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The use of platelet-rich plasma, hyaluronic acid, and botulinum toxin for the treatment of TMJ disorders

Abstract

The temporomandibular joint (TMJ) is a synovial joint that connects the mandibular to the skull. Its main function is to facilitate the movement of the jaw and when it suffers any type of damage or injury, it leads to a decrease in mobility and pain in the area. This localized pain is called temporomandibular joint disorders (TMJD), and it can be caused by intraarticular or extraarticular disorders. The most common symptoms include acute pain, decreased mouth opening, tightening of the muscle, headache, and loss of joint function.

Nowadays, there are treatments for temporomandibular joint dysfunction from surgical procedures up to less invasive methods, such as the use of splints. Platelet rich plasma (PRP), hyaluronic acid (HA) and botulinum toxin (BTX) injections have been categorized as a complement of primary treatment in TMJD, as well as decrease drug excess in patients.

Due to their natural origin, PRP and HA can regenerate tissue in cases of cartilage degeneration, inhibit inflammation, slow down the progression of osteoarthritis and increase the production of natural lubricating fluid in the joint. Its intra-articular application reduces pain due to lubrication and nutrition to the avascular areas of the disc and condylar cartilage.

Botulinum toxin (BTX) has been used for years in the medical and cosmetic field, but its use in TMJD refers to injections specifically within masseter muscle, with the objective to reduce the muscular tension TMJ overload, therefore, pain decreases, and movement increases.

Over the years these less invasive methods have been increasing in the medical area due to the great pain management in the neuro-muscular and articular complex.

Keywords: temporomandibular joint disorders, temporomandibular joint dysfunction, hyaluronic acid, platelet-rich plasma, botulinum toxin.

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Abbreviations: TMJ, temporomandibular joint; TMJD, temporomandibular joint disorders; PRP, Platelet rich plasma; HA, hyaluronic acid, BTX, botulinum toxin; NSAID, nonsteroidal anti-inflammatory drugs; MPDS, myofascial pain–dysfunction syndrome; ACP, autologous conditioned plasma.

Introduction

The temporomandibular joint (TMJ) is a complex, sensitive and highly mobile joint that joins the lower jaw with the bones of the skull, allowing translational movements (protrusion/retraction and lateral deviation) and rotational movements (elevation/depression). The main components of the TMJ are the joint capsule, synovial membrane, and the articular disc which is composed of synovial fluid and a great abundance of hyaluronic acid which provides viscoelastic properties.

The mandibula and the skull are connected by the major ligaments (lateral temporomandibular ligament), minor ligaments (stylomandibular ligament, sphenomandibular ligament), and muscles including the temporalis, masseter, lateral pterygoid, and medial pterygoid, infrahyoid and suprahyoid muscles.

Temporomandibular joint disorders (TMJD) are a group of musculoskeletal and neuromuscular conditions that involve the temporomandibular joint, as well as the musculature and skeletal components. Masticatory muscle disorders can occur in isolation or can be combined with other TMJD. The most common cause is parafunctional behaviors that cause irritation and inflammation of the muscles of mastication.

Within the conventional treatment of these disorders, modern therapeutics has been considered such as the use of injections of platelet-rich plasma, hyaluronic acid and Botox.

Temporomandibular disorders diagnosis

More than 10 million Americans suffer from TMJD[1] and it affects up to 15% of adults, with an incidence of 20 to 40 years of age.

Based on the patient physical exam and history is important to consider bruxism, since it is a potential factor for TMJD for the increase of muscle tension and is often accompanied by symptoms of headache, jaw soreness, neck pain, and mouth opening Evaluation of behaviors of the patient such as depression, anxiety, stress, are key to diagnose these disorders. For several years, authors on the etiological factors of TMJD have been emphasizing that stress is an increasingly important etiological factor in its development.[3,4]

The main symptoms of TMJD include muscular jaw pain, poor mouth opening, otologic symptoms, tightening of the muscle, tension-type headache, masticatory muscles pain and facial pain, clicking or popping sounds and sometimes a change in the way the upper and lower teeth fit together [2]. The relationship between tension-type headaches and TMJD can be confirmed by the decrease in headache intensity observed after the management of temporomandibular joint dysfunction.[2,3] Sleep and awake bruxism are potential factors for TMJD, as they can increase muscle tension and TMJ overload.[4]

Temporomandibular joint disorders treatment

The treatments for temporomandibular joint disorder range from techniques that relieve pain, such as the use of nonsteroidal

anti-inflammatory drugs (NSAID), up to surgical procedures.[5] Arthrocentesis is a procedure in which a small sample of synovial fluid is aspirated to detect some joint diseases and to lavage the joint space by irrigating physiological saline or Ringer's solution with the objective to remove inflammatory substances and degraded tissue which will help to relieves adhesions, increase mobility, and reduce pain.[6,19] Arthroscopy is another procedure, which has the benefit of visualization into the joint during the procedure with a fiber-optic video camera which allows the surgeons repair some types of joint damage.[6]

Intra-articular administration of NSAIDs is an accepted treatment in orthopedic and rheumatic disorders, they have the disadvantage that they can cause cartilage destruction and accelerate the osteoarthritis process when used excessively.[7] Instead, it has been discovered that platelet rich plasma (PRP) and hyaluronic acid (HA), have elements to regenerate tissue in cartilage degeneration cases and specialists have developed new techniques with the use of these natural agents, which have obtained great result in relieving pain.

Classification of temporomandibular joint disorders[1,5,6]

- Disorders of the joints. Arthralgia

Include dislocation, arthritis, ankylosis, meniscus disorders, and tumors.

- Disorders of the masticatory muscles. Myalgia

Myofascial pain–dysfunction syndrome (MPDS)

- Headaches associated with TMJD.

Platelet rich plasma

Plasma refers to the liquid component of blood, mostly water but also includes proteins, nutrients, glucose, antibodies, among other components and is responsible for redistributing water, delivering hormones, supporting blood vessels, regulates body temperature and as defense. Platelets, the main component of the blood in the process of hemostasis, secrete growth factors and other proteins that regulate cell division, stimulate tissue regeneration, and promote healing.[8]

Platelet rich plasma (PRP) contains the proteins responsible for adhesion; fibrine, fibronectin and vitronectin, which stimulate tissue and fibroblast regeneration to produce structural proteins for the formation of new collagen and elastin, allowing the remodeling and angiogenesis as well as training mesenchymal stem cell.[7]

PRP has been used as a novel method to regenerate damaged tissues, including liver, bone, cartilage, tendon, and dental pulp helping to stimulate the healing process and decreasing pain (Table 1).[9]

Table 1 Dental and cranial applications of Platelet Rich Plasma

Dental and cranial applications of Platelet Rich Plasma (PRP)[9]	
Bone regeneration	Soft tissue regeneration
Sinus lift grafting. Ridge augmentation grafting. Third molar sockets. Periodontal defects. Temporomandibular joint disorders. Reconstruction of major tumor and trauma defects. Mandibular reconstruction. Maxillary and midface reconstruction. Alveolar cleft grafting. Reconstruction of the severely resorbed mandible.	Periosteal and connective tissue flaps. Free connective tissue and gingival grafts. Root coverage procedures.

Platelet Rich Plasma (PRP) therapy method

The autologous conditioned plasma (ACP) therapy consists of intra-articular injections of PRP directly into the affected joint with the aim to reduce pain, improve joint function, possibly slow, halt, or even repair damage to cartilage. It has been proposed as a biological therapy, given its easy isolation, availability and the absence of immunological reactions or transmission of diseases, since it is autologous.

This therapy can be used in patients with dislocated articular disc, joint hyper-excursion, articular disc perforation and osteoarthritis. [7] Intra-articular injections of PRP includes an increase in maximum mouth opening, decreased pain and improved joint function.[6–8]

Specialists who use PRP therapy to treat osteoarthritis theorize that the platelet-rich plasma might inhibit inflammation and slow down the progression of osteoarthritis, stimulate the formation of new cartilage, increase the production of natural lubricating fluid in the joint, decrease joint friction and reduce pain sensation (Table 2).[6–8]

Table 2 Platelet Rich Plasma

Platelet Rich Plasma (PRP)[6,10]		
Advantages	**Disadvantages**	**Adverse effects**
Autologous treatment. Minimal adverse reaction. Allows reduction significance of painful symptoms in patients with TMJD. Increase maximum mouth opening. Modification of the presence of joint noises. Proliferative properties of chondrogenic differentiation and analog.	The FDA does not regulate PRP injections but does approve the process and equipment used for preparation of PRP. Insurance companies still consider PRP injections experimental.	Postoperative pain and swelling.

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Hyaluronic acid

Hyaluronic acid (HA) is a natural and essential glycosaminoglycan found in many extracellular tissues, synovial fluid, and cartilage. It is produced by chondrocytes and synoviocytes in the joints.[6,11]

HA has an important role in cell migration, since it is involved in growth, inflammatory and repair processes due to its cellular and extracellular interactions with growth factors. It also helps maintaining the structural and homeostatic integrity of the tissue by regulating the osmotic pressure, tissue elasticity, resistance, and lubrication.[12]

During aging, the concentration of HA tends to decrease, causing loss of elasticity and viscosity of tissues, especially joints lubrication, which makes them more susceptible to injury (Table 3).[13]

Table 3 Dental and cranial applications of Hyaluronic acid

Dental and cranial applications of Hyaluronic acid (HA)[11,12]
Promotes tissue repair processes and traumatic processes.
Reduces bleeding.
TMJD pain decreases and enhances function.
Anti-inflammatory and antibacterial effects.
Bone regeneration.
Angiogenesis effect.

Hyaluronic acid (HA) therapy method

The Viscosupplementation (Balazs 1986) consists of inject intra-articular injections of viscoelastic solutions of hyaluronate and its derivatives with the aim of improving the elastic and viscous properties of synovial fluid in cases such as arthroscopy and osteoarthritis.

HA was found to be efficacious by 4 weeks, reaching its peek effectiveness at 8 weeks but exerting a residual detectable effect at 24 weeks. It is an advantageous treatment in terms of pain relief and improved functionality, achieving an appreciable regeneration of the cartilage.[10,13]

Generally, viscosupplementation is used to treat osteoarthritis, but the technique also benefits people with other kinds of arthritis (Table 4).

Table 4 Hyaluronic acid

Hyaluronic acid (HA)[6,14]		
Advantages	**Disadvantages**	**Adverse effects**
Minimal adverse reaction. Allows reduction significance of painful symptoms in patients with TMJD. Regenerates cartilage of the joint. Useful in healing the lubrication system. Improves mouth opening.	The FDA has approved HA for only used in the knee, does not apply to TMJ. Insurance companies cover its use for the knee.	Pain with injection and postoperative pain.

Botulinum toxin

Botulinum toxin (BoNT or BTX) is a neurotoxic protein produced by the bacterium Clostridium botulinum which interferes with neural transmission by blocking the release of acetylcholine, the principal neurotransmitter at the neuromuscular junction, causing muscle paralysis.[15,16]

BoNT has been used for several years in medicine for cosmetic procedures, cervical dystonia, hyperhidrosis, and prevent chronic migraines, although the therapeutic effect is temporary.[21]

The use of BoNT injections in TMJD is to release facial and cranial muscles, preventing over-contraction, muscle growth and myofacial pain (Table 5).

Table 5 Maxillofacial applications of Botulinum Toxin

Maxillofacial applications of Botulinum Toxin (BoNT)[4,16,21]
Strabismus.
Blepharospasm.
Hemifacial spasm.
Cervical dystonia.
Spastic movement disorders.
Headaches.
Hyperhidrosis.
Chronic migraine.
Hypersalivation.
Gummy smile
Hypertrophy and hyperactivity of the masticatory muscles.
Myofascial pain dysfunction syndrome.
Cosmetic purposes: wrinkles, asymmetry.
Bruxism.

Botulinum toxin therapy method

Botulinum toxin injections in TMJD are specifically administrated in masseter muscle, unlike PRP and HA injections within the joint, BoNT are contraindicated. This drug is deposited for neuromuscular purposes within the temporal and masseter muscles.[22] Studies have shown that botulinum toxin injections are effective in reducing tension-type headache intensity, are effective, safe, and well tolerated.[17,18] This therapeutic should be taken under consideration as a complementary treatment but not the primary option. In conjunction with occlusal splints indicate favorable results (Table 6).[3,4]

Table 6 Botulinum Toxin

Botulinum Toxin (BoNT)[16,18,22]		
Advantages	**Disadvantages**	**Adverse effects**
Allows reduction significance of painful symptoms in patients with TMJD. Increase movement	The FDA has approved HA for only used bladder dysfunction, chronic migraine, upper limb spasticity, cervical dystonia, primary axillary hyperhidrosis, blepharospasm, strabismus, glabellar rhytides and lateral canthal rhytides, does not apply to TMJ. Not able to patients with neuromuscular disorders	Muscle weakness. Anticholinergic adverse effects: reduced salivation (dry mouth), reduced sweating, constipation, postural hypotension and, less frequently, cholestasis and biliary colic. Postoperative pain and swelling.

Results and discussion

Although nowadays there are treatments and therapies for joint dysfunction, currently there is no effective treatment for articular cartilage regeneration or osteoarthritis resolution produced by TMJD.[23]

Use of PRP turns out to be a therapeutic method of easy manipulation, with minimal adverse reaction due to its autologous characteristic, it's an efficient treatment that allows reduction of painful symptoms in patients with TMJD. In rheumatology field PRP has been shown as an effective treatment for joint degenerative disorders, which regenerate chondrocyte, improve function, and decrease pain.

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The results of HA are like PRP except for its use in healing the lubrication system and increased mouth opening, but with an inferior short-term result compared to PRP.

Botulinum toxin has been implemented in the medical area for several years by weakening or paralyzing certain muscles or by blocking certain nerves is intended to restore relief to the pain area.

BoTN injections within masseter muscle are effective in reducing tension-type headache intensity due to decreased overload of masticatory muscles, therefore joint pain decreases.

Conclusion

These 3 substances that have been discussed have not yet been approved by the FDA for their use in the treatment of temporomandibular disorders; however, studies have been proved as complementary use to the primary treatment showing positive results with a lower rate of adverse effects.

Alternative therapeutic should also be considered to obtain better results such as stretching techniques, chiropractic adjustments, hot and cold therapy, and acupuncture.

More clinical studies must be done to use these substances in the treatment of joint disorders.

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Conflict of interest

The author declares no conflict of interest.

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