Comparative Efficacy of Platelet-Rich Plasma and Dry Needling for Management of Trigger Points in Masseter Muscle in Myofascial Pain Syndrome Patients: A Randomized Controlled Trial

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Aims: To compare the efficacy of platelet-rich plasma (PRP) injection vs dry needling (DN) for management of trigger points in the masseter muscle in myofascial pain syndrome (MPS) patients. **Methods:** This randomized controlled trial included 30 clinically confirmed cases of myofascial trigger points (MTrPs) in the masseter muscle who were randomly and equally (1:1) assigned to the test (PRP) and control (DN) groups. Both groups were evaluated for pain (visual analog scale [VAS]), range of functional movements, need for pain medication, patient satisfaction (Likert scale), and sleep (VAS) at baseline and 2-week, 1-month, and 3-month follow-ups. VAS pain and Likert score were also obtained at 6-month intervals. **Results:** The use of PRP solution in MTrPs in MPS patients had a better effect on pain and patient satisfaction compared to DN. **Conclusion:** PRP appears to be a more effective treatment modality compared to DN in the management of MTrPs in MPS patients. *J Oral Facial Pain Headache 2022;36:253–262. doi: 10.11607/ofph.3188*

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Myofascial pain syndrome (MPS) is defined as a regional muscular pain condition characterized by myofascial trigger points (MTrPs) found in one or more muscles and/or connective tissues.[1] A trigger point (TrP) is an exceedingly tender spot in a discrete taut band of muscle that produces local and referred pain, among other symptoms.[2] TrPs may be active (ie, always tender) or latent (ie, tender only if palpated). Palpation by a skilled clinician remains the gold standard for MTrP detection.[3]

Any type of muscle overuse or direct trauma to the muscle can result in the development of TrPs. Although muscle damage is not required for the development of TrPs, they may be caused by disruption of the cell membrane, damage to the sarcoplasmic reticulum with a subsequent release of high amounts of calcium ions, and disruption of cytoskeletal proteins such as desmin, titin, and dystrophin.[4] Muscle overuse causes adenosine triphosphate (ATP) depletion, which results in oxidative stress and leads to local ischemia and lowered pH with subsequent accumulation of inflammatory mediators at these TrPs.

MTrPs may result in limited range of mouth opening, masticatory difficulty, and facial pain. These sequelae have an impact on the patient's daily functioning, well-being, and quality of life. Most treatment strategies begin with a conservative approach. Various therapeutic modalities have been used to treat MTrPs and MPS, including therapeutic ultrasound, muscle stretching, manipulation, acupuncture, occlusal appliances, botulinum injection, pharmacotherapy, and TrP injection.[3]

Dry needling (DN) has been proven to be beneficial in myogenous temporomandibular disorder. DN involves insertion of the needle into a TrP to elicit a local twitch response, which is a spinal reflex. This local twitch is characterized by a brief increase in activity in the muscular band that contains the trigger point. It is hypothesized that a local twitch at the spot reflexively stretches the muscle fibers there. The relaxation of the muscle following the twitch is considered to alleviate apillary constriction, restoring microcirculation. This re-oxygenates the muscle

at the trigger location, therefore ending the positive feedback loop. According to recent research, DN improves blood flow and oxygenation to the muscular band containing the TrP, but not to the remainder of the muscle.[5]

Platelet-rich plasma (PRP) is a newer therapeutic modality for treatment of TrPs. PRP contains multiple growth factors necessary for muscle regeneration and myogenesis. The goal of PRP therapy is to concentrate the main growth factors from native blood and to reintroduce them in the injured tissue.[6] Besides healing, PRP also exerts anti-inflammatory and analgesic effects by decreasing proinflammatory and apoptotic cells.[7] PRP may therefore be helpful for the management of MPS.

In most of the studies available in the literature, PRP injections were aimed at achieving symptomatic as well as functional relief in muscle injuries at other body sites. A few studies have been performed using PRP in various muscle injuries with good results; however, to the authors' knowledge, no randomized controlled trials (RCTs) on PRP for MPS are available in the literature to date. Additionally, it is still not clear whether it is the regenerative effect of PRP or the mechanical injury caused by the needle that produces the desired result. Thus, the present study was designed to evaluate the efficacy of PRP injection in TrPs in the masseter muscle in MPS patients and to compare the results to those produced by DN.

MATERIALS AND METHODS

Study Setting

The present RCT (registration no. NCT04286880) was conducted in the Department of Oral Medicine in accordance with the ethical standards outlined in the Declaration of Helsinki 1975, as revised in 2013. The study design was revised, approved, and ethically cleared by the institutional ethical committee (PGIDS/IEC/2019/18). The study period was from January 1, 2020 to April 30, 2021.

Study Population

A sample size of 11 patients in each group was calculated by using mean and SD values ascertained from previous studies found to be sufficient to detect a decrease in visual analog scale (VAS) pain score (95% CI, 95% power) and a clinical difference of three units with a pooled SD of 1.93; ie, an effect size of 1.55. In order to compensate for attrition, it was decided to enroll 15 patients in each group. The participants were randomly allocated into the two groups using a simple random sampling method (lottery method) by the examiner (A.G.). All patients reporting to the outpatient Department of Oral Medicine from January 2020 to January 2021 were screened for the presence of MPS as per the Diagnostic Criteria for TMD (DC/TMD) 2013.[8] After recording medical history and careful clinical and hematologic examination, the subjects who fulfilled the inclusion criteria were included in the study. Extraoral examination was performed carefully to rule out any pathology/derangement related to the temporomandibular joint (TMJ) and any intraoral pathologic changes related to the teeth, especially third molars, or the tongue, mucosa, floor of the mouth, oropharynx, palate, alveolar ridges, etc, before recruiting the patients. The inclusion criteria were as follows:

- Diagnosis of myofascial pain in the masseter muscle with referral, as per the DC/TMD[8]
- Consent to participate in this study

The exclusion criteria were as follows:

- Phobia of needles
- Previous treatment for myofascial pain in the past 3 months
- Active infection at the site of injection
- History of trauma to the head and neck region in the past 6 months
- Healing disorder or systemic disease where the healing response is compromised
- Anticoagulant medication
- Bleeding and clotting disorder
- Epilepsy/seizures
- Pregnancy/lactation
- Addiction to alcohol/drug(s)

Study Protocol

A total of 30 patients were randomized using the simple random sampling method, with 15 participants each in the test and control groups. The patients in the test group were given PRP injection with 0.5 mL of solution per TrP in the masseter muscle with a 1.5-inch, 27-gauge needle, while in the control group, DN was performed in the TrPs in the masseter muscle with a 1.5-inch, 27-gauge needle but no solution. The therapy was administered at baseline in both groups and repeated at the follow-up visits if the relief according to VAS score was less than 50%. After treatment, the patients were advised not to consume nonsteroidal anti-inflammatory drugs (NSAIDs) and not to use hot or cold fomentation. Patients were informed about the mild occurrence and persistence of some amount of pain, swelling, and slight numbness near the injection site for 24 to 48 hours. Opioid analgesics were used as rescue medication for pain relief if needed.

The primary investigator (V.A.) was calibrated for the diagnosis of myofascial pain and for administering

the TrP injection and also performed the initial assessments and injections. PRP preparation was performed by another author (M.K.). All follow-up assessments—VAS score for pain, range of functional movements assessed with the help of digital vernier callipers, need for pain medication, and Likert score for patient satisfaction—were performed by an investigator who was blinded to the treatment group (A.G.).

Preparation of PRP Solution

After briefly explaining the procedure to the patient, a tourniquet was tied to the patient's arm and a 70% isopropyl alcohol swab was used to clean the patient's antecubital fossa. Blood (20 mL) was drawn from the antecubital vein and then transferred to 3.2% sodium citrate vacutainers. The blood sample was centrifuged using a T-8M machine (Laby Instruments). The anticoagulant-mixed blood samples were centrifuged at 1,000 rpm for 10 minutes, which resulted in separation of the supernatant plasma. The plasma was then transferred to another plain vacutainer with the help of a syringe with a 16-gauge needle and then centrifuged at 1,200 rpm for 10 minutes. This resulted in the formation of a platelet pellet settled at the base of the plasma-filled tube. The upper two-thirds portion of the plasma (platelet-poor plasma) was discarded, and the pellet was mixed in with the lower one-third portion of the plasma. The agitated solution thus prepared was the PRP,[9] which was evaluated for the presence of a sufficient amount of platelets before the injection. Solutions containing a concentration between 200 x 103 and 1,000 x 103 platelet/μL were considered as quality PRP solutions.[10]

PRP Injection

After explaining the procedure to the patient, the skin surface overlying the masseter was wiped with a 70% isopropyl alcohol swab, and the TrPs were marked. A total of 0.5 mL of PRP solution per TrP was injected in the masseter muscle with the help of a 27-gauge, 1.5-inch needle. Then the needle was gently withdrawn, and an alcohol swab was again used at that region.

Dry Needling

For the DN treatment, all of the markings, armamentarium, and procedure were the same as for PRP, except that the syringe did not contain any solution. DN was performed using a 27-gauge needle in a back-and-forth motion three to four times.

Outcome Measures

The primary outcome measures were:

- VAS (0–10) assessment of pain
- Mean maximum unassisted mouth opening (MUMO) and maximum assisted mouth opening (MAMO; in millimeters)
- Range of right and left lateral excursive movements (RTLEM and LTLEM, respectively; in millimeters)
- Range of protrusive movement (PM; in millimeters)

Secondary outcome measures were:

- Need for pain medicine (number of tablets consumed per week)
- Likert scale (1–5) assessment of patient satisfaction (LPS)[11]
- Range of mandibular motion, assessed quantitatively with the help of digital vernier calipers (in millimeters)

All parameters were assessed and evaluated for each patient at before treatment at baseline and at 2-week, 4-week, and 3-month follow-ups. Additionally, VAS score for pain and LPS were obtained via telephone at a 6-month follow-up. A flowchart depicting the study methodology is shown in Fig 1.

Statistical Procedures

Data obtained for all 30 patients were analyzed using SPSS version 21.0 (IBM). Normality of data was checked using Shapiro-Wilk test. Parametric tests were used for the comparison of normally distributed variables, and nonparametric tests were used for the comparison of nonnormally distributed variables. Continuous variables were described with mean values.

Intragroup comparisons of VAS score for pain in the study groups at baseline, 2 weeks, 4 weeks, 3 months, and 6 months were performed using Wilcoxon signed-rank test. Intergroup comparisons of age and duration of pain were performed using independent *t* test, and for gender, chi-square test was used. Intergroup comparisons of MUMO and MAMO, PM, and RTLEM in both the test and control group at baseline, 2 weeks, 4 weeks, and 3 months were performed using independent *t* test. Intergroup comparisons of VAS score for pain, LTLEM, and LPS in both the test and control groups at baseline, 2 weeks, 4 weeks, and 3 months was performed using Mann-Whitney *U* test. Intergroup comparison of VAS score for pain at 6 months was performed using the same test. Intergroup comparison of need for pain medicine (number of patients) at baseline, 2 weeks, 4 weeks, and 3 months was performed using chi-square test.

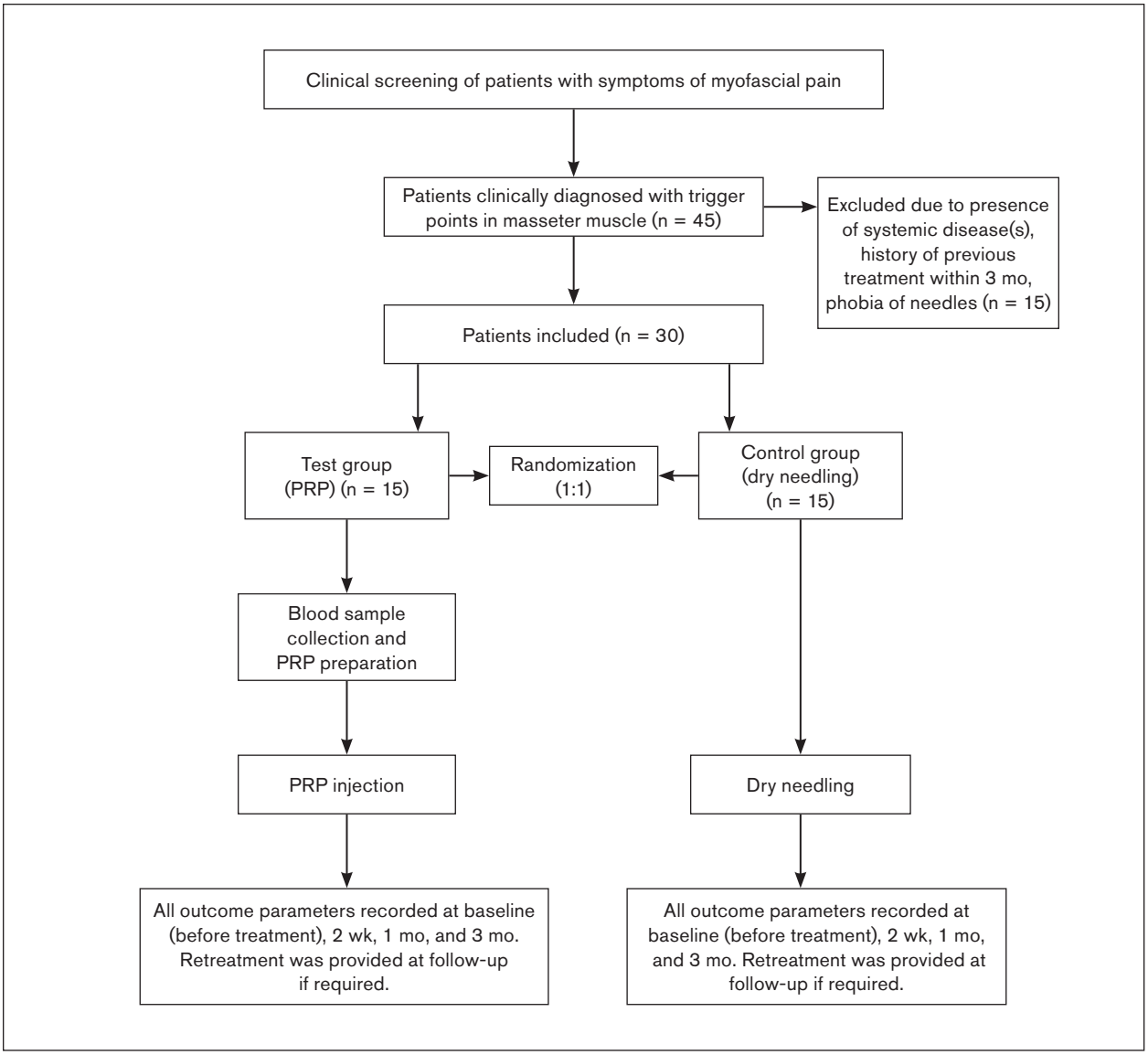

Fig 1 Flowchart of study protocol.

$P < .05$ was considered to be statistically significant, keeping α error at 5% and β error at 5%, thus giving a power to the study of 95%.

Results

Table 1 depicts the demographic characteristics of patients in both groups, suggesting the possible confounding factors age, gender, and duration of presentation had negligible roles in the outcome. Tables 2 and 3 show intragroup and intergroup comparisons of change in mean VAS pain score. All patients in the study groups were divided into three classes based on their VAS pain score at each time interval per the categorization done by Boonstra et al, as seen in Table 4.[12] Most of the patients (n = 13, 86.66%) in the test group had moderate pain severity at baseline that improved drastically at the 2-week follow-up, with a larger portion in the mild category (n = 11, 73.33%), and at the 6-month follow-up, with a majority in the asymptomatic category (n = 10, 66.66%). However, in the control group, most of the cases belonged to the moderate category at baseline (n = 11, 73.33%), the mild and moderate categories at 2 weeks, and the mild category (n = 9, 60%) at 6 months. Intergroup comparisons of various functional movements in the study groups at different time intervals are depicted in Table 5.

At the 2-week follow-up, 12 patients (80%) in the test group and 10 patients (66.67%) in the control group required pain medication ($P = .409$). At 4 weeks, only 3 patients (20%) in the test group

Table 1 Baseline Characteristics in Both Study Groups

Parameters	Test group	Control group	*P* value
Mean ± SD age, y	40.40 + 15.505	32.60 + 10.907	.122
Male to female ratio	14:1	10:5	.068
Duration of presentation, mo	16.733 + 18.572	8.267 + 9.944	.134

Table 2 Intragroup Comparisons of Change in Mean VAS Pain Score in the Test (PRP) and Control (DN) Groups for Different Time Intervals

	Baseline–2 wk	2 wk–4 wk	4 wk–3 mo	3 mo–6 mo
Z (Test)	–3.417 [a]	–3.357 [a]	–0.638 [b]	–1.633 [a]
P value	**.001**	**.001**	.523	.102
Z (Control)	–3.238 [a]	–2.276 [a]	–0.085 [b]	–0.085 [a]
P value	**.001**	.023	.932	.932

Significant values are in bold.
[a] Based on positive ranks.
[b] Based on negative ranks.

Table 3 Intergroup Comparisons of Mean VAS Pain Score at Each Follow-up

Group	Baseline	2 wk	4 wk	3 mo	6 mo
Test	5.47 + 1.506	1.53 + 1.060	0.67 + 0.816	1.13 + 2.167	0.60 + 1.056
Control	5.13 + 1.959	3.07 + 2.219	2.00 + 1.732	2.00 + 2.449	2.00 + 1.964
P value	.735	**.047**	**.015**	175	**.019**

Significant values are in bold.

Table 4 Distribution of Patients in Each Group Based on VAS Pain Severity at Each Follow-up

Group	Severity of pain	Baseline	2 wk	4 wk	3 mo	6 mo
Test	Asymptomatic	0 (0)	3 (20)	7 (46.66)	10 (66.66)	10 (66.66)
	Mild	1 (6.66)	11 (73.33)	8 (53.33)	3 (20)	5 (33.33)
	Moderate	13 (86.66%)	1 (6.66)	0 (0)	2 (13.33)	0 (0)
	Severe	1 (6.66)	0 (0)	0 (0)	0 (0)	0 (0)
Control	Asymptomatic	0 (0)	2 (13.33)	3 (20)	6 (40)	4 (26.66)
	Mild	3 (20)	9 (60)	9 (60)	5 (33.33)	9 (60)
	Moderate	11 (73.33)	6 (40)	3 (20)	4 (26.66)	2 (13.33)
	Severe	1 (6.66)	0 (0)	0 (0)	0 (0)	0 (0)

Data are reported as n (%). Asymptomatic = VAS score of 0; Mild = VAS ≤ 3.4; Moderate: VAS = 3.5 to 7.4; Severe: VAS ≥ 7.5).

required pain medication, whereas 8 patients (53.33%) in the control group needed medication (*P* = .058, odds ratio [OR]: 3.2, Φ: 0.25). Thus, patients in the PRP group required 37.5% less medication at 4 weeks compared to the DN group (relative effect size). However, at the final follow-up, 3 patients (20%, *P* = 1.000) in each group required medication.

Table 6 shows intergroup comparisons of the need for reinjection at follow-up if the reduction in VAS score was less than 50%.

The mean LPS score among the study groups is shown in Fig 2. The *P* values at the different follow-ups were 1.000 (baseline), .110 (2 weeks), .062 (4 weeks), .364 (3 months), and .010 (6 months). In the test group, only 1 patient (6.66%) was neither satisfied nor dissatisfied, and the remaining 14 patients (93.33%) were satisfied, with an LPS score of 4 or more at 6 months. Of these 14 patients, 10 patients (66.67% of the whole sample) were very satisfied, with an LPS score of 5. However, out of the 15

Table 5 Intergroup Comparison of Mean MUMO, MAMO, PM, RTLEM, and LTLEM at Different Time Intervals

Parameter	Group	Baseline	2 wk	4 wk	3 mo
MUMO	Test	41.33 + 8.242	44.01 + 7.895	44.39 + 7.110	44.65 + 6.694
	Control	39.39 + 8.806	41.40 + 8.281	42.05 + 8.077	42.40 + 8.365
	P value	.538	.385	.405	.424
MAMO	Test	42.61 + 7.846	44.39 + 7.525	44.83 + 6.882	45.03 + 6.571
	Control	40.56 + 8.228	41.91 + 8.384	42.23 + 8.085	43.33 + 8.304
	P value	.490	.400	.350	.539
PM	Test	6.17 + 1.787	6.69 + 2.137	7.03 + 2.279	7.21 + 1.963
	Control	5.53 + 2.256	6.83 + 2.801	6.87 + 2.825	7.20 + 2.783
	P value	.401	.879	.860	.988
RTLEM	Test	8.83 + 2.907	10.15 + 2.612	10.67 + 2.501	11.20 + 2.282
	Control	9.25 + 1.998	10.10 + 2.123	10.27 + 2.086	10.60 + 2.293
	P value	.648	.952	.638	.478
LTLEM	Test	9.68 + 2.349	10.38 + 2.448	10.55 + 2.462	11.17 + 2.160
	Control	9.85 + 2.556	10.27 + 2.441	10.67 + 2.067	10.97 + 2.159
	P value	.691	.883	.950	.784

Table 6 Intergroup Comparison for Need for Reinjection at Different Time Intervals

Group	2 wk	4 wk
Test	0 (0)	0 (0)
Control	4 (26.66)	3 (20)

Data are reported as n (%).

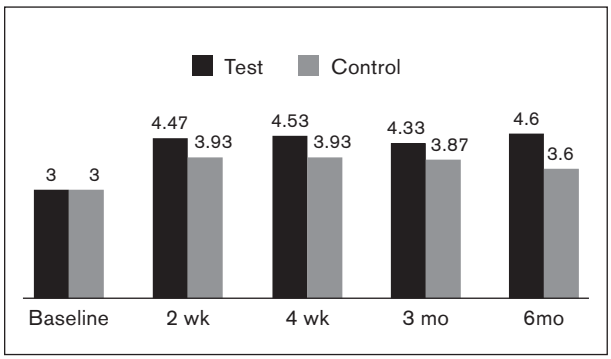

Fig 2 Intergroup comparison of mean LPS score.

patients in the control group, 1 (6.66%) was very dissatisfied, with an LPS score of 1; 1 patient (6.66%) was dissatisfied, with an LPS score of 2; 5 patients (33.33%) were neither satisfied nor dissatisfied; and only 8 patients (53.33%) had an LPS score of 4 or above at the 6-month follow-up. Among these 8 patients, only 4 (26.67% of the whole sample) were very satisfied, with an LPS score of 5.

Discussion

With a prevalence of 10% to 26% worldwide, the orofacial region is one of the most common sites for chronic pain.[13] Myofascial pain is the second most recurring type of orofacial pain and a frequent cause for visiting a pain clinic.[14]

The Cinderella hypothesis emphasizes muscle recruitment patterns during submaximal-level exertions with moderate or low physical load as a possible explanation for muscle participation in MTrP development. This sort of muscle exertion recruits small type 1 muscle fibers first. These fibers are continuously activated and overloaded metabolically. These characteristics render the muscle more susceptible to muscle injury and calcium dysregulation, which are both important for the development of MTrPs. Office employees, musicians, and dentists are examples of people who engage in these forms of activities. A reduction in intramuscular perfusion as a result of persistent low-level contractions has been proposed as the mechanism leading to ischemia, hypoxia, and inadequate ATP production in type I motor unit fibers, as well as increased acidity, calcium ion (Ca2+) buildup, and eventual sarcomere contraction. This may lead to a vicious cycle of ischemia and contraction. As a result, a variety of sensitizing chemicals may be produced, resulting in local and referred pain as well as muscular soreness, which are all clinical characteristics of MPS.[3] This theory is supported by histopathologic examinations of muscle biopsies from MTrPs.[5]

Stecco hypothesized the role of traumatic injury or muscle overuse in TrP development based on the

increased production and aggregation of hyaluronic acid (HA) after a traumatic event. Aggregated HA molecules are viscous and no longer function as a lubricant, resulting in interference in sliding in muscle fibers and causing difficulty in movement and stiffness. The friction may also cause increased neural hyperstimulation, resulting in allodynia, pain, paresthesia, and abnormal proprioception.[3,15,16]

Quinter and Cohen theorized the sensitization of nervi nervorum as the cause of MPS and explained MTrPs as a region of secondary hyperalgesia originating from a peripheral nerve. This hypothesis was supported by Butler.[3,17]

Simons et al proposed that excessive acetylcholine release at the motor end plate is a causative factor for the development of MTrPs. This mechanism acts by inducing neurogenic inflammation and interacting with dysfunctional end plates, thus resulting in shortening of the sarcomere and muscle band formation.[18] These bands, which are latent in asymptomatic individuals, become active in response to predisposing factors, resulting in active MTrPs.[13]

The release of algetic compounds like cytokines, bradykinins, substance P, potassium, and ATP in the presence of an acidic environment depletes acetylcholinesterase, perpetuating chronic muscle contraction and ischemia. The anaerobic release of lactic acid results in stimulation of algetic compounds, irritating muscle nociceptors and leading to the persistence of MTrPs.[5]

The minimally invasive DN procedure, which involves inserting a needle into TrPs to inactivate them, has emerged in recent decades for the management of MPS. Stimulation of these TrPs by needling alone produces an analgesic effect by altering somatosensory thresholds. Cummings and White examined 23 randomized controlled experimental studies that investigated MTrP needling with different injectable medicines (known as "wet needling") and found that the intervention's positive impact was independent of the injectable drug.[19,20]

PRP is a newer therapeutic modality for treatment of TrPs. It has grown in popularity as a means of delivering a high concentration of autologous growth factors and bioactive compounds in physiologic proportions at a cheap cost and with minimal invasiveness.[21]

Based on the these grounds, it was hypothesized that PRP would be more effective than DN for TrP management. Thus, the present study was designed to compare the efficacy of PRP injection compared to DN in TrPs in the masseter muscle. The masseter muscle was selected because it has clinical implications for TMD, bruxism, and hypertrophy. This muscle is crucial for jaw elevation and is a key contributor to jaw closure strength, with its size being directly related to biting power.[13]

The peak incidence of myofascial pain is seen in individuals 20 to 60 years of age.[22] In the present study, the mean age of the patients was consistent with other studies in the literature. Most studies report that myofascial pain is more common in female patients owing to greater psychosocial stress and the female sex hormone estrogen.[23] A similar trend of gender distribution was also seen in the present study, with 80% female and 20% male patients.

The significant reduction in mean VAS pain score in the test group of the present study is in accordance with studies done by Nitecka-Buchta et al and Sakalys et al.[6,24] Also, the significant reduction in mean VAS score in the control group was in accordance with Silva et al, Lopez-Martos et al, and Ziaeifar et al, among others.[25–27] The intergroup comparisons of mean VAS scores were significant at 2 weeks, 4 weeks, and 6 months. The mean reduction in VAS in the test group was higher than in the control group at 3 months as well, although these results were not significant. Thus, it seems that PRP therapy in the test group was more effective for pain reduction than only the local twitch response caused by DN in the control group. Although Nitecka-Buchta et al and Sakalys et al used saline and lidocaine in their respective control groups, PRP yielded significantly better results in their studies as well.[6,24] No previous studies have compared DN to PRP in MPS. PRP has proven to be beneficial over DN, providing better healing of muscle injuries after trauma as studied by Rha et al, Dragoo et al, and El Mallah et al, likely because PRP contains bioactive proteins that attract macrophages and mesenchymal stem cells more than normal blood.[28–30] These cells can not only promote necrotic tissue removal but also accelerate tissue regeneration and healing.[28] So, based on the results of the present study, it can be inferred that the regenerative reaction may have been induced by PRP in addition to the needle effect, which may have initiated the healing process in the affected muscles. The results at 2 and 4 weeks also reflect that pain relief was achieved significantly earlier in the test group compared to the control group and was better sustained at the 6-month follow-up.

In the present study, the treatment was repeated at the follow-up visits up to 4 weeks if the reduction in the VAS score was less than 50% of the previous visit. None of the patients in the test group required reinjection, but this was not so in the control group. This finding suggests that a single injection of PRP was enough to alleviate pain, but DN required multiple sessions. Thus, PRP has a more sustained effect compared to DN for the treatment of masticatory MPS.

As per the categorization done by Boonstra et al, the patients in both groups were distributed into mild,

moderate, and severe categories based on their VAS pain score.[12] It was noted that in most of the patients in the PRP group, there was commendable reduction in pain severity from moderate at baseline (n = 13) to mild at 2 weeks (n = 11) and to asymptomatic at 3 and 6 months (n = 10 for both). However, in the control group, the reduction in severity of pain was less, and the majority of the cases belonged to the mild category (n = 9) at the final 6-month follow-up. This finding suggests that patients in the PRP group had a shorter treatment period compared to the DN group. When comparing patient distribution at the 3- vs 6-month follow-ups in both groups, it was noted that in the control group, the number of patients in the asymptomatic category had decreased and the number in the mild category increased at 6 months, whereas the number in the asymptomatic category remained constant in the PRP group. This suggests that there was a relapse of pain in the DN group that was not evident in the PRP group. Evaluation of patient habits such as bruxism, occlusal discrepancies such as premature contacts or deep bite, patient posture, TMJ pathology, and history of stress should be performed in order to eliminate and prevent relapse of MPS. However, these parameters were not evaluated or addressed in the present study.

The majority of the patients in the present study presented with normal mouth opening, and only a few patients had reduced mouth opening. Both MUMO and MAMO were measured to clinically evaluate the cause of reduced mouth opening; ie, soft end feel, as seen with muscle-induced restrictions, or hard end feel, as seen with intracapsular sources (eg, disc dislocation). None of the patients recruited in the study had a hard end feel, which ruled out intracapsular etiology when recruiting the patients. During the follow-up visits, none of the patients developed any hard end feel. The intergroup changes in mean MUMO and mean MAMO showed that there was a nonsignificant difference in the change of these parameters from baseline to the 3-month follow-up. No previous studies have separately evaluated assisted and unassisted mouth opening, so the results of the present study were compared to the maximum incisal opening (MIO) reported in the literature. These results were similar to those reported by Lopez-Martos et al for DN in MPS.[26] It is prudent to note that both MUMO and MAMO were within the normal limits at baseline, so this minimal improvement in mouth opening in both groups may be attributed to a decrease in pain scores, thereby improving the function of the muscle. So, it is safe to assume that the reduced maximum mouth opening in these patients was either due to pain or fear of pain secondary to the muscular component and not due to intracapsular etiology. Similarly, the mean RTLEM and LTLEM did not significantly differ ($P > .05$) between groups at any time interval during the study. The RTLEM and LTLEM were within normal limits at baseline, so the improvement in values may again be attributed to remission of pain.

In the present study, many patients reported with a reduced protrusive movement (PM) at baseline. It was also noted that an improvement in PM occurred after the initiation of therapy in both groups. The results of intergroup comparisons of mean PM from baseline to 3 months were nonsignificant. The contraction of superficial fibers of the masseter protrudes the mandible, while the contraction of deep and intermediate fibers retracts the mandible. As PRP was injected only in the TrPs in masseter muscles, this change in range of PM may be attributed to the minor role of the masseter in protrusion and to remission of pain.

In the present study, the need for pain medication increased significantly immediately after treatment at the first follow-up and then decreased significantly at further follow-ups in both groups. At the 4-week follow-up, only 3 patients (20%) in the test group required pain medicines, whereas 8 patients (53.33%) in the control group needed medication. However, the intergroup comparisons were nonsignificant ($P > .05$) at all time intervals.

A Likert scale was used to evaluate patient satisfaction. The results revealed that the patients in the PRP group were more satisfied with their treatment than the DN group, as there was better pain reduction and less need for pain medication in the PRP group than the DN group. It was also noted that the LPS scores improved at the 2-week follow-up in both groups, with greater improvement in the test group ($P > .05$); however, during further follow-up visits up to 6 months, the LPS score increased in the test group but decreased in the control group. This finding suggests that patient satisfaction increased in the PRP group over the follow-up period of 6 months, but it did not in the DN group.

Reported adverse effects of PRP include bruising as a result of the blood harvesting procedure, edema and muscle pain, and injection site infection.[6] Anxious patients occasionally report dizziness and are at risk of syncope, which can be minimized by supine positioning of the patient during the procedure. No major side effects were reported in the present study, except for transient pain after PRP and DN lasting for a few hours up to 24 hours.

Limitations of the study were the small sample size, lack of patient blinding, lack of long-term follow-up, the fact that the psychologic component was not addressed, and the fact that the concentration of platelets in the PRP solutions was not uniform, ranging from 2.5 to 10 times the blood platelet count. Also, a VAS, which is highly subjective, was used to

analyze pain. Use of objective methods, such as pressure pain threshold, may have been more reliable.

Conclusions

Based on the findings of this study, it can be concluded that PRP appears to be a more effective treatment modality compared to DN for the management of MTrPs in MPS patients. This may be attributable to the proregenerative effect of the growth factors retained in the platelets, as well as the anti-inflammatory and analgesic properties of the interleukins present in the PRP solution modulating inflammatory pathways. In addition to the local twitch response caused by needle insertion into the TrP, the inherent properties of the autologous PRP solution resulted in a sustained treatment outcome with no major adverse effects. To the authors' knowledge, this was the first study to compare the efficacy of PRP to DN in masticatory MPS. However, further research with a greater sample size and longer follow-up must be conducted.

Key Findings

- PRP seems to be an effective therapeutic modality for the management of MTrPs in MPS patients in terms of pain relief, functional improvement, and patient satisfaction.
- PRP has a better efficacy than DN for management of MPS, as it is more efficient in reducing pain severity, shortens the therapy time, and produces sustained results.

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