

Clinical and Functional Outcome of Intraarticular Platelet-Rich Plasma in Early Primary Osteoarthritis Knee Joints and Comparison of Single Vs Double Dose.

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Abstract

Introduction : Osteoarthritis (OA) is chronic progressive, softening and disintegration of articular cartilage and new growth of cartilage and bone at joint margins. Now a days, so many non surgical modalities of treatment are being developed to delay the surgery for osteoarthritis. Out of which PRP is being widely used and portrayed as a wonder drug. The purpose of this study was to evaluate Clinical and functional outcome of intraarticular platelet-rich plasma in early primary osteoarthritis knee joints and compare single vs double dose.

Materials and Methods: It is a prospective randomized study conducted from Nov 2017 to Nov 2018 on 200 primary osteoarthritic knee joints, selected from the Outpatient Department of Orthopaedics, Sri Venkateswara RamnarainRuia Government General Hospital (SVRRGGH). Clinical examination and x rays of the knee joints were done and blood sample of the patients were collected and PRP prepared in the Department of Pathology of the same institute. By computer based randomization, patients are divided into two groups group A and group B. Group A received two doses of PRP 3 weeks apart, group B received single dose of PRP. Infiltration was done in Operation Theatre under strict aseptic conditions. Patients were assessed with WOMAC (Western Ontario McMaster Universities Arthritis Index) scoring pre injection of PRP and post injection period of 1 month, 3 month and 6 months. A reduction in WOMAC score is suggestive of improvement in the patient's condition. The collected data been computed in excel and analyzed through SPSS version 2.0, EPI.INFO and the p value and mean values been obtained.

Results: A Prospective study with 100 patients with bilateral primary osteoarthritis (200 knees) grade 1/2 to study clinical and functional outcome of intraarticular PRP and effect of single vs double dose. Out of 200 knees, 70 were males, 130 were females, 97 were grade 1, 103 were grade 2. According to Womac score, grade of result in group A – poor - 3, fair - 8, good - 41, excellent – 48. Group B - poor - 7, fair - 27, good - 58, excellent – 8. On assessing the results, there is a significant improvement in WOMAC score of all the patients and the results sustained for 6 months.

Patients showed better results with two doses of PRP when compared with patients who received single dose.

Though clinically better results are seen in grade I knee joints than grade II knee joints, the difference is statistically not significant.

There is no significant difference between males and females in group A and group B with grade 2 OA, but females showed better results than males in group A and group B with grade 1 OA.

Conclusion: We can safely conclude that Intraarticular Autologous PRP infiltration in early primary Osteoarthritis (Grade I and Grade II) of Ahlback's radiological grading gives relief from pain, stiffness and improves physical functionality without major side effects and can be used as modality of treatment.

There is significant difference between single dose and double dose regimen, we conclude that double dose offers additional advantage.

Key words: Platelet- rich plasma (PRP), Womac score, Ahlback's grading.

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I. Introduction

Osteoarthritis (OA) is chronic progressive, softening and disintegration of articular cartilage and new growth of cartilage and bone at joint margins. Osteoarthritis is a common, debilitating and degenerative disease which is associated with a large economic burden¹. Osteoarthritis (OA) of the knee is one of the main causes of

morbidity and disability². Osteoarthritis is the fourth leading cause of 'years lived with disability' (YLD), accounting for 3.0% of total global YLD's. As per WHO by 2030, the demand for total knee arthroplasties will increase up to 670%. This condition places a major burden on our current economy, with billions of dollars of annual expenditure associated with pharmaceutical treatment for pain relief, rehabilitation, and joint replacements³. Current opinion is that the disease progression results from an imbalance between proinflammatory cytokines (including interleukin [IL]-1a, IL-1, and tumor necrosis factor-1 and anti-inflammatory cytokines (including IL-4, IL-10, and IL-1ra). This cytokine imbalance is thought to activate proteolytic enzymes, leading to the destruction of cartilage. The majority of recently proposed therapeutic modalities for osteoarthritis have a foundation in attempting to address this cytokine imbalance. In addition to cartilage loss, arthritis of the knee joint may adversely affect subchondral bone, synovium, ligaments, capsule, menisci, surrounding musculature, and perhaps the sensory nervous system³. Autologous PRP is a volume of plasma having a platelet concentration above normative baseline values⁴. Platelets are source of high concentrations of cytokines well documented to regulate a number of processes related to healing and tissue regeneration.^{5, 6, 7}. PRP therapy provides delivery of a highly concentrated cocktail of growth factors to accelerate healing. Currently, most studies on PRP therapy are anecdotal, nonrandomized, or involve insufficient sample sizes and are underpowered⁸.

However, at present, there are limited studies documenting the safety and efficacy of a nonsurgical PRP injectable for intraarticular use in knee Osteoarthritis^{9, 10}.

PRP is being portrayed as a "wonder drug," without sufficient evidence to support its application in almost all the areas in which it is used. No specific guidelines per dosage regimen.

Keeping in view these grey areas in our knowledge, this prospective study was designed to evaluate the role of PRP in the early stages of knee OA. In this study PRP from the patient's own blood i.e. autologous PRP has been immediately infiltrated into their knee joints with early osteoarthritis and the results of injection of PRP have been observed over a period of time. We also wanted to study if the beneficial effects, if any results from the PRP injection may be prolonged by giving the second dose.

II. Materials and Methods

It is a prospective randomized study conducted from Nov 2017 to Nov 2018 on 200 primary osteoarthritic knee joints, selected from the Outpatient Department of Orthopaedics, Sri venkateswararamnarainruia government general hospital (SVRRGGH). Clinical examination and x rays of the knee joints were done and blood sample of the patients were collected and PRP prepared in the Department of Pathology of the same institute by computer based randomization, patients are divided into two groups group A and group B. Group A received two doses of PRP 3 weeks apart, group B received single dose of PRP. Infiltration was done in Operation Theatre under strict aseptic conditions. Patients were assessed with WOMAC (Western Ontario McMaster Universities Arthritis Index) scoring pre injection of PRP and post injection period of 1 month, 3 month and 6 months. A reduction in WOMAC score is suggestive of improvement in the patient's condition. The collected data been computed in excel and analyzed through SPSS version 2.0, EPI.INFO and the p value and mean values been obtained.

AHLBACK RADIOLOGICAL GRADING OF OSTEOARTHRITIS OF KNEE JOINTS(Image – 1)

- Grade I– Joint Space narrowing (< 3mm)
- Grade II – Joint space obliteration
- Grade III – Minor bone attrition (0-5mm)
- Grade IV – Moderate bone attrition (5-10mm)
- Grade V – Severe bone attrition (>10mm)

Image-1: Ahlback's radiological grading of Osteoarthritis of knee joints.



Normal knee joint



Osteoarthritis of knee joint with Ahlback's radiological grade III



Osteoarthritis of knee joint with Ahlback's radiological grade I



Osteoarthritis of knee joint with Ahlback's radiological grade IV



Osteoarthritis of knee joint with Ahlback's radiological grade II



Osteoarthritis of knee joint with Ahlback's radiological grade V

PATIENT SELECTION

All patients with primary osteoarthritis of knee joints were evaluated clinically using WOMAC scoring and radiographically based on Ahlback's radiological grading, patients with Grade I and II Osteoarthritis were selected irrespective of age, sex and socioeconomic status. Selected patient's blood samples were sent for complete blood picture, erythrocyte sedimentation rate, C-reactive proteins, random blood sugar. Patients' blood was evaluated to assess the white blood cell count and platelet count prior to the infiltration. Patients with elevated white blood cells, and platelet counts less than 100000/cubic mm, elevated erythrocyte sedimentation rate and positive C-reactive proteins, random blood sugar levels beyond 80-150 range excluded from the study. patients were enquired about oral medications like NSAIDS, if any was asked to stop one week before administration of PRP. Selected patients WOMAC score was recorded in a separate chart for each patient and follow up scorings were noted down in the same chart of the patient.

STANDARD OPERATING PROCEDURE FOR THE PREPARATION OF PLATELET RICH PLASMA (PRP)

In the Department of Pathology, from each patient 20 ml of venous blood was collected from the antecubital vein atraumatically in an effort to avoid irritation and trauma to the platelets with a syringe, blood was transferred to the test tubes of 2 ml containing sodium citrate as an anticoagulant. The tubes were then centrifuged for 5 and 10 minutes at 3000 rpm on a table-top centrifuge, and the blood was separated into PRP and residual red blood cells. The PRP was then extracted through a pipette and transferred to a test tube. The final PRP was assessed for platelet count and was supplied for injection in a 10-mL syringe (approximately 5 mL per knee). Total leucocyte count and platelet count were measured from the patient's peripheral blood as well as in the final PRP. Total leucocyte count was zero in our PRP, The mean platelet count achieved by our method was more than five times the platelet count of blood of that patient.

In the operation theatre, with the patient in supine position, knee was scrubbed, painted and draped with sterile towels. With the patient's knee in 15 - 20 degrees of flexion, through lateral parapatellar approach, under aseptic conditions, 5 mL platelet concentrate was injected into the knee joint with an 18- gauge needle without local anesthetic. Patients were observed for 30 minutes for any possible side effects like dizziness, sweating.

Follow up : During the follow-up period, nonsteroidal anti-inflammatory drugs were not allowed, and tramadol (dosage, 50 mg bds) was prescribed in case of discomfort; cefixime 200 mg bds for 3 days, all patients were asked to stop medications 48 hours before follow-up assessment.

Image-2: Centrifuge for PRP separation with timer on the front side



Image-3: Test tubes inside the centrifuge



Image-4: Vacutainers after 15 minutes of centrifuge with 3000 RPM



Image-5: 5ml of PRP in syringe



Image-6: infiltration into the knee joint in Operation Theater



III. Results

A Prospective study with 100 patients with bilateral primary osteoarthritis (200 knees) grade 1/2 to study clinical and functional outcome of intraarticular PRP and effect of single vs double dose. Out of 200 knees, 70 were males, 130 were females, 97 were grade 1, 103 were grade 2. According to Womac score, grade of result in group A – poor - 3, fair - 8, good - 41, excellent – 48. Group B - poor - 7, fair - 27, good - 58, excellent – 8. On assessing the results, there is a significant improvement in WOMAC score of all the patients and the results sustained for 6 months.

Patients showed better results with two doses of PRP when compared with patients who received single dose.

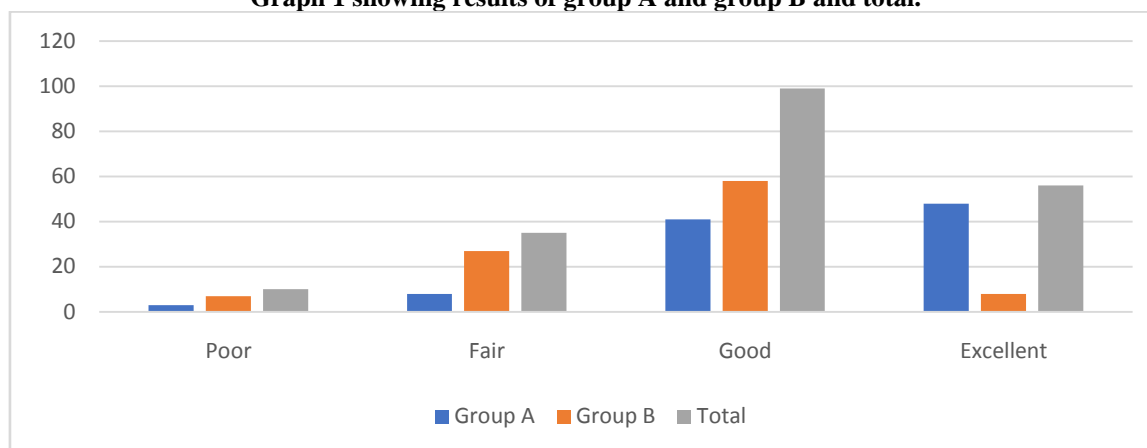
Though clinically better results are seen in grade I knee joints than grade II knee joints, the difference is statistically not significant.

There is no significant difference between males and females in group A and group B with grade 2 OA, but females showed better results than males in group A and group B with grade 1 OA.

Table 1 Grade of result in group A and group B

Grade of result	Group A	Group B	Total
Poor	3 (1.5 %)	7 (3.5 %)	10
Fair	8 (4 %)	27 (13.5 %)	35
Good	41 (20.5 %)	58 (29 %)	99
Excellent	48 (24 %)	8 (4 %)	56
Total	100 (50 %)	100 (50 %)	200

Graph 1 showing results of group A and group B and total.



In group A, with (24 %) excellent, (3 %) poor results. In group B, with (4 %) excellent, (3.5 %) poor results. Better results were seen in group A.

Discussion and Analysis

Hyaline cartilage has low healing potential, hence it's lesions and degeneration are difficult to treat. Present pharmacologic options available may only temporarily decrease chronic pain, but for the time being, no proven disease modifying agent is available¹².

In this prospective randomized study, patients were randomized into two groups, one for single dose regimen, other for double dose regimen. WOMAC scores were evaluated pre-injection and post-injection period on first month, three months and sixth months. There is a correlation in Grade I and Grade II mean WOMAC scores. In Grade I, the mean WOMAC score of pain, stiffness and functionality is lower than the Grade II osteoarthritis knee joints. There was no control group in this study. The number of platelets used are more than 5 times the base line, as all the patients selected were having more than one lakh platelets, every patient got more than 5 lakh platelets per ml, which is prepared by double spinning of the sample for 5 minutes and 10 minutes with 3000 RPM (Rotations per minute) and leucofilters were not used.

Kon et al in 2011, used double spinning with more than 5 times the base line platelets activated with CaCl₂ and given more than three doses of injection with 2 weeks gap¹⁴.

Patel et al in 2013, used single spinning technique with leuco-filters. They have given two injections of PRP activated with CaCl₂ each 8 ml, with 3 weeks gap. Their platelet count is less than 5 times the base line^(2, 14).

In 2011, Filardo et al, used 5 ml PRP with 5 times the platelet count prepared from double spinning technique and activated with CaCl₂. They have infiltrated three injections of PRP with one week gap¹¹. In 2012, they compared the single versus double spinning and found no significant difference in the results. All the patients who have received the PRP have shown decrease in the pain, stiffness and functionality¹⁷.

Cerza et al in 2012 used 5ml of PRP not activated with CaCl₂, platelet count less than the 5 times the baseline with single spinning and without leuco- filters. They have infiltrated four injection with each one week gap. The idea of using CaCl₂ was, it activates the platelets¹⁵.

Spakova et al in 2012 did a similar study, PRP prepared after spinning it for three times and without using leuco-filters and they have used three injections with one week gap. They have stated that the leucocyte content did not seem to induce negative effects or to impair the potentially beneficial effects of PRP, even when used in joints. However, they cannot conclusively claim that increased white blood cells in PRP have positive effect on knee joint¹³. The preparation of PRP, number of platelets, amount of PRP infiltrated, and frequency of injections were not uniform. Different researchers have used different methods of preparation, different amount of PRP and at different time periods (table-2).

Table- 2: comparison of different studies of PRP in treating osteoarthritis of knee joints.

Study	Type of study	Sample size		No. of Injections	Time of injection in weeks	Volume of PRP in ml	Platelet concentration	WOMAC score improvement
		PRP	Control					
Vaquerizo et al ¹⁶ (2013)	PRP vs HA	60	60	3	0-2-4	8	<5×baseline	+
Patel et al ² (2013)	PRP vs Placebo	54	50	2	0-3	8	<5×baseline	+
Filardo et al ¹⁷ (2011)	PRP vs PRGF	54	55	3	0-1-2	5	5×baseline	VAS
Cerza et al ¹⁵ (2012)	PRP vs HA	60	60	4	0-1-2-3	5	>5×baseline	+

Spakova et al ¹³ (2012)	PRP vs HA	60	60	3	0-1-2	3	<5×baseline	+
Filardo ¹¹ et al (2012)	Single vs Double spinning	72	72	3	0-3-6	5	<5×baseline	VAS
Kon et al ¹⁴ (2011)	PRP vs HA	50	50	3	0-2-4	5	>5×baseline	VAS & IKDC
This study	PRP	200	NA	2	0-3	5	>5×baseline	+

VAS- Visual analogue score, IKDC – International Knee Documentation Committee

Thus we can conclude that the method of preparation of PRP; the platelet count to be achieved before infiltration; the usage of leucofilters; the number of injections for each knee joints; the duration between injections; all are varying and not standardized at present.

In this study, all the patients have shown decrease in the WOMAC score. Their mean pain, stiffness and functionality scores have decreased. The decrease in WOMAC score continued up to six months. The improvement in our patients could be explained by the fact that injected platelets might have acted at different levels and were stimulating the chondral anabolism or slowing the catabolic process.

As we have given a working classification to assess the results, in group A, 48 joints have shown excellent results, 41 joints have shown good results, 8 joints have shown fair results and 3 joints have shown poor results. In group B, 8 joints have shown excellent results, 58 joints have shown good results, 27 joints have shown fair results and 7 joints have shown poor results. Though the mean pain scores have decreased in all the patients, the efficacy has been varied from patient to patient. Results were poor in obese, patients doing heavy work. The results have shown better improvement in grade I osteoarthritis knee joints than grade II knee joints. In every patient, there is decrease in WOMAC score, but in no one it has reached '0'. **It means that PRP delays the osteoarthritic progression in the joints, but it has not cured osteoarthritis.** To evaluate its duration of action long term follow up studies are required.

Spakova et al. in 2012, in their study found statistically significant improvement in WOMAC score, VAS and pain relief when compared to viscoelastic supplementation¹³. Kon et al. in their study in 2011 had shown significant improvement in all parameters of the WOMAC score in the group of patients who were infiltrated with PRP up to 6 months follow up. But the condition of the patients were decreased from 6 months to 12 months follow up, i.e the effect of PRP decreasing from 6 months onwards. Some influencing factors were detected, in particular it was observed that young male patients were the best responding group, especially in case of simple chondropathy without signs of oateoarthritis¹⁸. In a later study evaluating the same patients at 24 months of follow up confirmed this trend with a further decrease in the clinical outcome, thus **concluding that intra articular therapy with PRP is time dependent with an average duration of 9 months and better and longer results are achieved in younger patients with lower levels of joint degeneration. They have also stated that PRP has no beneficial effect in advanced Osteoarthritis.**

IV. Conclusion

Osteoarthritis (OA) of the knee is one of the main causes of morbidity in elderly.

It is a process of destruction and repair.

Osteoarthritis is a common, debilitating disease with a large economic burden.

The mechanism and duration of action of PRP is still not understood completely which requires further studies.

We can safely conclude that Intraarticular Autologous PRP infiltration in early primary Osteoarthritis (Grade I and Grade II) of Ahlback's radiological grading gives relief from pain, stiffness and improves physical functionality without major side effects and can be used as modality of treatment.

The efficacy goes off early in those who continue to do heavy work on comparison to those with sedentary lifestyle.

There is significant difference between single dose and double dose regimen, we conclude that double dose offers additional advantage.

Immediate post infiltration, all patients have complained of severe pain. Four patients had effusion on the day of infiltration, but no systemic and long term complications noted.

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