SUNTEXT REVIEWS

SunText Review of Dental Sciences
ISSN: 2766-4996

Open Access
Research Article
Volume 4:2

Intraarticular Injection of Visco-PRP in Treatment of Internal TMJ Derangement

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Received date: 16 September 2023; **Accepted date:** 02 October 2023; **Published date:** 10 October 2023

Citation: ElMonem Arboud KAA (2023) Intraarticular Injection of Visco-PRP in Treatment of Internal TMJ Derangement. SunText Rev Dental Sci 4(2): 167.

DOI: https://doi.org/10.51737/2766-4996.2023.167

Abstract

The temporomandibular joint (TMJ) is a bilateral synovial articulation between the mandible and temporal bone. The name of the joint is derived from the two bones which form the joint: the upper temporal bone which is part of the cranium (skull), and the lower jaw bone or mandible.

Keywords: Temporomandibular joint; Synovial joints; Temporomandibular joint disorders; Anterior disc

Background

The temporomandibular joint (TMJ) is a bilateral synovial articulation between the mandible and temporal bone. The name of the joint is derived from the two bones which form the joint: the upper temporal bone which is part of the cranium (skull), and the lower jaw bone or mandible [1]. The common features of the synovial joints exhibited by this joint include a disk, bone, fibrous capsule, fluid, synovial membrane and ligaments. However, the feature that differentiate and make this joint unique is its articular surface covered by fibrocartilage instead of hyaline cartilage. Movement is not only guided by the shape of the bones, muscles, and ligaments but also by the occlusion of the teeth, since both joints are joined by a single mandible bone and cannot move independently of each other [2]. Temporomandibular joint disorders (TMD) are among the most misdiagnosed and mistreated maladies in medical practice. TMDs is a collective term for conditions including pain and/or dysfunction of the temporomandibular joint involving either muscular or skeletal structures or both. The condition characterized by clinical signs of pain or malfunction occurring in the temporomandibular joint or muscles of mastication, articular sounds (clicking) and abnormities in mandibular movements [3]. Temporomandibular joint disorders (TMDs) affect the jaw joints and related structures and includes painful myofascial problems, internal derangement of joint space, degenerative and rheumatologic problems. TMD is characterized by pain, joint noise, a limited range of motion, impaired jaw function, deviation or deflection upon mouth opening, malocclusion, and closed or open locking [4]. Internal derangements that result in progressive displacement of the articular disc are present in a proportion of TMD cases. Anterior disc displacement with reduction refers to an unnatural forward movement of the disc during opening, which reduces on closing. When there is a tear in the back part of the joint capsule, called a retrodiscal ligament, the articular disc may be displaced forwards (anterior disc displacement). The upper head of the lateral pterygoid muscle normally acts to stabilize the disc; however, the disc displacement makes it ineffective and the lower head tries to compensate, thus producing abnormal muscle activity during mouth closure [4, 5].Anterior disc displacement without reduction refers to an unnatural forward positioning of the articular disc, which does not reduce when the mouth is closed. The articular surfaces of the bones are exposed to a greater degree of wear, which may progress to (OA) in later life [6]. There are essentially two types of therapy for temporomandibular joint (TMJ) disorders – conservative (non-invasive) and surgical (invasive), during which the joint structures themselves are entered. A number of conservative methods are used in the treatment of temporomandibular joint internal derangement, including

occlusal splints of various designs, supportive physical therapy procedures, rehabilitation involving muscular training, and specialist psychological support. Surgical treatment can be divided into invasive (open) and minimally invasive (which includes arthrocentesis and arthroscopy) [7]. In internal derangement the protocols for initial treatment consists of choosing reversible and little invasive therapies, such as occlusal splints, non-steroidal anti-inflammatory drugs (NSAID), analgesics, physiotherapy and patient advice. However, in some cases, conservative treatment becomes little responsive due to current structural changes. Thus, more complex procedures such as intra-articular injections with corticosteroids or hyaluronic acid, arthrocentesis appear as therapeutic options to control and treat TMJ internal derangements [6]. Intra-articular administration of medications is an established method of treatment, particularly in orthopedic and rheumatic disorders associated with pain, effusion, inflammation of cartilage, and bone and joint capsules as well as fibrous adhesions. Currently, agents used for intra-articular injection within the temporomandibular joint regions include hyaluronic acid and steroids [8]. Current research is investigating new methods of stimulating repair or replacing damaged cartilage, such as matrix metalloproteinase inhibitors, gene therapy, cytokine inhibitors, artificial cartilage substitutes, and growth factors. The influence of the growth factors in cartilage repair is now being widely investigated in vitro and in vivo. Platelet-rich plasma (PRP) is a natural concentrate of autologous growth factors from the blood. The method is simple, low cost, and minimally invasive. Currently, a wide range of experiments is taking place in different fields of medicine in order to test the potential of enhancing tissue regeneration [9]. PRP has been used clinically in humans for its healing properties attributed to the increased concentrations of autologous growth factors and secretory proteins that may enhance the healing process on a cellular level. The hope is that PRP enhances the recruitment, proliferation, and differentiation of cells involved in tissue regeneration. The rationale for the use of PRP is that the supraphysiological release of platelet-derived factors at the direct site of cartilage injury or disease can stimulate the natural healing cascade and tissue regeneration. Platelet activation leads to a release of a hundred of growth factors from its α-granules to promote cartilage matrix synthesis, increase cell growth, migration, and phenotype changes, and facilitate protein transcription within chondrocytes [10]. Hyaluronic acid (HA) is naturally found in body and joints. It enhances lubrication and facilitates joint movement. TMJ patients were diagnosed with ID, suffer considerable diminish of HA levels at their joints [8]. Although, hyaluronic acid safety and efficacy compared to corticosteroids but it is also costly effective and its half-life within the joint is very short.

Studies of the efficacy of intra-articular TMJ injections have shown mixed results, with improvement in some patients and disease progression in others. Reports of intra-articular corticosteroid injections to the TMJ showing that high doses of corticosteroids were increasing the risk of aseptic bone necrosis. Also, patients with severe damage may be less responsive to intra-articular corticosteroids, and require multiple injections to treat persistent, severe TMJ symptoms [8]. Current methods of intra-articular drug injection often require frequent injections that have a high financial burden, impact patient quality of life, and also increase the risk of complications. Immediately following each intra-articular injection, patient joint activity (e.g., chewing, talking, etc.) is restricted so as to minimize the risk of either joint overload or tissue reaction resulting in increased drug clearance, so, the need for a material to be safe, low cost, effective in reliving symptoms and able to induce tissue regeneration is evoked [5].Visco-PRP is a mixture of PRP and HA. Visco-PRP injection showed good chance for combing two different materials with different moods of action as a treatment of ID [11].

The Purpose of the Studs

Evaluation of Visco-PRP intraarticular injection in treatment of ID cases.

Methods

The study included 20 patients with TMJ unilateral internal derangement. Study sample divided into two equal groups

- **Group 1**

10 patients diagnosed with anterior disc displacement with reduction.

- **Group 2**

10 patients diagnosed with anterior disc displacement without reduction.

Both groups were treated with arthrocentesis and intraarticular injection of one material Visco-PRP: 0.5 ml ampoule HA and 0.5 ml PRP with ratio 1:1.

Inclusion criteria

Patients with unilateral internal derangement causing functional disability and pain and who had not responded to conservative treatment.

Exclusion criteria

- An inflammatory or connective tissue disease.
- A history of or an ongoing autoimmune disease.

- Neurologic disorders.
- Blood diseases, severe anaemia and thrombocytopenia.
- Malignant disease in the head and neck region.
- Patients who were injured severely or received injection in their affected joint within six months, which would make evaluation of the TMJ difficult.
- Treatment with systemic corticosteroids < 3 months or medication That could interfere with platelet aggregation < 7days
- Patients allergic to hyaluronic acid.

Workflow and Surgery

Preoperative evaluation

- Full dental, medical history and chief complaint.

Clinical evaluation

- The patients will be photographed at both resting and maximum opening positions.
- The presence of clicking or crepitation with joint movement will be assessed by auscultation with a stethoscope and recorded.
- Maximal mouth opening (MMO) will be measured as the distance in millimeters (mm) between the incisal edges of the upper and lower incisors.
- Lateral excursions of mandible to right and left sides will be measured as the distance in millimeters between midline of lower teeth to midline of upper teeth.
- Evaluation of pain during opening and closing by visual analogue scale (VAS).
- Of mandible as the distance between midlines of upper and lower incisors teeth during jaw movements to right and left.
- Evaluation of pain during opening and closing by Visual Analogue Scale (VAS) by drawing a circle on the diagram to indicate the site of pain and pain score from 0 to 10 (0 is no pain at all and 10 is severe pain).

Radiographic evaluation

1. Panoramic x-ray to check general TMJ condition.
2. Magnetic resonance imaging (MRI) will be used to asses anterior disc displacement in all patients of both groups.

Arthrocentesis

The temporomandibular region will be prepared with antiseptic surgical scrub solution (Betadine). The first injection point will be marked 10 mm forward from the tragus and 2 mm below the tragus-lateral canthus line. The second point will be marked 20 mm forward from the tragus and 7 mm below the tragus-lateral canthus line The technique is usually performed under local anesthesia (Lidocaine Hydrochloride)** for good analgesia in the preauricular area, the correct technique involves inserting a fine needle into the subcutaneous tissues of the mandibular angle, and then pushing the needle superiorly until the TMJ area, where the anesthetic solution (2 mL) is injected. A second injection of (2 ml) anesthetic solution will be given first around the capsule and then inside the joint itself (in the upper compartment of TMJ). The needle has correctly entered the joint and that the anesthetic has been injected inside the upper joint space will be confirmed by the movement of the patient's mandible towards the opposite side, with outflow from the needle if the patient closes his mouth. This technique allows anesthetizing the joint and the auriculo-temporal nerve.

- Once the preauricular area has been anesthetized, the first needle can be introduced into the upper compartment of the joint.
- The patient will be asked to open the mouth wide in order to keep the glenoid fossa empty and to gain space. Then a 20-gauge needle, supported and guided by the forefinger, will be introduced into the upper joint space in a medio-superio-anterior direction, with the bevel oriented upwards and needle angled at 45° on sagittal plane to a depth of about 2 cm until the tip of the needle has come into contact with the posterior wall of the articular eminence.
- Once the upper joint space is entered there is an outflow of the previously injected anesthetic solution. The joint compartment will be distended by injecting 2ml of normal saline, and then the second 20-gauge needle will be inserted (at 2nd point into the anterior recess of upper compartment) as the needle.
- While patient on maximal mouth opening with needle direction 45 degrees forward upward inward into the upper compartment of TMJ and injection of 0.5 ml local anesthetic solution.
- A line is drawn by surgical marker from lateral canthus to most posterior and central point on the ear tragus (Holmlund–Hellsing Line).
- Enters the joint space there will be some outflow through it (Figure 1).
- It is important to note that if the outflow stops or if there is swelling in the preauricular area, the needles will need to be reinserted. At the end of the lavage, the 2nd needle will be removed and injection of Visco-PRP is done through only one needle (Figure 3).

PRP Preparation

PRP will be prepared from a 10 mL autologous venous blood sample taken from the antecubital vein. The blood will be drawn into test tubes containing sodium citrate and then undergoing 2

spines protocol for PRP preparation. The first spin will be at 1500 rpm for 15 min. for separation of RBCs from plasma. Then the plasma will be transferred into empty tube undergoing the second spin. The second spin will be at 3500 rpm for 10 min. for more plasma concentration of platelets into PRP and less plasma concentration of platelets PPP (platelet poor plasma).

1ml of Visco-PRP is obtained mixing 0.5 ml ampoule HA and 0.5 ml PRP in one syringe (Figure 2).

Figure 1: *Showing arthrocentesis step.*

Figure 2: *Visco -PRP is prepared in syringe.*

Figure 3: *Injection of Visco-PRP using one needle only.*

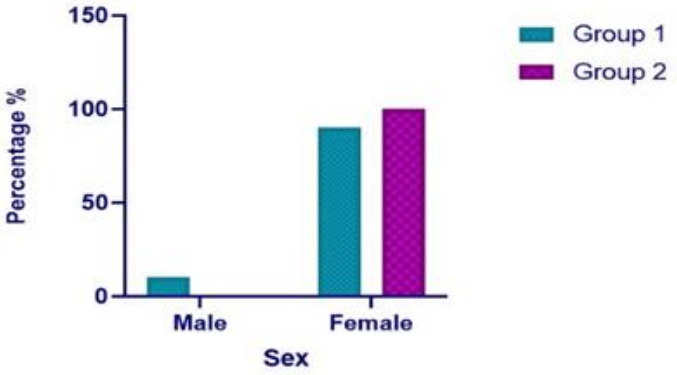

Figure 4: *Showing age distribution***.**

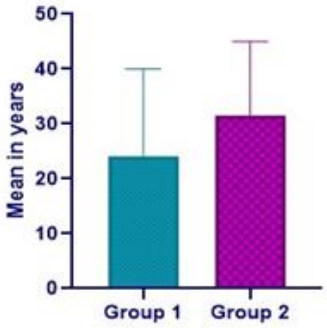

Figure 5: *Showing sex distribution.*

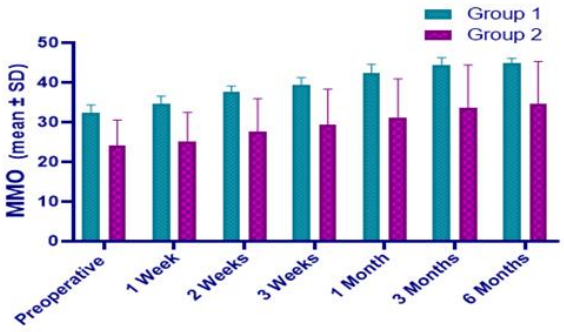

Figure 6: *showing 6 months evaluation of all patients.*

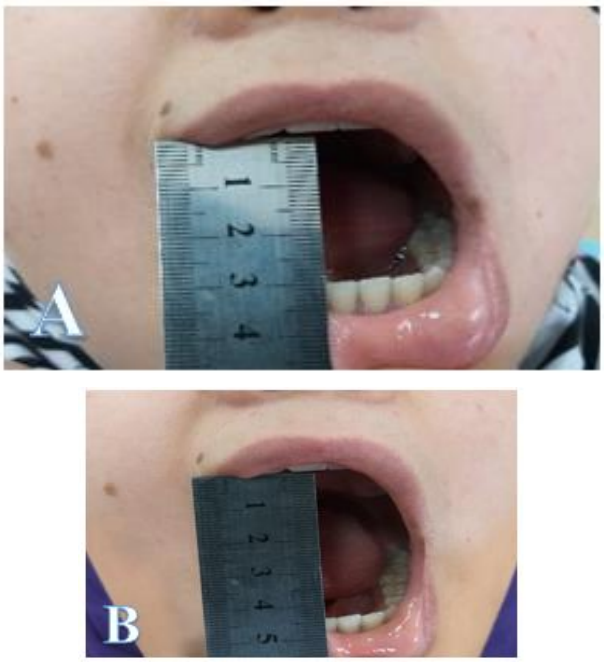

Figure 7: *Case no. 8 group II A: showing maximal mouth opening (13 mm) at preoperative stage. B: showing maximal mouth opening (17 mm) after 6 months.*

Figure 8: Case no. 5 group I A: *showing maximal mouth opening (30 mm) at preoperative stage. B: showing maximal mouth opening (44 mm) after 6 months.*

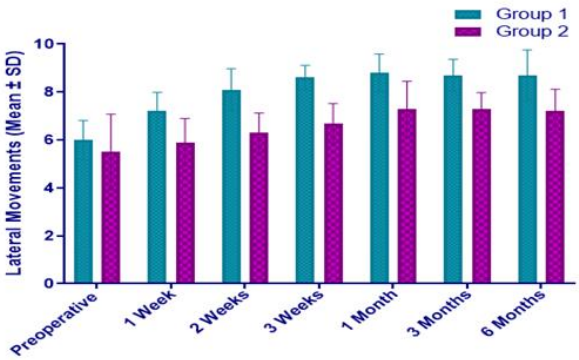

Figure 9: *showing mean ± standard deviation of lateral movements in both groups.*

Figure 10: *Case no. 4 group I A: showing lateral excursion (6 mm) at preoperative stage. B: showing lateral excursion (11 mm) after 6 months.*

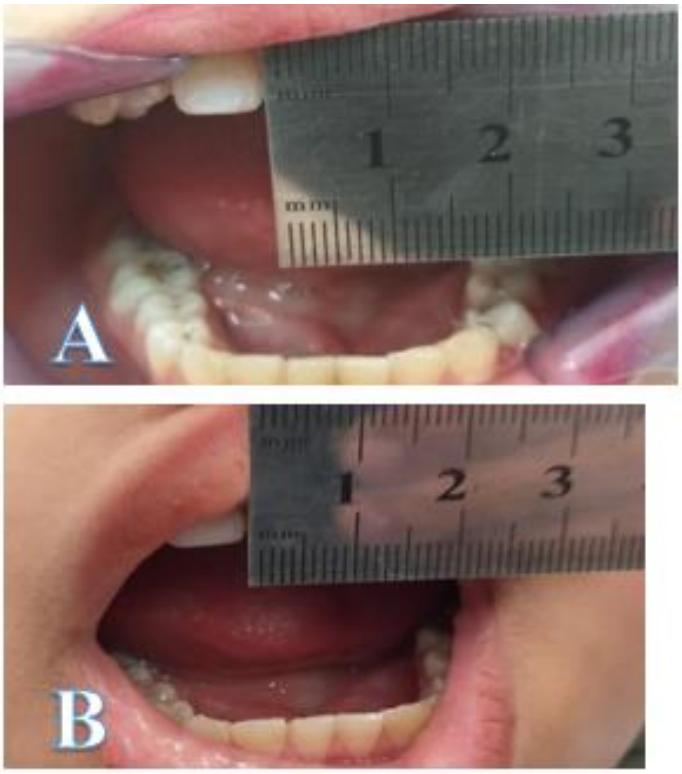

Figure 11: *Case no. 7 group II A: showing lateral excursion (5 mm) at preoperative stage. B: showing lateral excursion (6 mm) after 6 months.*

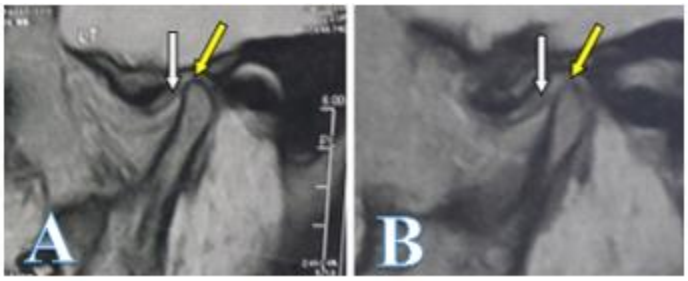

Figure 12: *showing (MRI) sagittal view on left closed joint of case no. 5 group I*
A: Preoperative. B: After 6 months with no change of the disc position. (The white arrow shows the disc position and the yellow arrow shows retrodiscal tissues).

Post-operative evaluation

Follow up and clinical assessment for all patients at interval of 1 and 2 weeks, 1, 2, 3 and 6 months. MRI is done after 6 months to show if we get better results.

Results

Age and sex

20 adult patients with unilateral ID: 1 male and 19 females. In group. Patient's age ranged from 16 to 45 years old (Figure 4, 5).

Pain score

Pain score VAS decreased and showed improvement outcomes of pain during 6 months evaluation as (Table 1).

Table 1*: Showing pain score for all patients.*

VAS		Group 1	Group 2	T- test	
				t	P-value
Pre-operative	Range	6.00 – 9.00	6.00 – 9.00	0.220	**827.0**
	Mean ±SD	6.900 ± 0.994	6.800 ± 1.038		
1 Week	Range	2.00 – 5.00	3.00 – 6.00	1.961	**0.061**
	Mean ±SD	3.400 ± 0.843	4.300 ± 1.059		
2 Weeks	Range	1.00 – 3.00	1.00 – 2.00	1.987	**0.0624**
	Mean ±SD	1.700 ± 0.674	1.200 ± 0.421		
3 Weeks	Range	0.00 – 2.00	0.00 – 1.00	1.395	**0.180**
	Mean ±SD	0.900 ± 0.737	0.500 ± 0.527		
1 Month	Range	0.00 – 1.00	0.00 – 2.00	0.397	**0.695**
	Mean ±SD	0.800 ± 0.421	0.700 ± 0.674		
3 Months	Range	0.00 – 1.00	0.00 – 2.00	0.397	**0.695**
	Mean ±SD	0.700 ± 0.483	0.800 ± 0.632		
6 Months	Range	0.00 – 1.00	0.00 – 2.00	0.670	**0.510**
	Mean ±SD	0.600 ± 0.516	0.800 ± 0.788		

**P <0.05 (significant)*

Mouth Opening

All patients showed gradual increase of MMO six months postoperatively follow up. As illustrated in (Figure 6).

Jaw Lateral excursion

Lateral excursion was measured for all patients from 1 week to 6 months. Mean of lateral excursion for group (1) was 6.00 ± 0.816, increased gradually to 8.70 ± 1.059 mm after 6 months. For group (2) was 5.50 ± 1.531 mm increased to 7.20 ± 0.918 mm (Figure 9-12).

Discussion

TMJ ID is such a challenging disorder, manifested by pain, joint sound, and malfunction. Minimal invasive procedures are considered a highly demanding treatment because of its simple, easy and of low cost compared to other invasive surgical procedures. Recently, Pathogenesis of this TMD pointed to biochemical factors, separate from the disc pull mechanical theory. Inflammatory reactions that take place in TMJ are essential for the development and progression of the disease, including high levels of inflammatory mediators in the synovial fluid such as interleukin 1 beta (IL-1β), or tumour necrosis factor alpha (TNF-α). And others. Furthermore, the disintegration of the important component of the synovial fluid or mainly hyaluronic acid (HA) leads to a decrease in the viscosity of the synovial fluid and deterioration of proteoglycan matrix. Many TMJ researchers have declared that articulating surfaces under increased friction get torn faster and that might be a corner stone cause for ID and osteoarthritis. Therefore, whatever the cause or theory, all above-mentioned pathologies must be taken into consideration [12].

Some suggested Visco-PRP as intraarticular injections in TMD patients, they believed they both have PRP and HA have effective impact and good results but with different modes of actions. High concentration of autologous growth factors in PRP is expected to reduce the time needed for healing based on the accumulated data collection and clinical researches. HA is widely used to treat ID for many years with good results as its beneficial effect related to its main role as a Visco-supplement with anti-inflammatory activity [13]. Compared clinically the efficacy of using PRP with HA as injections and showed that PRP presented more eminent improvements especially in physical function. However, the efficacy of combination treatment with PRP and HA remains unknown [14] also compared the clinical efficacy of PRP with HA and found both treatments were effective in improving functional status and symptoms over time. HA did not provide an overall preferable clinical improvement than PRP either in different follow-up readings or effect of duration [15]. Published an in vitro study of the synergistic anabolic action of Visco-PRP on cartilage regeneration. In study's results, mixture of PRP and HA raised articular chondrocyte proliferation and chondrogenic differentiation also the mixture reduced the levels of pro inflammatory cytokines. Authors declared that synergistic effects were a result of different molecular mechanisms however, the

direct influence of HA on the platelets in PRP was not discussed. Studies used HA with PRP as a mixture forming Visco-PRP for intraarticular injection and discussed the effect of one component on each other [12]. the authors hypothesized that HA adding to the PRP would raise the concentration of released growth factors, stimulating healing process in damaged tissues, relieving pain by delivering more potent cocktail of growth factors which are released by platelets [16-20].

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