

Platelet-rich plasma therapy or arthroscopic surgery on repair of anterior cruciate ligament rupture

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Abstract

The Anterior Cruciate Ligament (ACL) rupture reduces knee stability. In old patients with ACL rupture, surgery is not recommended due to the person's low level of activity and knee osteoarthritis. Platelet-rich plasma (PRP) is a good treatment option in inflammatory cases in orthopedics. Hence, the aim of this study was to assess and compare the effect of PRP and arthroscopic surgery on anterior cruciate ligament rupture. This is a clinical trial that was performed in 2020-2021 in Tehran. 100 patients were randomly divided into two groups. The first group of patients underwent ACL tendon repair surgery by arthroscopy and tendon graft. The second group were treated by PRP injection. Both groups of patients were visited from 3 months to 14 months after surgery or PRP treatments. The pain was assessed by Visual Analogue Scale (VAS), we also used Knee Score by the Oxford Score Knee Outcome Scale (OKS) to assess patient's functions. The mean VAS score was 3.05 ± 2.47 in patients in surgery group and mean VAS score was 4.39 ± 2.66 in patients in the PRP group ($p = 0.03$). These data showed significant improvements in VAS score in both groups with higher improvements in surgical group. After procedures, the ROM was $120.33 \pm 19.60^\circ$ in surgery group and $109.31 \pm 17.22^\circ$ in PRP group ($p = 0.03$). Patients in both groups had significantly decreased pain severity after 14 months, but the patients in the surgical treatment group had significantly lower pain and higher ROM compared to PRP group.

Key Words: Anterior cruciate ligament; rupture and repair; platelet-rich plasma; surgery.

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The Anterior Cruciate Ligament (ACL) is an extrasynovial element and fibroblasts are involved in its renewal and ongoing maintenance.¹ This ligament is also involved in preventing excessive rotation or rotation of the tibia and angulation in both directions of varus and valgus.² ACL rupture is considered as a common complication due to exercise and one of the most common reasons for the need for knee treatment in young people.^{3,4} ACL rupture reduces knee stability. It can also cause problems with a patient's athletic performance, increase the risk of subsequent meniscus injuries, and increase the risk of premature knee joint degeneration.⁵⁻⁷ In general, the treatment of anterior cruciate ligament ACL is either non-surgical or surgical. Physiotherapy is effective in both non-surgical and surgical methods (sometimes even before surgery) to accelerate and increase the quality of the treatment process.⁸ The most

important goals of physiotherapy are: reducing pain, inflammation and swelling, increasing joint range of motion, strengthening muscles according to the degree of injury, training deep sense exercises, training closed chain exercises, increasing balance and function, faster return to daily activities or professional sport.⁹⁻¹¹ In old patients with ACL rupture, surgery is not recommended due to the person's low level of activity and knee osteoarthritis. But surgery is usually recommended if a young, active person, or especially a professional athlete, has a complete rupture.^{12,13} In patients who, in addition to the anterior cruciate ligament, also develop an internal lateral ligament rupture (MCL) (which is also very common), the time of ACL surgery is usually delayed to prevent artherofibrosis.^{14,15} Management of complete ruptures are performed in two surgical ways: i) by repair, but it is usually not successful and does not bring good results; ii) by reconstruction method that can be done in

two ways, namely by intra-articular or extra-articular reconstruction. In ligament reconstruction, another tissue is used (for example, the patella tendon or the tendon of the muscles behind the thigh).¹⁶ The reconstruction method has usually better results. The main purpose of ACL reconstruction is to stabilize the knee. To achieve this goal and minimize the complications of tendon resection, researchers have used many methods so far.¹⁷ Different methods with different sources such as autograft, allograft and artificial grafts have been used for ACL reconstruction.¹⁸ Currently, autologous patellar tendon grafts, toxic tendon tendons, and gracilis tendons are the most common grafts used to reconstruct the ACL through the joint, but any of the above methods is associated with side effects.¹⁹ Platelet-rich plasma (PRP) is a good treatment option in orthopedics inflammatory cases. PRP is part of autologous own plasma containing high platelet concentrations (relative to baseline) and various growth factors involved in biosynthetic pathways.²⁰ By injecting concentrated PRP into the target area, it is possible that different growth factors initiate regenerative processes in acute injury conditions.²¹ Despite the abundance of articles on ACL reconstruction in different ways and their consequences, there is no consensus on which method or graft is superior to the others, and there is much debate as to which of the two links is superior to the other. Studies have shown that PRP treatment can be an alternative to surgery and improve patient performance and disability.^{21,22} Hence, the aim of this study was to assess and compare the PRP and arthroscopic surgery on anterior cruciate ligament rupture.

Materials and Methods

Study Design

This clinical trial was performed in 2020-2021 in military hospitals affiliated to AJA University of Medical Sciences in Tehran. The current study was conducted on military personals with ACL rupture. The study protocol was approved by the Research Committee of AJA University of Medical Sciences and the Ethics committee (Ethics code: IR.AJAUMS.REC.1399.258, Iranian Registry of Clinical Trials (IRCT) code: IRCT20200217046523N18).

The inclusion criteria were age more than 18 years, diagnosis of ACL rupture by orthopedics after to clinical examination and MRI findings; signing the written informed consent to participate in this study. The exclusion criteria were previous rupture or injury of the ACL of knee joint at similar side, major hematologic diseases and patient will to exit the study.

Sample size

According to the following sample size calculation formula at least 50 people were enrolled in each group:

$$n = \frac{Z^2_1 - a / 2 \times P(1 - P)}{d^2}$$

Z, the 95% confidence interval, is 1.96.

P is the relative estimate of each of the clinical signs, which we consider 0.5 due to its variety to obtain the maximum number of samples.

d is the degree of accuracy that is assumed to be 0.1.

Study design

Patients were randomly divided into the two groups. The first group of patients underwent ACL tendon repair surgery by arthroscopy and tendon graft. The second group were treated by PRP injection. PRP treatment involved taking 40 cc of venous blood plasma from patients that were centrifuged and the pellet of platelets was collected. After disinfecting the injection site, PRPs were injected into the affected joint.

Both groups of patients were visited from 3 months to 14 months after surgery or PRP treatments. Patients were contacted by phone for evaluation at the clinics of military Hospitals or a home visit was made for necessary evaluations and visits. The data collection method included a pre-prepared checklist designed by the project manager. This questionnaire included the type of rupture in full or partial as well as the presence of simultaneous rupture such as internal or external meniscus ruptures, and the presence of cartilaginous lesions. In addition, the pain was assessed by Visual Analogue Scale (VAS), which is a visual criterion for determining the amount of pain in patients, is determined and is given a score from 0 to 10. We also used Knee Score by the Oxford Score Knee Outcome Scale (OKS) to assess patient's functions. OKS is a concise measuring tool to measures the amount of pain and physical activity associated with the knee. This scale was first developed and validated to evaluate the outcome of hip and knee replacement.²² The instrument consists of 12 questions, each of which scores between zero and four.²² A score of zero means the worst situation and a score of four means no problem.²³ Findings from clinical tests such as the Lockman test for laxity, positive anterior and posterior drawer tests were also collected, and knee range of motion (ROM) was reviewed. After completing the questionnaire, the information of this study was compared between the two groups to determine the importance of these therapies in patients.

Statistical analysis

The obtained data were entered into the Statistical Package for Social Sciences (SPSS) (version 24, SPSS Inc., Chicago, IL). Quantitative data were reported as mean± standard deviation and qualitative data as frequency distribution (percentage). Independent t-test, Chi-square were used to analyze the data. The significance threshold was considered as p-value < 0.05.

Results

In the present study, 110 patients with ACL tear were assessed for eligibility. Four patients were excluded due to lack of consent. 106 patients were randomized into 2 groups each containing 53 patients. During the study, 8

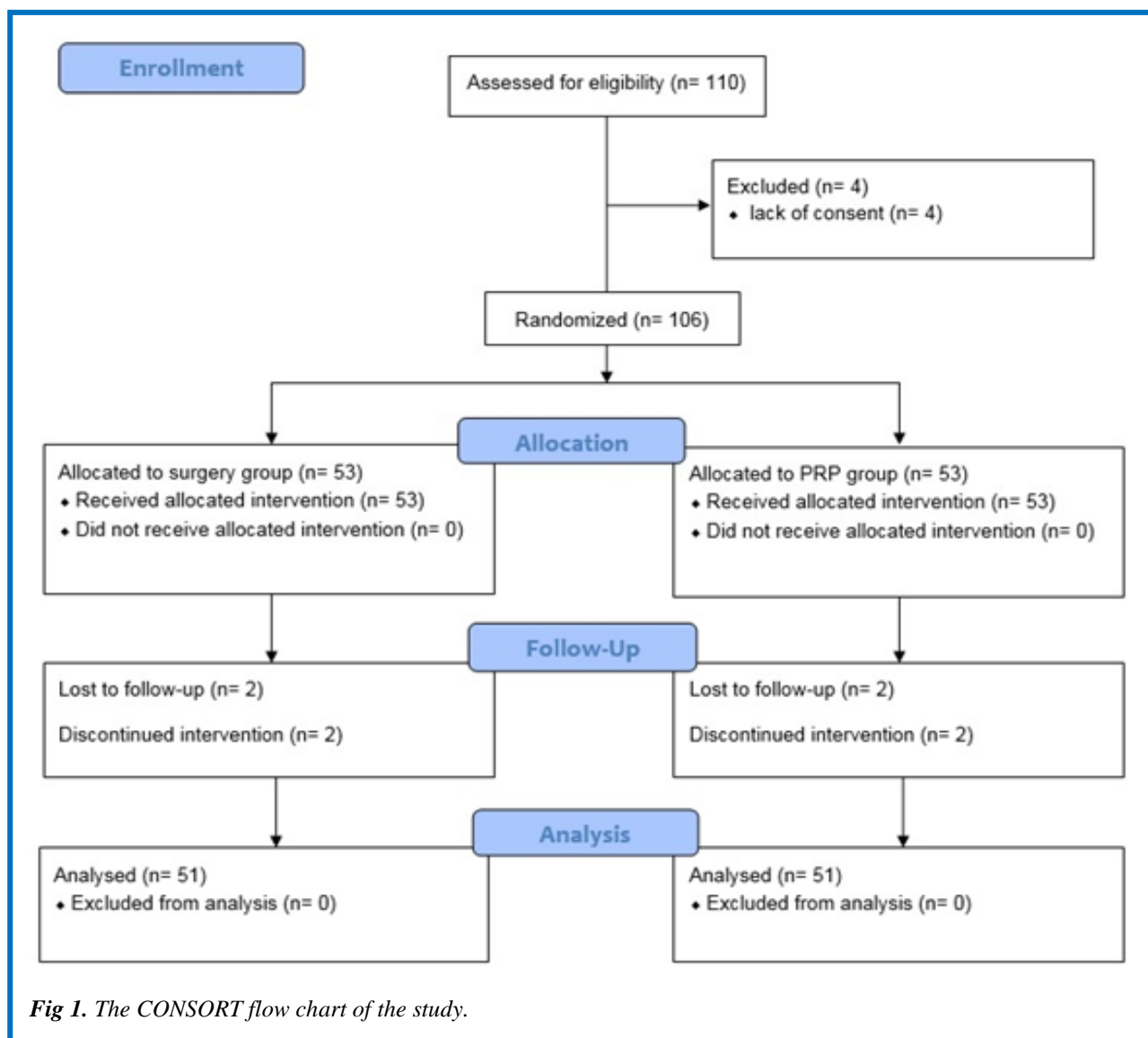


Fig 1. The CONSORT flow chart of the study.

patients were excluded due to lack of proper follow-up and cooperation. At the end, data of 98 patients were analyzed. The CONSORT flow chart of the study is shown in Figure 1.

Evaluation of demographic data showed that the study population consisted of 98 males with the mean age of 32.26 ± 3.69 years. The mean follow-up time of patients was 10.26 ± 2.11 months. Evaluation of MRI findings showed that all cases (100%) had complete ACL tear. We evaluated data regarding pain severity, oxford Knee Score (OKS) scores and ROM in patients before interventions showed mean pain severity of 7.22 ± 3.18 and 7.39 ± 2.95 in surgery and PRP groups respectively ($p = 0.87$).

By the time of visits after interventions, these data showed that the mean VAS score was 3.05 ± 2.47 in patients in surgery group and mean VAS score was 4.39 ± 2.66 in patients in the PRP group ($p = 0.03$). These data showed significant improvements in VAS score in both groups with higher improvements in surgical group. The

OKS score before procedures was 15.28 ± 4.33 and 16.07 ± 2.69 in surgery and PRP groups respectively ($p = 0.42$). After procedures, the OKS score of surgery group was 40.31 ± 5.12 and the scores in the PRP group was 39.22 ± 6.18 ($p = 0.622$). These data showed significant improvements in both groups but no significant differences between two groups. We also assessed the ROM of cases. Before procedures, the ROM was $85.20 \pm 14.08^\circ$ in surgery group and $86.22 \pm 11.91^\circ$ in PRP group ($p = 0.333$). After procedures, the ROM was $120.33 \pm 19.60^\circ$ in surgery group and $109.31 \pm 17.22^\circ$ in PRP group ($p = 0.03$). We assessed the posterior tibial slope in the lateral plateau in patients before surgeries.

These measurements were $7.62^\circ \pm 2.17$ in the patients undergoing PRP injections and $7.93^\circ \pm 1.93$ in patients undergoing surgical procedures. There were no significant differences between two groups ($p = 0.68$). Further evaluations of data based on age groups were performed. These data revealed that in patients aged 25 to 32 years, there were no significant differences between

PRP and surgical methods regarding pain, ROM and knee score ($p > 0.05$ respectively). On the other hand, among patients aged 25 to 32 years, PRP injections led to a slightly better pain improvements compared to surgical group (3.95 ± 1.02 vs. 4.18 ± 1.11 respectively, $p = 0.04$) but none of the other variables were different among them ($p > 0.05$).

Discussion

There have been some previous studies on the use of surgical reconstruction or PRP injections in ACL rupture. Andriolo et al. (2015)²⁴ conducted a review study on 32 previous researches on the use of PRP in ACL rupture. Based on their data, PRP augmentation did not provide superior functional results at short term evaluation compared to surgical interventions.²⁴ Our data are in line with those findings.

In another study Figueroa et al. (2015)²⁰ performed a systematic review of the literature on 516 patients that underwent ACL repair using surgical repair and PRP injections. Based on the comparison of two groups, they stated that there was promising evidence that the addition of PRP could be a synergic factor in acquiring maturity more quickly than grafts with no PRP,²⁰ but the clinical implication of this remaining unclear. Regarding tunnel healing, it appeared that there was not an improvement with the addition of PRP. There was no proof that clinical outcomes of ACL surgery were enhanced by the use of PRP.²⁰

Similar study was conducted by Everhart and colleagues (2019)²² on 550 patients. They showed that RP preparations used in the current study had a substantial protective effect in terms of the risk of isolated meniscal repair failure over 3 years. In the setting of concomitant ACL reconstruction, PRP does not reduce the risk of meniscal repair failure.²² Our findings are in line with all those results showing the effectiveness of PRP injection and ACL reconstruction surgery, but with priority of surgical reconstruction. Davey and colleagues (2020)²³ evaluated the use of PRP in ACL reconstruction, assessing data of 13 clinical trials and showed that the current level I evidence does not support the use of PRP to improve graft healing, improve donor-site morbidity, reduce postoperative pain levels, or improve functional outcomes following ACL reconstruction.²³

In contrast, here we observed significantly improved pain, knee score and ROM in patients that received PRP. In addition, we observed significantly higher efficacy of surgical ACL repair in those patients. These differences could be due to variations in the study population and characteristics. We believe that further studies on larger population are needed. Indeed the main limitations of this study were restricted study population and not combining two treatment methods in a third group of patients.

Here by assessing 98 patients with ACL tear, we showed that both PRP injection or ACL reconstruction surgery had beneficial results. Based on our data, patients in both groups had significantly decreased pain severity after 10

months after surgeries. In addition, they had significantly improved OKS score and ROM. However, we also observed that patients in the surgical treatment group had significantly lower pain and higher ROM compared to PRP group.

Thus, based on our data, surgical reconstructions are associated with better results and are highly recommended, while injection of PRP could also improve patient's pain and knee functions. Therefore, according to previous studies and protocols, younger patients with higher physical activities are better candidates for surgical ACL repair, while older patients with ACL rupture could benefit more from PRP injections.

In conclusion, patients in both group had significantly decreased pain severity after 14 months after treatments. In addition, they had significantly improved OKS score and ROM. However, patients in the surgical reconstruction group had significantly lower pain and higher ROM compared to PRP group.

List of acronyms

ACL - anterior cruciate ligament
AJA - The Islamic Republic of Iran Army
CONSORT - Consolidated Standards of Reporting Trials
MCL - medial collateral ligament
OKS - Oxford Score Knee Outcome Scale
PRP - platelet-rich plasma
ROM - Range of motion
SPSS - Statistical Package for Social Sciences
VAS - Visual Analogue Scale

Contributions of Authors

SE contributed in the conception of the work, conducting the study, revising the draft. SF contributed in analysis, or interpretation of data, drafting the work and revising it critically for important intellectual content. SAT contributed in draft and critical revision for important intellectual content. ZR contributed substantially to the conception, design and drafting the work.

All authors have read and approved the final edited typescript.

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Conflict of Interest

The authors declare no conflict of interests.

Ethical Publication Statement

We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

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