Review Article

Nerve blocks in the management of acute temporomandibular disorder emergencies—a narrative review

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Background and Objective: Musculoskeletal disorders (MSDs) are among the prime contributors to disability worldwide affecting approximately 1.71 billion people. Temporomandibular disorders (TMDs) are one of the most frequently encountered MSDs of the orofacial region. Patients with TMD often present to the emergency room (ER) with acute emergencies or acute flare up of chronic conditions. Nerve blocks (NBs) are invaluable chairside tools that can be used for diagnostic and therapeutic purposes. The objective of the current narrative review is to familiarize healthcare professionals with clinical presentations and management of acute TMD emergencies using NBs.

Methods: A search was conducted on indexed databases (PubMed, EMBASE, Scopus, ISI Web of Knowledge, Cochrane library) using keywords "temporomandibular disorders", "emergencies" and "nerve block" from 1st January 1974 till 30th September 2021 and 298 articles were identified and approximately 100 relevant English full text articles were included in this narrative review.

Key Content and Findings: TMD's may present significant diagnostic and therapeutic dilemmas to a healthcare professional in an ER setting. Auriculotemporal NB, masseteric NB and temporo-masseteric nerve block (TMNB) are the most commonly used NBs to provide accurate diagnosis, immediate, effective pain relief and facilitate manual reduction procedures.

Conclusions: NBs are indispensable tools that can be used in the ER to provide immediate and effective pain relief. NB can be used to solve diagnostic dilemmas by identifying the source of the pain and differentiating odontogenic from non-odontogenic causes in complex orofacial pain cases. They may also assist in improving pain related outcomes and manual reduction procedures.

Keywords: Nerve blocks (NBs); temporomandibular disorders (TMDs); emergencies; pain; temporomandibular joint

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Introduction

It is estimated 1.71 billion people worldwide have musculoskeletal disorders (MSDs) (1). MSDs affect individual's quality of life by causing functional pain and disability. Patients with acute MSDs or acute exacerbation of chronic MSDs presenting to the ER contribute to the increase burden on an already taxed healthcare resource (1).

Temporomandibular disorders (TMDs) are the

predominant MSDs affecting the orofacial region and the primary cause of non-odontogenic facial pain. TMDs are further subcategorized into temporomandibular joint disorders (TMJD) and disorders of the masticatory musculature (MMD). TMDs encompasses a group of more than thirty-five different diagnostic conditions affecting the surrounding structures of the temporomandibular joint (TMJ), they include the masticatory musculature and the contiguous structures of the TMJ (2,3). Patients with TMD's often present to the emergency room (ER) with symptoms of pain, headache, acute limitation of mouth opening or inability to close the mouth (4).

The etiopathogenesis of TMDs has evolved from the occlusal gnathological concepts to the current biopsychosocial model which states that varying degrees of biological, psychological, and social factors play a role in the predisposed individual with TMD complaints. The OPPERA study comprising three different study designs, comprehensively studied the risk factors for incident TMDs (5). The study reported major and minor trauma to be a major risk factor for TMDs (6). The strongest parameters associated with risk for incident TMDs included risk of yawning, prolonged mouth opening, extrinsic and intrinsic trauma. Single impact injuries were reported to be more deleterious than repeated trauma (5). These patients can be both diagnostically and therapeutically challenging for the ER physician. Several healthcare professionals in the ER reported inadequate training for the comprehensive evaluation, management of TMD's resulting in a significant proportion of the patients being undertreated. The emergency management of the patient in the ER should be directed towards pain relief, jaw mobilization and patient stabilization.

The use of the peripheral nerve blocks (NBs) is one of the most effective management strategies to come up with a diagnosis and to treat the patient's TMD pain complaints (7,8). The objective of this narrative review is to familiarize healthcare professionals with an overview of the relevant anatomy, patient presentations, detail different extraoral peripheral NB for the management of acute emergencies in TMD's. The key question was "To identify and describe the role of NBs in the management of acute TMD emergencies". We present the following article in accordance with the Narrative Review reporting checklist (available at https://joma.amegroups.com/article/view/10.21037/joma-21-17/rc).

Methods

Indexed databases (PubMed, Embase, Ovid Medline, Cochrane, Web of science, Scopus) were searched using the Mesh terms ("nerve block"[MeSH Terms] OR ("nerve"[All Fields] AND "block"[All Fields]) OR "nerve block"[All Fields] OR ("nerve"[All Fields] AND "blocks"[All Fields]) OR "nerve blocks"[All Fields]) AND ("temporomandibular joint disorders"[MeSH Terms] OR ("temporomandibular"[All Fields] AND "joint"[All Fields] AND "disorders"[All Fields]) OR "temporomandibular joint disorders"[All Fields] OR ("temporomandibular"[All Fields] AND "disorders"[All Fields]) OR "temporomandibular disorders"[All Fields])("emerge"[All Fields] OR "emerged"[All Fields] OR "emergence"[All Fields] OR "emergences"[All Fields] OR "emergencies"[MeSH Terms] OR "emergencies"[All Fields] OR "emergency"[All Fields] OR "emergent"[All Fields] OR "emergently"[All Fields] OR "emergents"[All Fields] OR "emerges"[All Fields] OR "emerging"[All Fields]) AND ("temporomandibular joint disorders"[MeSH Terms] OR ("temporomandibular"[All Fields] AND "joint"[All Fields] AND "disorders"[All Fields]) OR "temporomandibular joint disorders"[All Fields] OR ("temporomandibular"[All Fields] AND "disorders"[All Fields]) OR "temporomandibular disorders"[All Fields]). Two authors MK, SPS independently searched indexed databases using MeSH terms mentioned from 1st January 1974 till 30th September 2021 and 298 articles were identified and approximately and 100 relevant English full text articles were included in this narrative review. In case of disparity, consensus was obtained with a third author (JK). The search strategy summary is shown in *Table 1*.

Main body

TMJ anatomy

Knowledge of the anatomy is paramount for diagnosis and to perform successful NB. We will be detailing the anatomy of the TMJ and the innervation of some of the prime movers of the mandible.

TMJ is ginglymodiarthrodial synovial joint, capable of hinge like and translational movements. The TMJ is unique in several aspects; unlike other synovial joints the articular surfaces of TMJ are lined by fibrocartilage. Both the TMJ's functions together as a unit during mandibular movements. Unlike the other joints in the body the TMJ

Table 1 The search strategy summary

Items	Specification
Date of search	1st October 2021
Databases and other sources searched	PubMed, Embase, Ovid Medline, Cochrane, Web of Science, Scopus
Search terms used	("nerve block"[MeSH Terms] OR ("nerve"[All Fields] AND "block"[All Fields]) OR "nerve block"[All Fields] OR ("nerve"[All Fields] AND "blocks"[All Fields]) OR "nerve blocks"[All Fields]) AND ("temporomandibular joint disorders"[MeSH Terms] OR ("temporomandibular"[All Fields] AND "joint"[All Fields] AND "disorders"[All Fields]) OR "temporomandibular joint disorders"[All Fields] OR ("temporomandibular"[All Fields] AND "disorders"[All Fields]) OR "temporomandibular disorders"[All Fields]) ("emerge"[All Fields] OR "emerged"[All Fields] OR "emergence"[All Fields] OR "emergences"[All Fields] OR "emergencies"[MeSH Terms] OR "emergencies"[All Fields] OR "emergency"[All Fields] OR "emergent"[All Fields] OR "emergently"[All Fields] OR "emergents"[All Fields] OR "emerges"[All Fields] OR "emerging"[All Fields]) AND ("temporomandibular joint disorders"[MeSH Terms] OR ("temporomandibular"[All Fields] AND "joint"[All Fields] AND "disorders"[All Fields]) OR "temporomandibular joint disorders"[All Fields] OR ("temporomandibular"[All Fields] AND "disorders"[All Fields]) OR "temporomandibular disorders"[All Fields])
Timeframe	January 1st 1974 – September 30th 2021
Inclusion and exclusion criteria	Clinical trials, research studies, case reports, systematic reviews were included. Studies that were not relevant to the current topic, duplicates, or did not have the focused question were excluded
Selection process	Two authors MK, SPS independently searched indexed databases using MeSH terms and screened the titles and abstracts of the identified studies. Disagreements were solved through mutual discussion between authors and in case of a lack of consensus through discussion involving a third author (JK)

has a rigid end point of closure, the teeth. The TMJ is enclosed by a capsular ligament which is reinforced by the temporomandibular ligament. The TMJ capsule support the synovial membrane, the neuronal end-organs and the joint blood supply. The TMJ capsule is also attached to the articular disc which delineates the superior and inferior joint spaces. The articular disc is a fibrous connective tissue filling in the incongruent space formed by the glenoid fossa and the head of the mandibular condyle. The articular disc has an anterior band, a posterior band and an intermediate zone the primary load bearing area. Rotational movements occur primarily in the lower joint space while translational movements occur in the upper joint space. Retrodiscal tissue is present behind the articular disc and comprises superior, inferior retrodiscal tissue and intermediate region. Synovial membrane lines the upper and lower joint cavities. The joint is lubricated by synovial fluid, which also provides nourishment to the joint, and decreases friction during joint movements (9,10). The retrodiscal tissue is attached to the posterior aspect of the articular disc and the posterior neck of the condyle. Anteriorly the 15–25% of the fibres of the superior head of the lateral pterygoid inserts through the capsule into the anterior aspect of the articular disc. The fibres of the inferior head of the lateral pterygoid muscle insert into the fovea of the condyle—allowing for protrusion of the mandible upon bilateral contraction of this muscle (11,12). The anatomy of the temporomandibular joint is shown in *Figure 1*.

Furthermore, it should be noted that the fibres of the inferior head of the lateral pterygoid muscle insert into the fovea of the condyle—allowing for protrusion of the mandible upon bilateral contraction of this muscle. The majority of the blood and nerve supply is found in the retrodiscal tissues (9,10).

The accessory ligaments of TMJ are the stylomandibular and sphenomandibular ligaments. The ligaments of the TMJ function to stabilize the TMJ and restrict excess movements of the TMJ. Temporalis, masseter, lateral and medial pterygoids are the primary muscles of mastication while digastric, mylohyoid, buccinator and geniohyoid act as accessory muscles of mastication.

The auriculotemporal nerve (ATN), a branch of the

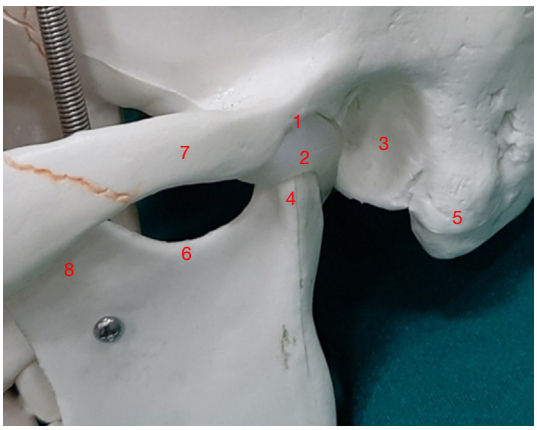

Figure 1 Anatomy of the temporomandibular joint. 1, glenoid fossa; 2, articular disc; 3, auditory canal; 4, condyle; 5, mastoid process; 6, sigmoid notch; 7, zygomatic arch; 8, coronoid process.

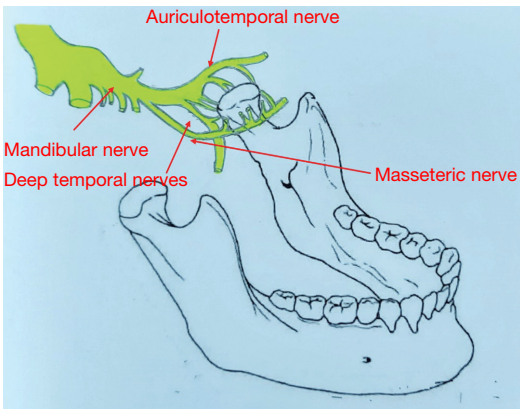

Figure 2 Innervation of the temporomandibular joint.

trigeminal nerve's mandibular division, contains sensory, parasympathetic and vasomotor fibres. The masseteric nerve (MN) and the deep temporal nerve (DTN) are branches of the anterior division of the mandibular nerve, innervating the medial and the anterior-lateral region of the joint respectively. These two nerves mainly provide proprioception to the TMJ and minor sensory innervations (13-15). A study to determine the pattern of innervation of the TMJ on cadaveric specimens determined that the ATN innervated the lateral capsule of TMJ in all the specimens, while the anteromedial aspect of the TMJ was innervated by the MN in approximately 75% of the specimens under study and in 33% of the specimens the anteromedial aspect of the capsule was innervated by a branch entering through the mandibular notch which is believed to be derived from the V2 branch of the trigeminal nerve after passing through the lateral pterygoid (16).

The anatomy of the TMJ and stomatognathic system is further complicated by multiple structures in the close proximity to the external, medial, anterior, lateral, superior, inferior surfaces of the TMJ. The medial surface include the following structures: arteries (anterior tympanic and internal maxillary), nerves (inferior alveolar, auriculotemporal, lingual, and chorda tympani), petrotympanic fissure and gland (parotid); the external surface comprises of skin, subcutaneous tissue, arteries (transverse facial, zygomatic-orbital and superficial temporal), vein (superficial temporal), nerves (facial and auriculotemporal), muscle (masseter muscle), lymph nodes (pre-auricular), lymphatic ganglia, gland (parotid). The superior surface is bounded by the cerebral fossa, posterosuperior surface consists of the ear (17).

These structures have clinical and diagnostic significance as pathologies of the different components of the stomatognathic system and the adjacent structures may result in referral of pain to the TMJ. Distinguishing the source and origin of pain is critical to successful management (18-20). Knowledge of the morphology is critical to avoid complications during NB. The innervation of the temporomandibular joint is shown in *Figure 2*.

Clinical presentation, diagnosis of acute TMD emergencies

The DC-TMD is a widely accepted, validated classification of TMD for clinical and research purposes. TMDs are broadly classified into TMJD and MMD. In the following sections, we will be detailing diagnosis and management of acute TMD's presenting as emergencies using the DC-TMD criteria (2). The primary symptoms at the time of presentation of acute TMD emergencies may be classified as:

Pain and limitation of opening

TMJD such as disc displacement without reduction with limited mouth opening and MMD such as myalgia, myospasm and myositis may cause pain and limitation of opening.

Disc displacement without reduction with limited mouth opening often referred to as "closed lock"; is one of the intracapsular TMJD presenting with acute limitation of mouth opening. In this biomechanical disorder, the articular disc is displaced (most commonly anteriorly, occasionally medially or laterally) creating an obstruction for the translation path of mouth opening on the dislocated side. The condyles retain their ability to rotate; but translation is

restricted only to the side without the displaced disc. The gold standard for diagnosis is MRI imaging (2,21).

Complaints of pain and limited jaw opening may also be seen in MMD patients, examples of which are myalgia and myospasm of the muscles of mastication. Myalgia is further subcategorized into local myalgia, myofascial pain and myofascial pain with and without referral by the DC-TMD criteria. Myalgia is defined as pain of muscular origin with pain being replicated by provocation tests of the affected muscles. The nature of pain is affected by functional and parafunctional movements of the jaw. When the pain is restricted to the site of palpation, it is referred to as local myalgia, when it is restricted to the limits of the boundary of the palpating muscle it is referred to as myofascial pain and when it spreads beyond the palpating muscle producing characteristic patterns of referral it is referred to as myofascial pain with referral (2,3,21). The diagnosis relies primarily on clinical examination and palpation using myofascial examination protocol. The referral patterns have been detailed by Simons and Travell (22).

Myospasm is an acute, sudden, involuntary tonic contraction of the muscle which is reversible. The clinical features are dependent on the muscle involved and it may present with pain, functional limitation and acute malocclusion. Diagnosis is by intramuscular electromyography which is elevated on the affected side (21,23).

Myositis is pain of muscular origin generally presenting as an acute condition secondary to trauma, inflammation, infection or chronic autoimmune condition; often accompanied by functional restrictions and signs of inflammation/infection (21,23).

Inability to close the mouth

Luxation is a hypermobility disorder in which the head of the condyle translates beyond the articular eminence and is unable to slide back into the glenoid fossa without mechanical assistance from the clinician. It is referred to as "open lock" (21,23).

Fractures

Trauma to the orofacial region may result in displaced or non-displaced break in the bone and occasionally cartilage producing fractures in the mandible, condyle, sub condylar regions. The clinical features vary depending on whether it is unilateral/bilateral and displaced or non-displaced. Patients may present with pain, limitation of opening, swelling and acute malocclusion (21,23). Diagnosis of fractures relies on radiographic evaluation (plain radiographs and advanced imaging such as computed tomography (CT), cone beam computed tomography (CBCT).

NBs for the diagnosis and management of acute TMD emergencies

General guidelines

Accurate knowledge of the anatomy is paramount to isolate the structure to be blocked, and to ensure that critical structures are not injured during NB procedure. Aspiration aids in the avoidance of injections into a blood vessel. The clinician must be aware of the type of pharmacological agent used, mechanism of action, half-life, amount to be injected, indication and contraindications. Bupivacaine, for example, has myotoxicity and should not be injected into muscle. Injection into the inflamed or infected tissue must be avoided strictly. During the process, asepsis and the use of sterile instruments are required (24,25).

Pharmacological agents

A variety of pharmacological agents may be used for NBs in an ER setting. Local anesthetics are routinely available in all emergency room settings. Local anesthetics are broadly classified into amide and esters. They act by reversibly inhibiting conduction of neural impulses by blocking ionic influxes necessary for propagation of neural impulses. A network meta-analysis on different aesthetic agents reported that lidocaine had the best safety profile (26). Lidocaine 2% is an amide local anesthetic and with a rapid onset combined with a short duration of action for 30–45 minutes. It is the most commonly used agent and may be used alone or in conjunction with epinephrine in 1:100,000 ratio. Epinephrine is a vasoconstrictor and is primarily used to increase the intensity and duration of action to 180–300 minutes (27). The maximum recommended dose is 7 and 4.4 mg/kg for lidocaine with epinephrine and without epinephrine. Contraindications for lidocaine with or without epinephrine include allergic reaction, heart block, severe hepatic disease and concurrent class 1 antiarrhythmic medications (28). Lidocaine with epinephrine is contraindicated for trigger point injections as epinephrine is myotoxic. Long-acting agents such as bupivacaine especially in combination with steroids are myotoxic and should not be used for trigger point injections (29).

Other local anesthetics which can be used in NBs include procaine 1% and 3% mepivacaine (25). Mepivacaine is a short acting amide local anesthetic. Some practitioners combine local anesthetic with steroids. However, research

Figure 3 Anatomy and injection technique for auriculotemporal nerve block. This image is published with the patient/participant's consent.

has suggested that addition of steroids to local anesthetics may not confer additional effects and at present there is lack of evidence to demonstrate superior efficacy of either short or long acing local anesthetics in these NBs (30,31).

Mechanism of action

Peripheral NBs have therapeutic effect on pain by inhibiting peripheral nociceptive inputs to the trigeminal nucleus caudalis and higher CNS centers which can contribute to peripheral and central sensitization. Their effects frequently last longer than the effect of local anesthesia (31). Often, elimination of deep pain inputs even temporarily allows the sensitized neurons to return to normal states (32). Convergence of neurons from multiple sites occurs in the CNS. Inhibiting or changing nociceptive inputs from one source can modulate other components and this has been suggested to be one of the mechanisms for effects of NBs on a wider territory (31,33-36). This reduces pain intensity enhances patient comfort and compliance and also enables the healthcare professional to perform manual reduction procedures such as in disc displacement without reduction or in TMJ luxation. The auriculotemporal NB, masseteric NB and twin block (TB) can also reduce pain, decrease protective muscle splinting, and improve mouth opening (37). NBs can also be used diagnostically to ascertain the source of pain. For instance, if the pain is emanating from the TMJ, then injection of local anesthetic into the source of pain can help in elimination of the pain complaint (25).

Auriculotemporal NB

Anatomy of ATN

ATN arises as two roots looping the middle meningeal artery, then runs backward to medial aspect of condylar neck (14). Then it takes an upward coarse, ascending over the zygomatic arch dividing into superficial temporal branches. The ATN has communication branches (communicating with branches of otic ganglion and facial nerve) and distribution branches (5 in number-articular; anterior auricular; branches to parotid; branches to the external acoustic meatus; superficial temporal). ATN provides sensory supply to scalp, parasympathetic fibres to parotid gland; upper part of auricle; posterior aspect of TMJ (38). Because blocking ATN reduces TMJ pain, it's used to determine if the source of pain is the TMJ or if it was a referred region of pain (24).

Technique

A 27-gauge long needle is used for this technique with a 1.8-mL syringe and 2% lidocaine with 1:100,000 epinephrine. First, the mandibular condyle is palpated, and neck of the condyle is located. With patient in closed mouth resting position, the needle is inserted at a point inferior and anterior to the junction of the tragus and earlobe, till the needle reaches posterior part of neck of the condyle. 0.5 mL of solution is deposited here, after which, the needle is advanced to the posterior aspect of the neck of the condyle depositing 1.0 mL of solution slowly over 4 to 5 minutes (24,25). At this position, the depth of needle penetration is approximately 1 cm. Modified AT block has also been described (39). The anatomy and injection technique for auiculotemporal NB is shown in *Figure 3*.

Complications

Studies by Donlon *et al.* and Nascimento *et al.* have reported temporary facial nerve paralysis (29.4%), hematoma (0.44–2%), positive aspirations (2.23%), zygomaticotemporal paralysis (14%), orbicular muscle paralysis (24%) as complications of ANT NB (39,40).

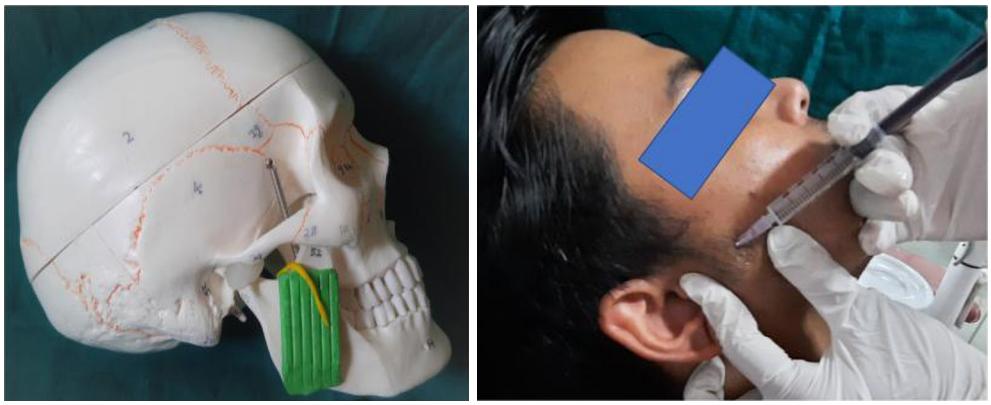

Figure 4 Injection technique for masseteric nerve block. This image is published with the patient/participant's consent.

Masseteric NB (MNB)

Anatomy of MN

The MN is a branch of the anterior division of the mandibular nerve, which is a branch of the trigeminal nerve. The MN traverses in close proximity to the roof of the infratemporal fossa passes above the superior head of the lateral pterygoid and proceeds to the mandibular notch and courses downwards and forward innervating the masseter muscle. Sensory impulses from this muscle can be suppressed by administering a masseteric NB. Introduced in 2009, this block is ideal for the management of masseter muscle pain; such as muscle soreness, protective muscle splinting, mandibular dislocations, or chronic masseter muscle pain, such as myofascial pain dysfunction syndrome (MPDS), myalgia, subluxation, and neuropathic pain.

Technique

The width of the ramus is first outlined with the index and middle fingers, the mandibular notch is palpated just below zygomatic arch with the index finger. The needle's point of entry is posterior to the index finger at an obtuse angle towards the neck of the mandibular condyle to a depth of about 1.5 cm. The injection technique for masseteric NB is shown in *Figure 4*.

For the masseteric NB a long 27-gauge needle is directed towards the fovea of the mandibular condyle, deposit a full carpule of lidocaine 2% with 1:100,000 epinephrine with the needle inserted all the way to the hub (41,42).

Complications

Although this is a relatively safe technique, caution should be exercised not to harm the temporal branch of the facial nerve. A transient loss of blink reflex may occur due to anaesthesia of this nerve, which can occur as a result of local anaesthetic agent penetration into the parotid fascia.

Temporo-masseteric nerve block (TMNB) previously called the TB (28)

Anatomy of deep temporal nerve (DTN) and MN

DTN and MN are branches of anterior division of mandibular nerve V3 after it exits foramen Ovale. Both the nerves traverse the infratemporal fossa and passes over the superior head of the lateral pterygoid muscle, emerging at the infratemporal crest. From here, the DTN turns superiorly along the greater wing of sphenoid bone to innervate the temporalis muscle. The MN passes through mandibular notch, turns downward and forward to supply masseter muscle. MN also supplies the mesial aspect of the TMJ.

The TMNB anaesthetises both the DTN and MN as they emerge from the infratemporal crest. The TMNB is diagnostic and therapeutic for both acute and chronic myofascial pain originated from masseter and temporalis muscles, pain secondary to extended opening of mouth during dental procedures. TMNB can also be used diagnostically for differentiating muscle pain from odontogenic pain (42).

Technique

The TMNB injection is a suprazygomatic injection. The needle's entry point is located by palpating for the depression created by the greater wing of the sphenoid bone which is located 1 cm posterior to the posterior border of the frontal process of the zygomatic bone. A 27-guage long

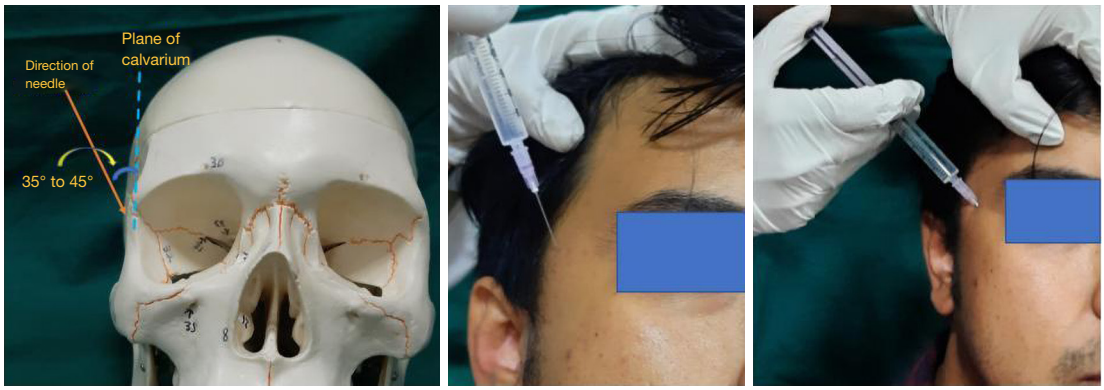

Figure 5 Injection technique for twin block nerve block. This image is published with the patient/participant's consent.

dental needle is angled 35–45 degrees from the calvarium and perpendicular to the zygomatic arch (along the coronal plane), the needle is advanced to its length before injecting 1.8 mL of 2% lidocaine with 1:100,000 epinephrine (42,43). The injection technique for TMNB is shown in *Figure 5*.

General clinical features of acute TMD's, management strategies have been detailed in *Table 2*.

Discussion

NB are invaluable chairside tools that can be used diagnostically and therapeutically in the ER and are an indispensable component of a healthcare professionals' armamentarium for pain relief. NB may be useful in determining the origin of pain (various components of the TMJ, adjoining structures) and differentiating odontogenic from non-odontogenic sources of pain. They also facilitate manual reduction procedures, reduce protective muscle splinting and thus aid in restoring the range of motion, functional movements of the jaw.

Pain and limitation of opening

A study on patients with TMD treated with a combination of ATNB, mild interventional procedures and physical therapy reported that the combination was effective in reducing pain, improving mouth opening and protrusive movements and the authors suggested that it may be an effective tool for diagnosis and management of acute conditions of the TMJ associated with pain. The protocol comprised of 8 sessions of once-a-week injection of 1 mL of bupivacaine 0.5% without vasoconstrictor, minimal interventional procedures and additional physiotherapy. Both subsets of TMJD and MMD patients were included in this study (44). Protective muscle splinting is reduced by anaesthetizing TMJ by ATN block. The reduction in pain may enable clinician to perform manual reduction manoeuvres causing an increase in range of jaw movements and producing stretching forces on the displaced disc thereby allowing it to reduce and return to its normal position.

A case series published by Kanti *et al.* revealed that TMNB was useful in the therapy of chronic myofascial pain (45). Ananthan *et al.* compared the efficacy of TMNB and trigger point injections in 48 patients with myofascial pain and discovered that TMNB was just as effective as trigger point injection for long term pain relief in myofascial pain (46). Ananthan *et al.* reported a case where the TMNB was used to treat a 19-year-old male patient diagnosed with myofascial pain in masseter and temporalis muscle and an acute anterior disc displacement without reduction of TMJ (47). After administrating the TMNB to this patient, both his TMJ disc displacement and myofascial pain resolved without any additional interventions.

Inability to close mouth

Young administered a TMNB injection to an 84-year-old Chinese patient with a dislocated condyle and spasm of the elevator muscle, which was resisting manual TMJ reduction, and observed that the reduction was only minimally painful and quick (48).

Trauma

Considerable controversy exists on management of patients

Table 2 Summary of clinical presentations, diagnosis and management strategies for acute emergencies in TMD's

Diagnostic features and management	Local myalgia	Myofascial pain	Myofascial pain with referral	Myositis	Myospasm	Disc Displacement without reduction	Luxation	Fracture
History	Soreness in muscle of mastication, muscle stiffness and weakness	Pain in the area of muscle, modified by jaw movement and/ parafunction habits	Pain in the area of muscle radiating to adjacent area, modified by jaw movement and/ parafunction habits	History of trauma or infection. Continuous pain in the involved muscle, which increases during muscle function	Acute and continuous contraction of involved muscle that is involuntary; pain, muscle stiffness	Closed lock; limited mouth opening; significant interference in functional movements of the jaw	Open lock; inability to close the mouth during instances of wide mouth opening. Inability to self-reduce	Pain; arthralgia; limited mouth opening; deranged occlusion
Clinical feature	Bilaterally stiff, and aching muscle with spasm or tightness; range of mandibular movement may be reduced	Muscle tenderness on palpation beyond the point of palpation, but within the muscular boundary	Muscle tenderness on palpation beyond the point of palpation and muscle boundary	Entire involved muscle is tender; decreased movement due to pain	Decreased muscle activity leading to decreased range of motion, function of muscle aggravates pain	Absence of joint noises; reduced mouth opening	Patient presents with mouth wide open or in protrusion or with jaw in a lateral position; occlusal derangement	Preauricular swelling; limited mouth opening; occlusal derangement
Diagnosis	Pain at the site of palpation only using myofascial examination protocol	Pain at the site of palpation which spreads along the muscle, but within the boundary of palpated muscle by using myofascial examination protocol	Pain at the site of palpation which spreads along the muscle, and beyond the muscle boundary to adjacent area	History, radiographs, computed tomography	Increased activity of muscle in electromyography	MRI	Transcranial, CT, CBCT, MRI	Radiographs of TMJ, CT, CBCT shows condylar head or neck fracture
Management	Education, physiotherapy, appliance therapy, pharmaceutical agents, anaesthetic nerve blocks, behavioural therapy	Education, physiotherapy, appliance therapy, pharmaceutical agents, anaesthetic nerve blocks, behavioural therapy	Education, physiotherapy, appliance therapy, pharmaceutical agents, anaesthetic nerve blocks, behavioural therapy	Physiotherapy; pharmaceutical agents	Education, physiotherapy, appliance therapy, pharmaceutical agents, anaesthetic nerve blocks, behavioural therapy	Manual manipulation for reduction of TMJ. Manual reduction may be facilitated by use of ATNB, TMNB nerve blocks. The acute management may be followed by conservative management strategies including palliative home care measures, pharmacotherapy for pain, temporary intra oral splints, physiotherapy	Manual reduction of jaw; ATNB, TMNB may facilitate quick and less painful reduction. This may be followed by strengthening exercises, physiotherapy, injection of sclerosing agents, prolotherapy, surgery in some cases	Relieve acute symptoms and restore proper occlusion and prevent ankylosis; intermaxillary fixation; open reduction

TMD, temporomandibular disorder; CT, computed tomography; CBCT, cone beam computed tomography; MRI, magnetic resonance imaging; ATNB, auriculotemporal nerve block; TMNB, temporo-masseteric nerve block.

with mandibular fractures, condylar and subcondylar fractures. NB administered after surgery may lead to prolonged pain free periods, required lower doses of rescue analgesia and resulting in early discharge when compared to patients with general anesthesia. Thus, regional NB may be effective and safe alternatives for general anesthesia (49).

Recently, a 'hematoma block' technique mostly reported for closed reduction (CR) of the long bone fractures or ankle fracture has been reported for use during CR of mandibular condylar fractures. The authors suggest that it helps in evacuating accumulated hematoma, thereby reducing chances of TMJ ankylosis. In addition, it blocks ATN and MN causing relaxation of the lateral pterygoid muscle, and thereby facilitating accurate anatomical reduction of the fracture (44).

MMD's such as myofascial pain and myofascial pain with referral are characterized by trigger points (hyperirritable spots in taut bands of muscle), which can refer pain locally at the site of palpation or to distant sites (22,25,50). Trigger point injections with local anesthetics such as 2% lidocaine without epinephrine may be used to deactivate the trigger points, reduce pain, dysfunction and restore range of movement. Epinephrine is generally avoided in trigger point injections and bupivacaine is generally considered myotoxic and avoided especially in combination with steroids. Studies have not demonstrated statistically significant results between dry/wet needling and needling with plain local anesthetics without epinephrine and addition of steroids. Multiple steroid injections in face are generally avoided as it may result in cosmetic disfiguration at the site of injection. Trigger point injections are simple effective techniques for distinguishing myofascial pain and myofascial pain with referral from other causes of facial pain (50). However, in some instances, repeated trigger point injections and multiple trigger point injections in a muscle may be essential to achieve desired results. Trigger points are generally used therapeutically in MMD's and may not be effective in biomechanical TMJD such as disc displacement without reduction.

Trigger point injections into the muscles of mastication have been described in detail (22). In brief, trigger point injection to the superficial masseter, which is one of the most common trigger points in the muscles of mastication is described. The trigger point is identified, marked and the area is prepped. The trigger point is isolated between the index and middle finger and a short 27-gauge needle is inserted into the trigger point and following aspiration, the area is needled while injecting the local anesthetic. A single carpule of local anesthetic without epinephrine commonly 2% lidocaine may be used for 2–3 trigger points in the masseter. A vapocoolant spray and stretch is done to stretch the muscle to its length (22,25).

Temporal tendinitis is an inflammatory disorder affecting the fibrous insertion of temporal tendon on the coronoid process and can cause pain in the orofacial region and headaches. It is important to differentiate it from odontogenic causes and other causes of facial pain especially in an ER setting. A study on 449 patients diagnosed with TMD, reported that 78% had temporal tendinitis and 83% out of them had bilateral temporal tendinitis. This may result in facial pain and headache complaints (51). In these instances, intra oral injections into the temporal tendon with 2% lidocaine in two separate areas of temporal tendon may be used to confirm the diagnosis and act therapeutically as well. Initially 0.5–1.0 cc is injected near the retromolar area at the insertion of temporal tendon followed by a superior injection of remaining of the carpule into an area adjacent to coronoid process (52,53).

NBs are regional anesthesia techniques which may be used to achieve broader area of anesthesia in the area of sensory innervation of a nerve. NBs may also be used diagnostically to differentiate odontogenic from non-odontogenic sources of pain (musculoskeletal, neuropathic and neurovascular) and can be used therapeutically in different subsets of orofacial pain as mentioned. Local anesthetics most commonly lidocaine with or without epinephrine may be used. It is a safe alternative to augment pain relief without side effects of general anesthesia. They can be used both in MMD and TMJD. They are more beneficial than trigger point injections in MMD, when a single muscle has multiple trigger points or multiple muscles have trigger points. A single NB such as TMNB (in case of trigger points in masseter and temporalis) may be administered as opposed to multiple trigger point injections (54).

Summary

NBs may be an invaluable chairside diagnostic and therapeutic tool that can be used in acute TMD emergencies. Diagnostically they may be used to identify the source of pain and differentiate odontogenic from non-odontogenic causes of orofacial pain. They provide safe, effective and immediate pain relief in myogenous and arthrogenous TMDs and facilitate manual reduction

procedures in instances of open and close lock of the TMJ.

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