Temporomandibular Joint Hypermobility Disorders

18

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18.1 Introduction

Hypermobility of the temporomandibular joint (TMJ) is characterized by mandibular condyle having greater than normal range of motion (ROM) that can occur naturally in otherwise normal individual indicating a sign of joint instability. Several extrinsic or intrinsic predisposing factors are known to contribute to this condition (Table 18.1). Conservative methods of management should be initiated in such patients before considering the patients for surgery [1, 2].

While performing unstrained/normal mouth opening, the condylar head translates forward and stops in a position under the articular eminence. In hypermobility it translates anteriorly beyond the eminence (Fig. 18.1). Hypermobility disorders may be subdivided into subluxation and dislocation. Temporomandibular joint dislocation involves a non self-limiting displacement of the condyle, outside of its functional position within the glenoid fossa and posterior slope of the articular eminence [3]. Dislocation may be unilateral and/or bilateral (Table 18.2), acute or chronic. Chronic dislocation may further be divided into protracted or recurrent (Adekeye et al.) [3]. In subluxation, the joint is transiently displaced without complete loss of the articulating function and is self reducible by the patient at most instances.

Table 18.1 The various intrinsic and extrinsic factors for temporomandibular joint dislocation

Intrinsic factors (Related to joint structure or function)	Extrinsic factors (Systemic or other factors not related to joint architecture)
Laxity of ligaments, capsule and abnormality of skeletal structure	Previous injury to the mandible, occlusal disharmonies
Flattened eminence and/or shallow fossa	Ehlers-Danlos or other connective tissue diseases, neurodegenerative or neurodysfunctional diseases including epilepsy and Parkinson disease, Muscle dystrophies or dystonias (extra-pyramidal reactions)
Injury to the joint altering the joint anatomy and function	Anti-psychotic and neuroleptic drugs

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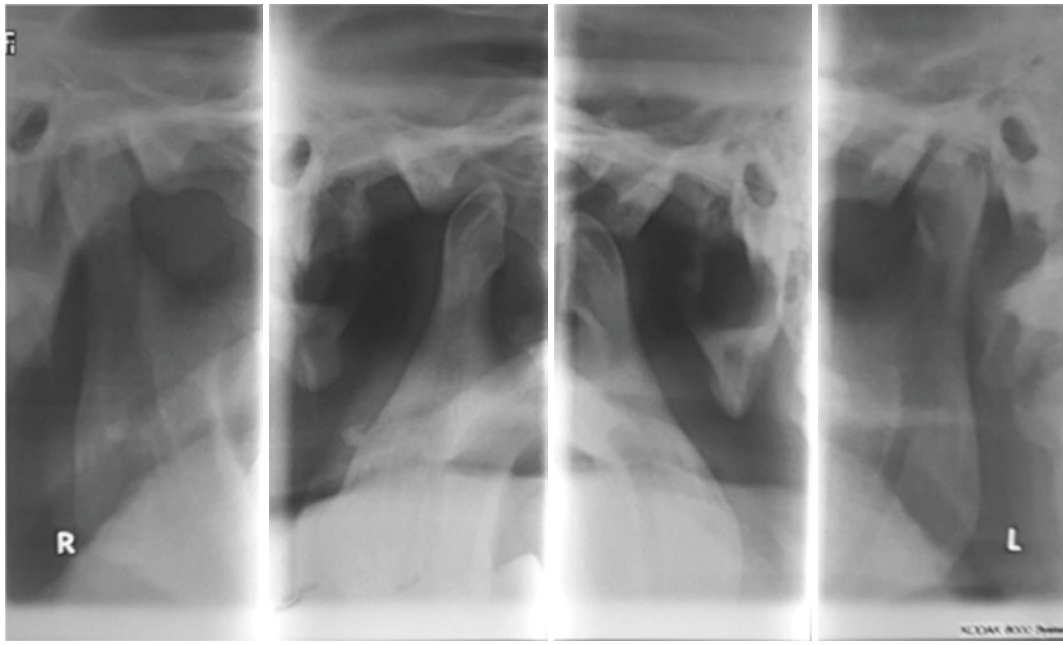


Fig. 18.1 TMJ tomogram depicting the position of condylar head during open and closed mouth position showing the condyle placed much anterior to the articular eminence during mouth opening. (Picture Courtesy: Dr. Darpan Bhargava, TMJ Consultancy Services, Bhopal, India)

Table 18.2 Clinical features of unilateral and bilateral temporomandibular joint dislocation

Unilateral acute dislocation	Bilateral acute dislocation
Difficulty in speech, mastication, deglutition Drooling of saliva Deviation of chin with lateral cross and open bite to the contralateral side Affected condylar movements may not be palpable. A depression may be noted in front of the tragus	Pain Inability to close mouth Contracted masticatory muscles Speech difficulty Excessive salivation and drooling Gagging of molar teeth with anterior open bite

Table 18.3 Classification of temporomandibular joint hypermobility (Rowe and Killey)

Sub-luxation	**Dislocation** (non self-reducing)	
Reduces spontaniously or usually self-reduced by the patient	*Acute*	*Chronic*
	Isolated	
	Recurrent	

In unilateral dislocation, deviation of the midline to the contralateral side with an ipsilateral open bite will be evident. Whereas bilateral dislocation is a more advanced hyper-translation where both the condyle locks out anterior to the eminence to a position where it cannot be self-reduced. Subluxation is the abnormal anterior excursion of condyle beyond the articular eminence where the patient can manipulate the joint back into normal position. It occurs when the condyle translates anterior to its normal range and the patient exhibits a temporary locking sensation that either abates spontaneously or can be reduced with manual self-manipulation. An incomplete recurrent, self-reducing, habitual dislocation is known as chronic subluxation (Table 18.3).

18.2 Clinical Examination

Clinical evaluation should include obtaining a history followed by examination of the patient. The common clinical features seen in dislocation

include pre-auricular hollowing on maximal ROM, inability to close the mouth (open lock) caused by posterior disc displacement and reactive muscle spasm, difficulty in speech, drooling of saliva secondary to incompetent lips. The classic "click" in the terminal phases of mouth opening can be a sign of subluxation (a palpable preauricular feel of the condyle slipping at the eminence anterioly, on complete mouth opening). Chronic subluxation may become symptomatic, with pain as a presenting feature. Major cause of pain in subluxation is the compression of the intervening tissue between the condylar head and the height of the eminence along with the undue stretch in the retrodiscal area.

In acute dislocation, pain in the pre-auricular and temporal region may be present, but it is rarely a presenting feature in chronic recurrent dislocation. Emptiness in the joint space can be felt on palpation over the pre-auricular region. Predisposing factors for acute dislocation could be excessive mouth opening upon yawning, vomiting, laughing, prolonged dental procedures, facial trauma, epileptic attacks, and direct laryngoscopy [4, 5]. Acute dislocations are one time events, which when managed appropriately pose no long-term problems. Chronic dislocation include events of acute dislocations that are not self-reducing and require interceptive treatment to prevent its progession to chronic recurrent dislocations, which are non-self reducing and occur very frequently. Patients with Ehlers-Danlos or other connective tissue diseases, neurodegenerative or neurodysfunctional diseases including epilepsy and Parkinson's disease, muscle dystrophies or dystonias or patients on neuroleptic drugs may report with recurrent dislocation.

The optimal TMJ range of motion (ROM) is between 40 and 50 mm. Initial 20–25 mm of opening is achieved primarily through rotation which occurs in the lower half of the joint between the mandibular condyle and beneath the disc surface. The remaining 15–25 mm is achieved during forward gliding (anterior translation) motion that occurs between upper surface of the disc and the temporal bone (Fig. 18.2). Mostly in TMJ hypermobility ROM is beyond 50 mm following which the lock occurs. Various authors have classified the hypermobility based on the ROM, from 50 to 55 mm as mild hypermobility,

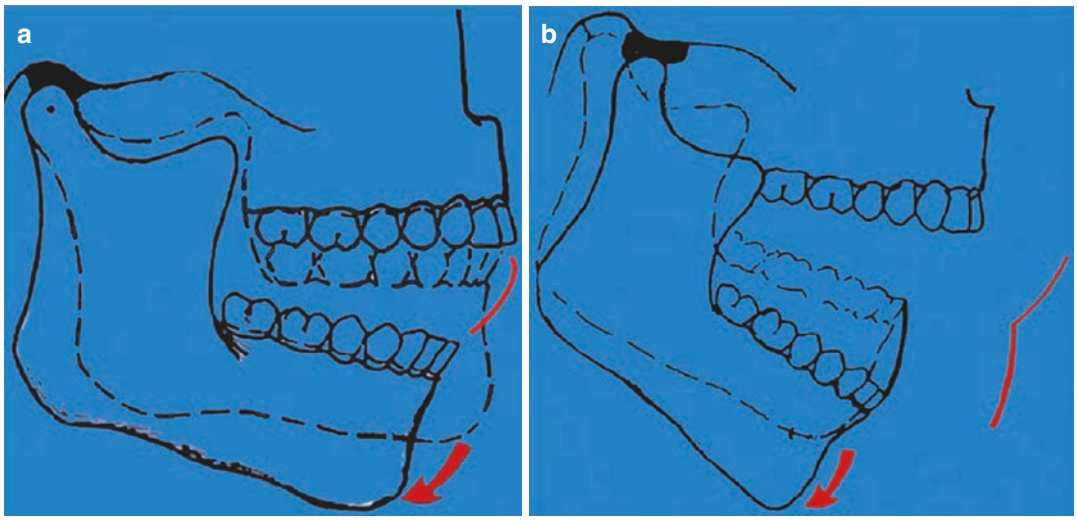


Fig. 18.2 (**a**) Mouth opening with hinge or rotational movement of the temporomandibular joint. (**b**) Mouth opening produced by a combination of rotation and translation movement of the temporomandibular joint. Note in the transition in the position of the disc and the mandibular condyle in relation to the articular eminence. (Adapted from Ozkan Y.K. (2018) Movements and Mechanics of Mandible Occlusion Concepts and Laws of Articulation. In: Ozkan Y. (eds) Complete Denture Prosthodontics. Springer, Cham. https://doi.org/10.1007/978-3-319-69032-2_8)

55–65 mm as moderate hypermobility, and > 65 mm as severe hypermobility disorder.

For establishing a diagnosis the instrumental movement analysis to assess the quantitative characteristics and analysis of performance of bilateral condyle may be used. It also records the condylar path length to determine hypermobility of the joint. It is performed using an electronic recording system, i.e. axiography for recording the mandibular movements based on ultrasonic measuring device [4]. Although, these equipments may not be universally available, and clinical assessment remains the best choice.

18.3 Pathogenesis of TMJ Hypermobility

The classic triad of chronic recurrent subluxation includes (1) Ligamentous and capsular flaccidity (2) Eminential erosion and flattening (Fig. 18.3) (3) trauma (macro or micro), myospasm, and aberrancy in masticatory movements. The dislocation is known to occur due to elevation of mandible caused by lack of muscular co-ordination. This is caused by lack of relaxation of the protractors (lateral pterygoid, digastric, mylohyoid, geniohyoid) with associated firing of the elevators (masseter, temporalis, medial pterygoid) causing myo-spastic contractions. It initiates a feedback loop that induces spastic contractions prohibiting self-reduction [3].

18.4 Radiographic Examination

TMJ hypermobility can be confirmed by the history of the patient and clinical examination. Radiographs such as open and closed mouth TMJ tomogram, computed tomography (CT) scan, dynamic magnetic resonance imaging (MRI, closed and open mouth with maximum ROM) can be obtained to evaluate the joint and periarticular tissues, and to aid in any surgical interventions that may be needed. Haghigah A et al. evaluated condylar distance in hypermobile TMJ with excessive mouth openings using CT. They

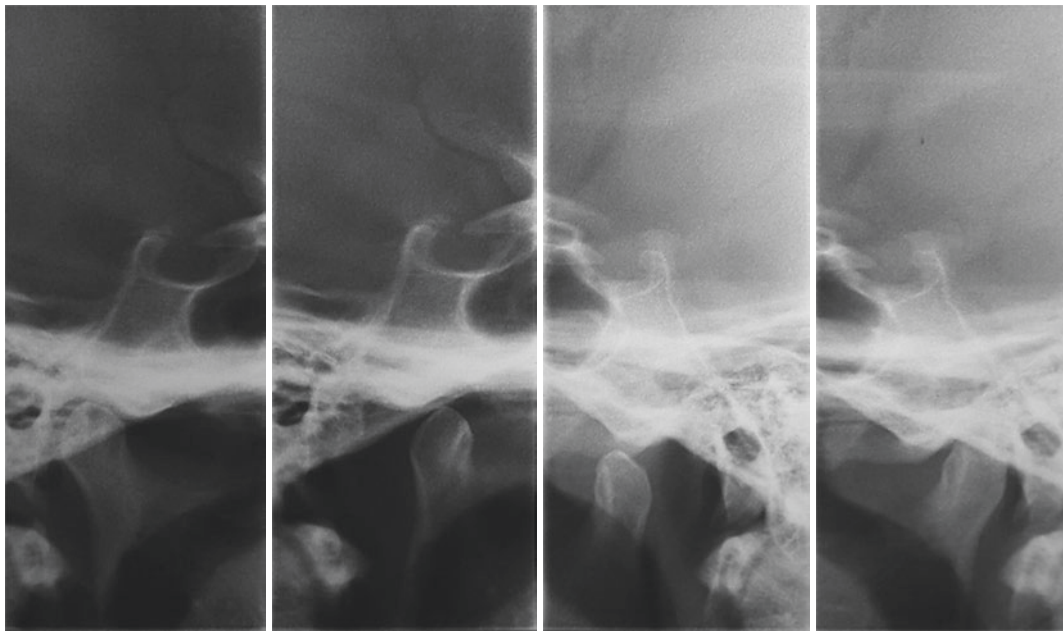


Fig. 18.3 TMJ tomogram depicting the position of condylar head during open and closed mouth position showing flattened articular eminence bilaterally allowing the condyle to slip anteriorly during mouth opening. (Picture Courtesy: Dr. Darpan Bhargava, TMJ Consultancy Services, Bhopal, India)

evaluated the position of the condyle from the articular eminence while MMO; and measured the distances from anterior, superior and posterior border of condyle and facing wall of glenoid fossa in closed mouth. The conclusion from the study indicate that the superior and posterior distances would be significantly higher in hypermobility patients when compared with healthy individuals [6–8].

18.5 Management of Hypermobility of TMJ

The management includes conservative, minimally invasive, and surgical methods depending upon the duration, severity and response to previous treatment methods. All the available treatment modalities fall in one of the following categories: 1) tightening of the capsule; 2) connecting the joint or mandible to adjecent fixed structure; 3) mechanical interferences for condylar translation; 4) elimination of interferences; 5) removal of lateral pterygoid pull preventing translation. Approaches to the condylar region have been discussed in detail elsewhere for open joint procedures (Refer Chap. 14). The history and various management methods for TMJ hypermobility are listed (Tables 18.4 and 18.5) [3, 9, 10].

Table 18.4 Management methods for TMJ hypermobility

Non-surgical/minimally invasive procedures
Intermaxillary fixation using elastics/Barton's bandage/Chin strap to limit oral opening
Administering Sclerosing agents/Proliferants in the joint space
Autologous blood injection (ABI)
Botulinum toxin injection
Surgical procedures
Capsule tightening procedures
- Arthroscopic capsulorrhaphy
- Open capsulorrhaphy
Surgical procedures that limits the condylar path
- Lindemann's procedure
- Mayor's procedure
- Dautrey's procedure
Placement of an obstacle using other materials
- L shaped plates, Steel pins
- Titanium screws
- Blocks of porous coralline hydroxyapatite
- Iliac/calvarial bone grafts
- Mitek bone anchors—Wolford
Creation of muscular balance
- Masticatory muscle myotomy
- Shortening of temporalis tendon

18.5.1 Conservative Method

Patient presenting with a locked jaw in open mouth position reports usually in a state of anxiety, specially when it is an acute dislocation experienced by the patient for the first time. Severe muscle spasm would be present surrounding the dislocated jaw. Initial management should aim at reducing the anxiety and limiting the muscle spasm by counselling, reassuring and with the use of pharmacotherapeutic agents that may include anxiolytic agents or sedative drugs (eg. Diazepam) before undertaking a reduction manoeuvre. The management of patients with chronic dislocation or chronic recurrent non-self reducing dislocation will have a better operator ease, as these patients are in a less anxious state from their previous experiences. Patients with symptomatic chronic subluxation may present with pain as the only presenting feature.

18.5.1.1 Conventional Intraoral Technique (Nélaton's Maneuver or the Hippocratic Technique)

Acute dislocation can be reduced under local anesthesia or general anesthesia or sometimes without the use of anesthesia using a bimanual intra-oral traction. Patient should be seated against a firm back and head rest and is instructed to remain calm which helps in relaxation of the elevator muscles of the mandible. The operator should stand in front of the patient grasping the mandible in the retro-molar region on both the sides firmly using the thumb intra-orally and the other fingers placed below the chin. Downward pressure should be exerted on the molars followed by a backward and an upward thrust below the lower border of the mandible extra-orally to push the mandible downward below

Table 18.5 History of treatment modalities for TMJ hypermobility

Year	Proposed by	Procedure
1945	Hudson	Plication of capsule to reduce the size of hollow viscus
1947	Schultz	Injection of sclerosing solution into joint to produce capsular fibrosis and restrict excessive condylar movements
1949	Bowman	Detachment of external pterygoid muscle from condyle along with a capsulorrhaphy
1951	Dingman	Meniscectomy to treat hypermobility
1961	Ward	Recommended condylotomy
1962	Litzow and Royer	Condylectomy should be reserved for long-standing dislocations
1964	Findlay	Inserted a stainless steel pin into the zygomatic process of temporal bone
1965	Georgiade	Ligation of condyle to zygomatic arch using mersilene (Dacron) strips
1968	Merril	Similar technique using Dacron strips in patient with Parkinson's disease
1968	Boudroux and Spire	Plication of capsule
1969	Thoma	Bone graft onlay to the articular eminence
1975	Sanders and Newman	Plication of capsule combined with a ligamentorraphy
1978	Howe and Kent	Attached a vitallium mesh to the zygoma
1978	Gould	Intra-oral scarification to effect a shortening of the temporalis tendon
1951	Myrhaug	Described the reduction in height of the articular eminence enabling the condyle to slip back into the fossa if sub-luxation occurs.
1957	Irby	
1972	Hale	
1975	Jacques Dautrey	Procedure describing an oblique cut through zygomatic arch posteriorly, arch is brought down and impacted under the articular eminence

the articular eminence and backward into the fossa (Fig. 18.4) [2, 3]. Combining the procedure with local anesthesia and/or sedation usually allows less painful reduction for the patient. Auriculotemporal nerve block through the preauricular approach helps in pain reduction due to dislocation and also aids for pain control during reduction. Young et al. (2009) have advocated the use of peripheral nerve blocks of the masseter and deep temporal nerve along with infiltration of the joint capsule for minimizing discomfort while reduction and also to, decreasing the muscle spasm.

18.5.1.2 External Method (Ardehali et al.)

Ardehali et al. described an extraoral approach for condylar dislocation reduction where each joint is reduced separately. In this method, on one side, the thumb is placed just above the anteriorly displaced coronoid process, and the fingers are placed behind the mastoid process to provide a counteracting force. On the other side, the fingers hold the mandible angle and the thumb is placed over the malar eminence. To reduce the dislocated jaw, one side of the mandible angle is pulled anteriorly by the fingers, with the thumb

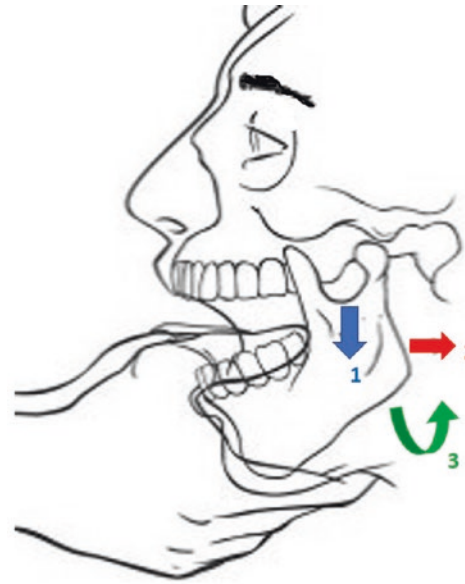


Fig. 18.4 Bimanual intra-oral traction manoeuvre for reduction of the dislocated mandible. Note the downward pressure (**1**) that should be exerted on the molars followed by a backward (**2**) and an upward thrust (**3**)

over the malar eminence acting as a fulcrum. While the mandible angle is pulled anteriorly, steady pressure is applied on the coronoid pro-

cess of the other side, with the fingers behind the mastoid process providing counteracting force. The mandible is rotated by this maneuver and the dislocated temporomandibular joint is usually reduced on one side. When one side of the dislocation is reduced, the other side will usually get reduced spontaneously [11].

18.5.1.3 Gag Reflex

Awang MN reported a technique of initiating a gag reflex to reduce acute dislocation using a mouth mirror to stimulate a gag by contacting the soft palate/pharynx. The impulse is carried to central nervous system causing stimulation of all the depressor and protruder muscles of the mandible along with reflex inhibition of elevator muscles causing mandible to relocate into the condylar fossa [12].

Following reduction, immobilization should be done to restrict the mouth opening using a Barton's bandage or inter-maxillary fixation (IMF) for 7 days. Diet modification should include liquid to semi-solid diet. Muscle relaxants should be prescribed. Long-standing cases, more than 15–30 days may not respond to the above-mentioned procedures. In such cases, reduction should be done under general anesthesia. For patients with persistant or protracted dislocations, who report late for the treatment, traction with wires at the angle under general anesthesia may be attempted. If manoeuvres described fail to achieve reduction, then surgical procedure should include osteotomising the mandible in the midline or paramidline region and reducing both the condyles individually, followed by fixation of the mandible. Alternatively, temporal myotomy via an intraoral anterior ramal incision is advocated (Laskin, 1972), which usually aids in repositioning of the condyles into the glenoid fossa.

18.5.2 Minimally Invasive Methods

18.5.2.1 Autologous Blood Injection

Autologous blood injection (ABI) was first described by Brachmann in 1964. The injected blood initiates an intra-capsular and peri-capsular inflammatory response caused by transferred platelets and blood constituents causing fibrosis and adhesions. Fibrosis and cicatricial maturation cause physiologic reduction in compliance to the peri-articular soft tissue causing a decreased ROM. Blood is injected following arthrocentesis procedure where the whole blood is drawn from the patient and deposited via the inflow needle into the superior joint space. The outflow needle is either removed or blocked during the blood injection. Some authors advocate the deposition of blood aditionally to the retrodiscal region and the pericapsular area apart from the superior joint space. The patient is advised to minimize mandibular function postoperatively. Based on clinical improvement, which should be assessed no earlier than 6-12 weeks post ABI, repeated injections may be administered. The advantages of ABI include reduced chance for allergic reactions and the technique is simple where the blood can be collected as a chair-side procedure. Autologous blood injections can be performed on an outpatient basis offering a safe and effective treatment [3, 13–16]. Autologous blood injections may be attempted for patients with chronic dislocation, symptomatic subluxation and recurrent acute dislocation with a suspected progression to chronic recurrent subluxation.

18.5.2.2 Sclerotherapy/Injection of a Sclerosing Agent

Injection of sclerosants produces an inflammatory response which causes fibrosis in the pericapsular region reducing the temporomandibular joint hypermobility. Several sclerosing agents are used in practice that include sodium tetradecyl sulfate, bleomycin, cyclophosphamide, tetracycline, iodine, alcohol, ethanolamine oleate and OK- 432 (Picibanil). Disadvantages of sclerotherapy include sensation of local irritation and the risk of allergic reaction to the sclerosant. There are documented reports on various sclerosing agents causing chondrocyte degeneration leading to the development of the degenerative joint disease [3, 17]. For this reason, repeated injections should be considered with caution.

While using the sclerosing agents, the control on the extent of fibrosis induced, is beyond clinical control. These injections are generally painful as they cause local irritation on injection, and thus requring the need for local anesthetic blocks before the injection.

18.5.2.3 Botulinum Toxin Injection

Botulinum toxin type A is known to cause a dose related weakness of skeletal muscle by inhibiting acetylcholine release at the neuromuscular junction. In TMJ dislocation it is used as a primary modality as a treatment or as an adjunct to other procedures. The target muscle is the lateral pterygoid as it is involved in spasm during dislocation.

Fu et al. assessed landmarks to approach lateral pterygoid belly percutaneously through the sigmoid notch inferior to the zygomatic arch. After aspiration, 25–50 units of Type A botulinum toxin should be injected directly into the muscle belly. It can also be injected trans-orally under electromyography (EMG) guidance. A single injection is usually effective.

However the disadvantage of botulinum injection includes hemorrhage on needle insertion. Rarely, toxin induced velopharyngeal insufficiency (VPI), dysphagia, and dysarthria is reported, which usually subside within 2–4 weeks [3, 18].

18.5.2.4 Prolotherapy

Prolotherapy for temporomandibular joint (Schultz, 1937), also known as proliferation treatment or regenerative injection therapy is infiltrating a non-pharmacologic agent around the peri-capsular tissue which initiates an inflammatory process causing local fibrous proliferation increasing the tissue robustness, thereby increasing joint stability and reducing laxity. Several agents have been used as proliferants for TMJ dysfunction since the 1930s such as dextrose, psyllium seed oil, glycerin, phenol and combinations. Commonly used proliferant is dextrose. 2 ml of 10–50% dextrose is injected in the superior joint space and the pericapsular area followed by diet modification and minimal jaw function for 2 weeks. Repeated injections may be required to achieve optimal therapeutic effects [3, 19]. *Refai et al. (2011*) conducted a prospective, randomized, double-blind, placebo-controlled clinical trial on twelve patients with painful subluxation or dislocation, where the study group received 4 injections of dextrose solution (2 mL of 10% dextrose and 1 mL of 2% mepivacaine) for each TMJ, each 6 weeks apart. Authors reported prolotherapy as a promising treatment for symptomatic TMJ hypermobility, as evidenced by the therapeutic benefits, simplicity, safety, patients' acceptance of the injection technique, and lack of any significant side effects. Injection of a proliferant is usually painful, mandating adequate use of local anaesthesia during prolotherapy. During the treatment with autologous blood, sclerosing agents or proliferants, use of anti-inflammatory medication, should be avoided including the non steroidal anti inflammatory drugs, as these management strategies utilize induction of an inflammatory response to induce fibrosis. The mainstay for pain management during the course of the treatment should be opioid class of analgesics, of which commonly used is tramadol. Dextrose, which is commonly used and is considered safe, is an osmotic proliferant which acts by dehydrating the cells at the injection site which utlimately leads to release of cellular fragments that act as chemoattractants and start the inflammatory cascade leading to deposition of collagen. Another proposed mechanism is by glycosylating tissues and making them appear foreign to the immune system thereby initiating an inflammatory response. Irrespective of the triger mechanism, the subsequent inflammatory reaction and the consequent wound healing cascade leads to the collagen formation by the fibroblasts in the due course [19].

18.5.3 Surgical Methods

Once the conservative and minimally invasive methods have failed to treat the patient symptomatically, surgery should be considered as an option. Approaches to the condylar region have been discussed in detail elsewhere (Refer Chap. 14). The various surgical procedures for manage-

ment for hypermobility of TMJ are listed (Table 18.4).

18.5.3.1 Creation of Muscular Balance

Lateral Pterygoid Myotomy

Juxta-articular muscle alteration is a surgical method to correct the spastic muscle unit. The formation of resulting intra-muscular scar tissue facilitates hypomobility. Lateral pterygoid myotomy can be performed trans-orally or percutaneously using a pre-auricular incision. Under general anesthesia, after achieving maximal mouth opening, local anesthetic solution with a vasocontrictor should be infiltrated in the medial and lateral aspect of mandibular ramus. A vertical incision is placed extending from the coronoid process along the ascending ramus to the distal surface of the posterior most tooth. The soft tissues must be gently elevated from the medial aspect of the mandible to expose the lateral pterygoid. It is then detached from the anterior capsule of the condyle. Wound closure should be done followed by IMF for 7 days [3, 9].

Temporalis Scarification

Temporalis scarification creates a cicatricial restriction in dynamic muscular function, and reduce condylar translation. This technique was proposed by Gould JF [10, 20]. It is indicated for unacceptable late joint snapping on mouth opening associated with TMJ hypermobility and for recurrent dislocation. This procedure principally involves dissecting the tendinous fibres from the ascending ramus and suturing them to the surrounding periosteum and mucosa, this induces tightening of the tendon by scaring. The length of the tendon or the muscle may be surgically reduced depending on the amount of hypermobility.

18.5.3.2 Capsulorrhaphy

Arthroscopy is employed to identify the landmarks of the internal joint anatomy and facilitate posterior capsulorrhaphy using laser (Hol:YAG) or electro-thermal device. A cicatricial contracture is created with the removal of retrodiscal synovial tissue. The capsule is tightened and sutured to the desired position. External or open capsulorrhaphy procedure can be performed as an open joint surgical procedure [3]. MacFarlane (1977) has described capsular plication as a simple and effective method for recurrent dislocation of the temporomandibular joint (Fig. 18.5).

18.5.3.3 Open Surgical Methods

Eminectomy

Eminectomy, described by Myrhaug in 1951, reduces the vertical height of the articular eminence. The condyle slips posteriorly into the fossa without anatomic restriction in an episode of dislo-

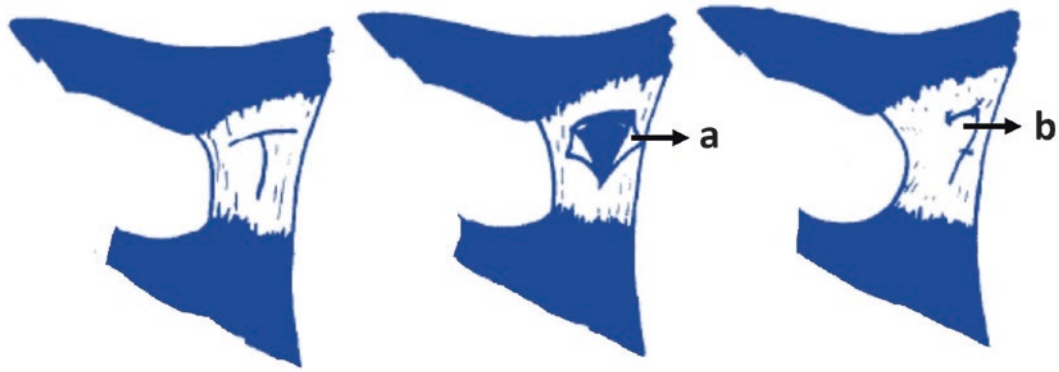


Fig. 18.5 MacFarlane's capsular plication procedure for recurrent dislocation. Note the 'T' shaped incision on the lateral capsule; (**a**) portion of capsule that is excised; (**b**) the flap is pulled and sutured. [Adapted from MacFarlane WI. Recurrent dislocation of the mandible: treatment of seven cases by a simple surgical method. Br J Oral Surg. 1977 Mar;14(3):227-9. https://doi.org/10.1016/0007-117x(77)90029-4.]

cation. A pre-auricular incision is placed, followed by layered dissection to expose the articular eminence. The articular eminence is reduced using a bone cutting bur or an osteotome in the medial aspect. The lateral tubercle may be removed or salvaged as a guide plane followed by layered wound closure. Post-operatively gentle physiotherapy with soft diet is advised to ensure functional mouth opening. Potential risks of this procedure include intra-cranial violation and damage to the surrounding neurovascular bundles [3, 10].

Dautrey's Procedure (Fig. 18.6)

There are few techniques documented in the literature wherein zygomatic arch is utilized to create a mechanical obstruction to the condylar translation (Table 18.6). Dautrey's procedure is done through a pre-auricular incision followed by layered dissection without violation of the TMJ capsule. An osteotomy cut is placed in the zygomatic arch anterior to the eminence. Slight pressure should be applied on the osteotomy site to create a greenstick fracture in the anterior region followed by mobilizing the fractured arch medially or laterally and inserting it under the articular eminence. It can be left passively or secured using a mini-plate followed by wound closure. Bone grafts can be placed as an interpositional material between the arch and articular eminence that can be secured using wires, screws, or mini-plates. Post-operatively soft diet with restriction of mandibular movements for 2 weeks followed by physiotherapy should be advocated [3, 9, 10].

Norman's procedure is an another documented technique where glenotemporal osteotomy is done along with the augmentation of the zygomatic root of the temporal bone by placing a bone graft from the iliac crest to prevent the forward movement of the condyle beyond the eminence. Modification to Norman's procedure for hypermobility of the temporomandibular joint is proposed by Sharma R (2021), where along with the conventional procedure, an inferiorly based pedicled flap from the temporal fascia was sutured to the antero-lateral aspect of the capsule. Authors proposed that an added modification of an additional intra-oral pterygoid disjunction should be executed in cases where hypermobility is associated with pain [21].

Neuro-sensory disturbances and risk of zygomatic arch fracture can be the possible complications. Fractured zygomatic arch may require stabilization.

Mechanical Obstruction with Mini-plate Placement

A 'L' shaped mini-plate can be secured with short arm fixed laterally to the eminence and long arm

Fig. 18.6 Post-operative 3D reconstructed computed tomogram depicting osteotomized zygomatic arch for the management of temporomandibular joint recurrent dislocation using Dautrey's procedure. (Reproduced with permission from: Bhandari SK, et al. Management of temporomandibular joint recurrent dislocation using Dautrey's procedure: report and review. Int J Otorhinolaryngol Head Neck Surg 2019;5:1748–52)

Table 18.6 Glenotemporal osteotomy for TMJ hypermobility involving the zygomatic arch

Year	Proposal by	Procedure
1925	Lindemann	Utilized a bone chip from zygomatic arch
1933	Mayer	Segmental dislocation of zygomatic arch to act as physiologic obstruction
1943	LeClerc and Girard	A vertical osteotomy in the zygomatic arch anterior to the tubercle, inserting the osteotomized segment to impede the path of hypermobile condyle
1967	Gosserez and Dautrey	Greenstick fracture of zygomatic arch, with its displacement in downward and forward direction just in front of the articular eminence and locked under the eminence

can be contoured and fixed along the eminence inferiorly. The procedure should always be contained to the extra-capsular region and is relatively less morbid. There is a potential chance of plate fracture which requires a second surgery for hardware removal [3, 10].

Wolford's Procedure

Mitek anchor fixation for temporomandibular joint disorders work on the principle of using a bone anchor and artificial ligaments for disc stabilization.This procedure utilizes Mitek mini bone anchors which has osseointegration potential. Usually two Mitek anchors are utilized for the treatment of chronic mandibular dislocation. After exposing the zygomatic arch and lateral capsule, articular disc position is ensured. One anchor is placed in the lateral condylar pole and the second anchor is placed in the most posterior part of the zygomatic arch. The suture strings can be adjusted based on the desired mobility and tied. Eminectomy is not required with this procedure. The anchor sutures are tightened to a length that permits laxity for controlled translation of the mandible while preventing dislocation. The disadvantages are breakage of sutures or failure of the anchors [3, 5]. The use of Mitek anchor is also advocated for disc repositioning by Mehra and Wolford (2001) (Fig. 18.7). The modifications in the procedure for various clinical scenarios is summarized in the Table 18.7. Mitek anchors require specialized armamentarium which may not be universally available. An alternative to Mitek anchors, is the use of orthodontic mini-screw as advocated by Zachariah and Neelakandan (2015) (Fig. 18.8).

Tocaciu S et al. in their study proposed a new surgical treatment protocol for patients diagnosed with recurrent TMJ dislocation after retrospective observation of 14 patients over a period of 6 years. Successful long-term results were observed in the study population who underwent a combination of eminectomy and a disc plication (meniscopexy) procedure. The authors also emphasized that for the patients who are not eligible for surgery, may be treated using botulinum injections or sclerotherapy [22]. Very little literature evidence is available for dislocation of the TMJ in pediatric population as the treatment options can be limited in such age group. Ludovic S et al. proposed a management protocol for pediatric TMJ dislocation which can be useful for clinicians [23].

Stergiou GS et al. have described mini-plate eminoplasty for non-compliant patients and for patients with muscular disorders [24]. Krishnakumar Raja VB et al. have advocated inferior repositioning of the coronoid process to address subluxation or recurrent dislocation. This procedure is based on the principle of stretching of the muscle thereby increasing the neuromuscular activity and resistance training resulting in hypertrophy. They highlighted that there was an increase in mitochondrial content and the cross-sectional area of the muscle fibers. Ultrasonographic evaluation post-operatively revealed an increase in thickness and length of temporalis muscle which translated into better contraction [25].

The affected individual diagnosed with a hypermobility disorder must be screened for previous history of trauma, systemic disorders affecting the joint or connective tissue which can be a predisposing factor followed by devising a custom-made treatment plan, as no single modality of treatment is found to be effective in all the cases.

18.6 Goals of Treatment

Identification of the etiological factor causing the hypermobility, patient education, and reassurance followed by conservative to minimally invasive management are the important elements to achieve relief in such patients. If the non-surgical methods fail to provide relief, surgery should be considered as an option to improve the quality of life.

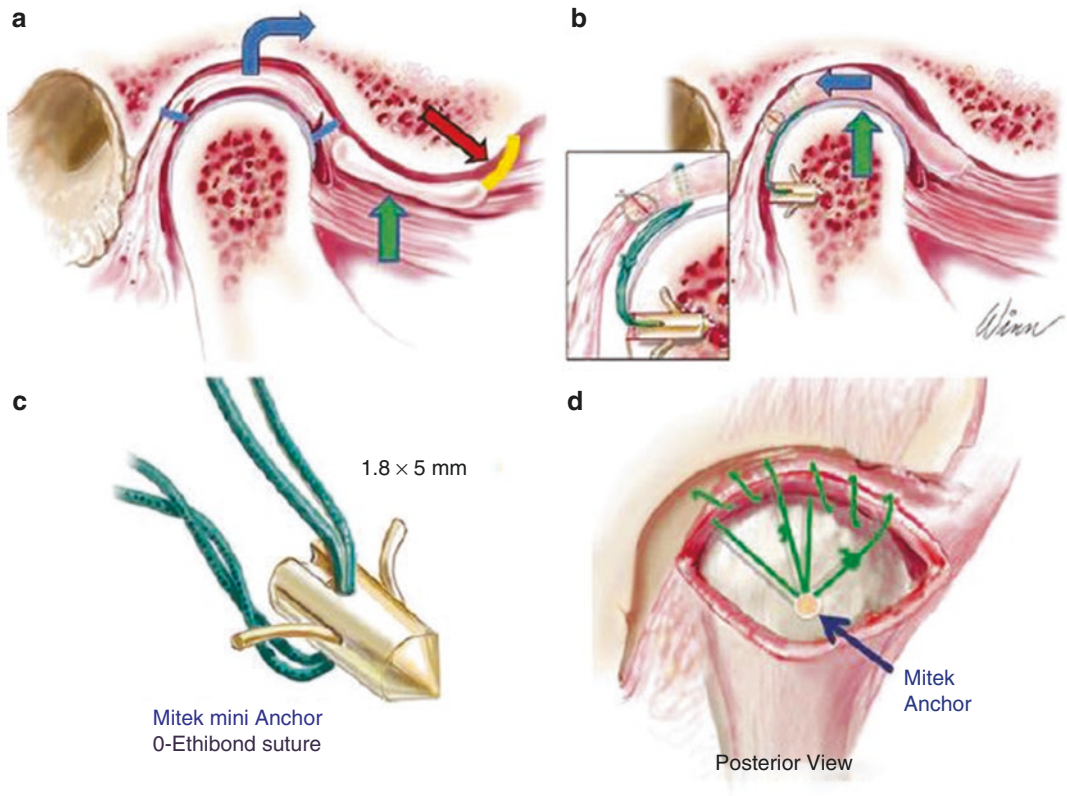


Fig. 18.7 (**a**) Sagittal view of the right TMJ. The TMJ articular disc is anteriorly displaced (green arrow). Bilaminar and synovial tissues cover the top of the condyle. This tissue is excised to eliminate excessive tissue when the disc is repositioned. The ligament that attaches from the anterior aspect of the disc to the anterior aspect of the articular eminence must be detached in order to mobilize the disc and reposition it passively over the condylar head (red arrow). (**b**) The disc has been mobilized and repositioned passively over the condyle. A hole is drilled into the posterior head of the condyle with the dedicated Mitek drill, and the Mitek anchor is inserted into the posterior head of the condyle into the medullary bone with the wings locking it in place against the cortical bone. The 0 Ethibond suture that was doubled and passed through the eyelet of the anchor provides two artificial ligaments to secure the disc in position. (**c**) The Mitek mini anchor is 1.8 mm in diameter and 5 mm in length. The body of the anchor is titanium alloy, and the wings are composed of nickel titanium with shape-memory technology to allow the wings to compress against the body of the device as it passes through the cortical bone of the condyle and then re-expand once into the medullary bone, locking the device in place against the cortical bone. (**d**) Posterior view of the anchor inserted into the condyle. The pilot hole is placed approximately 8 mm below the crown of the condylar head and just lateral to the midsagittal plane. The first suture (artificial ligament) is passed from beneath up through the posterior aspect of the posterior band of the disc toward the medial side. Two more throws are completed for a total of three throws. The second suture is passed in the same manner with three throws but positioned more laterally. The disc should be slightly overcorrected, and then the sutures are tied. Additional support sutures can be placed, for example, at the lateral pole area if additional support is required to stabilize the disc laterally. The 0 Ethibond suture can be passed through the lateral capsular tissue and up through the lateral aspect of the disc and secured to provide additional lateral support. (Reproduced with permission: Han, Michael et al. Surgery of the Temporomandibular Joint: Discectomy and Arthroplasty in, S. T. Connelly et al. (eds.), Contemporary Management of Temporomandibular Disorders, https://doi.org/10.1007/978-3-319-99909-8_6, Springer Nature Switzerland AG 2019)

Table 18.7 Wolford's procedure (modifications based on various clinical scenarios)

TMJ charateristics	Procedure
Chronic forward mandibular posture	Two artificial ligaments are tightened to retain the condyle seated in postero-superior aspect of the fossa, preventing forward translation
To prevent dislocation anterior to articular eminence	Artificial ligaments can be left loose to provide translation but limit forward movement by preventing condylar translation beyond the articular eminence
Dislocation of articular disc	Usage of third anchor to reposition the disc into a normal relation

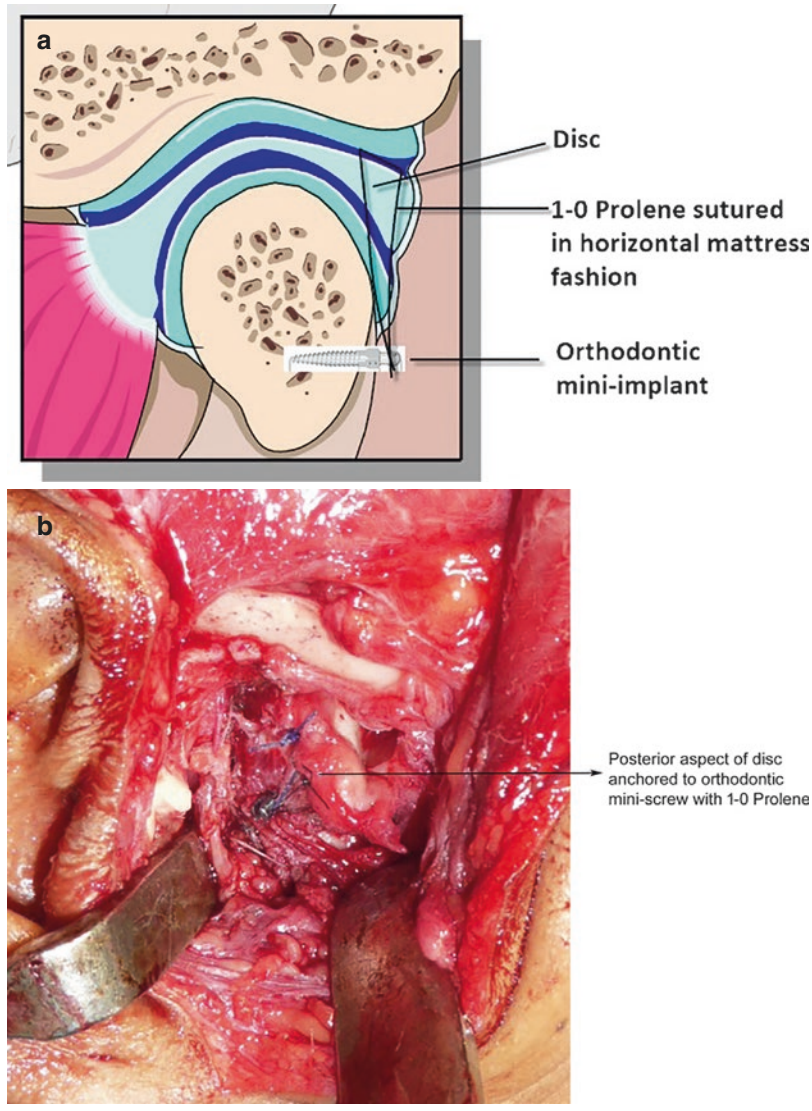
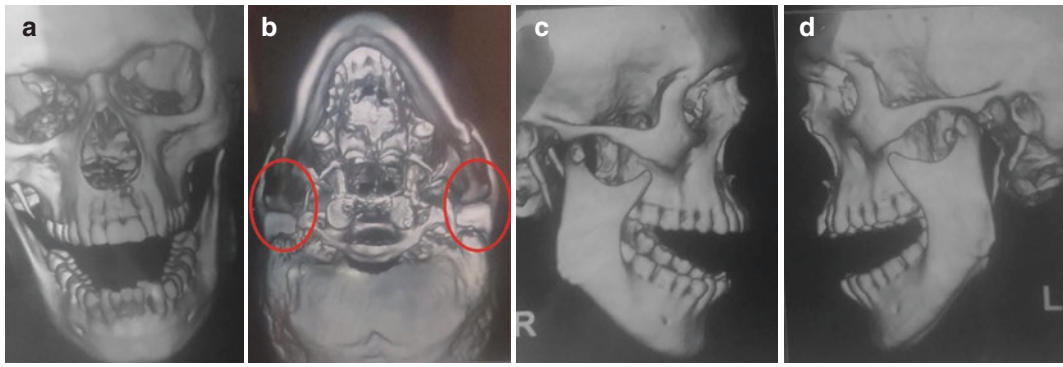
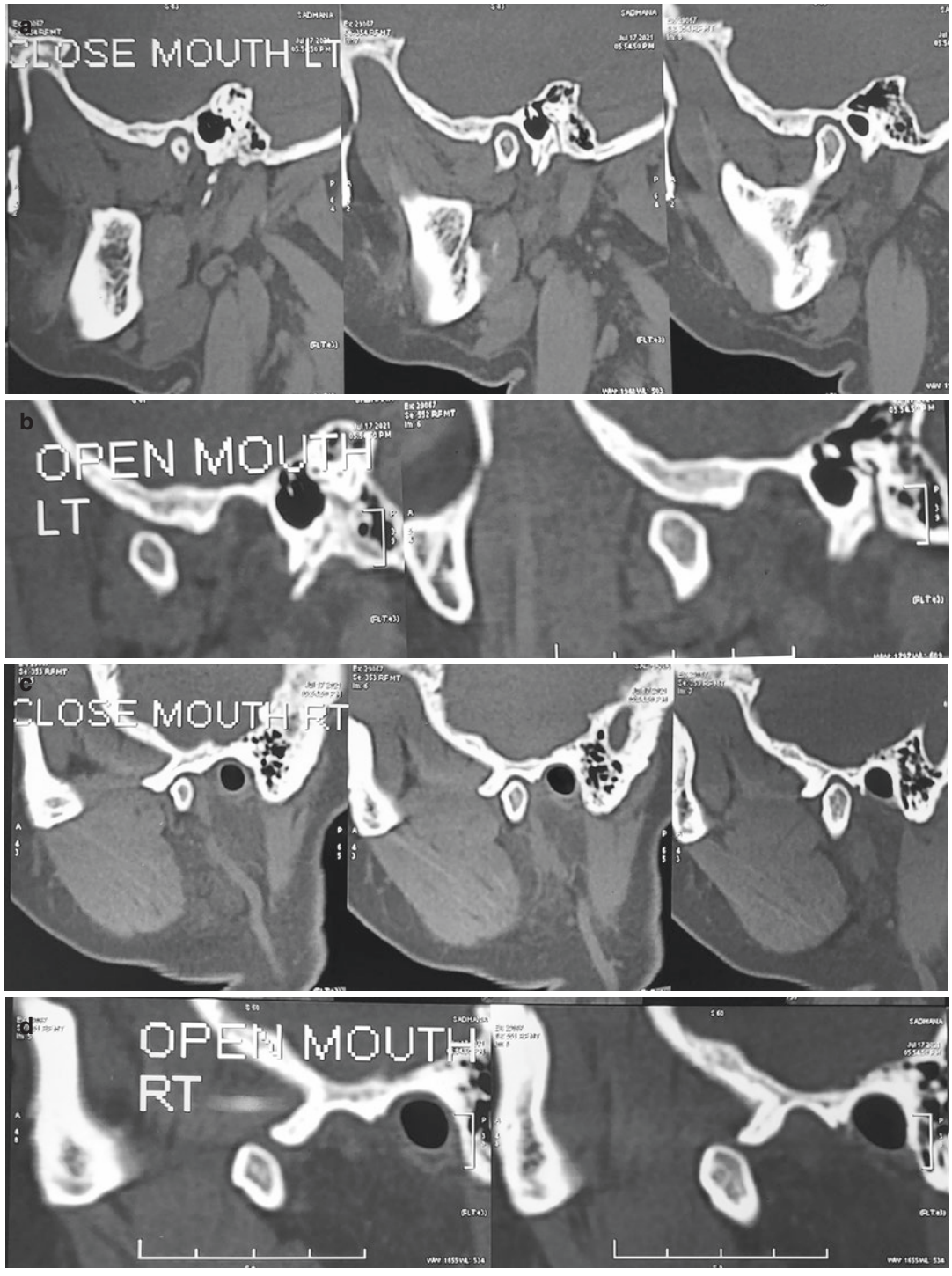


Fig. 18.8 Use of an orthodontic mini-screw for disc anchoring in cases with chronic meniscocondylar dislocation of the temporomandibular joint. Schematic diagram showing disc anchoring technique (**a**); Disc anchored to orthodontic miniscrew (**b**) [Adapted from Zachariah T, Neelakandan RS, Ahamed MI. Disc Anchoring with an Orthodontic Mini-Screw for Chronic Meniscocondylar Dislocation of TMJ. J Maxillofac Oral Surg. 2015;14(3):735–744. https://doi.org/10.1007/s12663-014-0729-2]

Appendix



Atlas 18.1 3D reconstructed computed tomographic images of a patient with acute dislocation of the temporomandibular joint. (**a**) frontal view; (**b**) inferior view, note the condylar position and the empty glenoid fossa (marked in red); (**c**) right; (**d**) left, note the position of the condyle locked in front of the articular eminence



Atlas 18.2 Sagittal view of the computed tomographic images in a patient with chronic subluxation of the temporomandibular joint. (**a**) closed mouth view of the left joint; (**b**) open mouth view of the left joint, note the anterior translation of the condyle and its relation to the eminence; (**c**) closed mouth view of the right joint; (**d**) open mouth view of the right joint, note the anterior translation of the condyle and its relation to the eminence

References

1. Nosouhian S, Haghighat A, et al. Temporomandibular joint hypermobility manifestation based on clinical observations. J Int Oral Health. 2015;7(8):1–4.
2. Malik NA. Textbook of oral and maxillofacial surgery. 4th ed. New Delhi: Jaypee Publishers.
3. Liddell A, Perez DE. Temporomandibular joint dislocation. Oral Maxillofac Surg Clin N Am. 2015;27:125–36.
4. Badel T, Laškarin M, Zadravec D, Čimić S, Savić Pavičin I. Subluxation of temporomandibular joint – a clinical view. J Dent Probl Solut. 2018;5(2):029034.
5. Sharma NK, Singh AK, Pandey A, Verma V, Singh S. Temporomandibular joint dislocation. Natl J Maxillofac Surg. 2015;6(1):16–20. https://doi.org/10.4103/0975-5950.168212.
6. Haghigaht A, Davoudi A, Rybalov O, Hatami A. Condylar distances in hypermobile temporomandibular joints of patients with excessive mouth openings by using computed tomography. J Clin Exp Dent. 2014;6(5):e509–13. https://doi.org/10.4317/jced.51562.
7. Kalaykova S, Naeije M, Huddleston Slater JJR, Lobbezo F. Is condylar position a predictor for functional signs of TMJ hypermobility? J Oral Rehab. 2006;33:349–55.
8. Kalaykova S, Naeije M, Huddleston Slater JJR, Lobbezo F. Occupational differentiation in dentistry 3. Hypermobility of the temporomandibular joint and condylar position at maximal mouth opening. Ned Tijdschr Tandheelkd. 2006;113(10):391–6.
9. Martin WD, et al. Recurrent dislocation of the temporomandibular joint: a literature review and two case reports treated with eminectomy. J Craniomandibular Sleep Prac. 2014;32(2):110–7.
10. Lawlor MG. Recurrent dislocation of the mandible: treatment of ten cases by the Dautrey procedure. Br J Oral Surg. 1982;20:14–21.
11. Ardehali MM, et al. Temporomandibular Joint reduction technique: a new external method versus the traditional. Ann Plastic Surg. 2009;63(2):176–8.
12. Awang MN. A new approach to the reduction of acute dislocation of temporomandibular joint: a report of 3 cases. Br J Oral Maxillofac Surg. 1987;25:244–9.
13. Coser R, De Silveira H, Medeiros P, Ritto FG. Autologous blood injection for the treatment of recurrent mandibular dislocation. Int J Oral Maxillofac Surg. 2015; https://doi.org/10.1016/j.ijom.2015.05.004.
14. Hegab AF. Treatment of chronic recurrent dislocation of the temporomandibular joint with injection of autologous blood alone, intermaxillary fixation alone, or both together: a prospective randomized controlled clinical trial. Br J Oral Maxillofac Surg. 2013;51:813–7.
15. Varedi P, Bohluli P. Autologous blood injection for treatment of chronic recurrent TMJ dislocation: is it successful? Is it safe enough? A systematic review. Oral Maxillofac Surg. 2015; https://doi.org/10.1007/s10006-015-0500-y.
16. Oshiro N, Yoshida H, Uemura M, Suwa F, Morita S. Analysis of MRI findings in minimum invasive treatment for habitual temporomandibular joint dislocation by autologous blood injection around the temporomandibular joint capsule. J Cranio-Maxillofac Surg. 2014; https://doi.org/10.1016/j.jcms.2014.04.018.
17. Matthews NS. Dislocation of temporomandibular joint. A guide to diagnosis and management. Springer. In: Conservative management for TMJ dislocation. p. 67.
18. Ataran R, Bahramian A, Jamali Z, et al. The role of botulinum toxin A in treatment of temporomandibular joint disorders: a review. J Dent (Shiraz). 2017;18(3):157–64.
19. Majumdar SK, Krishna S, Chatterjee A, Chakraborty R, Ansari N. Single injection technique prolotherapy for hypermobility disorders of TMJ using 25% dextrose: a clinical study. J Maxillofac Oral Surg. 2017;16(2):226–30. https://doi.org/10.1007/s12663-016-0944-0.
20. Gould JF. Shortening of the temporalis tendon for hypermobility of the temporomandibular joint. J Oral Surg. 1978;36(10):781–3.
21. Sharma R. Modifications to Norman's procedure for hypermobility of TMJ. Med J Armed Forces Ind. 2012;68:231–5.
22. Tocaciu S, McCulloughb MJ, Dimitroulis G. Surgical management of recurrent dislocation of the temporomandibular joint: a new treatment protocol. Br J Oral Maxillofac Surg. 2018;56:936–40.
23. Ludovic S, O'hana D, Khonsari RH, Kaddour Brahim A. Bilateral dislocation of the Temporo-Mandibular Joint in children. J Oral Maxillofac Surg. 2018; https://doi.org/10.1016/j.joms.2018.04.004.
24. Stergiou GS, Obwegeser JA, Grätz KW, Zwahlen RA. Surgical treatment of anterior TMJ-dislocation with mini-plates: a case report (in German). Schweiz Monatsschr Zahnmed. 2007;117:523–6.
25. Krishnakumar Raja VB, Balasubramanian S, Sridharan G, Tarun S, Panneerselvam E. Inferior Repositioning of Coronoid Process for the Treatment of Temporomandibular Joint Subluxation/Dislocation. Ann Maxillofac Surg. 2019;9(2):397–9. https://doi.org/10.4103/ams.ams_137_19.