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Does application of moderately concentrated platelet-rich plasma improve clinical and structural outcome after arthroscopic repair of medium-sized to large rotator cuff tear? A randomized controlled trial

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Background: Platelet-rich plasma (PRP) has the potential to improve tendon-bone healing. The evidence is still controversial as to whether PRP application after repair of medium-sized to large cuff tears leads to superior structural and clinical outcome, especially after single-row repair.

Methods: In a randomized study, 102 patients (PRP group, 52 patients; control group, 50 patients) with medium-sized and large degenerative posterosuperior tears were included for arthroscopic repair with a minimum follow-up of 2 years. Patients were evaluated with clinical scores (visual analog scale score, Constant-Murley score, University of California–Los Angeles score, and American Shoulder and Elbow Surgeons score) and ultrasound to assess retear and vascularity pattern of the cuff.

Results: Visual analog scale scores were significantly lower in the PRP group than in controls at 1 month, 3 months, and 6 months but not later. Constant-Murley scores were significantly better in the PRP group compared with controls at 12 and 24 months, whereas University of California–Los Angeles scores were significantly higher in the PRP group at 6 and 12 months ($P < .05$). The American Shoulder and Elbow Surgeons score in both groups was comparable at all the times. At 24 months, retear in the PRP group (n = 2; 3.8%) was significantly lower than in the control group (n = 10; 20%; $P = .01$). The retear difference was significant only for large tears (PRP:control group, 1:6; $P = .03$). Doppler ultrasound examination showed significant vascularity in the PRP group repair site at 3 months postoperatively ($P < .05$) and in peribursal tissue until 12 months.

Institutional Ethical Committee approval was provided by Kasturba Hospital, Manipal, India: IEC 325/2011.

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Conclusion: Application of moderately concentrated PRP improves clinical and structural outcome in large cuff tears. PRP also enhances vascularity around the repair site in the early phase.
Level of evidence: Level I; Randomized Controlled Trial; Treatment Study

Keywords: Rotator cuff; tear; degenerative; repair; platelet-rich plasma; healing; vascularity

The symptomatic torn cuff often requires surgical repair of the cuff onto the footprint to restore strength and movement and to relieve pain.[52] The major concern after repair of the rotator cuff tendon is in healing of the tendon-bone interface as retear rates vary from 25% to 90%.[20] In a recent systematic review comparing 32 studies, Hein et al concluded that retears at 1 year after the repair of small to massive cuff tears vary from 0% to 78% with use of the single-row, double-row, and suture bridge technique.[33] Currently, even with advanced techniques of cuff repair, the retear rate after cuff repair remains unacceptably high, especially in medium-sized to massive tears. One of the major factors contributing to retear is the degenerative nature of cuff tissue at the time of repair. Degenerative rotator cuff tear is a common problem encountered in an aging population, with prevalence ranging from 17% to 72%.[19,34,35,61] In comparison to traumatic tears, degenerative cuff tears are a result of poor vascularity,[7,52] tenocyte apoptosis,[65] inflammatory mediators altering gene expression,[55] and decrease in procollagen alpha 1 in tendon margins,[31] leading to poor quality of tissue. This poor quality of cuff tissue compromises healing onto the footprint after repair. Furthermore, the poor tissue quality of degenerative tendon succumbs to mechanical stress, leading to retear. Also, a layer of scar tissue is formed between the tendon and the bone that further prohibits proper blood flow, as new capillaries cannot penetrate through the scar tissue to provide blood flow to the injured area.[13,50]

Biologic factors like platelet-rich plasma (PRP) contain high platelet concentrations, which on activation release a series of growth factors like transforming growth factor β, fibroblast growth factor, platelet-derived growth factor, vascular endothelial growth factor, connective tissue growth factors, and epidermal growth factors that participate in the tissue repair process.[1] These growth factors induce mitosis, extracellular matrix production, neovascularization, cell maturation, and differentiation.[24,54] Platelets also induce neoangiogenesis through vascular endothelial growth factor, thus promoting a better healing response in a repaired tissue. This forms a strong basis for the use of PRP to enhance the healing potential of the tendon to the bone. Several authors have described the favorable role of PRP in the superior postoperative healing of rotator cuff repair and better functional outcome,[3,30,37,38,49] whereas a few have found no such beneficial effect.[8,51,53,58] Hence, the role of PRP remains debatable in the healing of cuff onto the footprint. The variable effect of PRP on the healing of cuff in different studies can be attributed to various factors, such as size and type (traumatic or degenerative) of cuff tear, concentration of PRP application, and repair technique used (single-row or double-row or suture bridge technique) in the study. This investigation was undertaken to assess the role of application of institutionally prepared, moderately concentrated PRP in the clinical outcome and structural healing of medium-sized to large degenerative cuff tear with arthroscopic single-row repair.

Materials and methods

Study design

This was a randomized controlled trial (RCT) in which the patient, assessor surgeon, and radiologist were unaware of the intervention.

Patient inclusion and exclusion

The principal criterion for inclusion was the presence of ultrasonographically and arthroscopically confirmed nontraumatic medium-sized or large posterosuperior cuff tear that required operative intervention because of persistent symptoms of pain and difficulty in elevation of the affected shoulder. Further inclusion and exclusion criteria are listed in Table I. The power analysis suggested a minimum of 94 patients (47 in each group) to have power >80% and $P < .05$, taking data attrition into account. A total of 186 patients were screened for eligibility; 110 patients were found to be eligible for the study and were randomized, of which 102 (PRP group, 52 patients; control group, 50 patients) completed clinical and radiologic follow-up of a minimum of 2 years. Eight patients (4 from each group) were lost to follow-up or declined to come for final follow-up (Fig. 1).

Preparation of PRP

All patients who were to undergo arthroscopic cuff repair were admitted a day before the surgery. Each patient, irrespective of the later allocation group (PRP or control), was sent to the hospital blood bank in the evening for blood donation and PRP preparation. About 50 mL of venous blood was drawn from the antecubital vein and collected in a Terumo Penpol bag (Thiruvanathpuram, Kerala, India; Terumo Corp, Japan) containing citrate phosphate dextrose (CPD). CPD was added to blood in a ratio of 1:7 (1 mL of CPD to 7 mL of blood) to inhibit the clotting cascade and to prevent platelet activation.[9] The blood was subjected to a single-spin centrifugation technique of PRP preparation using the Heraeus Cryofuge 6000i centrifuge (Thermo Scientific, Waltham, MA, USA) for 12 minutes at 1500 rpm (*g* force of 75). Around 10 mL of PRP was thus formed. PRP was separated out with a manual plasma expressor device into another Terumo Penpol bag. The bag was mildly agitated and stored at room temperature (20°C-24°C) before being requested for use the next day during surgery. Storage for a day does not lead to a reduction in platelet number or platelet activation or reduction of a