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Cast immobilization and addition of platelet rich plasma in intraarticular distal radius fracture resulting a better functional outcome to the internal fixation and radius union scorings system



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ABSTRACT

Introduction: Intra-articular distal radius fracture is one of the most frequent injuries, especially in adults (20%). In this condition, anatomic reduction is required to reduce the possibility of complications, either with internal plate screw fixation (ORIF-PS) or conservatives such as the use of *casting*. Giving Platelet Rich Plasma (PRP) as one of the biologic agents to conservative management is expected to improve the outcome and become a promising alternative therapy.

Methods: This study was an experimental study with a post-test control only group design on patients with intra-articular radius fractures at Sanglah General Hospital Denpasar during the period September 2019 to March 2020. The samples were selected by random sampling. Evaluation of the functional outcomes of the therapy given through DASH and RUSS scores was

evaluated twice, namely at week 6 and week 12 post-therapy. Descriptive data analysis, General Linear Model (GLM) test and post hoc test were also carried out.

Results: There were 45 patients divided into 3 groups; the first group of a plaster cast therapy and PRP injection, the second group of only plaster cast and the third group of ORIF. The first group showed better in DASH scores than the second group but not better than the third group, both at week 6 and 12. The results of the GLM and post hoc analysis also showed that the first group showed better RUSS scores than the second group.

Conclusion: The addition of PRP has a better result than conservative therapy without PRP but ORIF still was the best therapy.

Keywords: Cast, intra-articular, ORIF, PRP, radius fracture.

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INTRODUCTION

Distal radius fractures are one of the most common injuries encountered in orthopedic practice, accounting for 8%-15% of all bone injuries in adults. Fractures of the distal radius involving the intra-articular space pose challenges in their management. Therapy for this type of fracture serves to restore wrist function and prevent post-traumatic osteoarthritis, which is one of the most common complications. The articular surfaces should be reduced as anatomically as possible so that the surfaces are congruent, then stably fixed to restore wrist stability.¹⁻³

As with all intra-articular fractures,

complete reduction is required so that joint function is not compromised.³ Reduction must also be maintained while the healing process is not perfect, this can be done by immobilization methods, external fixation, or internal fixation. If the reduction can be maintained during the healing process, this will have an impact on the therapeutic outcome of this type of fracture, which can be assessed from the Disabilities of the Arm, Shoulder, and Hand (DASH) scoring system.⁴

Reduction therapy can be done by conservative methods or operative methods. Type I and type IIA fractures according to the Melone classification

can be managed conservatively. Fractures should be observed closely to look for displacement. Although immobilization in casts has been widely applied, questions remain about the optimal position, duration of immobilization and the need to extend the cast proximal to the elbow. There is no clear consensus on the best position for wrist immobilization in plaster. Sarmiento et al. suggested immobilization in the supine position to reduce the force of the brachioradialis deformation, which can lead to loss of reduction. In contrast, Wahlstrom recommends immobilization in pronation because he claims that the pronator quadratus causes the deforming

force that accounts for the most loss of reduction.³

For the operative method, internal fixation can be performed which is the main treatment for intraarticular fractures of the distal radius to achieve anatomical reduction as possible. So far, internal fixation is the main treatment for intraarticular fractures of the distal radius to achieve an anatomical reduction as possible. This anatomical reduction is difficult to achieve with the use of immobilization with a cast so that it can lead to unacceptable reduction conditions, for example, a shortening of the radius by more than 3 mm from the contralateral wrist, changes in the volar (palmar) tilt of > 10 degrees, step off more than 2 mm, and radial inclination (change in radial angle) of more than 5 degrees (unacceptable fracture reduction). Operative methods with open reduction and internal fixation can be performed on the two fracture groups. The first group includes two-part shear fractures (Barton fractures). The second group includes complex intra-articular fractures in which the articular fragments are displaced or rotated.^{3,5}

Accelerating the healing process of distal radius fractures is known to indirectly improve therapeutic outcomes. Treatment outcomes can be assessed by the Disabilities of the Arm, Shoulder, and Hand (DASH) and Radius Union Scoring System (RUSS) scores. The DASH score is a scoring system to measure symptoms and disabilities related to disorders of the upper extremities in general, which includes the function of the shoulder, wrist, and elbow joints so that it does not require a separate questionnaire to assess the function of each joint. Meanwhile, the RUSS score is another scoring system that is also used to assess the outcome of therapy, where this scoring system assesses the radiographic outcome in patients with distal radius fractures. The RUSS score is a radiological assessment of radius bone healing obtained via wrist X-ray in the antero-posterior and lateral positions after the procedure and is calculated based on the four sides of the cortex seen in the two projections.⁶

One effort to accelerate the fracture healing process is to use platelet-rich plasma (PRP) which is applied to the

fracture gap just before closing the surgical wound. It is an autologous blood product with a high concentration of active platelets (about 1 million per microliter) containing a large number of growth factors that play a role in the repair and formation of granulation tissue in the human body. It has been used successfully in the treatment of musculoskeletal injuries and several studies have investigated the role of PRP application as the treatment of non-union fractures with promising results. Another advantage of using PRP is that it is relatively affordable, easier to get, and very rarely causes side effects in previous clinical studies.⁷⁻¹¹

Given the high incidence of fractures of the distal radius and their complications and considering the potential of PRP in the management of intra-articular fractures of the distal radius, the authors suggest the urge for further studies. This study aims the potential benefits of giving PRP as a complementary agent to conservative therapy and its effect on functional outcomes measured by DASH and RUSS scores, and the degree of callus formation in the management of intra-articular distal radius fractures comparing to the conventional therapy of open reduction internal plate screw fixation (ORIF-PS) therapy.

METHODS

This study was an experimental study using experimental post-test control only group design. This study was conducted

on patients with intra-articular radius fractures diagnosed at the Emergency Room and Orthopedic Polyclinic Sanglah General Hospital Denpasar during the period September 2019 to March 2020. Inclusion criteria were patients with intra-articular radius fractures who have decided to undergo conservative or operative therapy, age 18-50 years and met ASA 1 or 2 criteria, whereas the exclusion criteria in this study included a history of joint inflammation due to inflammation, autoimmune or inflammatory systemic disease, cancer, or other chronic diseases as well as unacceptable fracture reduction conditions. Sampling was done by using a simple random sampling method. The total samples of 45 were categorized in three groups, namely the first group of intra-articular radius fracture patients receiving conservative therapy (casting) and PRP injections, the second group receiving cast therapy without PRP and the third group receiving surgery of ORIF. This study consisted of independent variables in the form of conservative therapy with PRP injection, conservative therapy without PRP injection, and ORIF therapy. In addition, therapy outcomes assessed by the DASH Questionnaire and the RUSS form will be the dependent variable. This study has obtained ethics approval from the Ethics Committee of Universitas Udayana/Sanglah General Hospital prior to the study conducted.

Data analysis included descriptive, GLM, and post hoc analysis. GLM and post

Table 1. Characteristics distribution of research subjects in each group

Variable	Groups			Total
	Cast with PRP	Cast without PRP	ORIF	
Gender (n (%))				
Male	10 (22.2%)	6 (13.3%)	7 (15.6%)	23 (51.1%)
Female	5 (11.1%)	9 (20.0%)	8 (17.8%)	22 (48.9%)
Age(years) (mean ± SD)	50 ± 16.4	40 ± 17.9	39.9 ± 18.0	43.3 ± 17.7
Involvement site (n (%))				
Right	7 (15.6%)	9 (20.0%)	4 (8.9%)	20 (44.4%)
Left	8 (17.8%)	6 (13.3%)	11 (24.4%)	25 (55.6%)
DASH Score (mean ± SD)				
6 th week	34.9 ± 1.7	37.6 ± 3.4	31.3 ± 4.6	34.6 ± 4.3
12 th week	32.1 ± 2.6	36.1 ± 2.9	26.4 ± 4.4	31.5 ± 5.2
RUSS Score (mean ± SD)				
6 th week	4.8 ± 0.8	2.7 ± 0.9	-	3.8 ± 1.7
12 th week	6.3 ± 0.8	3.5 ± 1.2	-	4.9 ± 1.7

Table 2. General linear model test for DASH scores

Variable	Group	N	Mean ± SD	p
6 th week DASH Score	Cast with PRP	15	34.9 ± 1.7	0.000
	Cast without PRP	15	37.6 ± 3.4	
	ORIF	15	31.3 ± 4.6	
12 th week DASH Score	Cast with PRP	15	32.1 ± 2.6	0.000
	Cast without PRP	15	36.1 ± 2.9	
	ORIF	15	26.4 ± 4.4	

Table 3. Tamhane's T2 post hoc test

Procedure comparison		Mean difference	p	CI 95%
Cast with PRP	Cast without PRP	-3.37	0.01	-5.43 – (-1.30)
	ORIF	4.60	0.04	1.39 – 7.81
Cast without PRP	Cast with PRP	3.37	0.01	1.30 – 5.43
	ORIF	7.97	0.00	4.47 – 11.46
ORIF	Cast with PRP	-4.60	0.04	-7.81 – (-1.39)
	Cast without PRP	-7.97	0.00	-11.46 – (-4.47)

Table 4. General linear model test for RUSS scores

Variable	Group	N	Mean±SD	p
6 th week RUSS Score	Cast with PRP	15	4.80 ± 0.78	0.000
	Cast without PRP	15	2.73 ± 0.96	
12 th week RUSS Score	Cast with PRP	15	6.33 ± 0.82	0.000
	Cast without PRP	15	3.53 ± 1.19	

Table 5. Bonferroni post hoc test for RUSS scores

Procedure comparison		Mean difference	p	CI 95%
Cast with PRP	vs Cast without PRP	2.43	0.00	1.775 – 3.091

hoc analysis were conducted to determine the difference in the mean DASH scores on 2 measurements between the three groups and to determine the difference in the mean RUSS scores on 2 measurements between the first and second groups with a significance level of = 0.05.

RESULTS

Characteristics of Research Subjects

During the period September 2019 to March 2020 there were 45 patients with fractures of the distal intra-articular radius diagnosed at the Emergency Room and Orthopedic Polyclinic, Sanglah General Hospital Denpasar, which were further divided into three groups. Descriptive analysis and inferential analysis were carried out on the collected data, as seen in Table 1.

Post-Therapy Comparison of DASH Scores

The inferential statistical test used in this study is the General Linear Model (GLM) test which can be seen in Table 2. The assessment of test results uses 95% CI and p-value at the limit of significance of 0.05.

Tamhane's T2 post-hoc analysis was also carried out to see the comparison in each group is in Table 3. It was found in the post-hoc test that the DASH scores at the 6th and 12th weeks were significantly different with $p < 0.05$.

Post-Therapy Comparison of RUSS Scores

GLM statistical test was performed which can be seen in Table 4 using 95% CI and p value at the limit of significance of 0.05.

Bonferroni's post-hoc analysis was also carried out to see comparisons in each

group contained in Table 5. In the post-hoc test there were significant differences in the 6th and 12th week RUSS scores between the first and second groups ($p = 0.00$).

DISCUSSION

From 45 research subjects, it was found that the proportion of male (51.1%) and female (48.9%) research subjects was nearly equal. The mean age of patients with fractures of the distal radius was 43.3 years. It was said that the incidence of fractures of the distal radius increases with age because of the correlation with osteopenia and is more common in women.^{12,13} In this study, it was also found that there was a significant difference between DASH scores in the first, second and third groups both at week 6 and week 12 after the procedure. The results of the analysis with GLM showed that the first group showed significantly lower DASH scores (which means better upper extremity functional scores) than the second group, but still higher than the DASH scores in the third group, both at week 6 and the 12th.

The results of this study were in line with previous studies. The increased functional outcome of a distal radius fracture managed conservatively and receiving PRP may be associated with a reduction in the degree of pain. The study conducted by Namazi et al showed that PRP had a significant effect in reducing pain and various functional limitations in fractures of the distal radius.¹⁴ This improvement in function due to PRP is probably related to the biologic and immunomodulatory functions of PRP. PRP contains high levels of IL-1 receptor antagonist, effectively inhibiting IL-1 (proinflammatory agent). In addition, PRP contains high hepatocyte growth factor (HGF), which also decreases the production of COX-1, COX-2, PGE2 (agents that play a role in influencing pain) through interference with the NF- κ b signaling transcription factor.^{2,13,14} As well as the function to perform specific and usual activities, the administration of PRP resulted in a significant positive effect. This is most likely related to reduced inflammation and pain after PRP administration so that patients feel more comfortable in carrying out activities.^{2,13} In addition, the significant regulatory

role of growth factors in cell migration, proliferation, differentiation, and maturation as well as matrix production and remodeling can effectively influence bone healing.¹⁴

This study also found a significant difference between the RUSS scores in the first group and the second group, both at week 6 and week 12 after the procedure. The results of the GLM analysis showed that the first group showed significantly higher RUSS scores (which means a better degree of fracture union and callus formation) than the second group, both at 6 and 12 weeks. These results were in line with those of Namazi et al. who showed that plasma-rich plasma (PRP) has been widely used to improve fracture union.¹⁴ PRP modulates inflammation and angiogenesis primarily due to its ability to produce high levels of growth factors and chemokines, considered a tool to promote bone repair. In orthopedics, PRP is administered by injection at the fracture site for the treatment of *delayed union* or *non-union*. A possible explanation for the effect of PRP is associated with its angiogenic effect.¹⁴ Despite its promising potential, it must be acknowledged that the use of PRP in bone healing is still lacking. Studies on the effect of PRP on bone healing are not all positive, mixed results are reported.^{9,15}

This study has several limitations, one of which was the low sample size. Thus, it was hoped that in the future similar studies can be carried out with a larger sample size. In addition, in the future it was hoped that studies with longer follow-up times can be carried out, considering that some parameters of wrist fracture measurement results can continue to change up to and after 1 year after injury.

CONCLUSION

There was a significant difference in the treatment outcomes of conservative methods with the addition of PRP

based on DASH and RUSS scores. But conservative therapy with the addition of PRP is still not able to give better results than operative therapy.

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CONFLICT OF INTEREST

We declare that there were no conflicts of interest in this study.

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AUTHOR CONTRIBUTION

All of the authors have equally contributed to the study.

REFERENCES

- Mulders MAM, Walenkamp MMJ, Goslings JC, Schep NWL. Internal plate fixation versus plaster in displaced complete articular distal radius fractures, a randomised controlled trial. *BMC Musculoskelet Disord*. 2016;17(1):68.
- Zhang P, Jia B, Chen X-K, Wang Y, Huang W, Wang T-B. Effects of surgical and nonoperative treatment on wrist function of patients with distal radius fracture. *Chinese J Traumatol Zhonghua Chuang Shang Za Zhi*. 2018;21(1):30–3.
- Meena S, Sharma P, Sambharia AK, Dawar A. Fractures of distal radius: an overview. *J Fam Med Prim care*. 2014;3(4):325–32.
- Souer J-S, Lozano-Calderon SA, Ring D. Predictors of wrist function and health status after operative treatment of fractures of the distal radius. *J Hand Surg Am*. 2008;33(2):157–63.
- Kodama N, Takemura Y, Ueba H, Imai S, Matsue Y. Acceptable parameters for alignment of distal radius fracture with conservative treatment in elderly patients. *J Orthop Sci Off J Japanese Orthop Assoc*. 2014;19(2):292–7.
- MacIntyre NJ, Dewan N. Epidemiology of distal radius fractures and factors predicting risk and prognosis. *J Hand Ther Off J Am Soc Hand Ther*. 2016;29(2):136–45.
- Wei L-C, Lei G-H, Sheng P, Gao S-G, Xu M, Jiang W, et al. Efficacy of platelet-rich plasma combined with allograft bone in the management of displaced intra-articular calcaneal fractures: a prospective cohort study. *J Orthop Res Off Publ Orthop Res Soc*. 2012;30(10):1570–6.
- Simman R, Hoffmann A, Bohinc R, Peterson W, Russ A. Role of Platelet-Rich Plasma in Acceleration of Bone Fracture Healing. *Ann Plast Surg*. 2008;61:337–44.
- Kanthan SR, Kavitha G, Addi S, Choon DSK, Kamarul T. Platelet-rich plasma (PRP) enhances bone healing in non-united critical-sized defects: a preliminary study involving rabbit models. *Injury*. 2011;42(8):782–9.
- Ghaffarparand F, Shahrezaei M, Dehghankhalili M. Effects of Platelet Rich Plasma on Healing Rate of Long Bone Non-union Fractures: A Randomized Double-Blind Placebo Controlled Clinical Trial. *Bull Emerg trauma*. 2016;4(3):134–40.
- Gandhi A, Doumas C, O'Connor JP, Parsons JR, Lin SS. The effects of local platelet rich plasma delivery on diabetic fracture healing. *Bone*. 2006;38(4):540–6.
- EA P. Fractures of the Shoulder, Arm, and Forearm. In: *Campbell's Operative Orthopaedics*. 2013.
- Li W-W, Sabsovich I, Guo T-Z, Zhao R, Kingery WS, Clark DJ. The role of enhanced cutaneous IL-1beta signaling in a rat tibia fracture model of complex regional pain syndrome. *Pain*. 2009;144(3):303–13.
- Namazi H, Mehbudi A. Investigating the effect of intra-articular PRP injection on pain and function improvement in patients with distal radius fracture. *Orthop Traumatol Surg Res*. 2016;102(1):47–52.
- Aghaloo TL, Moy PK, Freymiller EG. Evaluation of platelet-rich plasma in combination with freeze-dried bone in the rabbit cranium. A pilot study. *Clin Oral Implants Res*. 2005;16(2):250–7.



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