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Surgical Management of Unilateral Condylar Hyperplasia of the Temporomandibular Joint

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Abstract

Objective: Unilateral Condylar hyperplasia of mandible is overdevelopment of condyle, unilaterally leading to facial asymmetry, mandibular deviation, malocclusion and TMJ dysfunction. The condition represents a challenge to both orthodontists and oral and maxillofacial surgeons because of the occasional progressive behavior of the anomaly and the subsequent severe dentofacial deformity. The aim of the current study is to evaluate different treatment modalities of unilateral condylar hyperplasia in relation to the condylar activity and facial asymmetry.

Methods: This a case-series study evaluated 16 patients with condylar hyperplasia that met the inclusion criteria between 2015 and 2023. Preoperative radiographic evaluation with panoramic, lateral cephalometric and posteroanterior cephalometric imaging for diagnosis, evaluation of the degree of facial asymmetry and treatment planning were performed for all the patients enrolled in the study.

Results: Five patients (31%) underwent condylectomy with orthodontic treatment, 2 (12.5%) underwent genioplasty with orthodontic treatment, and 3 (19%) underwent condylectomy with adjunctive jaw surgery with orthodontic treatment. While 6 (37.5%) patients selected to be treated by the orthodontic treatment regardless the minimal degree of facial asymmetry.

Conclusion: Simultaneous condylectomy and orthognathic surgery provides predictable and stable outcomes for patients with active unilateral condylar hyperplasia and associated dentofacial deformities. Virtual surgical planning allows the precise definition of the level of condylectomy, and custom-made 3D printed cutting guides are useful to reproduce virtual measurements during surgery.

Keywords: Condylar Hyperplasia; Condylectomy; Orthognathic surgery; Orthodontic treatment

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Introduction

Unilateral condylar hyperplasia is an uncommon malformation of the mandible involving change in size and morphology of the condylar neck and head. This results in facial asymmetry and deformity, occlusal discrepancies and temporomandibular joint dysfunction, deviation of the midpoint of the chin to the unaffected side, bowing of the inferior alveolar nerve canal and inferior margin of the involved mandible, a tilted occlusal plane and malocclusion.

The etiology of condylar hyperplasia is unknown with exceptionally rare cases of bilateral involvement. Several theories have been hypothesized to explain the Etiology of this condition including vascular, hormonal, traumatic, inflammatory, neoplastic, genetic causes and Insulin-like Growth Factor 1 (IGF-1) [1,2]. The higher prevalence in females, which may suggest an etiologic role of hormones, although this role is still not clear, or a stronger macro-aesthetic perception of the facial asymmetry in females, that could lead to higher request of consultation [3,4].

Asymmetric conditions attributed to condylar hyperplasia of the mandible were first reported by Adams in 1836. Gottlieb described condylar hyperplasia as an osteoma causing unilateral deformity. Rowe characterized unilateral condylar hyperplasia as being associated with elongation of the condylar neck, bowing of the inferior body of the mandible, lateral crossbite, and contralateral concavity of the lateral aspect of the ramus [5-8].

In the classification proposed by Obwegeser, the first group was categorized as Hemi-mandibular

Hyperplasia (H.H.) that characterized by unilateral 3-dimensional enlargement of the mandible including the condyle, condylar neck, ascending ramus, and mandibular body, which usually terminates at the symphysis., the second group was characterized as a Hemi-mandibular Elongation (H.E.) in which the mandible displaces horizontally toward the unaffected side. In the hybrid form, both anomalies can develop simultaneously in the mandibles of the same patient [8].

Another classification system divided the Condylar hyperplasia into vertical, horizontal, or combined [6-9].

Accurate assessment of the active condylar growth is very important because corrective surgery of facial asymmetry is usually not performed if there is still a possibility of progression of the asymmetry due to condylar growth activity. Cisneros was the first to use bone scintigraphy to study patients with mandibular asymmetry. Two frequently used scanning techniques are planar bone scanning and Single Photon Emission Computed Tomography (SPECT), both of which use the same basic technology. However, SPECT produces a tomographic bone scan image that may be more reliable than planar scanning [10,11].

Treatment aims to restore normal function and a balanced facial profile. To do this, it is necessary to establish whether the disease is active or not and to use the appropriate operative technique. The management of condylar hyperplasia requires variable approaches ranging from Condylectomy followed by orthognathic treatment to a "wait and see" policy.

Material and Methods

This was a case-series study evaluated 16 patients with condylar hyperplasia (active or inactive) that resulted in facial asymmetry between 2015 and 2023. Patients with conditions of previous trauma or surgery to the Temporomandibular Joint (TMJ), previous mandibular fractures, neoplastic pathology of TMJ, systemic diseases, or congenital conditions that could potentially affect the TMJ were excluded from the evaluation.

The study followed all the tenets of the Declaration of Helsinki for research involving human subjects and was reviewed and approved by the institutional reviewer board of Al-Azhar University School of Dentistry. Informed written consent was obtained from all patients enrolled in the study.

The chief complaints of these patients were gradual facial asymmetry and disordered occlusion over the years. Preoperative Technetium 99m (99mTc) bone scan was used for evaluation of the condylar activity. The history and physical examination details were recorded. Preoperative radiographic evaluation with panoramic, lateral cephalometric and posteroanterior cephalometric imaging for diagnosis, evaluation of the degree of facial asymmetry and treatment planning were performed for all the patients enrolled in the study.

Preoperative CAD-CAM

The digital workflow started with obtaining high-quality Multi-Slice Computed Tomography (MSCT) for data acquisition. DICOM files were imported into Mimics 21.0® software (Materialise, Leuven, Belgium), and bone segmentation was performed using a threshold range from 226 to 3071 Hounsfield Units (HU), however, this threshold may differ from one patient to another which needs meticulous radiographic examination to get all details of bone.

The amount of bone that should be removed during condylectomy is measured using 3-Matic 13.0® software (Materialise, Leuven, Belgium). According to this measurement, the virtual osteotomy line was put in, the surgical guide was designed, and a virtual condylectomy was performed.

Hence, the remaining height of the ipsilateral ramus could be compared with the contralateral height of the ramus and condyle of the unaffected side so the authors could determine the need for re-establishing the ipsilateral posterior height with Vertical Ramus Osteotomy (VRO), total joint replacement, or any other modalities.

In cases where VRO is a part of the surgical plan, the virtual osteotomy cut was drawn in the mid-ramus just posterior to the lingula from the sigmoid notch to the inferior border of the mandible. The upward-sliding movement was performed virtually, and the amount of the proposed movement was recorded (the difference between the contralateral ramus-condyle complex height and the ipsilateral ramus height). Similarly, another surgical guide for VRO was designed based on the drawn osteotomy line.

In cases of hemi-mandibular hyperplasia, the 3D enlargement of the whole one-half of the mandible requires special interest to establish perfect esthetic rehabilitation. Virtual mirroring of the unaffected half of the mandible helps in determining the amount of bone to be removed. The horizontal osteotomy cut was traced on the affected half conforming with the mandibular inferior border of the mirrored unaffected half. A surgical cutting guide was designed to transfer this maneuver to the theatre. Unfortunately, this horizontal body osteotomy may be encountered with the presence of the inferior alveolar canal. In this scenario, an additional guide was fabricated to reposition the canal with its neurovascular bundle into a new superior position to avoid nerve injury. This guide orients the surgeon to the original position of the bundle as well as the new proposed position of the canal that should be at least 5 mm away from the apices of the teeth as well as the new inferior border of the mandible.

Using the midline sagittal plane, any persistent midline deviation in the mandibular symphysis could be easily identified. Virtual genioplasty was performed to correct the midline deviation and the surgical guide replicated this operation to the actual patient accurately.

Treatment modalities (Figure 1)

Combined condylectomy with orthognathic surgery: In case of Condylectomy and orthognathic surgery to be performed simultaneously, the surgical procedures involved 1) computer guided Condylectomy, 2) computer guided intraoral vertical ramus osteotomy, 3) intraoral inferior alveolar nerve transposition, 4) intraoral inferior border osteotomy, and 5) genioplasty to correct chin and midline deviation.

Condylectomy was performed through modified preauricular incision with temporal extension using the prefabricated surgical guide. The articular disc was maintained in its original position by blunt dissection after resection of the condylar head. The disk maintained its place through its intact attachment posteriorly with the retrodiscal tissue and anteriorly with the lateral pterygoid muscle. This was followed by intraoral vertical ramus osteotomy with superior repositioning which was subsequently aligned to replace the resected condyle and act as pseudo joint. Next, through intraoral approach, inferior alveolar nerve transposition using prefabricated surgical guide was performed for nerve preservation during inferior

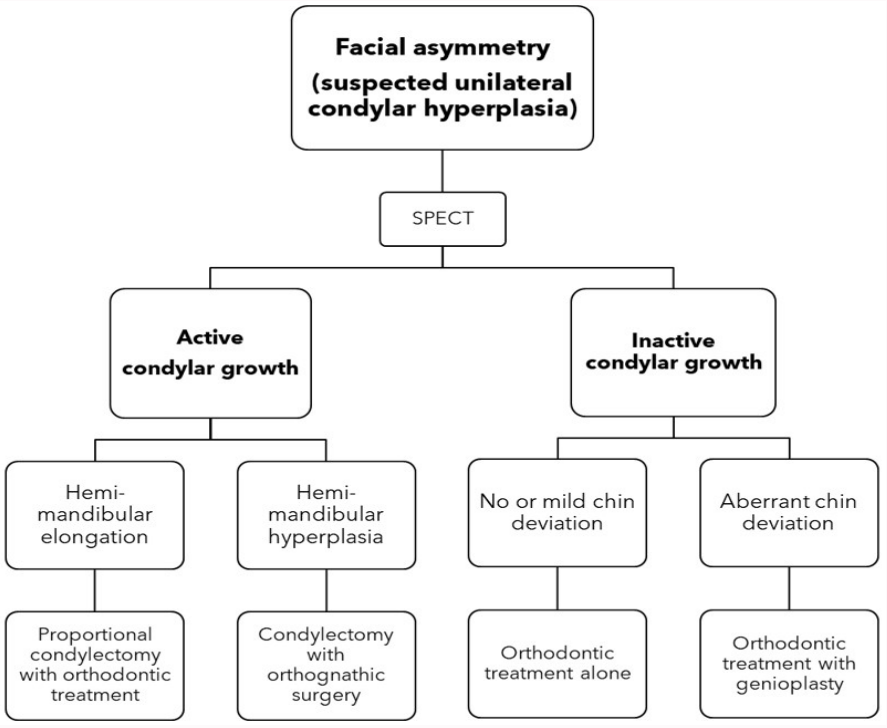

Figure 1: Flowchart represent the algorithm for management of unilateral condylar hyperplasia.

border osteotomy. With the aid of the surgical guide, inferior border osteotomy was performed. Postoperative care included the antimicrobials amoxicillin/clavulanic acid and metronidazole to avoid infection. Dexamethasone and vitamin C were applied to relieve swelling and facilitate healing.

Proportional condylectomy with orthodontic treatment: The low (proportional) condylectomy refers to the removal of the active portion of the condyle in cases of TMJ tumors and additionally resecting some of the bone on the affected side to match the unaffected side, thus correcting the mandibular height. In case of low condylectomy, the healthy side is used as a reference to level the occlusal plane. On the other hand, the term high condylectomy refers to the removal of the most superior aspect of the mandibular condyle (about 5 mm), which is considered the most active growth region of the condylar head. The presence of condylar activity is a very important parameter for determination of the level of condylectomy.

The condyle resection and reshaping of the mandibular condyle was planned using 3D imaging. The articular disc was maintained in its original position by blunt dissection after resection of the condylar head. The occlusion was verified clinically after resection and reshaping of the condyle. Orthodontic treatment entails two main parts, first to re-program the adaptive unbalanced muscles to the new corrected skeletal pattern using guiding elastics for a period ranging from 2 to 4 months, the second part to gain a stable functional occlusion to stabilize the re-programmed muscles. This done through pre-bended heavy st.st. wire over 0.022-inch brackets. Once these two goals had been achieved, careful orthodontic treatment through segmental mechanics is initiate to gain the most stable and aesthetic results.

Orthodontic treatment with genioplasty

The cases of inactive condylar growth associated with chin deviation and mild occlusion discrepancies treated with orthodontic treatment and genioplasty to correct the facial asymmetry. The position of the chin was prepared with surgical guide to correct the chin deviation and protrusion.

Orthodontic treatment alone

The cases of inactive condylar growth associated with small asymmetries with mild occlusion discrepancies treated with orthodontic treatment only after discussion of the alternative surgical procedures with the patients to treat the facial asymmetry. The tilted maxillary occlusal plane corrected by a selective molar intrusion using fixed orthodontic with temporary orthodontic mini screws anchorage.

Results

During the study interval, 16 patients (2 male – 14 female) with condylar hyperplasia that met the inclusion criteria between 2015 and 2023. The patients age ranges from 19 to 35 years with mean age of 25.4 years.

Preoperative Technetium 99m (99mTc) bone scan showed 8 patients had active condylar hyperplasia. Of them, five patients (31%) underwent condylectomy with orthodontic treatment, 3 (19%) underwent condylectomy with adjunctive jaw surgery with orthodontic treatment (Figure 2, 3).

While 8 patients had inactive condylar hyperplasia. of them 2 patients (12.5%) underwent genioplasty with orthodontic treatment, while 6 (37.5%) patients selected to be treated by the orthodontic treatment regardless the minimal degree of facial asymmetry.

Postoperative lip numbness occurred in cases of inferior border osteotomy, inferior alveolar nerve transposition, and genioplasty. The lip numbness showed complete recovery within 6 months in all cases (Figure 4).

Figure 2: Preoperative frontal view of patient with left side condylar hyperplasia showing the clinical characteristics of facial deviation to the non-affected side.

Figure 3: Preoperative postero-anterior X-ray showing facial asymmetry and deformity, deviation of the midpoint of the chin to the unaffected side, bowing of the inferior alveolar nerve canal and inferior margin of the involved mandible, a tilted occlusal plane.

At 6 months of follow-up, the patient presented with good facial symmetry and a stable occlusal relationship. The mandibular function was excellent, with a maximal incisal opening of 35 mm to 40 mm. A panoramic and PA cephalography revealed good symmetry of the mandible and a favorable condylar shape (Figure 5).

Discussion

Treatment of condylar hyperplasia depends on age, degree of deformity. The keystone of management of condylar hyperplasia is to determine whether the condylar hyperplasia is still active or not. The basic considerations in the management of facial asymmetry secondary to condylar hyperplasia must include control of the growth process to allow more balanced facial development [12,13].

Treatment usually includes condylectomy during the period of active growth. If growth has stopped, orthodontics and surgical mandibular repositioning are indicated. If the height of the mandibular body is greatly increased, facial symmetry can be further improved by reducing the inferior border [14].

Figure 4: Postoperative frontal view showing correction of the facial asymmetry and chin deviation.

Figure 5: Postoperative posteroanterior x-ray showing correction of the facial asymmetry, chin deviation through Condylectomy, intraoral vertical ramus osteotomy, intraoral inferior alveolar nerve transposition, intraoral inferior border osteotomy, and genioplasty.

A positive SPECT scan is not necessarily an indication for condylar surgery as there are degrees of positivity and rate of progression. Sometimes if the rate of progression is slow then it is worth waiting for the condition to burn out naturally. The timing of these surgeries is a subject of debate [5,10]. There is no agreement on when to perform Condylectomy [15]. Brusati et al. [16] evaluated articular function in 15 patients (mean age 22) who underwent high Condylectomy and found that postoperative articular function was satisfactory but not excellent. However, an age over 18 years old has been reported as a gold standard for Condylectomy [17]. Some studies reported lower risk of relapse and more stable outcomes when condylectomy is performed for adults compared to adolescents [9,18]. Two standard scintigraphic measurements of bone activity within 6 months are usually required to indicate the presence of active growth in which Condylectomy should be performed. Early intervention ensures excellent aesthetic and facial outcomes and minimize future intervention when combined with orthodontics [19,20].

The literature offers different perspectives and treatment modalities for high condylectomy. It is yet not clear whether high condylectomy as a solo surgical procedure is sufficient to correct asymmetry [21,22]. In studies in which high condylectomies were reported as the sole treatment for CH, there was a high chance that

these cases could have possibly better managed with proportional condylectomy instead [23].

The proportional condylectomy protocol was initially proposed by Delaire to solve the etiology of CH by resecting the condylar growth center and correcting the mandibular malformation [24]. This approach relied on estimating the vertical distance between the mandibular angles and included a full removal of the cartilaginous cap. The advantage of proportional condylectomy lies primarily in reducing the need for a secondary orthognathic surgery. The average reported age to perform proportional condylectomy was 19 years old in majority of the studies [23-26], indicating a potentially greater capacity at an earlier age for condylar remodeling and adaptation of hard and soft tissues, which might help avoiding secondary orthognathic surgery.

Conclusion

Inactive condylar growth associated with chin deviation and mild occlusion discrepancies could be treated with orthodontic treatment and genioplasty. While cases of inactive condylar growth associated with small asymmetries with mild occlusion discrepancies could be treated with orthodontic treatment only. Simultaneous condylectomy and orthognathic surgery provides predictable and stable outcomes for patients with active unilateral condylar hyperplasia and associated dentofacial deformities. Accurate 3D analysis was performed by virtual surgical planning and 3D printing. Virtual surgical planning allows the precise definition of the level of condylectomy, and custom-made 3D printed cutting guides are useful to reproduce virtual measurements during surgical manoeuvres.

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