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Menerva Elgazzaz

department of oral and maxillofacial surgery, faculty of dentistry, Badr university in cairo,
menervaelgazzaz@gmail.com

Fatma Khalifa

oral and maxillofacial Surgery department Faculty of Dental Medicine for Girls, Al-Azhar University, fa_khalifa@hotmail.com

Ghada Amin

professor of oral and maxillofacial surgery, ghadaamin@ymail.com

Shadia Elsayed

Department of Oral&Maxillofacial Surgery, Faculty of Dental Medicine for Girls, Al-Azhar University,Cairo,Egypt and College of Dentistry, Taibah University, KSA, shadiaelsayed25@gmail.com

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The Use of Injectable Platelet Rich Fibrin in the Treatment of Tempromandibular Joint Hypermobility

Menerva A Elgazzaz^{1*}, Fatma A khalifa², Ghada A khalifa³ and Shadia A Elsayed⁴

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azhardentj@azhar.edu.eg

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ABSTRACT

Purpose: A prospective consecutive case series study was performed during the period between December 2014 and July 2017, aimed to evaluate the effectiveness of the use of injectable platelet rich fibrin (PRF) in the treatment of tempromandibular joint hypermobility. **Patients and methods:** Twelve patients suffering from TMJ hypermobility were treated by PRF intra articular injection twice with one month interval. Patients underwent clinical investigation with complete assessment of pain, frequency of dislocation, range of motion and TMJ sounds, this was performed pretreatment then on first, third, sixth, and ninth months post treatment. Pre and post radiological CBCT was performed to assess the degree of capsular and ligamental laxity (DCLL), and the Condylar position (CP) at maximum range of motion. **Results:** The results of the study showed that PRF had a highly significant positive effect on the clinical signs and symptoms of TMJ hypermobility over the first 6 months post operatively, but at 9 months, the results were not sustained on the same clinical improvement level. **Conclusion:** The injection of PRF is an effective, minimally invasive method that could be used for treatment of TMJ hypermobility by improving capsular and ligamental integrity. Additionally, it significantly improves all signs and symptoms up to 6 months since the TMJ injection, so it is recommended to repeat the procedure yearly.

KEYWORDS

TMJ hypermobility,
Arthrocentesis,
PRF,
CBCT

INTRODUCTION

The TMJ Hypermobility is defined as an excessive anterior movement of the mandibular condyle, where it exceeds the articular

- A paper extracted from master thesis titled "The Use of Injectable Platelet Rich Fibrin in the Treatment of Tempromandibular Joint Hypermobility"

1. * Teaching Assistant at Badr University in Cairo. Email: menervaelgazzaz@gmail.com
2. Assistant Professor Of Oral And Maxillofacial Surgery Faculty Of Dental Medicine For Girls Al-Azhar University in Cairo
3. Professor Of Oral And Maxillofacial Surgery Faculty Of Dental Medicine For Girls Al-Azhar University in Cairo
4. Assistant professor Of Oral And Maxillofacial Surgery Faculty Of Dental Medicine For Girls Al-Azhar University in Cairo, Egypt, Associate Professor Of OMFS College Of Dentistry Taibah University, KSA.

eminence during maximal mouth opening that creating discomfort. It is described by the terms “subluxation”, “luxation”, and “dislocation”. In cases where repeated dislocations occur, the term “chronic”, “chronic recurrent”, or “habitual” could be used. It is more frequently represented in people with general ligamentous and capsular laxity, or eminent erosion and flattening⁽¹⁾. In literature, different surgical and nonsurgical techniques have been used for treating patients with the chronic recurrent TMJ dislocation⁽²⁾. The conservative methods include a restriction of the mandibular motions, applications of local anesthetics, injection of botulinum toxin to muscles of mastication, injection of sclerosing agents and recently the prolotherapy⁽³⁻⁷⁾.

The emergence and application of the platelet-enriched preparations have revolutionized the field of the regenerative medicine because of the repair capacities of the growth factors and proteins secreted by the platelets⁽⁸⁾. The platelet rich fibrin (PRF) is the second generation of platelet rich plasma (PRP) where autologous platelets are present in a complex fibrin matrix to accelerate the healing of soft and hard tissue and is used as a tissue-engineering scaffold⁽⁹⁾. This fibrin matrix presents a long-term slow release of growth factors and proteins that can last more than 28 days in vitro⁽¹⁰⁾, that is why several studies used it in clinical applications of orthopedics such as tendopathies, rotator cuff repair, anterior cruciate ligament repair and knee damaged joint to enhance the cellular regeneration decrease pain and inflammation^(11,12). A lot of researches postulated the importance PRP as a treatment modality for ID and osteoarthritis of temporomandibular joint, however up to date, there is no publication about its effect on the cases of hypermobility^(13,14). Therefore, this prospective case serious study was enrolled to answer the following questions: First, among patients with TMJ hypermobility is the injectable PRF able to restore the integrity of the joint capsule and ligaments? Second, to what extent will it be

able to reduce the sign and symptoms of the TMJ hypermobility?

PATIENTS AND METHODS

Twelve patients suffering from TMJ hypermobility and indicated for arthrocentesis and intra articular injection, were selected from the Outpatient Clinic of the Departments of Oral and Maxillofacial Surgery at Al Zahraa hospital, Faculty of Dental Medicine for Girls, Al-Azhar University. An informed consent was obtained from the patients after explaining the study design and procedures. The local ethics review committee of the Faculty of Dental Medicine for Girls at Al-Azhar University approved the study.

The patients were enrolled in the study after fulfilling the following criteria: 1) Adult patients (>18 years of age), 2) Did not receive any previous treatment, 3) Did not respond to conservative treatment (soft diet, analgesics, and movement restriction). Exclusion criteria were: 1) Presence of systemic disorders that required anticoagulant therapy, 2) patients refusing to attend all scheduled visits, 3) patients with physical or mental diseases.

Outcome variables: the primary Outcome variables were the patients' demographic data, occlusion, cause, duration of the hypermobility, the affected joint and whether the dislocation was self-reduced or healthcare provider reduced. The clinical variables included the frequency of the TMJ condylar dislocation, joint pain, range of motion, and joint sounds. The radiological variables included the degree of capsular and ligamental laxity (DCLL), and the Condylar position (CP) at maximum range of motion. Variables were tested at the first, third, sixth and ninth months post treatment. Also, the radiological variables were documented after 9 months postoperatively to determine the radiographic changes after treatment.

All patients were diagnosed and evaluated according to research diagnostic criteria for temporomandibular dysfunction (RDC)⁽¹⁵⁾. Pain

was recorded in visual analogue scale, where 0 = no pain, 1 = mild pain, 2 = moderate pain, and 3 = severe pain.

Radiographic examinations: They were performed to collect the data of the following variables: TMJ disc displacement by performance of bilateral open and closed preoperative T1, T2, and proton density weighted images of MRI scans to examine the disc position and if there was an associated ID with the hypermobile joints which was evaluated on the sagittal planes.

The condylar position at maximum range of motion (CP), this was evaluated by the classification of the type of condylar position in relation to the eminence. This was identified according to classification of Patel J et.al with some modifications have been done to the study's cases⁽¹⁶⁾. A four line axis perpendicular to the eminence was drawn. Then, by tracing the position of the condyle, 5 types of condylar relations were defined as follow: Type 1: the condyle is located posterior and superior to the highest point of the eminence, Type 2: it is also located posterior to the eminence but at the same level of the highest point, Type 3: it is located directly below it, Type 4: anterior to the eminence but at the same level of the highest point of the eminence, and Type 5: it is anterior and superior to it (Figure 1).

Degree of the capsular and ligamental laxity (DCLL) of each joint was evaluated preoperatively and after 9 months since the second TMJ injection, by using CBCT software tool was determined by measuring the amount of the condylar movement at the maximum mouth opening in the sagittal views. If the condyle located below the eminence, the readings were documented as zero mm, If the condyle located behind the eminence, then the readings were recorded in negative values (-) mm. Finally, if the condyle did not exceed the eminence the readings were measured in positive values (+) mm (Figure 2).

Treatment Procedures

Arthrocentesis was performed under general anesthesia for all the patients. The laskin double needle technique was chosen to do arthrocentesis⁽¹⁷⁾. Then, the lavage was done with 100 ml ringer acetate solution. The gauge of the needles used was 18; they were fixed on plastic syringes with sizes of 20 ml.

PRF preparation and injection: A 20-ml patient blood were drawn and equally distributed into 2 falcon plastic sterile tubes without adding anticoagulant agent. The Collection of the blood samples was done regarding the infection control guidelines of the WHO using sterile single-use

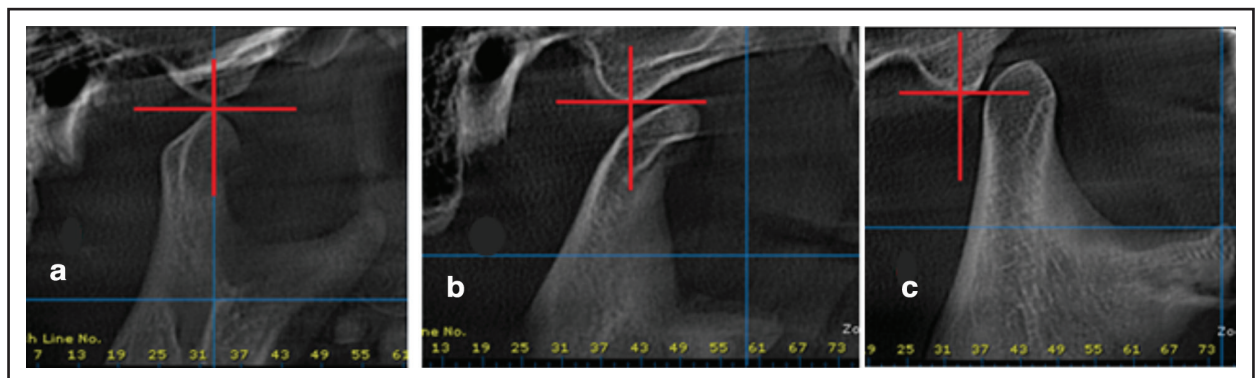


Figure (1): Sagittal CBCT cuts showing types of CP for different patients : a) Type 3: The condyle is directly below the eminence(subluxation), b) Type 4: Dislocated joint where the condyle is anterior and at the same level to the eminence, and c) Type 5: Dislocated joint in which, the condyle is anterior and superior to the eminence.

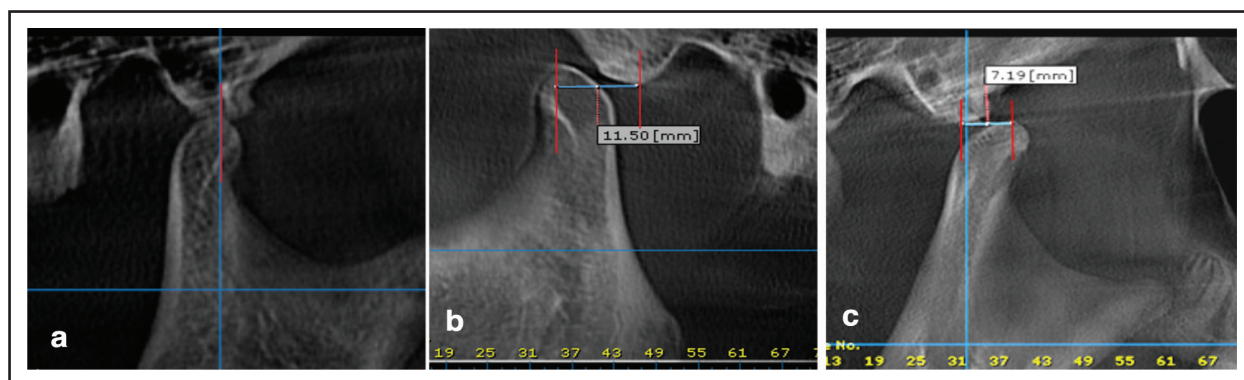


Figure (2): Sagittal CBCT cuts showing the measurement of DCLL for different patients. The red lines representing the lines passing through the highest point of the condyle and the lowest point of the eminence. The blue line means the distance between them referring to (DCLL). a) 0 mm measurement of DCLL (subluxation), b) High degree of DCLL in negative value measuring (-11.50 mm) which indicates that the condyle moved large distance in front of the eminence, and c) Moderate amount of DCLL in negative value (-7.19 mm).

disposable needles, and syringes, also, the donor site was disinfected with 70% alcohol swabs. The yellow layers were drawn with a plastic sterile syringe. This provided about 4 ml of plasma. An amount of 2.5 ml were injected in the superior joint space through the first needle, then, the needle was withdrawn outward around 1cm to inject 1.5 ml into the pericapsular tissues. Finally, a four tailed bandages were done for all the patients and were kept under observation for the rest of the day. After one month, the second PRF injection without arthrocentesis was performed under conscious sedation. IMF was used for three days postoperatively via orthodontic bands and medium elastics that was changed by the patient daily.

Statistical Analysis was performed using a commercially available software program (SPSS 25; SPSS, Chicago, IL, USA). Qualitative data were compared using chi square test. Values of pain score in different observations were compared using Friedman test. Data were compared using one way analysis of variance (ANOVA) test. Kruskal Wallis test was used to study the percent change in range of motion in different intervals. Wilcoxon signed Rank test was used to compare the distance between highest point of condyle and highest point

of articular eminence pre and post treatment. The level of significance was set at $P < 0.05$.

RESULTS

As summarized in Table 1, the study included 4 males and 8 females. With patients' age ranged between 16 to 50 years with a mean of 24 ± 10 years, the Table 2 summarized the preoperative clinical variables. The pain, which was related to the area of the TMJ, constituted the most common chief complaint in this study. The majority of the patients (71% of the joints, 17 out of 24 joints) had score 3 on the pain scale. A fifty percent of the patients recorded that their joints were dislocated twice per week.

Operative Results

There were no difficulties encountered during the arthrocentesis, except in 2 patients (16.67%). In these two patients, the palpation of the condylar position was difficult because they were obese with bulky cheeks. Therefore, the arthrocentesis was accomplished after multiple trials. The results also showed that there were no adverse events related to injections. All the patients had pain and swelling at the site of the injection which resolved within one week with postoperative analgesics. No signs of

Table (1): *The study's patients' demographic data*

P	Age	Sex	Cause	Occlusion	Duration	SR/ HCPR	Disc/condyle relation	
							Rt	It
1	17	M	trauma	Class I	3 years	HCPR	Normal	ADDWR
2	22	M	trauma	Class II	2 years	SR	ADDWR	ADDWR
3	27	F	Not defined	Class I	4 years	SR	Normal	ADDWR
4	16	F	stress	Class I	1 year	HCPR	Normal	ADDWR
5	50	F	trauma	Class I	1 year	HCPR	Normal	ADDWR
6	16	F	stress	Class III	1 year	HCPR	Normal	ADDWR
7	16	F	trauma	Class II	2 years	HCPR	ADDWR	ADDWR
8	29	F	Not defined	Class I	6 months	HCPR	Normal	Normal
9	25	F	trauma	Class I	2 year	SR	ADDWR	Normal
10	19	M	Not defined	Class III	1 year	HCPR	ADDWR	Normal
11	25	M	trauma	Class I	2 years	HCPR	ADDWR	ADDWR
12	17	F	stress	Class I	1 year	SR	Normal	Normal

SR: self reduced, HCPR: health care provider reduced, ADDWR: anterior disc displacement with reduction, RT: right side, LT: left side.

infection neither facial nerve injury was noted in all the study's cases.

Postoperative results

The Clinical results was summarized in Table2, patients preserved their improvement up to 6 months regarding frequency of dislocation , measurements of maximum mouth opening and pain, then gradual decline appeared till 9 months.

Regarding the radiographic results, the treatment which was followed in the study improved the position of the condyle in relation to the eminence. This indicates the increase in the integrity of the joint ligaments which limited the condylar movements. The results of the preoperative CP, at the maximum mouth opening, demonstrated that the Type 4 Predominated among the study's patients at the end of follow up, Types 1 and 2 were documented in 25% of the joints that indicates normal position between the condyle and the articular eminence.

There was also a significant reduction in the percent of the joints with type 4, where the percent decreased from 54.2% to 45.8%. A significant increase in the type 3 from 8.3% to 16.7% was also documented; this was summarized in table 3 and figure 3.

Regarding the DCLL, Table 4, there were no changes in the joints with subluxation, where the pre and postoperative DCLL measurements equaled Zero. The postoperative DCLL measurements of the joints with preoperative dislocation showed that the DCLL measurements equaled zero in 2 joints which means that the condition improved from TMJ dislocation to subluxation. The positive values (the condyle located before the tip of the eminence) were noted in 6 joints (25%). The rest of the joints (14 joints, 58.3%) were still had TMJ dislocation (negative values), but the distance, on which the condyles moved anterior to the eminence, was significantly decreased ($P\text{-value} < 0.05$), as shown in figure 4.

Table (2): The summary of the study's clinical variables

Examination/ Variable		Pre op.	Post op. 1 month	Post op. 3 month	Post op. 6 month	Post op. 9 month	p-value
Pain scale: (n=24 joints)	0	8% (2)	88%(21)	67%(16)	50%(12)	33%(8)	0.0001*
	1	4%(1)	8%(2)	25%(6)	42%(10)	33%(8)	
	2	17%(4)	4%(1)	8%(2)	8%(2)	30%(7)	
	3	71%(17)	0%-	0%-	0%-	4%(1)	
ROM mean		45.58±4.96	33.17±2.12	34.33±3.26	36.08±3.2	38.83±3.35	0.0001*
Frequency of dislocation (n=12 Patients)	No dislocation	0	100%	100%	75%(9)	58.3%(7)	< 0.05*
	Twice/ day	16.7%(2)	0	0	0	0	
	Twice/week	50%(6)	0	0	0	0	
	Twice / month	33.3%(4)	0	0	0	16.7%(2)	
	Once in 3 months	0	0	0	25%(3)	25%(3)	
Sounds ^s during movement (n=24 joints)	No clicking	16.7%(4)	0	91.7%(22)	58.3%(14)	16.7%(4)	<0.05*
	Unilateral clicking	50%(12)	0%	8.3%(2)	33.3%(8)	58.3%(14)	
	Bilateral clicking	33.3%(8)	0%	0%	8.3%(2)	25%(6)	

Pre op: Pre operative, Post op: Post operative, *: Significant, \$: Sounds related to TMJ ID

Table (3): The pre and post treatment joint types according to the condylar position (chi square test)

Joint type (n=24)	Pretreatment	Post treatment	P
Type 1	0	2(8.3%)	0.04*
Type 2	0	4 (16.7%)	
Type 3	2 (8.3%)	4(16.7%)	
Type 4	13(54.2%)	11 (45.8%)	
Type 5	9 (37.5%)	3 (12.5%)	

*: Significant, Type 1: (posterior-superior), Type 2: (posterior- at the same level), Type 3: (directly below), Type 4: (anterior- at the same level), and Type 5: (anterior-superior)

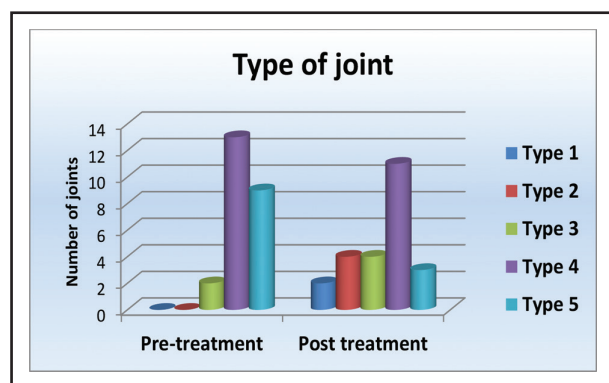


Fig. (3): A column chart showing the pre and post treatment joint types of CP

Table (4): The changes in the values of DCLL measurements

Categories of distance per joint (n=24)	Pretreatment	Post treatment	P
Zero (subluxation)	2 (8.3%)	4 (16.7%)	0.015*
Negative value (dislocation)	22 (91.7%)	14 (58.3%)	
Positive value (normal)	0	6 (25%)	

*: Significant

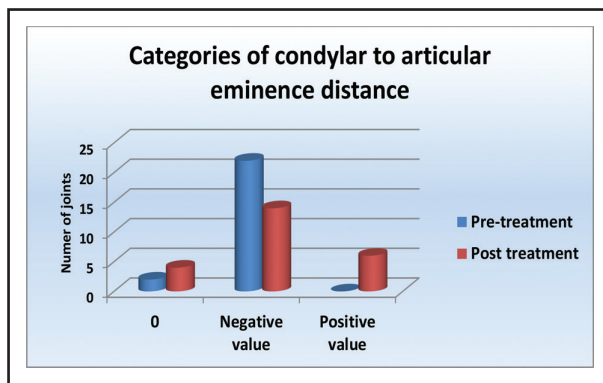


Figure (4): A column chart showing the pre and post treatment categories of DCLL (chi square test)

DISCUSSION

There are different treatments modalities have been documented for treatment of TMJ hypermobility. One of these methods is the injection of autologous blood into TMJ⁽¹⁸⁾. The authors of the current study believe that the use of autologous blood has many disadvantages. Its major one is that it increases the risk of TMJ ankylosis if the patient did not perform the proper physiotherapy after injection. Also, it leads to permanent joint destruction, degeneration of the cartilage, and apoptosis of chondrocytes which leads to long-lasting changes in cartilage matrix turnover that ends up by osteoarthritis. This was also reported by many authors^(19,20). Thus the injectable PRF was chosen to be injected in the study's cases. This was because it has the following advantages: it's high content of fibrin and platelet growth factors, its fluidity without the use of any anticoagulant materials, and has considerable working time which allows its injection before gelation. Many authors also reported these advantages^(21,22).

The results of the study showed that the PRF had a highly significant positive effect on the clinical signs and symptoms of TMJ hypermobility over the first 6 months postoperatively. This could be due to the synergistic actions of the platelet GFs on the tissue repair and enhancing neo-angiogenesis that improve the joints circulation. These effects occur because the GFs promote changes in the cell

proliferations and regulate the cellular metabolism. They also allow regeneration of the degenerated tissues, so they improve the media inside the joints and enhance regeneration of the capsular ligaments. This was also proved by other authors who found that PRP promotes healing through regeneration of degenerative changes in cartilage, bone, and synovial tissues. They also documented that the GFs promote healing of degenerated ligaments and capsule^(23,24).

On the other hand, at 9 months, the results were not sustained on the same clinical improvement level, where 41.7 % of the patients (5 patients) recorded recurrent episodes of dislocation but their frequencies were significantly decreased. This could be explained by the fact which was proved by many authors and found that there is a complete consumption of the PRF within 27 to 30 days since their injection into the tissues⁽²⁵⁾. Two (16.7 %) out of those 5 cases received trauma directly to their face. This also could be the cause of the recurrence. The other 3 cases were also suffering from the presence of ID with reduction. They mentioned that they dislocated while they tried to overcome the mechanical obstacle of the disc. This could be also the cause of the recurrent dislocation, where this is considered as a jerky movement and parafunctions that lead to dislocation. It is well documented that the most important factor that affect the success of the TMJ treatment is to remove the cause of the problem otherwise the condition is temporary improved whatever the type of the treatment that has been done^(26,27).

The positive effect of the PRF on the treatment of the TMJ hypermobility could be also speculated from the CBCT scans. The PRF improved the integrity of the capsule and ligaments, where it significantly decreased the distance at which the condyle travelled anteriorly and also improved the condylar position in the glenoid fossa at maximum mouth opening. This is attributed to its high content of fibrin and its ability to enhance deposition and formation of collagen fibers and elastin as proved by many authors^(28,29). The collagen fibers constitute

the main content of the capsules and ligaments of all body joints. In our cases, the PRF was injected both intra and extra capsular. This enhanced deposition of fibrin and regeneration of capsules from its inner and outer surfaces. This helped in increasing the capsular integrity and limited the movement of the condyles outside the glenoid fossi. Despite that, 58.3% (14 out of 24 joints, 7 patients) still had dislocation. This demonstrated that the regeneration of the joint integrity is too difficult procedure, and it is better to be avoided by avoiding all the predisposing factors that lead to TMJ hypermobility. Nevertheless, five patients of them reported a significant reduction in the frequency of the dislocation, and the rest of them (2 patients) had no clinical manifestation of the dislocation. This is because the measurement of the distance between the condyle and eminence was significantly decreased and the type of CP was improved which also indicates the improvement in their capsular integrity as a result of PRF. This is in accordance with other studies^(11,29). On the other hand, there are few studies that proved the insignificance of the plasma derivatives usage to improve the integrity of the joints, but they only tested the use of PRP^(30,31).

The study showed some limitations such as the small sample size, lack of a preferred comparative nature of studies. Additionally, all the study patients needed to arthrocentesis procedures to overcome the presence of pain. The improvement of hypermobility could be enhanced with the effect of arthrocentesis that induced fibrosis around the area of TMJ as a result of surgical trauma.

CONCLUSION

From the study's results, it could be concluded that the injection of PRF is an effective, realistic method that could be used for treatment of TMJ hypermobility by improving capsular and ligamental integrity. Additionally, it significantly improves all clinical signs and symptoms up to 6 months since its injection, so it is recommended to repeat the procedure yearly.

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