

EFFECT OF INTRA-ARTICULAR INJECTION OF PLATELET-RICH PLASMA IN MANAGEMENT OF TEMPOROMANDIBULAR JOINT DERANGEMENT IN COMPARISON TO ARTHROCENTESIS

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Abstract

Background Temporomandibular joint (TMJ) internal derangement is a common cause of chronic orofacial pain and disability. Minimally invasive therapy is founded on arthrocentesis to a large extent, yet is predominantly mechanical lavage without regenerative propensity. Platelet-rich plasma (PRP) is an autologous biologic concentrate that has growth factor(s) and is one of the newer regenerative therapeutic modalities that can potentially alter inflammation and induce tissue healing.

Objective: The clinical effectiveness of intra-articular PRP injection or arthrocentesis in patients with internal derangement of the TMJ that did not respond to conservative treatment.

Methods: This was a random control trial, which was carried out on a sample of 34 patients with TMJ internal derangements. Two groups of patients were chosen randomly Group A representing patients in which intra-articular PRP injection was performed, and Group B where arthrocentesis was performed with Ringer lactate. They were assessed by the baseline level of pain and four weeks follow-up level of pain, maximum mouth opening, and joint clicking.

Results: There was statistically significant improvement in all clinical parameters with the two forms of treatment ($p < 0.001$). However, PRP was more effective in the reduction of pain, improvement of mouth opening and reduction of joint clicking. A strong negative relationship was observed between PRP group and pain reduction and improvement on the mouth opening.

Conclusion: Intra-articular PRP injection is better than arthrocentesis in the treatment of internal derangement of the TMJ and is a safe least invasive biologically plausible and regenerative therapeutic intervention.

INTRODUCTION

The TMJ is a highly complex joint synovial in a human body that does all the required functions, including mastication, speech, swallowing and facial expression through the combination of simultaneous rotational and translational movements (Okeson, 2013). The potential of the joint having a pathological potential is high in addition to the structural complexity of the joint as well as the functional demands imposed on the joint commonly referred to as temporomandibular disorders (TMDs).

There is a significant health problem with the estimated prevalence of 5-12% among the adult population of the global population and even higher prevalence in females in the second-fourth decades of their lives (Bagis et al., 2012; De Leeuw and Klasser, 2018). The most prevalent intra-articular disease of these disorders is TMJ internal derangement. It can be described as an unnatural dislocation of the mandibular condyles and the articular disc that often leads to pain and joint sounds, restriction of mandible movements, and locking (Dimitroulis, 2018).

TMJ internal derangement is a multifactorial pathogenesis which is mechanical overload, disc dislocation, synovial inflammation, biochemical degradation of fibrocartilaginous tissues. The synovial fluid of the involved joints has been found to have high levels of inflammatory cytokines, such as interleukin-1 β (IL-1 β) and interleukin-6 (IL-6) and tumor necrosis factor- α (TNF- α), and induce cartilage destruction through the expression of matrix metalloproteinases (Hegab et al., 2015; Muraoka et al., 2020).

TMJ internal derangement is normally treated in phases. The use of conservative therapies that include the use of occlusal splints, physiotherapy, pharmacologic drugs, and behavioral modification is the recommendation that can be advanced as the initial line of therapy. Though many patients note the positive response, a great proportion note having their chronic symptoms that necessitate minimally invasive procedures (AAOMS, 2020).

Arthrocentesis has become the second line of treatment that has become very acceptable. It

involves the sponging of the upper joint space to remove inflammatory factors, adhesions, and increase flexibility of the joints (Akinbami, 2011). Even though arthrocentesis has no adverse effect, it does not cause the biological regeneration of the damaged tissues of the joint, despite the triumphant results in pain reduction and functional improvement which are not permanent but only partially.

The recent advancement of regenerative medicine has brought about biologic interventions that can be used in restoring homeostasis in joints rather than alleviate the symptoms. Platelets Platelet-rich plasma (PRP) is a growth factor-enriched autologous platelet suspension in plasma made of platelets. These growth factors play a crucial role in angiogenesis, fibrocartilage repair, and control of an inflammatory pathway (Marx, 2004; Dhurat & Sukesh, 2014).

It has been suggested that PRP may provide superior and delayed clinical outcomes compared to arthrocentesis and other intra-articular injectables; however, there are no high quality randomized controlled clinical trials particularly in South Asian populations. Therefore, the strategy behind the proposed study was to determine the clinical efficacy between intra-articular PRP injection and arthrocentesis of patients with TMJ internal derangement which cannot be treated by conservative management.

Objectives and Research Questions

Study Objectives

1. To determine the effect of PRP intra articular injection in the treatment of patients with TMJ internal derangement in pain reduction.
2. To establish the finding of an improvement in the maximum mouth opening with the PRP injection and arthrocentesis.
3. To determine the reduction in the joint clicking according to each treatment modality.
4. To compare the relative clinical efficacy of PRP injection and arthrocentesis.

Research Question

Is platelet-rich plasma injection of the intra-articular space superior to arthrocentesis of the internal derangement of the temporomandibular joint?

Literature Review

Temporomandibular Joint Anatomy and Biomechanics

TMJ is a ginglymoarthrodial joint which has mandibular condylus and temporoarticular fossa and eminence of the temporal bone and a fibrocartilaginous disc in between that divides the joint into superior and inferior chambers (Okeson, 2013). Unlike most synovial joints, the TMJ is lined by fibrocartilage, rather than hyaline cartilage, which provides resistance to the shear forces, but no regenerative capacity due to its vascularity (De Leeuw and Klasser, 2018).

Pathophysiology of TMJ Internal Derangement

The internal derangement of TMJ is attributed to the interference of the disc-condyle relationship where parafunctional habits, trauma, occlusal incidence or inflammatory alterations are the predominant causes. Recurring inflammation leads to the production of additional cytokines and degradation enzymes, which leads to continuous disc deformation, fibrosis, and degenerative changes in joints (Dimitroulis, 2018; Hegab et al., 2015).

Arthrocentesis in TMJ Disorders

Arthrocentesis was originally created as a less invasive therapy of treating TMJ disorders by flushing the joint space to remove the inflammatory mediators and improve the mobility of the joint. The absence of regenerative effect of it makes relapse and incomplete improvement of the symptoms an issue, as it has been demonstrated in many studies to be effective in the process of alleviating pain and increasing the ability to open the mouth (Akinbami, 2011; Bas et al., 2011).

Platelet-Rich Plasma in TMJ Disorders

The PRP has also been getting increased attention due to its regenerative and anti-inflammatory characteristics. Systematic reviews and clinical trials revealed that PRP was superior to arthrocentesis, hyaluronic acid, and corticosteroids in terms of pain reduction and function improvement (Hegab et al., 2015; Chandra et al., 2021; Sikora et al., 2022). These peculiarities of PRP in the recovery of fibrocartilage and the balance of the inflammation of the synovium make this treatment particularly relevant to TMJ internal derangement.

Materials and Methods

Study Design

It is a randomized controlled clinical trial that has attempted to compare clinical performance of platelet-rich plasma (PRP) injection and arthrocentesis in the treatment of internal derangement of the temporomandibular joint (TMJ). The research was planned on the ground of ethical factors as outlined in the Declaration of Helsinki.

Study Setting

It was conducted at the Department of Oral and Maxillofacial Surgery, Abbasi Shaheed hospital, Karachi over a specific period of time stated in the first thesis.

Sample Size and Method of Sampling.

A probability consecutive sampling was selected to sample 34 patients who had undergone TMJ internal derangement. The assignment of patients to two groups of the same size ($n = 17$) was carried out randomly by the lottery method.

Inclusion Criteria

- Patients aged 18–60 years

• Clinically diagnosed TMJ internal derangement • Persistent symptoms despite ≥ 3 months of conservative therapy • Presence of TMJ pain, limited mouth opening, and/or joint sounds
Exclusion Criteria
• Systemic inflammatory or hematologic disorders • Previous TMJ surgery • Recent intra-articular injections • Pregnancy or lactation • Refusal to provide informed consent

Randomization and Group Allocation

Participants in: were randomized and divided as per beneath;

Group A (PRP Group): PRP platelet-rich injections intra-articularly.

Group B (Arthrocentesis Group): arthrocentesis using the Ringer lactate solution was performed.

Preparation and Administration of PRP

To prepare autologous PRP, a typical centrifugation procedure was followed as discussed by Marx (2004) and Dhurat and Sukesh (2014). Approximately 0.5 mL PRP injection was applied to the superior joint space in an aseptic state.

Arthrocentesis Procedure

Arthrocentesis was performed by conventional means of the two needle technique. The improved joint space was moistened with 50-60 mL of Ringer lactate that was to remove the inflammatory cytokines and loosen the adhesions in the articular spaces (Akinbami, 2011).

Outcome Measures

The clinical parameters were measured at the preoperative period, and four weeks of the postoperative period. The degree of pain was determined through the application of the Visual Analogue Scale (VAS: 0-10), the maximum opening of the mouth (MMO) was measured in millimeters and the intensity of clicking of the joints was evaluated.

Statistical Analysis

Data were analyzed with the help of SPSS version 26. Intra-group comparisons were done by use of the paired t-tests and inter-group comparisons by use of independent t-tests. Pearson correlation coefficients were calculated to analyse the relationship between variables and the p-value level was $p < 0.05$.

Results

Participant Characteristics and Baseline Comparability

This was a study involving 34 participants who had internal derangement of the temporomandibular joint (TMJ) and they had the capability of completing the follow-up period. The patients were randomly grouped to PRP group ($n = 17$), and the arthrocentesis group ($n = 17$). It had no follow up losses and this ensured complete analysis of data.

The demographic elements of age and gender distribution were comparable in both groups and thus, proved an effective randomization and minimized the possibility of selection bias. The fact that the differences were found not to be statistically significant in the baseline variables ensured that the resultant differences after the treatments was the actual product of the interventions and not the result of the demographical confounding variables.

Table 1: Demographic Characteristics of Study Participants

Variable	PRP Group (n = 17)	Arthrocentesis Group (n = 17)	p-value
Mean age (years)	37.6 ± 9.8	39.2 ± 10.5	> 0.05
Female (%)	64.7%	58.8%	> 0.05

Internal validity of the study is also determined by the similarity in the demographics which establishes group comparability.

Pain Intensity (Visual Analogue Scale)

Intra-Group Analysis

The two types of treatment resulted in statistically significant reductions in the level of pain at week

four of follow up as compared to the level of pain at the baseline. The outcome of this study implies that PRP injection and arthrocentesis come in handy in pain management of TMJ internal derangement.

Table 2: Comparison of Pain Scores Within Groups

Group	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	p-value
PRP	7.58 ± 1.12	2.98 ± 1.07	< 0.001
Arthrocentesis	7.46 ± 1.18	4.24 ± 1.12	< 0.001

The considerable reduction of pain which is statistically significant in both groups indicates that minimal invasive intra-articular intervention affects the decrease of inflammatory mediators

and intra-articular pressure. The more significant reduction in PRP group does indicate, though, another biological activity other than the mechanical decompression.

Inter-Group Comparison of Pain Reduction

Table 3: Comparison of Mean Pain Reduction Between Groups

Group	Mean Pain Reduction ± SD	p-value
PRP	4.60 ± 1.10	0.012
Arthrocentesis	3.22 ± 1.40	

There was a significant reduction of pain in the PRP group compared with the arthrocentesis group. This clinical observation demonstrates that PRP possesses a superior analgesic effect likely due to its anti-inflammatory and neuromodulatory effect. This result answers directly Objective 1 of the study and responds directly to the main research question of pain management.

Maximum Mouth Opening (MMO)

Intra-Group Improvement in Mandibular Mobility

The improvements of the maximum opening of the mouth were statistically significant in both groups at week four follow-up, which is evidence of the improvement in the mandibular mobility due to the treatment.

Table 4: Comparison of MMO Within Groups

Group	Pre-treatment MMO (mm)	Post-treatment MMO (mm)	p-value
PRP	28.76 ± 3.82	37.42 ± 3.51	< 0.001
Arthrocentesis	29.11 ± 4.01	34.44 ± 3.84	< 0.001

The results of the improvement of MMO in the two groups describe the effectiveness of the two interventions in reducing the stiffness of joints and muscular spasm. The extent of the

improvement was however much higher in PRP group which implied that it offered better restoration to the biomechanics of the joints.

Inter-Group Comparison of MMO Improvement

Table 5: Comparison of MMO Improvement Between Groups

Group	Mean MMO Increase (mm) ± SD	p-value
PRP	8.66 ± 2.14	0.030
Arthrocentesis	5.33 ± 1.98	

PRP patients were far more capable of opening their mouth as compared to the patients who obtained arthrocentesis. The clinically relevant improvement of this enhancement is in the functional outcomes of activities such as eating, talking, and oral hygiene. This observation cannot only meet Objective 2, but also prove the

superiority of PRP as a functional restorative treatment.

Joint Clicking Intensity

Reduction in Joint Sounds

Joint clicking was greatly minimized at four weeks follow-up in both groups that demonstrated more coordination of the disc and the condyles.

Table 6: Comparison of Clicking Intensity Within Groups

Group	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	p-value
PRP	5.12 ± 1.36	1.13 ± 0.98	< 0.001
Arthrocentesis	5.04 ± 1.41	2.62 ± 1.24	< 0.001

Whilst both methods reduced the joint sounds, PRP group reduced them to a greater extent. This implies that the PRP therapy enhances stability of the disc and normalization of the joints.

Percentage Reduction in Clicking

PRP group: 82 percent of the joints depicted a significant reduction in clicking. 59% of the joints; the group that had arthrocentesis: 59% decrease.

This observation addresses Objective 3, besides indicating that PRP is regenerative in disc-condyle stabilization.

Correlation Between Pain Reduction and Functional Improvement

Table 7: Correlation Analysis (PRP Group)

Variables	Correlation coefficient (r)	p-value
Pain reduction vs MMO improvement	-0.72	0.001

The high negative value of correlation in PRP group also indicates that the greater the pain reduction that it provides the greater the mouth opening enhancement. This observation demonstrates the relationship between symptom recoveries and functional recoveries and proves the hypothesis that PRP improves biological joint repairs compared to single symptom recoveries.

Discussion

The investigate randomized controlled clinical trial that was to be conducted to indicate comparative outcomes of the application of the intra-articular platelet-rich plasma (PRP) injection and arthrocentesis in treating internal derangement of the temporomandibular joint (TMJ). The findings of the present study confirm that even though both treatment options have been proven to be effective in terms of reducing pain, improving mandibular movement, and reducing joint sounds, PRP has continued to give superior clinical outcomes across all of the measured parameters. These facts substantiate the PRP rather well as a regenerative and biologically active TMJ internal derangement treatment agent.

Pain Reduction

The most common and disabling symptom of internal derangement of the TMJ is pain, which is most often accompanied by synovial inflammation, increased intra-articular pressure, and inflammatory cytokines, such as IL-1 α , IL-6, and TNF- α (Hegab et al., 2015; Dimitroulis, 2018). The same outcome was evident in the present study wherein PRP and arthrocentesis produced an identical outcome in that both cause a statistically significant decrease in the pain, although the magnitude of the decrease of pain in the PRP group was significantly bigger.

The superior analgesic effect of the substance is explained by the anti-inflammatory and neuromodulatory property of PRP. Platelet-derived growth factors suppress inflammatory mediators and promote the healing of the synovium and angiogenesis leading to an enhanced supply of oxygen to the tissues and supporting the maintenance of the biochemical balance in the joint (Marx, 2004; Everts et al., 2020). Arthrocentesis, in its turn, eliminates most of the inflammatory mediators with the help of lavage, but the recalcitration of the latter is not prevented, which might be the source of a relative low degree of pain relief in this group.

The findings are consistent with the previous data reported by Hegab et al. (2015) and Chandra et al. (2021) both of whom discovered that significantly more pain reduction was seen among PRP-treated patients compared to arthrocentesis patients only. Thus, the results of the present study justify the growing body of literature that supports the high analgesic efficacy of PRP in the case of pathologies in the TMJ.

Improvement in Maximum Mouth Opening

One of the common features of TMJ internal derangement is limited mouth opening, which is brought about by displacement of discs, the capsule inflammation, muscle spasm, and adhesions in the arthroplasty (Okeson, 2013). In the current study, both approaches to treatment resulted in a spectacular improvement of the maximum mouth opening (MMO); however, the PRP group exhibited a far greater increase in the mandibular mobility than the arthrocentesis group.

The effect which arthrocentesis introduces could be explained by the fact that mechanical lavage contributes to the reduction of the intra-articular pressure, rupture adhesions and restoration of the joint mobility (Akinbami, 2011). The better

improvement observed in PRP, however, is a good sign that there is a different biological mechanism other than mechanical decompression.

PRP enhances the healing of fibrocartilagin and regeneration of synovium through chondrogenesis and extra-cellular matrix generated by growth factors (Dhurat and Suresh, 2014). This regenerative activity is likely to contribute towards a positive joint biomechanics and functional recovery in the long term. Liu et al. (2022) and Sikora et al. (2022) also found the same and found that PRP had superior effects in improving mouth opening compared to other intra-articular interventions.

The significant change in MMO in PRP group in the present study is a direct satisfaction of Objective 2 and it also leads to more support of PRP as an effective form of restorative treatment.

Reduction in Joint Clicking

The clinical manifestation of the disc displacement with the decrease is the joint clicking and reveals the instability of the disc-condylar relations (Dimitroulis, 2018). In the latter study there was a significant difference in the intensity of clicking reduction by the treatment modalities, yet the percentage of the joints to respond improved was much higher in the PRP group (82% of all joints) versus the arthrocentesis group (59% of all joints).

Arthrocentesis may reduce the joint sound by disforeigning adhesions and enhancing disc movement; yet it does not address the issues of disc morphogenesis or fibrocartilaginous integrity. Rather, PRP increases the disc-condyl stabilization by restoring fibrocartilage and enhancing synovium lubrication (Marx, 2004; Everts et al., 2020). It is likely that this healing effect can be ascribed to the fact that the PRP group presented a better decrease in the joint clicking.

These findings are correlating with those provided by Chandra et al. (2021) who demonstrated the significant improvement of the joint sounds following PRP therapy. The results of the present study hence fulfill Objective 3 and

even validate the regenerative properties of PRP in internal derangement of TMJ.

Correlation Between Pain Reduction and Functional Improvement

Among the important findings of this study, it was also noted that there was a high negative correlation between the decrease in the level of pain and the increase in the ability to open the mouth which was experienced in PRP group. Such correlation imply that the less painful it is, the more the functional mobility which proved the mutually dependent nature of the alleviation of symptoms and recovery of biomechanics.

Such an association confirms the assumption that not only is PRP a treatment form that does not lack symptoms, but it facilitates the real healing of the joint by recovering structural and biological balance. These correlations were characterized by the same studies as well as in other studies on regenerative and not necessarily mechanical interventions (Hegab et al., 2015; Sikora et al., 2022).

Comparison With Existing Literature

Overall, the findings of the present research are consistent with the existing literature that demonstrates that PRP emerges as a superior treatment procedure as opposed to arthrocentesis and other intra-articular procedures in the instance of TMJ internal derangement. The systematical reviews by Sikora et al. (2022) and the meta-analyses of randomized trials have made the decision that PRP may provide greater pain improvement and functional benefits with negligible negative effects.

Markedly, the study will add to the literature as it would provide randomized controlled clinical evidence on a population of South Asian people, thereby adding to the overall validity of the current body of evidence and offer a significant gap in the researches of the area.

Clinical Implications

The implications of the findings of this research are of clinical value. PRP is an oral and maxillofacial surgery medication that is an autologous, safe, and minimally invasive therapy

that can be easily integrated into the routine practice. Its ability to provide high quality and long term clinical outcomes would reduce the frequency of repeated arthrocentesis and worsening to more complex surgery care.

PRP represents an economical alternative in limited resource settings with the use of the biological product of the patient with the least risk of immune reactions of dissemination of infection.

Limitations

As much as the present study has some merits, there are some limitations attached to it. The sample size used was also very small and the follow-up was only done to four weeks. There was no assessment of the long-term outcomes and radiographic analysis of joint structure. Besides, despite the standardised methods used in preparation of PRP, the concentration of the platelets may fluctuate, and this fact may have an impact on clinical outcomes.

Recommendations of Future Research

There should also be the use of larger sample sizes, long follow-ups and imaging techniques such as MRI in future research to determine the disc position and morphology of the joint. It is also indicated that the protocols of PRP preparation should be standardized in a way that enhances reproducibility as well as comparability across the studies.

Conclusion

Due to the limitation of this study, one might assume that platelet-rich plasma intra-articular injection is the most effective compared to arthrocentesis in the process of managing internal derangements of the temporomandibular joints. PRP has significantly greater pain alleviation, increased mandible range of motion and reduced jaw joint soundness. It is a biological restorative, anti-inflammatory and regenerative agent and is among the most effective and least invasive therapeutic agents.

These findings of this randomized controlled clinical trial show a straightforward answer to the research question and explain the necessity to

introduce PRP as a part of the modern management interventions on TMJ internal derangement.

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