomalies of the mandible have an influence on the growth and development of the maxilla. This in turn can influence the function, especially mastication and speech. The abnormal growth of the mandible, leads to an abnormal shape and position which can lead to a pronounced facial disfigurement. For these two reasons, most of the mandibular anomalies would require a surgical and an orthodontic correction. While the abnormal growth of the mandible has a negative influence on the growth of the maxilla, the reverse is not true.

MANDIBULAR ASYMMETRY

Mandibular asymmetry could be due to various reasons such as developmental, pathological, traumatic and functional.³

Developmental

1. Hemimandibular elongation (H.E.)
2. Hemimandibular hyperplasia (H.H.)
3. Hemifacial microsomia
4. Achondroplasia
5. Hemifacial hypertrophy
6. Torticollis

7. Hemifacial atrophy

Pathological

1. Tumors and cysts
2. Infection
3. Condylar resorption

Traumatic

1. Condylar fractures
2. Trauma during delivery

Functional

1. Mandibular displacement

AETIOLOGY OF MANDIBULAR ASYMMETRY⁴

The aetiology of mandibular asymmetry can be due to:-

1. Embryonic genetic origin
2. Embryonic non-genetic origin
3. Postnatal adverse events during growth
4. Adverse events after growth has ceased
5. Misregulation of growth after birth

Embryonic origin

- Unilateral condylar hypoplasia and aplasia
- Unilateral mandibular hypoplasia and aplasia
- Unilateral mandibular and facial hypoplasia
- Hemifacial microsomia
- Hemifacial hyperplasia

Postnatal adverse events during growth period

- Trauma
- Arthritis
- Osteomyelitis
- Ankylosis
- Irradiation
- Perimandibular haemangioma
- Tumor or tumor-like lesions

Adverse events after growth has ceased

- Hyperactivity of condylar growth factors
- Acromegaly
- Trauma
- Chronic osteomyelitis
- Hyperplasia of the condyle which can be simple, arthritic or of tumorous origin

Misregulation of growth after birth

This may be due to either hyper or hypo activity of the local condylar growth regulation mechanism. It can occur on one or both sides of the mandible. It can lead to various possibilities such as:

- Hemimandibular Hypoplasia
- Hemimandibular Hyperplasia (H.H.)
- Hemimandibular Elongation (H.E.)
- Hybrid type of hemimandibular elongation and hemimandibular hyperplasia.

These manifestations can be unilateral / bilateral.

This article would endeavor to throw light on the two hemimandibular anomalies due to local growth misregulation namely, H.H. and H.E.

CONDYLAR HYPERACTIVITY

Many authors have used the term “condylar hyperplasia” in the literature, but in a generalized manner. They have all failed to distinguish between the various types of condylar hyperplasia. Obwegeser HL and Makek SS⁵ (1986) after doing extensive research on condylar hyperplasia found that there were distinct types of condylar hyperactivity. The two classical types they found out were – Hemimandibular Hyperplasia (H.H.) and Hemimandibular Elongation (H.E.). These anomalies arise without any known causal factors, either during the course of growth or even later.

They become apparent in early childhood at the age of 6-7 years. Rarely they can occur even after the general growth has ceased. They maybe unilateral, in an isolated form or in a bilaterally asymmetric form.

HYPOTHESIS OF PATHOGENESIS

It is hypothesized that the major steering mechanism for this abnormal growth lies within the condyle. This is further proven by the fact that even in rapidly developing cases the abnormal growth ceases immediately post resection of the condylar head.

Two different growth regulators within the cartilaginous portion of the condyle was hypothesized to be responsible for the pathogenesis of H.H. and H.E. The one responsible for growth in length is called Factor L and the one responsible for growth in mass is called Factor M which could not however be proven histologically though. Obwegeser HL and Obwegeser JA⁶ (2010) published a clinical based evidence for the existence of these two growth regulators.

DIAGNOSTIC AIDS

The various methods routinely used to diagnose and plan the treatment for any orthodontic patient, (i.e. clinical photographs, study models, facebow transferred mounting, Orthopantomogram and Lateral Cephalogram) gives a whole lot of information to diagnose H.H. or H.E. The other special methods such as Frontal Cephalogram, Stereophotogrammetry, CBCCT, Technetium isotope scan can further supplement for better understanding of each patient and for the formation of the best treatment plan for each individual.

PA Cephalogram

Most of the posteroanterior cephalometric analyses described in the literature are quantitative and they evaluate the craniofacial skeleton by means of linear absolute measurements of width or height, angles, ratios and volumetric comparison. The analysis proposed by Grummons and Kappeyne van de Coppello (1987) contains quantitative assessment of vertical dimensions and proportions.⁷ The primary indication for obtaining a posteroanterior cephalometric film is the presence of facial asymmetry. Many analyses contain variables and measurements of the transverse dimension. Relating the midline landmarks to the midsagittal plane will provide a qualitative evaluation to help clarify the source of the asymmetry.

OPG

A simple method to evaluate the volumetric composition of both sides of the mandible by the use of a digital OPG was proposed by Gupta S and Jain S⁸ in 2012. With the use of set landmarks, a vertical

reference plane and many horizontal planes, measurements were made for each half of the mandible. A comparison between the two sides showed exactly the extent of the anomaly of the affected side.

HEMIMANDIBULAR HYPERPLASIA (H.H.)

The extent of manifestation of the hemimandibular hyperplasia is dependent on the age during the initial stage the abnormal growth occurs. It also depends on the duration to which this abnormal growth occurs. It may cease with the cessation of the mandibular growth or it can continue into adulthood. Sometimes it stays dormant post the growing phase and suddenly shows exacerbated growth in the later ages, say fourth or fifth decades of life.

1. Classical hemimandibular hyperplasia

Hemimandibular hyperplasia⁹ is characterized by the three-dimensional enlargement of the affected half of the mandible. It may lead to enlargement of the condyle, condylar neck, ascending ramus, horizontal ramus, width of the body and length of the body but it terminates exactly at the symphysis of the affected side.

Clinical features

Increased height of ramus on the affected side is observed. Face shows rotated appearance. From below, unilateral downward projection of ramus and angle of the mandible is seen. Before puberty maxilla undergoes compensatory downward growth on affected side to maintain occlusion resulting in a canted occlusal plane. The rate of growth of the mandible is rapid with the maxilla not being able to catch up with it resulting in an open bite malocclusion. Clear demarcation of the anomaly is seen on the symphysis. The lower anterior teeth tilts towards the affected side. Posterior teeth on the affected side roll in lingually to compensate and maintain the occlusion. The maxillary growth on the unaffected side can sometimes leads to a buccal non-occlusion due to the lingual roll in. Slight asymmetry but no pronounced displacement of chin to the unaffected side is seen.

Radiographic features

- Increased ramal length on the affected side,
- Enlarged condylar head
- Elongated and thick condylar neck
- Bowing and vertical downward displacement of the lower border of mandible on the affected side
- Rounded angle of mandible on the affected side
- Increased height of the body of the mandible as expressed by increased distance between the tooth roots and inferior alveolar nerve canal on the affected side
- The mandibular canal is displaced towards the lower border of the mandible
- Clear demarcation of the anomaly at the symphysis in the orthopantomogram and the postero-anterior view
- Downward growth of maxilla and the maxillary sinus on the affected side

Histological features

Histologically, the affected condyle of these cases is covered by a very broad layer of fibrocartilage. The outer fibrous layer is relatively thin and the cells are loosely distributed, spindle-shaped and run parallel with the surface. The next underlying intermediate proliferation zone is very broad, cell-rich and exhibits occasional myxoid areas. The transition to the underlying very broadened fibrocartilaginous layer is not clearly defined.

2. Bilateral hemimandibular hyperplasia

It can manifest in conditions like acromegaly. Here the features of hyperplasia are evident on both sides. There is increase in all three dimensions of the mandible.

3. Hemimandibular hyperplasia vs condylar hyperplasia

Condylar hyperplasia^{10,11,12} involves only the condyle. The condyle becomes enlarged and shows a coarse structure in the radiograph.

Clinical features: There is increase in facial height of the affected side. The chin is shifted to the unaffected side. It is not as pronounced as in hemimandibular hyperplasia. Open bite on the affected side may be present on intraoral examination but an occlusal cant in the maxillary plane cannot be appreciated.

Radiographic features: Massive enlargement of the condyle is seen. There is no increase in width of the ramus. The height or length of body of mandible on the affected side is normal. There is no displacement of the mandibular canal, no line of demarcation at the symphyseal region and no rounded angle of the mandible.

Treatment Planning¹³

Treatment planning would most likely involve a combined orthodontic and an orthognathic surgical approach. Depending on the severity and degree of the anomaly and the active growth period a decision can be made whether or not to undergo surgical resection of the condylar head. The active growth ceases in such cases and further worsening of the patient's profile is thus prevented. In case the vertical component of the maxillary bone involved is more pronounced a bi-jaw surgical plan would be required. In classical cases there is not much of deviation of the chin, and hence the lower border of the mandible of the affected side is resected and used to augment the unaffected side. The orthodontic plan would be to correct the occlusion by eliminating all the dentoalveolar decompensations.

HEMIMANDIBULAR ELONGATION (H.E.)

Hemimandibular elongation can be defined as the horizontal displacement of the mandible plus chin, to the unaffected side. H.E. is commonly called "unilateral mandibular prognathism" or "deviation prognathism" (R. Bruce and J. Hayward, 1968).

Clinical features

The lower border of the mandible on both the sides lie in the same level. There is unilateral elongation of the mandible terminating at the symphysis. The lips on the unaffected side show a furrow effect. The lateral displacement of the mandible is a striking feature on intra-oral examination. There is an absence of maxillary occlusal cant. The displacement of the mandible leads to the shift in midline towards the unaffected side with a posterior crossbite. There is no open bite. Extra-orally and occlusally it resembles unilateral prognathism, which despite the elongation on one side does not produce the profile of true progenia. Hemimandibular elongation is clinically similar to functional mandibular lateral deviation and it is important to differentiate between the two, as noted by Elbaz and colleagues.

Radiographic features

The unilateral elongation of the mandible can be noticed in the orthopantomogram as well as in the PA cephalogram in an open mouth position.

Types

A. Slender form

The slender form affects the condylar neck, ramus and body of the mandible. The angle of the mandible is more oblique. There is no change in trabecular pattern. Condyle is occasionally enlarged but to a minor degree only. Condylar neck appears clearly slender and elongated.

B. Non – Slender form

Though the condylar neck is not noticeably elongated the features of hemimandibular elongation is present. Condyles appear nearly normal. They are somewhat bigger than the slender form. The body of the mandible is elongated. Dentally crossbite and shift of midline to affected side is present. A small proportion of hyperplastic component exists in this form.

C. Bilateral hemimandibular elongation

It often presents asymmetrically and is not so rare. Both the forms can be present unilaterally and bilaterally. There is presence of an anterior crossbite. Chin prominence is deviated to one side. If there is presence of slender form on one side and non-slender form on the other side, the profile need not necessarily look prognathic. On the other hand, when both sides show a slender form of elongation, the appearance of a prognathic profile with a long and slender body of the mandible and protruding chin could manifest.

Histological features: In these cases the fibro-cartilaginous layer shows to a great extent a normal depth. Unlike H.H. the pathological hyperactive growth focus is characteristically located in the centre of the condyle and has a cuneiform structure with the tip lying in the newly formed spongiosa.

Hemimandibular elongation vs Hemimandibular hypoplasia:

The hypoplasia of one side of the mandible can also simulate the appearance of the normal side of the mandible as elongated. Cases of otomandibular dysostosis are typical examples. Here, the lengthening of the 3 parts – condyle ramus and body of the mandible is not seen, the angle of the mandible is not oblique and the crossbite is missing intraorally. Only a Class II malocclusion on the hypoplastic side discloses that it is indeed a hemimandibular hypoplasia. It is also possible for a combination of hemimandibular hypoplasia on one side and a true hemimandibular elongation on the other side. Cases of unilateral facial hypoplasia with contralateral hemimandibular elongation are observed.

Treatment planning: The surgical correction of the mandible would involve a bilateral sagittal split osteotomy with a rotation of the body of the mandible. This may not be able to fully correct the deviation of the chin prominence, hence an additional genioplasty with a lateral chin slide maybe needed to correct the chin position. This treatment modality though may not be for all the cases is suggested more so in pronounced cases. Orthodontic correction would involve correction of dental irregularities, elimination of decompensations and settling in of the occlusion.

COMBINED AND HYBRID FORMS: A unilateral hybrid form or a bilateral combined form can occur. Various combinations of the same with normal or a hypoplastic mandible on the contralateral side can also occur.

Types:

A. Bilateral combination forms

Both hemimandibular elongation and hyperplasia can occur in the same patient, on the same side of the mandible.

B. Unilateral hybrid forms

In this type, both the anomalies are summated on one side of the mandible. The affected side has an increase in height of the ramus and is elongated in the body of the mandible. There is flattening of the rima-orbis and the occlusal plane appears canted.

Histological findings: There is a hypothetical possibility that the same patient might exhibit hyperactive growth which begins in the form of activity areas (as in the case of H.E.) and then comprises the whole surface of the condyle. There are joints in which semblances of cuneiform sclerosed and static bony structures have been observed. Cartilaginous vestiges clearly demarcate these structures from the rest of the bony tissues.

Treatment planning¹³

These patients would require a bi-jaw surgery and depending on the degree of severity the surgical plan changes. Mostly these patients have a pronounced and grotesque facial appearance. They are most likely to require resection of a large amount of bone especially in the lower border of the mandible on the affected side. This is further complicated by the downward displacement of the mandibular canal. The

maxilla would also require impaction, depending on the amount of the vertical component involved. The various classical forms of the hemimandibular anomalies¹⁴, cannot be grouped under one heading and hence condylar hyperplasia wouldn't be an appropriate and a common terminology to be used. Condylar hyperactivity would rather be an appropriate term to be used that would encompass all the different hemimandibular anomalies under one heading.

CONCLUSION

A good understanding of condylar hyperactivity encompassing hemimandibular hyperplasia, hemimandibular elongation and the hybrid forms, their clinical and distinguishing radiographic & histologic features and treatment plan is hereby highlighted. Proper diagnosis and treatment planning of the above mentioned hemimandibular anomalies would go a long way in mitigating the severe jaw discrepancies and in restoring the facial symmetry, harmony and balance of the affected individuals.

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