International Journal Dental and Medical Sciences Research
Volume 7, Issue 6, Nov.-Dec. 2025 pp: 302-305 www.ijdmsrjournal.com ISSN: 2582-6018

Condylar Sag Following Orthognathic Surgery: A Literature Review

Dr Anup Kumar Singh[1], Dr Anu Bharti [2]
[1]*Dept of Oral & Maxillofacial Surgery, Govt Dental Centre, Yol, India*
[2]*Dept of Orthodontics & Dentofacial Orthopaedics, Govt Dental Centre, Mathura, India*

ABSTRACT: Condylar sag is a recognized complication following orthognathic surgery, particularly bilateral sagittal split ramus osteotomy (BSSO) and may result in postoperative malocclusion, temporomandibular joint (TMJ) dysfunction, pain, and long-term skeletal relapse. Despite advances in rigid fixation techniques, virtual surgical planning, and intraoperative verification protocols, condylar displacement remains a clinically relevant problem. Failure to detect and manage this condition appropriately can lead to progressive condylar resorption and compromised long-term outcomes. This literature review discusses contemporary international literature on the aetiology, pathophysiology, diagnosis, prevention, and management of condylar sag following orthognathic surgery, with emphasis on imaging-based assessment, risk stratification, and evidence-guided therapeutic strategies.

I. INTRODUCTION

Orthognathic surgery is widely accepted as a definitive modality for the correction of moderate to severe dentofacial deformities, providing predictable improvements in facial aesthetics, occlusal function, and quality of life [1]. Over recent decades, refinements in surgical technique, fixation methods, and perioperative care have improved outcomes and reduced complication rates [2]. Nevertheless, postoperative instability related to alterations in mandibular condylar position remains a persistent challenge in maxillofacial surgery [3]. Condylar sag refers to inferior, posterior, or rotational displacement of the mandibular condyle within the glenoid fossa following surgical manipulation of the mandible. It is the immediate or late caudal movement of condyle in glenoid fossa after surgical establishment of a preplanned occlusion and rigid fixation of bone fragments leading to a change in the occlusion.

It is most frequently reported following BSSO but has also been described after intraoral vertical ramus osteotomy and bimaxillary orthognathic procedures. Clinically significant condylar sag may manifest as postoperative malocclusion, mandibular deviation, restricted mouth opening, TMJ pain, or joint sounds. In severe or unrecognised cases, sustained abnormal joint loading may progress to condylar resorption and skeletal relapse, undermining the stability of the surgical correction. This review aims to provide an expanded synthesis of current evidence relevant to readership.

AETIOLOGY AND PATHOPHYSIOLOGY

The aetiology of condylar sag is multifactorial and encompasses mechanical, biological, and patient-specific factors [4]. Mechanical causes are most implicated and include improper seating of the proximal segment, inadequate control of the proximal segment during fixation, excessive torque during screw placement, and interference between fixation plates and the condylar neck [3]. During BSSO, rotation or posterior displacement of the proximal segment may occur if fixation is applied while the condyle is not fully seated in the glenoid fossa [2]. Biological factors contribute significantly to the progression from transient displacement to pathological condylar resorption [1]. Altered biomechanical loading of the TMJ following orthognathic surgery may induce inflammatory changes, cartilage degradation, and subchondral bone remodeling [5]. While adaptive remodeling is physiological in many patients, excessive or prolonged loading may exceed the adaptive capacity of the condyle, leading to progressive resorption [6]. Patient-related risk factors include female sex, younger age, high mandibular plane angle, large mandibular advancement or setback, counterclockwise rotation of the maxillomandibular complex, and pre-existing TMJ disorders [7]. Hormonal influences and reduced bone density have been proposed as contributing factors in susceptible patients [8,9].

TYPES OF CONDYLAR SAG

Two types of condylar sag may occur:

(a) Central
(b) Peripheral
(i) Type I
(ii) Type II

In central condylar sag, condyle is positioned inferiorly in the glenoid fossa and makes no contact with any part of the fossa. In the absence of intracapsular edema or hemarthrosis the condyle will move superiorly after removal of maxillomandibular fixation leading to malocclusion.

International Journal Dental and Medical Sciences Research
Volume 7, Issue 6, Nov.-Dec. 2025 pp: 302-305 www.ijdmsrjournal.com ISSN: 2582-6018

This type of sag produces repeatable patterns of occlusal shift that will help the surgeon identify the offending condyle.

Type I Peripheral sag occurs when condyle is positioned inferiorly with some fossa contact either at medial, lateral, posterior or anterior with the maxillomandibular fixation in position and rigid fixation placed. This type of condylar malpositioning provides physical support to the occlusion. Postoperative resorption or change in condylar shape will lead to late relapse. This type of sag is difficult to diagnose intraoperatively because the contact between condyle and glenoid fossa supports the occlusion.

Type II Peripheral sag occurs when condyle is positioned correctly in the fossa with the maxillomandibular fixation in position, however with the placement of rigid fixation, a torquing force is applied to the condyle and ramus of the mandible. The tension on the ramus is released when the maxillomandibular fixation is removed and the condyle either moves laterally or medially and slide inferiorly in the fossa. It is possible to diagnose central and Type II peripheral condylar sag intraoperatively immediately after removal of maxillomandibular fixation [3].

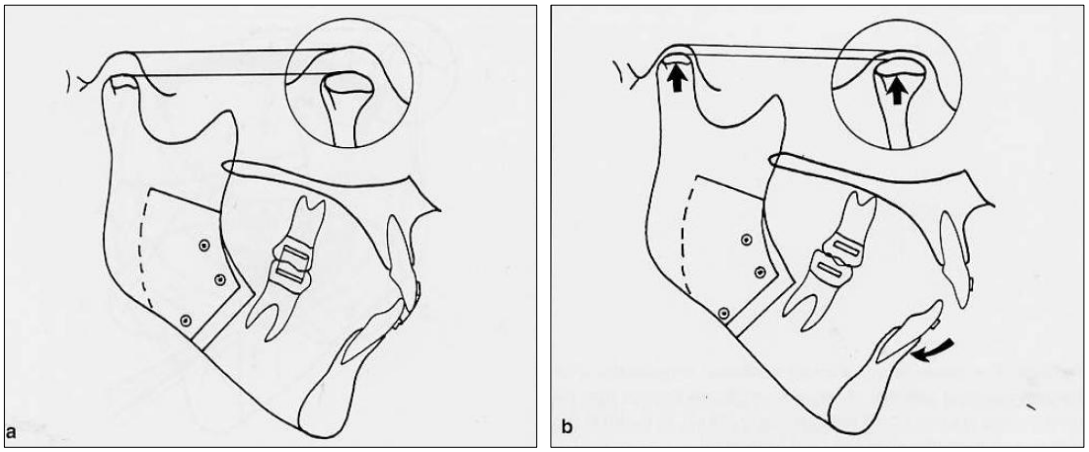

Fig 1: (a) Central condylar sag. The condyle is positioned inferiorly in the glenoid fossa while in maxillomandibular rigid fixation. (b) After removal of rigid fixation, the condyle moves superiorly leading to immediate relapse.

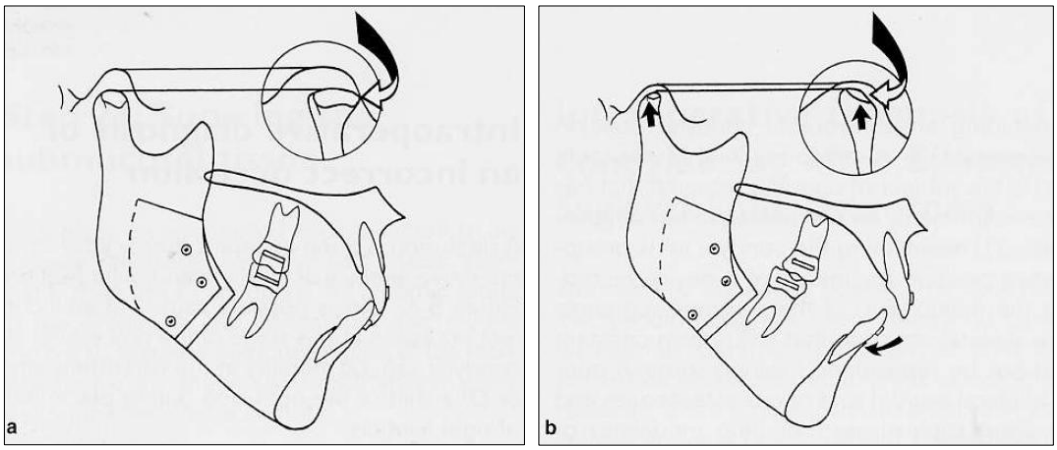

Fig 2: (a) Type I peripheral condylar sag. The condyle is displaced inferiorly with contact at one surface of fossa. (b) Postoperatively condylar resorption will lead to superior positioning of the condyle leading to relapse (broad arrow depicts anterior open bite).

DIAGNOSIS AND IMAGING ASSESSMENT

Early and accurate diagnosis of condylar sag is essential for successful management. Clinically, suspicion is raised by immediate or early postoperative occlusal discrepancies, midline deviation, changes in mandibular range of motion, and new-onset TMJ symptoms [1]. However, clinical examination alone lacks sensitivity and specificity

for definitive diagnosis [10]. Cone-beam computed tomography (CBCT) has become the imaging modality of choice for postoperative assessment of condylar position [11]. Three-dimensional evaluation allows objective quantification of linear, angular, and volumetric changes of the mandibular condyle relative to the glenoid fossa [1]. Serial imaging at preoperative, immediate postoperative, and follow-up intervals is recommended to differentiate transient adaptive changes from progressive condylar resorption [11]. Magnetic resonance imaging is indicated in selected cases where disc displacement, joint effusion, or inflammatory pathology is suspected [11,12]. Standardized imaging protocols and reproducible landmarks are essential to improve inter-study comparability and clinical decision-making [13].

PREVENTION STRATEGIES

Prevention of condylar sag begins with meticulous surgical technique and careful intraoperative handling of the proximal segment [14]. Manual seating of the condyle combined with temporary intermaxillary fixation prior to definitive fixation remains a widely practiced method [1]. Verification of occlusion before and after fixation is critical to detect early positional discrepancies. The introduction of virtual surgical planning and patient-specific surgical guides has improved accuracy in orthognathic surgery [1]. Condylar positioning devices have been proposed to standardise proximal segment positioning; however, current evidence suggests that while these devices may reduce rotational discrepancies, their routine use has not been definitively shown to improve long-term clinical outcomes compared with careful manual positioning. Balanced fixation techniques, avoidance of excessive fixation torque, and awareness of plate-condyle interaction are essential preventive measures [15,16].

MANAGEMENT OF CONDYLAR SAG

Management of condylar sag should be individualised based on timing, severity, and associated clinical findings [17]. When condylar sag is detected intraoperatively, immediate correction by re-seating the condyle and refixation is the preferred approach, as it allows restoration of normal joint position without compromising skeletal stability [3] Early postoperative condylar sag, typically within the first two to four weeks, may present with occlusal discrepancy and radiographic evidence of condylar displacement [1]. In such cases, selective loosening or removal of fixation hardware has been advocated to allow spontaneous re-seating of the condyle [18,19]. This approach is commonly combined with occlusal splints, guiding elastics, or short-term intermaxillary fixation to maintain occlusal stability during healing [20]. Conservative management is appropriate for mild displacement or predominantly symptomatic cases without significant mechanical malposition [17]. This includes occlusal splint therapy, non-steroidal anti-inflammatory medication, physiotherapy, and close clinical and radiographic monitoring [20]. Patients demonstrating progressive condylar resorption require escalation of care [8]. Minimally invasive procedures such as arthrocentesis or arthroscopy may address intra-articular pathology and reduce symptoms [21]. In advanced cases with significant structural loss, reconstructive procedures using autogenous or alloplastic TMJ prostheses may be required.

II. DISCUSSION

Despite extensive descriptive literature, the management of condylar sag remains supported primarily by retrospective studies and expert opinion [17]. There is a notable lack of randomized controlled trials comparing preventive measures and management strategies [17]. Nevertheless, consistent themes emphasise the importance of early detection, imaging-guided diagnosis, and timely intervention [11]. Differentiating transient adaptive remodeling from pathological condylar resorption is critical to avoid overtreatment or delayed intervention [8]. Advances in three-dimensional imaging analysis and artificial intelligence-based predictive models show promise for future risk stratification and early diagnosis [7]. Prospective multicentre studies using standardised imaging protocols and objective outcome measures are required to establish evidence-based clinical guidelines.

III. CONCLUSION

Condylar sag following orthognathic surgery is a multifactorial complication with potentially significant functional and occlusal consequences. Prevention through meticulous intraoperative technique and early recognition is of paramount importance. Management strategies should be tailored according to timing and severity, ranging from immediate correction and early hardware adjustment to conservative therapy or reconstructive surgery in advanced cases. The use of corrective measures intraoperatively may substantially reduce the complication rate of condylar sag.

REFERENCES

[1]. Proffit WR, White RP. Surgical-orthodontic treatment. Mosby; 2015.

[2]. Bell WH. Surgical correction of dentofacial deformities. Saunders; 2017.
[3]. Reyneke JP, Ferretti C. Intraoperative diagnosis of condylar sag after bilateral sagittal split ramus osteotomy. Br J Oral Maxillofac Surg. 2002;40(4):285-92.
[4]. De Moraes PH, Rizzati-Barbosa CM, Olate S, Moreira RW, De Moraes M. Condylar Resorption After Orthognathic Surgery: A Systematic Review. Int J Morphol. 2012 ;30(3):1023-1028.
[5]. Son HW, Park SH, Cho HO, Shin YJ, Son JH. Epinephrine-induced lactic acidosis in orthognathic surgery: a report of two cases. J Korean Assoc Oral Maxillofac Surg. 2016;42(5):295-300.
[6]. Petronis Z, Janovskiene A, Rokicki JP, Razukevicius D. Three-Dimensional Mandibular Condyle Remodeling Post-Orthognathic Surgery: A Systematic Review. Medicina. 2024; 60(10):1683.
[7]. Arnett GW, Milam SB, Gottesman L. Progressive mandibular retrusion-idiopathic condylar resorption. Part I. Am J Orthod Dentofacial Orthop. 1996;110(1):8-15.
[8]. Wolford LM. Condylar resorption after orthognathic surgery. J Oral Maxillofac Surg. 2003;61:735–48.
[9]. Verhelst PJ, Janssens S, Matthews H, Begnoni G, Claes P, Shaheen E, Peeters H, Politis C, Jacobs R. Analysis and prediction of condylar resorption following orthognathic surgery. Sci Rep. 2025;15(1):664.
[10]. Kim YJ. Postoperative TMJ symptoms after BSSO. J Oral Maxillofac Surg. 2021;79:121–29.
[11]. Shi J, Lin G, Bao R, Zhang Z, Tang J, Chen W et al. An automated method for assessing condyle head changes in patients with skeletal class II malocclusion based on Cone-beam CT images. Dentomaxillofac Radiol. 2024;53(5):325-35.
[12]. Han Y. CBCT evaluation of condylar position after orthognathic surgery. J Oral Maxillofac Surg. 2022;80:348–56.
[13]. Larheim TA, Abrahamsson AK, Kristensen M, Arvidsson LZ. Temporomandibular joint diagnostics using CBCT. Dento Maxillo Facial Radiology. 2015;44(1):14-35.
[14]. Bell WH, et al. Condylar positioning in orthognathic surgery. J Oral Surg. 1980;38:1–15
[15]. Straub A, Gubik S, Kübler A, Breitenbuecher N, Vollmer A, Renner T et al. Comparison of Patient-Specific Condylar Positioning Devices and Manual Methods in Orthognathic Surgery: A Prospective Randomized Trial. J Clin Med. 2024;13(3):737.
[16]. Leader R, Carty O. Condylar re-positioning devices in orthognathic surgery – is there a benefit to their use? J Oral Maxillofac Surg. 2023;81(6):1123–32.
[17]. Jang WS, Byun SH, Cho SW, Park IY, Yi SM, Kim JC et al. Correction of Condylar Displacement of the Mandible Using Early Screw Removal following Patient-Customized Orthognathic Surgery. J Clin Med. 2021;10(8):1597.
[18]. Faria-Teixeira MC, Azevedo-Coutinho F, Serrano ÂD, Yáñez-Vico RM, Salvado E Silva F, Vaz-Carneiro A, Iglesias-Linares A. Orthognathic surgery-related condylar resorption in patients with skeletal class III malocclusion versus class III malocclusion: a systematic review and meta-analysis. BMC Oral Health. 2025;25(1):72.
[19]. Okeson JP. Management of temporomandibular disorders. Elsevier; 2020.
[20]. Dimitroulis G. Management of TMJ disorders. Aust Dent J. 2018;63(Suppl 1):S53–S58.
[21]. Wolford LM, Cardenas L. Surgical management of condylar resorption. J Oral Maxillofac Surg. 2014;72:943–55.