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Arthrocentesis with or without Platelet Rich Plasma (PRP) in Management of Tempromandibular Joint Internal Derangement: Comparative Study

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ABSTRACT

Introduction: *Disc derangement disorders of the Tempromandibular joint (TMJ) are a group of intra-articular biomechanical disorders in which there is an abnormal relationship in the functional 'articular cartilaginous' condyle-disc complex. Arthrocentesis is a valuable effective non-invasive treatment option of many internal derangement cases. Adding benefit to arthrocentesis outcome through the use of platelet rich plasma (PRP) is a point of research taking benefit from growth factors to enhance tissue healing.*

Objectives: *the present study aims to compare the clinical outcome of the use of arthrocentesis alone and arthrocentesis +PRP in management of TMJ internal derangement.*

Materials and Methods: *Fourteen patients with disk displacement without reduction (DDwOR) were included in the study diagnosed according to The Research Diagnostic Criteria for Tempromandibular disorders (RDC/TMD). Cases are randomly allocated into two groups as follow; seven patients underwent intra-articular injections of 2 ml PRP after arthrocentesis (study group) and the other seven patients were treated by the conventional arthrocentesis using Ringer's solution (control group). The patients were clinically evaluated preoperatively and postoperatively at the intervals of 1 month and 6 months.*

Results: *there was no statistically significant difference between two groups in all the measured parameters were throughout the postoperative period. However both groups showed statistically significant improvement regarding mouth opening and joint pain.*

Conclusion: *arthrocentesis either alone or with PRP injection is a safe and effective method in the treatment of TMDs.*

Keywords

TMJ, Internal Derangement, PRP, DDwOR, Arthrocentesis.

Introduction

TMJ is a complex synovial joint consisting of temporal bone, mandibular bone, articular disc, synovial membrane, and associated ligaments and muscles. It consists of two compartments the upper and lower compartments [1,2], this unique structure facilitates a mouth opening of 40-60 mm as measured between the upper and lower incisors where rotation of the condyle occurs in the lower compartment enables about 15-25 mm opening while the translation of the condyle with the disc along affords a mouth opening of 40-60 mm as well as lateral movements of up to 10 mm, protrusive movement of up to 9 mm and retrusive movements of 1 mm [3].

TMDs are collection of medical and dental conditions affecting the joint and muscles of mastication, as well as contiguous tissue components [4]. The RDC/TMD applies a dual-axis system to diagnose and classify patients with TMD. The physical

axis 1 classify TMD patients into (I) myofascial pain, (II) disc displacement with/without reduction, and (III) arthralgia, osteoarthritis, and osteoarthrosis. The psychosocial axis 2 includes a 31-item questionnaire that assesses TMD-related pain and psychosocial factors [5]. this multi-axial approach allows better characterization of the patient from several standpoints [6].

One of the most common types of disorders is internal derangement of the disc. It may present with a numerous of overlapping signs and symptoms including pain in the joint, limitation of mandibular movements (e.g., locking), TMJ sounds and occasionally headaches [7].

The primary goal in the treatment of TMJ disorders is to alleviate pain and to restore mandibular function (mastication &speech) initially using conservative measures, which will resolve symptoms in over 80% patients [8].

Surgical intervention is typically employed only after failure of non-surgical treatment. Arthrocentesis and TMJ arthroscopy have been found to be minimally invasive effective treatment for articular TMJ disorders by decreasing pain and increasing mandibular range of motion.

Arthrocentesis is the first-line surgical intervention in TMD/DDwoR patients who do not respond to conservative management [9,10]. It is a minimally invasive procedure which is considered as an intermediate treatment modality between non-invasive conservative and more invasive surgical interventions [11,12].

Although the use of arthrocentesis in management of TMJ internal derangement proved reasonable degree of success ranging from 75 to 100%. Intra-articular injection using different medication was used in combination with arthrocentesis to enhance the clinical outcome and improve long term results.

PRP is a natural concentrate of growth factors from blood. It is observed that these preparations had bone forming properties as well as anti-inflammatory and antibacterial properties [13].

PRP therapy is based on the effects of GFs that promote changes in cell proliferation and regulate cellular metabolism. GFs have a vital role in modulating chondrogenic expression [14]. PRP promotes healing through regeneration of degenerative changes in cartilage, bone, and synovial tissue [15]. In oral surgery, PRP is used to support bone regeneration in sinus lifts, cleft surgery, and jaw reconstruction, promotes healing of oro-antral communications, bone defects, and cysts, and prevents further development of dry socket [16].

While articular cartilage has limited regenerative capacity due to its a vascularity and low mitotic activity, some GFs especially TGF beta, basic fibroblast growth factor, and bone morphogenic protein show a positive effect on cartilage tissue regeneration [17,18].

TGF-ß is one of the most important factor involved in the process of cartilage regeneration; its function includes increased chondrocyte phenotype expression [19]. The chondrocyte differentiation of mesenchymal stem cells, matrix deposition and counteract with most of the suppressive effects of inflammatory mediators IL 1 on cartilage specific macromolecules synthesis [20]. PDGF also plays an important role in the maintenance of hyaline like chondrogenic phenotype, increases chondrocyte proliferation, up-regulation of proteoglycan synthesis, and is a potent chemotactic factor for all cells of mesenchymal origin [21]. IGF is another important cartilage anabolic factor and it has an important role in augmenting the effects of other growth factors found in cartilage [22]. Many other growth factors are involved in cartilage regeneration and metabolism, like FDG and HGF, and they may have chondro-inductive actions, independently or more so with additive effects and synergistic interaction [23].

This study was designed to investigate the effectiveness of arthrocentesis either alone or with subsequent intra-joint medications as PRP.

Materials and Methods

Patients affiliated to our clinic were examined using research diagnostic criteria of Tempromandibular disorders RDC/TMD as the basic research diagnostic system. Complete clinical examination of head and neck was established for cases participants to the study.

Clinical examination included Site of pain, pattern of jaw movement, measurement of maximum inter incisal mouth opening, lateral excursions and protrusion as well as joint noises.

Cases involved in the study were allocated as follows

- Axis 1 group 2b (disc displacement without reduction with limitation)
- Axis 1 group 2c (disc displacement without reduction without limitation)
- Diagnosis was confirmed by a standardized preoperative MRI examination.

All the patients have undergone a period of conservative (splint, physiotherapy and medical therapy) treatment for period of 6 months. Patients who were not responsive to these non-surgical treatments had been enrolled to the present clinical trial. Informed written consents were obtained from them after explaining the nature of the procedure, duration of the postoperative follow up and the possible complications.

The study was conducted on 14 patients (with a total of 20 joints). They were randomly assigned into two groups; each group contained 7 patients with a total of 10 joints (3 bilateral and 4 unilateral cases). A control group received lavage and a study group received lavage with injection of PRP.

Each patient had completed a questionnaire evaluating TMJ pain, joint clicking, and maximum mouth opening. TMJ pain has been assessed using research diagnostic criteria (RDC), visual analog

scale (VAS) in a 10 cm line with one end labeled with no pain and another end with severe pain. Maximum mouth opening (MMO), lateral excursion, protrusion were measured with millimeter scale, clicking sound was assessed by palpating the joint during opening and closing of mouth.

Operative procedure

The procedure was performed under general anesthesia (nasal endotracheal intubation). A line was drawn from middle of the tragus to the outer canthus. Entrance points were located along the canthotragal line, where the first point was marked 10 mm from the middle of the tragus and 2 mm below the canthotragal line, it corresponds to the glenoid fossa. A second point corresponding to the articular eminence was marked 10 mm from the first point and 10 mm below the line (Figure 1).

A total of 150 -200 ml ringer lactate solution was then injected under pressure through the first needle into the superior joint space while the second needle provided the outflow.

The outflow needle was then removed and 2 ml platelet rich plasma was injected in the study group into the superior joint space through the inflow needle.

Patient's mandible was manipulated in vertical, protrusive and lateral excursions facilitating release of adhesions, distribution of the PRP, and freeing disc movement.

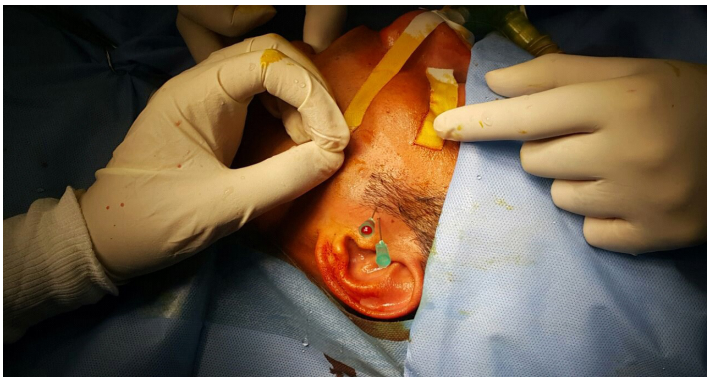

Figure 1: intra-operative clinical photograph showing inflow and outflow needles insertion and landmarks used.

PRP was prepared by double centrifugation process. A small amount of blood (10cc) was obtained from the patient by venipuncture in acid citrate dextrose tubes (ACD).

The blood was then centrifuged using a 'soft' spin (1500 rpm) for 10 minutes to separate RBCs from the remaining whole blood volume. After the first spin step, the blood was separated into three layers: an upper layer that contains mostly platelets and WBC, an intermediate thin layer that was known as the buffy coat and a bottom layer that consists mostly of RBCs.

For the production of pure PRP (P-PRP), upper layer (supernatant plasma) and superficial buffy coat were transferred to an empty sterile tube (without anticoagulant). Second spin step was then performed; it was centrifuged at a higher speed i.e a hard spin (3000rpm) for 10 minutes to obtain a platelet concentrate. PPP at the upper 2/3rd was then removed while PRP was obtained at lower 1/3rd of the tube by gently shaking the platelet pellets suspended in a minimum quantity of plasma (Figure 2).

At the end of the lavage procedure, the outflow needle was removed. Prefilled syringe with 2 ml prp was mounted on the inflow needle and the solution was injected in the joint. All patients were then recalled at 1 and 6 months postoperatively.

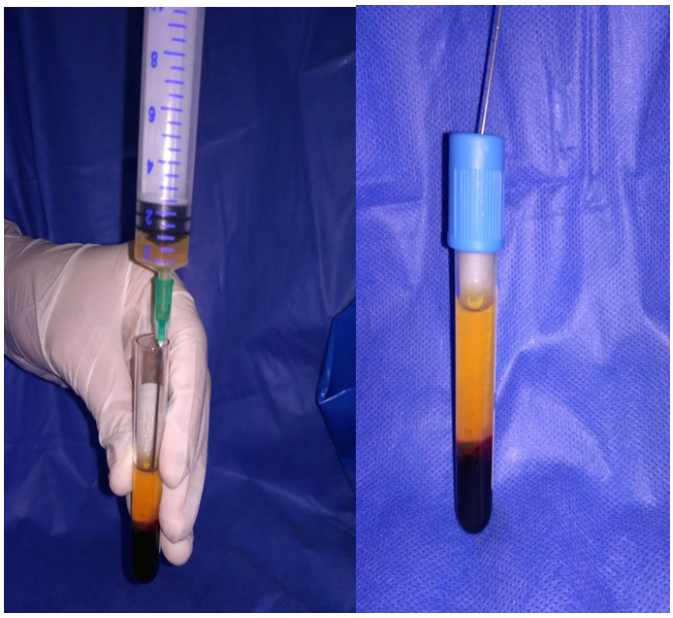

Figure 2: A: centrifuged blood. B: plasma separation.

Results

Group (I) included seven patients; 3 females & 4 males, their age ranged from 19 to 30 years. Group (II) included seven patients; 2 females and five males, their age ranged from 18 to 33 years.

Regarding VAS for the included joints in both groups showed gradual decrease of pain by time. The lowest mean value was at 6 months postoperatively, while the greatest value was recorded pre-operatively.

The statistical analysis of pain intensity (Table 1) Paired T test revealed a significant difference between each two subsequent intervals. The difference between pre-operative mean value and the last post interval was statistically significant ($P<0.001$) while comparing the two groups there was no statistically significant difference in the pain intensity between both groups during intervals period ($p > 0.05$).

Regarding the maximum mouth opening, all patients showed gradual increase in maximum painless opening reaching their peak at 6 month. The mouth opening increased in both groups throughout the follow-up periods with no statistical significant difference ($p>0.05$) between both groups (Table 2).

VAS		Groups						T-Test	
		Arthrocentesis only			Arthrocentesis + PRP			T	P-value
Pre	Range	6	-	8	3	-	9	0.548	0.594
	Mean ± SD	7.000	±	0.816	6.571	±	1.902		
Post 1 Month	Range	2	-	5	1	-	6	0.201	0.844
	Mean ± SD	3.429	±	0.976	3.286	±	1.604		
Post 6 Months	Range	0	-	3	0	-	3	0.000	1.000
	Mean ± SD	1.714	±	1.254	1.714	±	1.113		
P-1M	Differences	3.571	±	0.535	3.286	±	0.951		
	Paired Test	<0.001*			<0.001*				
P-6M	Differences	5.286	±	1.113	4.857	±	1.069		
	Paired Test	<0.001*			<0.001*				
1M-6M	Differences	1.714	±	0.951	1.571	±	0.787		
	Paired Test	0.003*			0.002*				

Table 1: Mean ± SD of VAS pain values in both group and significance of the difference between each two intervals and between both groups using Paired t test. ns= non-significant, *statistically significant.

MMO		Groups						T-Test	
		Arthrocentesis only			Arthrocentesis + PRP			t	P-value
Pre	Range	20	-	50	20	-	40	1.073	0.304
	Mean ±SD	32.429	±	12.026	26.857	±	6.644		
Post 1 Month	Range	29	-	51	26	-	41	1.613	0.133
	Mean ±SD	39.000	±	8.794	32.714	±	5.376		
Post 6 Months	Range	32	-	53	34	-	45	0.996	0.339
	Mean ±SD	42.714	±	7.064	39.714	±	3.684		
P-1M	Differences	-6.571	±	4.036	-5.857	±	3.024		
	Paired Test	0.005*			0.002*				
P-6M	Differences	-10.286	±	6.499	-12.857	±	5.305		
	Paired Test	0.006*			0.001*				
1M-6M	Differences	-3.714	±	3.498	-7.000	±	3.464		
	Paired Test	0.031*			0.002*				

Table 2: Mean ± SD of maximum mouth opening values in both group and significance of the difference between each two intervals and between both groups using Paired t test. ns= non-significant, *statistically significant.

Lateral movement		Groups						T-Test	
		Arthrocentesis only			Arthrocentesis + PRP			t	P-value
Pre	Range	2	-	11	2	-	10	-0.101	0.921
	Mean ±SD	5.143	±	2.854	5.286	±	2.430		
Post 1 Month	Range	5	-	13	5	-	11	0.346	0.736
	Mean ±SD	7.857	±	2.673	7.429	±	1.902		
Post 6 Months	Range	6	-	13	7	-	12	0.000	1.000
	Mean ±SD	8.857	±	2.410	8.857	±	1.574		
P-1M	Differences	-2.714	±	1.113	-2.143	±	1.345		
	Paired Test	0.001*			0.006*				
P-6M	Differences	-3.714	±	1.254	-3.571	±	1.272		
	Paired Test	<0.001*			<0.001*				
1M-6M	Differences	-1.000	±	0.577	-1.429	±	0.787		
	Paired Test	0.004*			0.003*				

Table 3: Mean ± SD of lateral excursion of the affected joint values in both group and significance of the difference between each two intervals and between both groups using Paired t test. ns= non-significant, *statistically significant.

Lateral movement towards the affected joint		Groups						T-Test	
		Arthrocentesis only			Arthrocentesis + PRP			T	P-value
Pre	Range	9	-	11	9	-	12	-0.655	0.537
	Mean ±SD	10.000	±	0.816	10.500	±	1.291		
Post 1 Month	Range	10	-	12	10	-	12	0.000	1.000
	Mean ±SD	11.250	±	0.957	11.250	±	0.957		
Post 6 Months	Range	11	-	12	10	-	12	0.000	1.000
	Mean ±SD	11.500	±	0.577	11.500	±	1.000		
P-1M	Differences	-1.250	±	0.500	-0.750	±	0.500		
	Paired Test	0.015*			0.058				
P-6M	Differences	-1.500	±	0.577	-1.000	±	0.816		
	Paired Test	0.014*			0.092				
1M-6M	Differences	-0.250	±	0.500	-0.250	±	0.500		
	Paired Test	0.391			0.391				

Table 4: Mean ± SD of lateral excursion of the non-affected joints values in both group and significance of the difference between each two intervals and between both groups using Paired t test. ns= non-significant, *statistically significant.

Protrusive movement		Groups						T-Test	
		Arthrocentesis only			Arthrocentesis + PRP			t	P-value
Pre	Range	2.5	-	4	2	-	4	0.403	0.694
	Mean ±SD	3.286	±	0.567	3.143	±	0.748		
Post 1 Month	Range	3	-	4.5	3	-	5	0.206	0.841
	Mean ±SD	3.929	±	0.535	3.857	±	0.748		
Post 6 Months	Range	3.5	-	4.5	3.5	-	5	0.258	0.801
	Mean ±SD	4.071	±	0.450	4.000	±	0.577		
P-1M	Differences	-0.643	±	0.244	-0.714	±	0.267		
	Paired Test	<0.001*			<0.001*				
P-6M	Differences	-0.786	±	0.393	-0.857	±	0.378		
	Paired Test	0.002*			0.001*				
1M-6M	Differences	-0.143	±	0.244	-0.143	±	0.244		
	Paired Test	0.172			0.172				

Table 5: Mean ± SD of protrusion values in both group and significance of the difference between each two intervals and between both groups using Paired t test. ns= non-significant, *statistically significant.

The lateral movement of the affected side was measured in groups I & II. They were increased in group I & group II throughout the follow up periods, but the difference between the two groups throughout the whole follow-up period was found to be statistically insignificant (p >0.05) (Table 3).

The lateral movement of the non-affected side was measured in both groups. There were slight increases throughout the follow up periods. In the control group, paired T test revealed a significant difference between preoperative and 1 month postoperative mean value, while there was no significant difference between 1 month and 6 months postoperative subsequent intervals. In the study group, paired T test revealed no significant difference between each two subsequent intervals. There was no significance difference between the two groups at different observation times (Table 4).

Regarding protrusive movement in both groups, the lowest mean value was preoperatively recorded, while the greatest value was in PO-6 months. Paired T test revealed no significant difference between each two subsequent intervals, except for a significant difference in the interval between preoperative and PO-1 month Moreover, the difference between 1 and 6 month post-operative interval was not statistically significant (P=0.172), (Table 5). All patients showed slight improvement in protrusion after the 6 months follow up visit, while there was no significance difference between both groups throughout the whole follow-up period (p >0.05).

Discussion

The validity of arthrocentesis in the management of ID is a point of debate either alone or in conjunction with intra joint medication as PRP.

In our study we assumed that arthrocentesis procedure followed by PRP injection will decrease pain and improve function. Where catabolites of inflammation washed out through the action of lavage and PRP injection reduce pain and provide a micro-environmental repair of disc, capsule, and retro-discal tissues. Therefore, our

hypothesis was that arthrocentesis associated with PRP injection will be more effective in decreasing pain and improving function when compared to arthrocentesis done alone in patients with internal derangement. However, the results of this single blind randomized controlled trial found no evidence for a superior treatment effect on painful disc displacement without reduction (DDwoR) by using arthrocentesis and PRP injection compared to using arthrocentesis alone regarding pain intensity and physical functioning 6 months after treatment.

The landmarks we used for joint access during arthrocentesis were those adopted by Alkan et al. [24] which provided for easier access into the posterior recess of the joint, in contrary to those from the standard technique adopted by Nitzan et al. which was more difficult and results in more trauma to the joint due to repeated needle insertion to successfully engage the joint space. The superior joint space is used for arthrocentesis hence, it's larger and provides a better access for the joint as well as it the site in which the translatory movement occurs and also most adhesions are formed in the superior joint compartment.

TMJ lavage was performed by at least 150 ml of lactated Ringer's solution to achieve the hydraulic effect necessary to release disc adhesions and at the same time efficiently remove the inflammatory and pain mediators [25].

The results of our study revealed that all groups showed significant improvement in all the parameters under investigation including the pain, maximal painless opening, lateral excursions and protrusion, but without significant difference between the two groups. The improvement gradually increased starting from 1 month and up to 6 month.

This success is contributed to that the simple and minimally invasive lysis and lavage of the TMJ under hydraulic pressure tend to eliminate the vacuum effect and at the same time release the adhesions permitting a free movement of the articular disc during function and restoring the normal range of motion. It also helps in reducing the pain dramatically by washing out the inflammatory and pain mediators.

The use of intra-joint medication (PRP) after arthrocentesis carries an extra value to the whole procedure outcome.

It has a potent anti-inflammatory effect, it focuses on the induction of functional recovery by means of regenerating weakened tissues, and its anabolic effect on synoviocytes lead to restoration of hyaluronic acid (HA) levels there by enhancing cartilage protection and joint lubrication [17,26-29].

Although the reduction in VAS of pain was insignificant between the two groups.

The reduction in pain in our study is in agreement with the results obtained by several authors [17,29-36] who reported an improvement in the pain levels in their studies after injection of PRP.

Pain decrease after injection of PRP was shown to be related to: early release of protease activated receptor 4 peptides from alpha granule in the platelets which has analgesic and anti-inflammatory effect lead to early relief of pain [17,29].

The reduction in pain in the control group is in agreement with the results obtained by several authors [37,38] who reported an improvement in the pain level post arthrocentesis in their studies by washing out of inflammatory mediators by arthrocentesis which had its effect in pain reduction and increasing range of movement.

The improvement in mandibular movement in the study group is in agreement with the results obtained by several authors [29,30,35-41] who reported an increase in the measurements of mandibular movements including maximal interincisal opening, lateral and protrusive movements in their studies after injection of PRP.

Nitzan et al. 1991 [37] reported that arthrocentesis proved to be highly effective in providing significant improvement in pain reduction, maximal mouth opening and lateral movement toward the unaffected side in all patients. They claimed that physiotherapy following such treatment produced further improvement which comes in accordance with the results of the control group. In addition, many authors reported the improvement of mandibular functions following arthrocentesis [37,38].

All patients in both groups had regional (joint and muscle) tenderness preoperatively which decreased gradually along the study period. The results were obtained in the study group as the same results were obtained in the other studies [29,30,34]. The results in the control group are in agreement with the results obtained by several authors [37,38,42].

In the present study, when comparing the clinical outcomes to the preoperative values, both groups showed improvement in all the measured parameters, it was found to be insignificant thus, demonstrating the effectiveness of both methods in treatment of TMD patients.

Conclusion

The use of arthrocentesis alone or in conjunction with single intra articular injection of PRP were effective in reducing pain in cases of ID while there was no added therapeutic effect of single intra articular injection of PRP when used after arthrocentesis in cases of ID.

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