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Functional outcome after arthroscopic debridement with microfracture and platelet rich-plasma injection in osteoarthritis of knee – A prospective study

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Abstract:

Surgical treatment for knee osteoarthritis (OA) involves debridement, lavage, and microfracture to enhance chondral resurfacing by providing a suitable environment for tissue regeneration. Platelet-rich plasma (PRP) stimulates chondrocyte proliferation. Combining microfracture with PRP injections helps promote early clinical improvement, and this study aims to assess the functional outcomes when all three techniques are used simultaneously. This prospective, observational, hospital-based study was conducted at R. L. Jalappa Hospital and Research Centre, SDUMC, Tamaka, involving patients with OA of the knee from June 2020 to November 2020. Clinical data were collected and evaluated with pre -and post-procedure Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and visual analogue scale (VAS) scores. In all, 74.29% of the patients had Kellgren-Lawrence grade III knee OA and 25.71% had grade II knee OA. The levels of pain and knee function were evaluated using WOMAC and VAS scores before and 1, 3, and 6 months after the procedure. It was observed that 68.57% had good VAS scores, while 31.43% had poor scores. The mean WOMAC scores showed a statistically significant improvement ($P < 0.001$) with a decrease in the preoperative WOMAC score from 67.11 ± 8.73 to 50.14 ± 9.99 at 1 month, 40.83 ± 7.8 at 3 months, and 31.66 ± 5.28 at 6 months. Intra-articular PRP injection after debridement and microfracture is beneficial for pain relief and functional improvement and prolongs the treatment efficacy of microfracture in patients with symptomatic knee OA.

Keywords:

Arthroscopic debridement, Microfracture, platelet-rich plasma, visual analogue scale, Western Ontario and Mcmaster universities osteoarthritis index

Knee osteoarthritis (OA) is a leading cause of musculoskeletal pain worldwide.[1] It is caused when the hyaline cartilage, which protects the bone from excessive load and trauma, is injured or degenerated.[2] The lack of treatment methods for OA has resulted in a focus on symptomatic relief by reducing pain and disability.[3] Surgical intervention depends on the degree of symptoms, stiffness of the knee, pain level, patient age, level of physical activity, and comorbidities.[4] Arthroscopic procedures for treating knee OA include lavage, partial meniscectomy, chondroplasty, synovectomy, removal of loose bodies, removal of offending osteophytes, and adhesiolysis. These procedures are performed in combination depending on the type of articular lesion.[5] The overall prevalence of knee OA in India was found to be 28.7%.[6] A community-based cross-sectional study using the Kellgren-Lawrence scale showed

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a prevalence of 28.7% of OA in the overall sample. City-wise estimates vary slightly with Agra at 35.5%, Bangalore at 26.6%, Kolkata at 33.7%, Dehradun at 27.2%, and Pune at 21.7%.[7]

Arthroscopic debridement is helpful for short-term symptom relief in early arthritis but ineffective for halting disease progression. In 1997, Steadman developed the "microfracture" technique, which involves penetration of the subchondral bone plate with an arthroscopic awl to allow bone marrow cells to repopulate defects, filling them with repair tissue.[8] The growth factors stored in platelet α-granules regulate articular cartilage metabolism,[9] and the alternative of injecting a concentrate with high levels of autologous growth factors and bioactive molecules in physiological proportions has been proposed.[10] Platelet-rich plasma (PRP) is thought to stimulate the proliferation of chondrocytes and differentiation of mesenchymal cells of the subchondral bone into the chondrogenic cell line. Combining microfracture with PRP injections helps promote early clinical improvement, as PRP is also thought to exert anti-inflammatory action on the synovial membrane.[11]

A prospective study of arthroscopic debridement procedures reported that 75% of the patients had good or excellent results.[12] Lesions measuring <4 cm^2 were likely to respond well to microfracture in the first 2 years. Systematic reviews have demonstrated a clear improvement in knee function at 24 months after microfracture but inconclusive results on durability and treatment failure rate after 5 years.[13,14] Patients with OA in the joints have different microenvironments depending on the disease stage, so they exhibit different therapeutic effects of PRP according to the specific milieu present in their joints.[15] In the extensive literature with positive reports on the use of PRP, very few high-level studies have been published. Randomized controlled trials present overall support for PRP injections for knee OA treatment, showing an early beneficial effect slightly superior to that obtained with viscosupplementation.[9]

The prevalence of OA of the knee increases drastically with age, and it is a leading cause of significant morbidity, job loss, and early retirement. Surgical treatment for symptomatic OA of the knee involves arthroscopic debridement and microfracture with PRP supplementation. There are few studies in which all three techniques are used simultaneously. This study assessed the functional outcomes of arthroscopic debridement in cases of mild-to-moderate knee OA using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score and visual analogue scale (VAS).

Materials and Methods

This was a prospective, observational, and hospital-based study conducted in the department of Orthopaedics at R. L. Jalappa Hospital and Research Centre attached to Sri Devaraj Urs Medical College, Tamaka, Kolar from November 2018 to June 2020 for 1.7 years. The sample size was estimated according to the mean difference in pre-and postoperative VAS scores in a study by Mancò *et al*.[16] The study was approved by the institutional ethics committee and informed written consent was obtained from all study participants, with confidentiality maintained. Patients aged 40–60 years with early knee OA (classified as Grade I, II, and III according to the Kellgren and Lawrence classification) were included in the study. Patients with major axis deviation, hematological diseases/coagulopathies, tumor/infection/crystal arthropathies, neuropathic arthropathy, metabolic bone diseases, and ligament instability were excluded from the study.

In all, 35 patients meeting the inclusion and exclusion criteria were selected for the study after informed consent was obtained. Clinical examination and radiographic imaging of the knee joints were performed, blood samples were collected, and PRP was prepared in the blood bank of the same institute. The baseline VAS and WOMAC scores were assessed, and arthroscopic debridement, microfracture (Steadman's technique), and PRP injection were performed. VAS and WOMAC were measured before and after the procedure at 1, 3 and 6 month intervals.

Statistical methods

The VAS and WOMAC scores were the primary outcome variables, and age and sex were the primary explanatory variables. Descriptive analysis was carried out using means and standard deviations for quantitative variables and frequency and proportion for categorical variables. A $P > 0.05$ in the Shapiro–Wilk test indicated normal distribution. The Wilcoxon signed-rank test was used to assess the statistical significance that was set at $P < 0.05$. IBM SPSS (IBM SPSS version 22, New York, United States) version 22 was used for the statistical analysis.[17]

Results

In all, 35 patients were included in the final analysis.

The mean age was 55.97 ± 4.93 with 22 (62.86%) women and 13 (37.14%) men [Table 1].

In all, 26 (74.29%) patients had OA of Kellgren-Lawrence grade III, and nine (25.71%), of grade II [Table 2]. The mean preoperative VAS score was 7.91 ± 0.74 and mean postoperative scores at 1,3 and 6 months were 5.71 ±

0.99, 4.51 ± 0.66, and 3.17 ± 1.07, respectively. The mean preoperative WOMAC score was 67.11 +/- 8.73 and postoperative scores were 50.14 ± 9.99 at 1 month, 40.83 ± 7.8 at 3 months, and 31.66 ± 5.28 at 6 months.

Table 1: Descriptive analysis of demographic parameter in the study population (*n*=35)

Parameters	Summary statistics
Age	55.97±4.93 (40-60)
Age group, *n* (%)	
40-45	1 (2.86)
46-50	4 (11.43)
51-55	9 (25.71)
56-60	21 (60.00)
Sex, *n* (%)	
Male	13 (37.14)
Female	22 (62.86)

Table 2: Descriptive analysis of clinical parameters of the study population (*n*=35)

Parameters	Summary statistics
Side, *n* (%)	
Right	24 (68.57)
Left	11 (31.43)
Grade Kellgren-Lawrence, *n* (%)	
Grade II	9 (25.71)
Grade III	26 (74.29)
VAS score	
Preoperative	7.91±0.74
1 month	5.71±0.99
3 months	4.51±0.66
6 months	3.17±1.07
WOMAC score	
Pre-operative	67.11±8.73
1 month	50.14±9.99
3 months	40.83±7.8
6 months	31.66±5.28
VAS score outcome, *n* (%)	
Good (>5)	24 (68.57)
Poor (<5)	11 (31.43)
WOMAC score outcome (%)	
Good (>35)	18 (51.43)
Poor (<35)	17 (48.57)

WOMAC=Western Ontario and McMaster Universities Osteoarthritis Index, VAS=Visual Analogue Scale

The median difference between the pre- and post-operative (at 1,3 and 6 months) VAS scores was statistically significant ($P < 0.001$). The median difference between the pre- and post- operative (at 1, 3 and 6 months) WOMAC scores was statistically significant ($P < 0.001$) [Table 3].

Discussion

Arthroscopic debridement for knee OA is helpful for short-term symptom relief in patients with early arthritis but ineffective in halting disease progression.[5] Arthroscopic microfracture is indicated as a routine treatment for OA. However, meta and systemic analysis indicate that although Arthroscopic Microfracture improves OA symptoms but the effect is short lived.[18,19] As an alternative approach, PRP is used to treat OA.[20] Some studies have shown that PRP improves OA symptoms.[21,10] Kon *et al*. noted a short-term efficacy in reducing pain and improving both knee function and quality of life.[10] The aim of this study was to evaluate the functional outcomes of treatment with a combination of arthroscopic debridement, microfracture, and PRP injection in patients with mild-to-moderate OA of the knee using the WOMAC and VAS scores.

This was a prospective, observational, and hospital-based study involving 35 patients diagnosed with knee OA. The WOMAC and VAS scores were the primary outcome variables; age and sex were the primary explanatory variables. Based on the VAS and WOMAC scores, it was observed that intra-articular PRP injection after debridement and microfracture are beneficial for pain relief and functional improvement in patients with symptomatic knee OA 6 months after injection. PRP injection significantly improved and prolonged the treatment efficacy of microfracture for OA.

Table 3: Comparison of pre-operative and post-operative (1 month, 3 months, 6 months) Visual Analogue Scale and Western Ontario and McMaster Universities Osteoarthritis Index scores (*n*=35)

Parameter	Median (IQR)	*P* (Wilcoxon signed-rank test)
VAS preoperative score versus postoperative score		
Preoperative VAS score (baseline)	8 (7-8)	
VAS score (postoperative 1 month)	6 (5-7)	<0.001
VAS score (postoperative 3 months)	5 (4-5)	<0.001
VAS score (postoperative 6 months)	3 (2-4)	<0.001
WOMAC preoperative score versus postoperative score		
Preoperative WOMAC score (baseline)	65 (58-76)	
WOMAC score (post-operative 1 month)	51 (39-62)	<0.001
WOMAC score (post-operative 3 months)	37 (34-46)	<0.001
WOMAC score (post-operative 6 months)	31 (28-35)	<0.001

WOMAC=Western Ontario and McMaster Universities Osteoarthritis Index, VAS=Visual Analogue Scale, IQR=Interquartile range

Table 4: Kellegren-Lawrence classification of knee osteoarthritis across studies

Kellegren-Lawrence	Grade I (%)	Grade II (%)	Grade III (%)
Our study	-	25.71	74.29
Gobbi *et al*.[21]	22	38	40
King and Yung[22]	21.2	13.5	51.9
Nguyen *et al*.[23]	-	30	70

Table 5: Visual Analogue Scale pre-procedure and at 6-month follow up

VAS	Pre-procedure	6-month follow up
Our study	7.91±0.74	3.17±1.07
Gobbi *et al*.[21]	3.2±1.4	1.9±1.7
Manunta and Manconi[25]	8.2±0.6	5.7±0.8

VAS = Visual Analogue Scale

The mean age of the study group was 55.97 ± 4.93 years, ranging 40–60 years, which is a slightly older age group than that in the study of Mancò *et al*.,[16] where the mean age was 52.4 years. King and Yung[22] had a younger age group in their study, with a mean age of 44.56 ± 12.74 years. The mean age of the sample was older in the study by Nguyen *et al*.,[23] and the mean age was 64.4 years in the study of Trueba Vasavilbaso *et al*.[24] The current study had a predominantly female population with 62.86% females and 37.14% males, in contrast to the sex distribution in the studies of Gobbi *et al*.[21] and King and Yung[22] with 62% and 69% males, respectively. Trueba Vasavilbaso *et al*.[24] had 52% males in their study, similar to the study by Manunta and Manconi.[25]

The majority of our sample (74.29%) had knee OA of kellgren-Lawrence grade III and 25.71%, of grade II [Table 4]. After arthroscopic debridement and microfracture (Steadman's technique) in dry conditions, PRP was injected into the joint. The levels of pain and knee function were evaluated using WOMAC and VAS scores before and after the procedure at 1, 3 and 6 month intervals. The mean VAS score decreased gradually from preoperative 7.91 ± 0.74-5.71 ± 0.99 at 1 month, 4.51 ± 0.66 at 3 months, and 3.17 ± 1.07 at 6 months showing good functional outcome in terms of pain with a statistically significant median difference between the pre and postoperative scores, with a $P < 0.001$. In all 68.57% of study population had good VAS scores, while 31.43% had poor VAS scores, similar to the findings of Manunta AF *et al*.[25] [Table 5]. Similarly, Mancò *et al*.[16] found that PRP combined with microfracture yielded better clinical and functional results than microfracture at the short-term follow-up with regard to pain, but at the 2-year follow-up, the clinical results were similar to those of the microfracture group. This finding is supported by the results of Elik *et al*.[26] and Manunta and Manconi[25] who noted that the difference between the VAS scores of patients treated with microfracture plus PRP and microfracture alone was not significant but that functional recovery and resolution of pain were obtained quickly in patients treated with PRP.

In line with the improved postoperative VAS score, the WOMAC score showed a statistically significant improvement ($P < 0.001$), with a decrease from preoperative 67.11 ± 8.73 to 50.14 ± 9.99 at 1 month, 40.83 ± 7.8 at 3 months, and 31.66 ± 5.28 at 6 months. Similar findings were noted in a study by Nguyen *et al*., where the WOMAC scores 18 months after treatment showed that all patients in the treatment group had significantly reduced pain and improved movement and capacity for physical activity.[23] In a meta-analysis, Dai *et al*.[27] reported that PRP was more effective than saline for pain relief (WOMAC pain score) and functional improvement (WOMAC function score) at 6 months and 12 months after injection.

Conclusions

A total of 35 patients diagnosed with knee OA with a mean age of 55.97 ± 4.93 years are included in the study. This is a predominantly female population group, with 62.86% of them being female and 37.14% males. Majority of the patients with 74.29% are diagnosed as having Kellegren-Lawrence grade III knee OA and 25.71% grade II knee OA. 68.57% had right side knee OA, and 31.43% had left side knee OA. After arthroscopic debridement and microfracture (Steadman's technique) and Ca-gluconate activated PRP injection is injected into the joint, around the site of the lesion under arthroscopy at the same setting. Patients are evaluated using WOMAC, VAS score for levels of pain and knee function prior to the procedure and after 1 month, 3 months, and 6-month postprocedure. It was observed that the mean VAS score has decreased gradually from preoperative which was at 7.91 ± 0.74–5.71 ± 0.99 at 1 month, further down to 4.51 ± 0.66 at 3 months and it was 3.17 ± 1.07 at 6 months showing the good functional outcome of the procedure in terms of pain. When assessed by the WOMAC score, there is a statistically significant improvement ($P < 0.001$) with a decrease in the WOMAC score from preoperative 67.11 ± 8.73-50.14 ± 9.99 at 1 month, and 40.83 ± 7.8 at 3 months and further reduced to 31.66 ± 5.28 at 6 months.

The study concludes that intra-articular PRP injection after debridement and microfracture has shown more benefit in terms of pain relief and functional improvement. It also prolongs the treatment efficacy of microfracture in patients with symptomatic knee OA. We acknowledge that our current manuscript has some limitations, i.e., small sample size, short follow-up period, No second-look arthroscopy for evidence of cartilage healing, and involvement of patients with only Kellgren-Lawrence grade II and III knee OA. Future studies taking into consideration long-term follow-up are

needed to validate the efficacy of PRP with debridement and microfracture in OA knee.

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Conflicts of interest
There are no conflicts of interest.

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