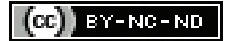


Idiopathic Condylar Resorption: How to Diagnose and When to Treat it?

RISHIKA AGARWAL¹, SHAILESH V DESHMUKH², AMOL S PATIL³, VEERA BHOSALE⁴

ABSTRACT

Idiopathic Condylar Resorption (ICR) has been frequently reported in patients undergoing orthodontic treatment especially in young adolescent females, so as dentists we could be the first ones to diagnose this condition. This condition represents an aggressive and fast-moving form of degenerative disease of the Temporomandibular Joint (TMJ) and the pathognomonic features of this condition include a deficit of condylar volume, furthermore reducing the ramus height and length of mandible and causing a clockwise rotation of the mandible leading to absence of anterior bite. The accurate cause of this condition is not known, however, there are multiple aetiological factors that could be contributing to this disease. ICR is a poorly understood disease and it could be a very difficult condition to treat because of its various expression and the large number of treatment options that are available. Over the past years a number of cases with ICR have been reported in the orthodontic literature. The aim of this review article is to present a compiled data to better understand the pathophysiology and aetiological factors contributing to ICR and provide an insight about the various clinical features and radiographic findings of this condition which will help us diagnose this condition better in our day-to-day practice. Various treatment modalities like splint therapy, orthognathic surgery, joint replacement have also been mentioned and discussed. A case of ICR that reported to our department with a chief complaint of progressive opening of the bite has also been included in this review article.

Keywords: Condyle, Diagnosis, Temporomandibular joint

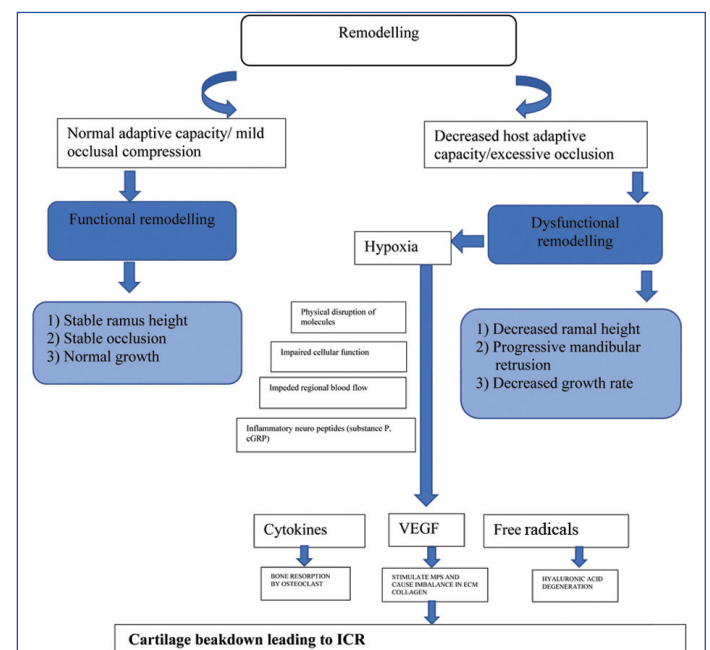
INTRODUCTION

Idiopathic Condylar Resorption (ICR), also referred to as condylar atrophy [1], idiopathic condylosis [2], aggressive condylar resorption, and acquired condylar hypoplasia [3], is a rare, aggressive, and degenerative disease of the Temporomandibular Joint (TMJ), which has a 9:1 [4] female to male prevalence. As a result, condylar resorption as a kind of acquired condylar hypoplasia was originally described by Berke in 1961. ICR is described as a localised and non-inflammatory disease of the TMJ that is marked by the breakdown and repair of articular cartilage and the bone beneath [2]. It has been categorised as a low inflammatory arthritic disorder. The name ICR has been given to this condition because patients with it typically report progressive modification of the condylar morphology and loss of the condylar mass with an unexplained origin [5].

PATHOPHYSIOLOGY

The pathologic process of ICR is characterised by localised thickening and remodelling of the underlying bone as well as degeneration and abrasion of the fibro articular cartilage. Secondary inflammatory alterations are frequently present in conjunction with these changes [6]. Our bodies undergo functional remodelling and dysfunctional remodelling, two different forms of remodelling. The pathophysiology of ICR involves dysfunctional remodelling, which is also known as functional overloading. When this occurs, the normal adaptive capacity of the TMJ is reduced or/and the functional loading is increased, which has a negative impact on the mechanical function of the joint and the occlusion. Reduced condylar volume, ramal height, increasing mandibular retrusion, and slowed condyle growth rate are a few of the morphological changes [7]. What takes place at the molecular level is that the overloading causes hypoxia and mediates destructive processes which includes breakdown of cells, reduced cellular function and impeded or restricted blood flow which is accompanied by release of inflammatory neuropeptides like substance P. The hypoxia also causes the release of inflammatory mediators such as cytokines, which promote bone resorption by activating osteoclasts, Vascular Endothelial Growth Factor (VEGF) [8], which increases Matrix

Metalloproteinases (MMPs) and promotes collagen degradation, and free radicals, which promote the degradation of hyaluronic acid. Condylar resorption is ultimately brought on by the destruction of the cartilage that all these inflammatory mediators ultimately induce. The following flowchart illustrates a synopsis of the pathophysiology of ICR [Table/Fig-1].

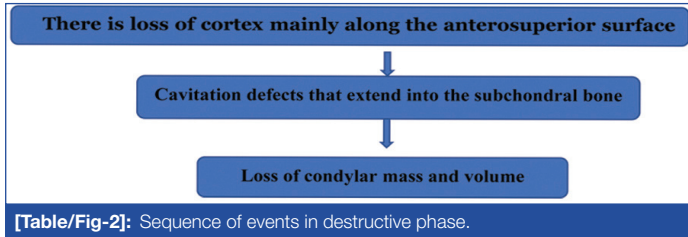


[Table/Fig-1]: Pathophysiology of ICR (self-made).

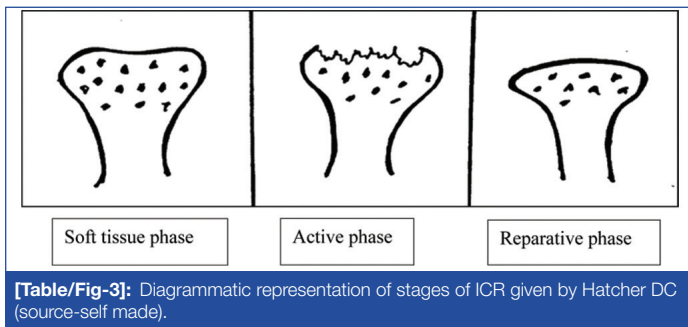
To better understand the pathogenesis of ICR it has been divided into three clinical stages by Hatcher DC (2013) [9]:

- 1) The soft tissue phase:** The changes in the soft tissue occur before the bony changes. It is suspected that joint becomes hypermobile and it can be an additive factor. A disk displacement without reduction displacement is frequently seen before ICR. No osseous changes are seen in this phase.

- 2) **Destructive/active phase:** This active phase of ICR is associated with excessive forces which limit the condylar motion and cause pain. During this phase, the TMJs are more susceptible to biomechanical forces. The sequence of events occurring in this phase is shown in the following flowchart [Table/Fig-2].
- 3) **Reparative phase:** The destructive phase is followed by a regenerative phase where condyle appears to be flattened and re-cortication is seen. Flattening is an adaptation to allow the functional loads to distribute over a larger area. Clinically, it is not easy to identify individuals with end-stage ICR. All the three stages of ICR are depicted in the following figure [Table/Fig-3].



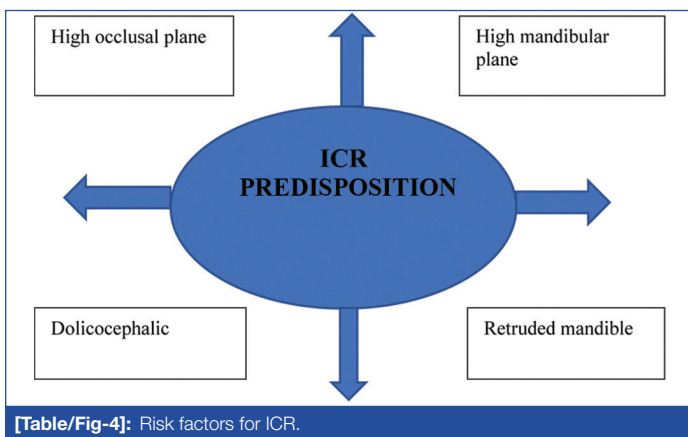
[Table/Fig-2]: Sequence of events in destructive phase.



[Table/Fig-3]: Diagrammatic representation of stages of ICR given by Hatcher DC (source-self made).

AETIOPATHOGENESIS

The aetiopathogenesis of ICR occurs due to factors that reduce the capacity for remodelling or increase the biomechanical stress on the TMJ. The TMJ's dysfunctional remodelling may be influenced by host factors, including ageing, systemic disease, hormones, and severe mechanical stress. Risk factors include certain circumstances and anatomical traits that make people more susceptible to ICR [5], as seen in the subsequent flowchart [Table/Fig-4].



[Table/Fig-4]: Risk factors for ICR.

Factors responsible for initiating ICR are enumerated in [Table/Fig-5] given by Arnett GW et al., (1996) [7]

A) Host Adaptive Factors

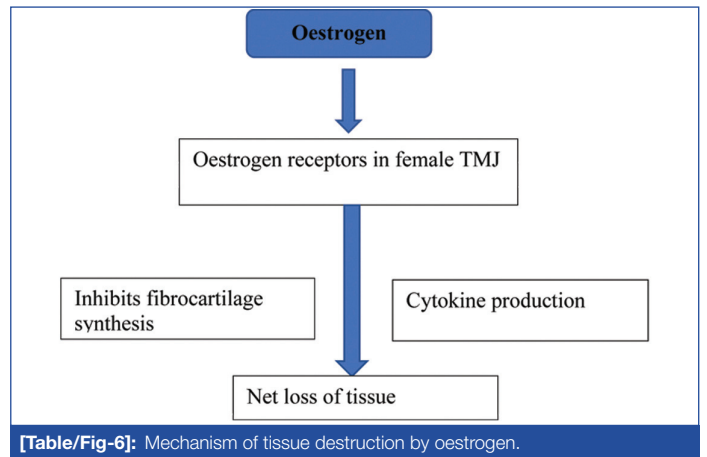
- 1) **Age:** The mean age of Progressive Condylar Resorption (PCR) is 20 years six months [8]. ICR usually occurs at a young age (20-30 years). This age is different from other degenerative diseases, which usually occur in late 50s and is secondary to reduced host adaptive capacity [7].
- 2) **Systemic illness:** Various systemic diseases influence the metabolism of condylar cartilage and can affect the capacity

A) Host adaptive factors	B) Mechanical stress
1) Age	1) Occlusal therapy
2) Systemic illness	2) Internal Derangement (ID)
3) Hormones	3) Parafunction
	4) Macro-trauma
	5) Unstable occlusion

[Table/Fig-5]: Aetiological factors of ICR.

of TMJ to adapt. The diseases are autoimmune disorders, endocrine disorders, nutritional disorders, metabolic disease, cardiovascular and blood disease, and psychological stress. Particularly, the autoimmune diseases are associated with condylar resorption [7]. Dick R and Jones DN (1973) studied 39 renal failure patients undergoing haemodialysis six patients (5 of 6 were asymptomatic) had condylar resorption which was related to hyperparathyroidism produced by haemodialysis [10].

- 3) **Hormones:** Hormonal factors have a great influence on remodelling of the condylar cartilage.
 - Sex hormones: Oestrogen receptors that are present in primate female TMJs are suggestive of a potential relationship between cellular activities caused by oestrogen and the prevalence of TMJ problems in females [7]. Abubaker AO et al., (1993) did a research on the human TMJs to check for oestrogen and progesterone receptors with the help of immune histochemical method. They found that around 72% of symptomatic females had oestrogen receptors and only 14% of asymptomatic females had oestrogen receptors in their TMJs [11]. Oestrogen increases the production of certain cytokines, which have been found in joint diseases. These cytokines allow the synthesis of certain matrix degrading enzymes by the local cell population. These matrix degrading enzymes cause the condylar remodelling [12]. The following flowchart depicts the cascade of ICR seen in females because of oestrogen hormone [Table/Fig-6].



[Table/Fig-6]: Mechanism of tissue destruction by oestrogen.

Oestrogen mediates pathological changes in the TMJ, causing excessive proliferation of the synovial tissues. This causes production of other destructive substrates that cause the breakdown of the TMJ ligaments that normally support and stabilise the articular disc in its position, which further causes the disc to become displaced anteriorly. The proliferated synovial tissue then attains a position around the head of the condyle, which causes further exposure of the condyle to the substrates that create the resorptive phenomenon [5].

- **Corticosteroids:** Corticosteroids have been reported to cause joint resorption [13]. Furstman L et al., (1965) reported that when the condylar cartilage becomes tapered, there is formation of osteosclerotic trabeculae and inhibition of normal calcification in rats subjected to exogenous hydrocortisone [14].
- **Parathyroid hormone:** This hormone also affects TMJ remodelling. Dick R and Jones DN studied 36 patients undergoing

haemodialysis and reported condylar resorption in six patients, which was secondary to hyperparathyroidism [10]. Therefore, parathyroid hormone could be a contributing factor in ICR.

B) Mechanical Factors

As dentists, occlusal therapy is the most relevant factor for us which initiates ICR and therefore, will be discussed in detail below.

- 1) **Occlusal therapy:** Occlusal therapy refers to the treatment modalities used to correct the occlusion. Dental procedures like third molar extractions, prosthetic care, fixed orthodontic treatment, orthognathic surgeries can produce heavy loading on the TMJ and cause ICR. It has been seen that orthodontic treatment can activate ICR in patients who have been asymptomatic, there are multiple case reports supporting this [7]. In a case report by Park et al., (2019), a patient (12-year-old female) with crowding and large overjet was reported to the clinic. The patient was treated successfully with fixed appliance along with fixed functional appliance (Forsus). However, after 10 months of treatment patient reported with a dull aching pain on both sides of the jaw and was diagnosed with ICR [15]. Handelman CS and Greene CS also reported two cases with ICR who were treated with combination of orthodontic treatment and orthognathic surgery [16]. Peltola JS et al., found condylar flattening in 9% of the patients after orthodontic treatment in 625 patients [17]. The occurrence rate of ICR after orthognathic surgery has also been reported with the rate being 5.8-20% [16]. A posterior inclined condylar neck has been considered as another contributing factor. Various studies have been done to see how and why ICR happens after surgery and factors during surgery influencing the amount of ICR [18,19]. The studies are mentioned in the following table [Table/Fig-7] [7,18,20-22].

The use of the Forsus fixed functional appliance in orthodontics has been increased due to its increased efficiency. Forsus was reported to increase the amount of posterior condyle repositioning during growth period in patients with Class-II Div I [23]. However, based on later studies conducted by Aidar LA et al., (2010), it was found that Forsus did not result in significant changes in condylar position [24].

- 2) **Articular disk and condyle relationship:** The relationship between Internal Derangement (ID) of the disc and remodelling of the condyle in adults is not studied very well. Hatcher DC in his study reported that disc displacement without reduction is seen with development of PCR [9]. However, it is unclear if displacement occurs before or after the progressive resorptive process begins.
- 3) **Parafunctional habits:** These produce compression of condyles in the fossa which initiates condylar resorption [25] or enhances the resorption, which is caused by other factors. It is possible that these parafunctional forces contribute to condylar resorption by mainly two mechanisms. First, because of the biomechanical

stress, it disrupts the integrity of articular tissue and inhibits important synthetic functions of affected cell populations. Excessive biomechanical stress can also damage capillary molecules physically in affected tissues. Second, the damage from excessive loading of TMJ is due to an ischaemic reperfusion injury [26].

- 4) **Macrotrauma:** Macrotrauma is one episode (compression or stretch) of large intensity force which is transmitted to the TMJ. This force is generally sufficient enough to acutely injure the affected articular tissues. The occlusion is not altered at the time of the macrotrauma. However, It has been seen that macrotrauma initiates condylar resorption [27]. Alterations in the TMJ occur over time after the episode of macrotrauma, leading to progressive mandibular retrusion (ICR). Resorption of this type has also been seen with removal of third molars [28], blows to the lower jaw without fracture [29] and certain orthognathic surgeries.
- 5) **Unstable occlusion:** This produces deflection and compression of the condyle when the teeth occlude. When maximal interdigitated position (CO) is produced with muscular forces, the condyle is compressed leading to ICR. The aetiology of ICR is multifactorial, and it is caused by the interaction of two factors, the adaptive capacity of the host and the mechanical stimulus [27].

CLINICAL EVALUATION AND DIAGNOSIS

A proper diagnosis of ICR requires a thorough patient history, clinical examination, and imaging modalities to confirm the diagnosis. On examining patients with ICR, they complain of gradual worsening of the occlusion and aesthetics (Chin moving behind) with symptoms in the TMJ and dull aching pain. TMJ sounds are absent sometimes because of the proliferated synovial tissue. Usually, the disease progression occurs on both the sides, and it is followed by a symmetric shift of the mandible (mandibular retrusion) posteriorly which leads to development of the skeletal Class-II occlusal relationship [30,31]. Patients with bilateral PCR usually develop a dolichofacial pattern. The overjet is increased and the lower incisors are retroclined [1]. The vertical ramal height is reduced [1] and posterior facial height is reduced, the mandibular plane angle is high. The presence of a small mandible and dolichofacial pattern contributes to posteroinferior repositioning of the tongue and suprahyoid tissues, which leads to reduced airway. Clinically, there is development of an anterior open bite as well (worsens with time) [15]. These clinical features help us in diagnosing ICR in our day to day orthodontic practice, and if ICR is suspected, it should be confirmed with radiographic imaging. The cascade of clinical features is mentioned in the following flowchart [Table/Fig-8].

However, when unilateral ICR occurs, decreased posterior facial height and skeletal Class-II is seen only on the side of the ICR. This leads to difference in the vertical height at the mandibular inferior

Studies	Results	Year	Place	Sample size
Arnett GW et al., (1996) [7]	Intraoperative condylar torquing and posteriorising during surgery leads to condylar resorption and late mandibular relapse	1996	Santa Barbara, California, USA	Review article
Scheerlinck JP and Stoelinga PJ (1994) [18]	Advancing mandible surgically <5 mm resulted in 2% of condylar resorption only. However, 10% of resorption was seen in 5-10 mm advancement and 67% of resorption when advancement was >10 mm concluding that with increase in the amount of mandibular advancement the chances of condylar resorption increases	1994	Catholic University of Leuven, Belgium	103
Joss CU and Vassalli IM (2009) [20]	Compared the stability of sagittal split osteotomy advancements between bi-cortical screws and miniplates. They found greater resorption (2-50.3%) in cases that were treated with bi-cortical	2009	Department of Orthodontics, University of Geneva, Geneva, Switzerland	Systematic review (24 articles included)
Xi T et al., (2015) [21]	The main differentiating factor between pathologic and non pathologic condylar resorption is the degree to which resorption has occurred. In the study by Xi T et al., it was seen that a 17% loss of the condylar volume was the threshold at which an anterior open bite occurred. They stated that a 17% loss of the condylar volume is the threshold value for diagnosing PCR. However, a larger sample size is needed to be more sure	2015	Department of Oral and Maxillofacial Surgery, Radboud University Nijmegen Medical Centre, Geert. Netherlands	56
NiNo-Sandoval TC et al., (2021) [22]	Bi-Jaw surgery is a risk factor for condylar resorption. Other factors like skeletal deformities, type of jaw movement, type of fixation can also contribute to the development of ICR	2021	Upe School of Dentistry, Brazil	An overview article

[Table/Fig-7]: Studies related to ICR after surgery.



[Table/Fig-8]: Clinical presentation of ICR.

border, ramus and occlusal plane and causes the midline to shift, leading to asymmetrical face [32]. These clinical feature help us in diagnosing ICR in our day to day orthodontic practice, and if ICR is suspected it should be confirmed with radiographic imaging. A 22-year-old girl with vertical growth pattern reported to our department with a history of upper left lateral incisor extraction who complaint of difficulty in chewing progressive movement of chin behind with asymmetry of face. After taking proper history on pain and associated symptoms she complained of pain in the temporomandibular area, she reported of nocturnal bruxism (which she was aware of) and joint sounds (clicking) on opening the mouth, all these symptoms and the radiographic imaging Orthopantomogram (OPG) which depicted condylar resorption confirmed the diagnosis of unilateral ICR. The asymmetry and vertical growth pattern can be well appreciated in the following picture [Table/Fig-9].



[Table/Fig-9]: A case of unilateral Idiopathic Condylar Resorption (ICR), note the chin deviation to patients right (original case).

RADIOGRAPHIC PRESENTATION AND DIAGNOSIS

Confirmation of clinical findings of ICR is made through the various imaging techniques, like OPG, lateral cephalogram, Magnetic Resonance Imaging (MRI) and Cone-Beam Computed Tomography (CBCT), however the diagnosis for the patient mentioned above was based on clinical history and OPG. The trigger to order imaging is mostly clinical symptoms which include pain in the temporomandibular area, clicking sounds, bruxism and progressive backward movement of the lower jaw.

Conventional Radiography

A) OPG: In cases of ICR, the condyle appears to have lost its mass and volume compared to the rest of the mandible, and the condyle thickness is reduced and shortened accompanied by flattening of anterosuperior curvature [33]. The OPG of the patient mentioned above is shown in the following picture [Table/Fig-10]. The diagnosis of ICR was confirmed through dental history of extraction of lateral incisors, after few months of which, the patient started having pain in the temporomandibular area and noticed progressive backward movement of jaw on one-side; she also complained of clicking sounds on opening and closing. The clinical findings were confirmed with an OPG where on the right side the condyle appears to have reduced in size. The treatment that was given to her was a stabilisation splint and the patient is under follow-up and her clinical symptoms have improved.

The panoramic radiographs are not very effective in diagnosing and monitoring ICR. They can only show gross changes of the condyle and don't provide us with a three dimensional view. Krajenbrink TG (1994) did a study on the radiographic and anatomic classification in dry mandibles [34]. The OPG revealed fewer changes in the articular surface compared to infra cranial or transcranial radiographs. The bony resorptive lesions did not affect the outer contour of the condyle completely, but it was evident that



[Table/Fig-10]: ICR of the right condyle with reduction in volume (orange arrow) can be appreciated in the OPG (original case- OPG).

flattening and erosions of the articular surface of the joints were detected much better on infra-cranial or transcranial radiographs compared to OPG. Therefore, he concluded that cranial views are better for diagnosing the condylar changes than OPG.

B) Cephalometric radiography: Lateral cephalogram shows mandibular divergence relative to cranial base and the maxilla, posterior facial height appears to be shortened, and anterior facial height increased in patients with ICR. Overjet is increased and a negative overbite is seen. Serial cephalometric radiographs are taken for diagnosis of ICR [13]. In a case report by Handelman CS and Greene CS, (2013) superimposition was done on the basion nasion plane, the articulare location was seen to reposition mesially when ICR was active [16]. On the succeeding cephalometric radiograph mandible showed an opening rotation.

Magnetic Resonance Imaging (MRI)

ICR may show disc displacement anteriorly which can be with or without reduction, and there is often a thick and unstructured-appearing soft tissue which occupies the interface between the condyle and fossa (hyperplastic synovial tissue) [35].

Cone-Beam Computed Tomography (CBCT)

Has better clarity and prevents any kind of super-imposition of the adjacent structures. CBCT allows the patient to be scanned with the patient sitting in an upright position. It also has a shorter scanning time, which reduces the effective radiation dose [36]. CBCT imaging techniques do not only measure the linear distances and angles between virtual cephalometric landmarks, but it also depicts the spatial and colour-coded map as mesh transparencies [37].

Role of CBCT in future investigations: A semi-automated method based on region based growing algorithm has been developed [37]. These algorithms allow fragmentation of the original data of CBCT images which is set by using the values of grayscale which is specific to condylar regions. Considering the shape of the condyle this method overcomes the low contrast resolution of grayscale value in CBCT scans. CBCT data also allows voxel-based superimposition of specific areas using the 3D data. Regions which are not subject to any changes after orthognathic surgeries are used as areas for registration of voxel-based superimposition. This method of regional superimposition of condyles with the help of voxel-based registration on the coronoid process may be helpful, as it is a region of the mandible in direct proximity to the condyles and is not likely to be affected by orthognathic surgery. The diagnosis of ICR is given only when all the other probable conditions have been ruled out. ICRs are frequently reported after orthognathic surgery [38], but ICR also occurs without a history of prior surgery. To better understand this condition, the research community needs more data. This can start with greater awareness amongst general dentists and oral and maxillofacial surgeons.

TREATMENT MODALITIES

Treatment for ICR is done mainly for two reasons. During the active stage of ICR, it is usually done for stopping the ICR from progressing.

If the treatment is done after the active progression of ICR has stopped, it is done to restore the dental occlusion and aesthetics of the patient. Variety of treatment options are available, which span from no treatment to a complete condylar replacement. Treatment of ICR usually begins with relieving the TMJ symptoms. Aspirin or Non Steroidal Anti-Inflammatory Drugs (NSAIDs) are commonly prescribed to relieve the pain, while muscle relaxants can be used to relieve muscle symptoms. Therapeutic exercises and steroid injections in the intra-articular space may be applied. Following this final occlusal treatment (Orthodontics, restorative therapy, and/or corrective jaw surgery) may be useful [39]. Splint therapy helps to prevent continuation of ICR and relieves the uneasiness and muscle hyperactivity. Hard acrylic material is preferred as a soft material isn't thick enough to cover the area of the open bite [1].

Orthognathic Surgery

This is done to treat ICR; however if ICR is in the active stage at the time of surgery, the chances of relapse is reportedly very high [40,41]. Surgical options range from bilateral split sagittal osteotomies to joint replacement completely, especially in case of severely resorbed condyles. Posnick JC and Fantuzzo JJ states that orthognathic surgeries and orthodontics are successful only if the active resorption has been stable for at least one year. If the ICR is in the active stage it is advised to postpone the orthognathic surgery [41].

Wolford LM and Cardenas L reported (1999) a treatment protocol for the discs that are still reparable. The stages of treatment includes: (1) removing pathological disc tissue which surrounds the condyle; (2) mobilising, relocating, and then attaching and stabilising the disc to the condyle using an anchor known as Mitek's anchor; it can be seen in following figure [Table/Fig-11]; (3) maxillary and mandibular orthognathic surgeries are performed which rotates the maxillomandibular complex in counter clockwise direction [4] additive surgical procedures like genioplasty is done as indicated. Two cases (First case of a 15-year-old girl who was undergoing orthodontic treatment and developed a significant joint deformity with mandible being more retruded and progressive open bite and a second case of girl who was 16-year-old was referred to the department as her lower jaw shifted to left-side and she developed a Class-II malocclusion with progressive open bite) were treated by this treatment protocol (mentioned above) by Wolford LM and Cardenas L (1999) and they were able to achieve predictable and stable outcomes [1].



[Table/Fig-11]: Mitek's anchor used for stabilising the articular disc (self-made).

Complete Condylectomy and Reconstruction with the Costochondral Graft is done for treating the active stage of ICR, where condyle has resorbed completely and needs replacement. Troulis MJ et al., (2008) reported study where 15 patients (mean age was 24 years) were in the active stage of ICR bilaterally, they were treated by condylectomy and reconstruction using costochondral graft [40]. The authors reported that during postoperative follow-up (mean 34 months), all patients had a stable and Class-I occlusion.

Alloplastic Joint Replacement

Mercuri LG (2007) advises the use of an artificial material for joint replacement in last stage of diseased joints [31]. Artificial joint guarantees removal of the diseased parts with no morbidity at donor site and immediate rehabilitation. One of the issues with the artificial joints is that it does not allow future growth and therefore the growth maybe retarded. In a case report by Chung CJ et al., (2011), a patient with skeletal Class-II open-bite malocclusion which was secondary to ICR was treated by joint reconstruction using alloplastic joint and it provided a satisfying outcome with maximum aesthetic improvement [42].

Orthodontic Treatment Protocols

Treating the orthodontic patients reported with ICR can be challenging due to constant change of the occlusion which is secondary to the unstable position of the condyle in the TMJ. An unstable position of the condyle can lead to misleading diagnosis during orthodontic evaluation, therefore TMJ should be stabilised with a splint before orthodontic and/or orthognathic treatment. The stabilisation splint banishes the protective co-contraction and produces a functional occlusion. Therefore, a stable position of the TMJ musculo-skeletally can be achieved. Using splints in the patients who have disc displacement promotes formation of a "pseudo-disc". Conventionally, open bite is treated with an orthognathic surgery, and it is the most common approach. However, molar intrusion using orthodontic Temporary Skeletal Anchorage Devices (TSADs) can improve the occlusion as well as the facial aesthetics for severe anterior open bite patients. The intrusion of the maxillary molar to allow a counter-clockwise rotation of the mandible and eliminate the anterior vertical problem can also be done with a combination of Trans-Palatal Arch (TPA) and of TSADs [33]. In a case report by Lee GH et al., a patient with Class-II malocclusion and anterior open bite with PCR was treated using a treatment protocol, which included a stabilisation splint followed by postsplint analysis to allow for definitive orthodontic diagnosis [43]. A comprehensive treatment protocol for ICR with anterior open bite was made with 3D surgical planning and self-ligated brackets which was reported in a case report by Rahman F et al., (2019) [44].

A summary of treatment options for ICR given by Collet T et al., (2020) is mentioned in the following table [Table/Fig-12] [45].

No treatment (given no TMD)
Conservative treatment approach (splints, orthodontic treatment alone)
3) Mandibular orthognathic surgery accompanied by genioplasty
4) Bimaxillary orthognathic surgery
5) Orthognathic surgery including bilateral TMJ autogenous or prosthetic joint reconstruction

[Table/Fig-12]: Treatment options for ICR.

Management of the Patient PCR/ICR and the Legal Implications

Although PCR/ICR is a serious medical condition it is not mandatory to inform every patient that PCR/ICR can occur before you start treating the patient, as its incidence is very rare- around one case per 5000 patients. What has to be done when ICR is detected and the patient is still undergoing the orthodontic treatment? First rule: The treatment should be discontinued and retained in the same stage. It is very important to monitor the patient regularly (every six months) and take cephalometric radiographs and CBCT scans yearly. Once the ICR is stable and condyle has healed and the occlusion is stable, orthodontic treatment should be discussed with the patient party [16].

CONCLUSION(S)

Idiopathic Condylar Resorption is a disease with multifactorial aetiology and it has still not been understood completely. Diagnosing and treating this condition as soon as possible will minimise the amount of damage to the condyle. Orthodontists should always

provide all the treatment options to the high risk patients and the patients who are diagnosed with ICR during any stage of orthodontic treatment which includes the retention phase. It is very important that the orthodontist make informed choices regarding the diagnosis and management of patients who are diagnosed with this rare and incompletely understood disease.

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REFERENCES

- Wolford LM, Cardenas L. Idiopathic condylar resorption: Diagnosis, treatment protocol, and outcomes. *Am J Orthod Dentofac Orthop.* 1999;116(6):667-77.
- Sansare K, Raghav M, Mallya SM, Karjodkar F. Management-related outcomes and radiographic findings of idiopathic condylar resorption: A systematic review. *Int J Oral Maxillofac Surg.* 2015;44(2):209-16.
- Burke PH. A case of acquired unilateral mandibular condylar hypoplasia. *Proc R Soc Med.* 1961;54(6):507-10.
- Chamberland S. Progressive idiopathic condylar resorption: Three case reports. *Am J Orthod Dentofac Orthop.* 2019;156(4):531-44.
- Wolford LM. Idiopathic condylar resorption of the temporomandibular joint in teenage girls (cheerleaders syndrome). *Proc (Bayl Univ Med Cent).* 2001;14(3):246-52.
- Tanaka E, Detamore MS, Mercuri LG. Degenerative disorders of the temporomandibular joint: Etiology, diagnosis and treatment. *J Dent Res.* 2008;87(4):296-307.
- Arnett GW, Milam SB, Gottesman L. Progressive mandibular retrusion-idiopathic condylar resorption. Part I. *Am J Orthod Dentofac Orthop.* 1996;110(1):08-15.
- Pufe T, Harde V, Peterson W, Goldring MB, Tillmann B, Mentlein R. Vascular Endothelial Growth Factor (VEGF) induces matrix metalloproteinase expression in immortalized chondrocytes. *J Pathol.* 2004;202:367-74.
- Hatcher DC. Progressive condylar resorption: Pathologic processes and imaging considerations. *Semin Orthod.* 2013;19:97-105.
- Dick R, Jones DN. Temporomandibular joint condyle changes in patients undergoing chronic haemodialysis. *Clin Radiol.* 1973;24:72-76.
- Abubaker AO, Raslan WF, Sotereanos GC. Estrogen and progesterone receptors in temporomandibular joint discs of symptomatic and asymptomatic persons: A preliminary study. *J Oral Maxillofac Surg.* 1993;51(10):1096-100.
- Cutolo MA, Sulfi A, Barone A, Seriola B, Accardo S. Macrophages, synovial tissue and rheumatoid arthritis. *Clin Exper Rheum.* 1993;11:331-39.
- Forslund G, Bjurwill B, Orrling S. Bilateral absorption of the capitulum mandibulae in rheumatoid arthritis. *Acta Odontol Scand.* 1961;19:247-57.
- Furstman L, Bernick S, Zipkin I. The effect of hydrocortisone and fluoride upon the rat's mandibular joint. *J Oral Therap Pharm.* 1965;1:515-25.
- Park JH, Park JJ, Papademetriou M, Suri S. Anterior open bite due to idiopathic condylar resorption during orthodontic retention of a Class-II Division 1 malocclusion. *Am J Orthod Dentofac Orthop.* 2019;156(4):555-65.
- Handelman CS, Greene CS. Progressive/idiopathic condylar resorption: An orthodontic perspective. *Semin Orthod.* 2013;19:55-70.
- Peltola JS, Nystrom M, Kononen M, Wolf J. Radiographic structural findings in the mandibular condyles of young individuals receiving orthodontic treatment. *Acta Odontol Scand.* 1995;53(2):85-91.
- Scheerlinck JP, Stoelting PJ. Sagittal split advancement osteotomies stabilized with miniplates 2-5 years follow up. *Int J Oral Maxillofac Surg.* 1994;23:127-31.
- Christof UJ, Isabella MV. Stability after bilateral sagittal split osteotomy advancement surgery with rigid internal fixation: A systematic review. *J Oral Maxillofac Surg.* 2009;67:301-13.
- Joss CU, Vassalli IM. Stability after bilateral sagittal split osteotomy advancement surgery with rigid internal fixation: A systematic review. *J Oral Maxillofac Surg.* 2009;67(2):301-13.
- Xi T, Schreurs R, Van Loon B, de Koning M, Berge S, Hoppenreijts T. 3D analysis of condylar remodelling and skeletal relapse following bilateral sagittal split advancement osteotomies. *J Craniomaxillofac Surg.* 2015;43:462-68.
- NiNo-Sandoval TC, Almeida RAC, Vasconcelos BCDE. Incidence of condylar resorption after bimaxillary, Lefort I, and mandibular surgery: An overview. *Braz Oral Res.* 2021;12:35-37.
- Arici S, Akan H, Yakubov K, Arici N. Effects of fixed functional appliance treatment on TMJ. *Am J Orthod Dentofac Orthop.* 2008;133:809-14.
- Aidar LAA, Dominguez GC, Yamashita HK, Abrahao M. Changes in temporomandibular joint disc position and form following Herbst and fixed orthodontic treatment. *Angle Orthod.* 2010;80(5):843-52.
- Stegenga B, Bont LG, Boering G, Van Willigen JD. Tissue responses to degenerative changes in the temporomandibular joint: A review. *J Oral Maxillofac Surg.* 1991;49:1079-88.
- McCord JM. Oxygen-derived radicals link between reperfusion injury inflammation. *Fed Proc.* 1987;46:2402-06.
- Arnett GW. A redefinition of Bilateral Sagittal Osteotomy (BSO) advancement relapse. *Am J Orthod Dentofac Orthop.* 1993;104:506.
- Arnett GW, Tamborello JA. Progressive class development female idiopathic condylar resorption. In: West RA, ed. *Oral maxillofacial clinics of North America.* Philadelphia: WB Saunders. 1990:699-716.
- Susami T, Kuroda T, Yano Y, Nakamura T. Growth changes and orthodontic treatment in a patient with condylolysis. *Am J Orthod Dentofac Orthop.* 1992;102:295-301.
- Huang YL, Pogrel MA, Kaban LB. Diagnosis and management of condylar resorption. *J Oral Maxillofac Surg.* 1997;55:113-14.
- Mercuri LG. A rationale for total alloplastic temporomandibular joint reconstruction in the management of idiopathic/progressive condylar resorption. *J Oral Maxillofac Surg.* 2007;65(8):1600-09.
- Mehra P, Nadershah M, Chigurupati R. Is alloplastic temporomandibular joint reconstruction a viable option in the surgical management of adult patients with idiopathic condylar resorption? *J Oral Maxillofac Surg.* 2016;74:2044-54.
- Young A. Idiopathic condylar resorption: The current understanding in diagnosis and treatment. *J Indian Prosthodont Soc.* 2017;17(2):128-35.
- Krajenbrink TG. The silhouette of the mandibular condyle on radiographs [thesis, University of Groningen]. Alphen aan de Rijn, Apress, 1994.
- Abramowicz S, Cheon JE, Kim S, Bacic J, Lee EY. Magnetic resonance imaging of temporomandibular joints in children with arthritis. *J Oral Maxillofac Surg.* 2011;69(9):2321-28.
- Ludlow JB, Ivanovic M. Comparative dosimetry of dental CBCT devices and 64-slice CT for oral and maxillofacial radiology. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2008;106(1):106-14.
- Tsiklakis K, Syriopoulos K, Stamatakis HC. Radiographic examination of the temporomandibular joint using cone beam computed tomography. *Dento Maxillofac Radiol.* 2004;33:196-201.
- Hoppenreijts T, Maal T, Xi T. Evaluation of condylar resorption before and after orthognathic surgery. *Semin in Orthod.* 2013;90:106-15.
- Huang YL, Pogrel MA, Kaban LB. Diagnosis and management of condylar resorption. *J Oral Maxillofac Surg.* 1997; 55:113-14.
- Troulis MJ, Tayebaty FT, Papadaki M, Williams WB, Kaban LB. Condylectomy and costochondral graft reconstruction for treatment of active idiopathic condylar resorption. *J Oral Maxillofac Surg.* 2008;66(1):65-72.
- Posnick JC, Fantuzzo JJ. Idiopathic condylar resorption: Current clinical perspectives. *J Oral Maxillofac Surg.* 2007;65:16-17.
- Chung CJ, Choi YJ, Huh JK, Kim HG, Kim KH. Total alloplastic temporomandibular joint reconstruction combined with orthodontic treatment in a patient with idiopathic condylar resorption. *Am J Orthod Dentofac Orthop.* 2011;140:404-17.
- Lee GH, Park JH, Lee SM, Moon DN. Orthodontic treatment protocols for patients with idiopathic condylar resorption. *J Clin Pediatr Dent.* 2019;43(4):292-303.
- Rahman F, Celebi AA, Louis PJ, Kau CH. A comprehensive treatment approach for idiopathic condylar resorption and anterior open bite with 3D virtual surgical planning and self-ligated customized lingual appliance. *Am J Orthod Dentofac Orthop.* 2019;155(4):560-71.
- Collett T, Chen L, Pritchett R, Poon C. A case of idiopathic condylar resorption. *Aust Orthod J.* 2020;36:195-204.

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