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Comparison of ultrasound-guided platelet rich plasma, prolotherapy, and corticosteroid injections in rotator cuff lesions

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Abstract.
BACKGROUND: Injections is a good alternative to conventional treatment-resistant cases with rotator cuff (RC) lesions before operation. Currently, different injection methods are used in RC lesions.
OBJECTIVE: To evaluate the efficacy of different injection methods (platelet-rich plasma [PRP], corticosteroid [COR] and prolotherapy [PRO]) in RC tendon lesions.
METHODS: One hundred and twenty-nine patients were divided into 4 groups as PRP, COR, PRO and the lidocaine group. Subacromial injection was applied to all groups. They were evaluated using the Visual Analogue Scale (VAS), American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES), and Western Ontario Rotator Cuff Index (WORC) at 3, 12 and 24 weeks post-injection.
RESULTS: In the COR group in the 3rd week, VAS and WORC scores were significantly lower than the other groups ($p < 0.01$ and $p < 0.05$ respectively). In the PRP group in the 24th week, VAS and WORC scores were found to be significantly lower than the COR group ($p < 0.01$ and $p < 0.05$ respectively). In the COR group in the 3rd week the ASES score was found to be significantly higher than the PRP and PRO groups ($p < 0.01$).
CONCLUSION: In patients with RC lesions, corticosteroid injection provides short-term relief for pain, function, and quality of life, while PRP injection works for long-term wellbeing. For all types of applied injections, improvement in pain, function and quality of life were observed.

Keywords: Injection, rotator cuff tendon, prolotherapy, platelet-rich plasma, corticosteroid, randomized clinical trial

1. Introduction

Rotator cuff (RC) tendon problems can be seen in one out of every five people [1]. The lesions are evaluated and diagnosed by sports physicians, physiatrists, and orthopedists, with different clinical pictures ranging from acute tendinitis to full-thickness tears. Internal and external factors, such as age-related degeneration, anatomical differences, and biomechanical problems, prepare the ground for the development of RC tendinopathy. The mechanism and pathogenesis of tendinopathy differ between age groups. In younger subjects, it is caused by recurrent overuse injuries or acute traumatic events, but at later ages, it develops in association with age-related degeneration without trauma. Education, rest, activity modification, ice application, physical therapy applications, exercise, and nonsteroidal anti-inflammatory drugs (NSAIDS) are the non-surgical approach to treating these problems. Subacromial injection is another treatment approach if

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healing is not achieved with these applications. Subacromial corticosteroid injection is an injection method that has been implemented for a short-term basis for many years [2,3]. Due to the limited capacity of the tendons to self-repair [4], new biological treatment methods have been brought into the agenda for the treatment of tendinopathies in recent years. However, there is not enough scientific evidence about their effectiveness.

Although the mechanism of prolotherapy is not clear, increased glucose in the extracellular matrix is thought to stimulate healing and tissue regeneration by eliciting an acute inflammatory response, fibroblast proliferation, and subsequent collagen synthesis [5]. According to another theory, high concentrations of dextrose cause osmotic rupture of local cells [6]. Increasing glucose in the extracellular matrix induces an acute inflammatory response and stimulates fibroblast proliferation. Then, new collagen synthesis is initiated [5]. PRP is an autologous blood product in which a person's blood is included in the tissue healing process of supraphysiological platelets, and growth factors are released from the platelets [7,8]. These growth factors are transforming growth factor beta (TGF-β), platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), hepatocyte growth factor, and insulin-like growth factor 1 (IGF-1) [9]. Although these factors are biologically active, they induce angiogenesis, epithelization, cell differentiation, proliferation of the extracellular matrix, and fibrovascular callus [10,11]. The aim of our study was to compare the effectiveness of different injection methods with corticosteroids, PRP, and prolotherapy in comparison with lidocaine in treatment-resistant rotator tendon lesions.

2. Methods

The study was planned as a randomized controlled trial in patients with RC lesions from sports medicine and physical therapy and rehabilitation outpatient clinics. Ethics committee approval was granted for the study, and a signed informed consent form was obtained from each patient. A total of 232 participants with symptoms of RC tendon injury were evaluated between June 2014 and January 2018. The participants were randomly assigned by a computer-generated program as the PRO, PRP, COR, and lidocaine groups. Each patient was evaluated before injection, and planned injections were applied. Only one injection was applied to each person in each group. In practice, the lateral subacromial injection method was preferred. For a safer and more efficient injection application, all applications were performed with USG (Toshiba Aplio 300 Japan 7.5 Hz linear probe) on the sagittal axis with the long axis in-plane technique. From a technical perspective, the patient sits in an upright position with the arms behind the back, internal rotation, shoulder in hyperextension, and elbow 90° degrees parallel to the ground for a subacromial view (Fig. 1). The USG in-plane technique was used in the subacromial area to confirm that the needle remained in the correct location as it progressed. The same technique was used for all patients. The needle endpoint was subacromial bursae. The nurse, preparing the injection solution, covered each injector syringe with an invisible opaque tape. The physician who applied the injection to the patient, the patient, and the physician who evaluated the patient after the injection did not know which injection had been applied to the patient. The information contained in the relevant nurse documentation and data from the chart were combined by the relevant data specialist, and the study data were created. The participants underwent face-to-face evaluations at the clinic at 3 and 12 weeks after injection and by phone after 24 weeks. The standard shoulder strengthening and stretching exercise programs were given to each group for 6 weeks. After the injection, the participants were told not to take any pain medi-

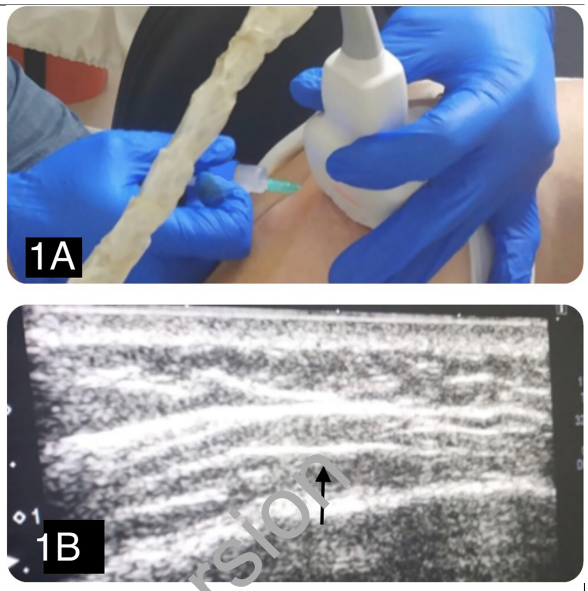

Fig. 1. A: Ultrasound-guided subacromial postero-lateral injection. B: Ultrasound image of an in-plane lateral to-medial approach of a 21 gauge needle (arrow) placement.

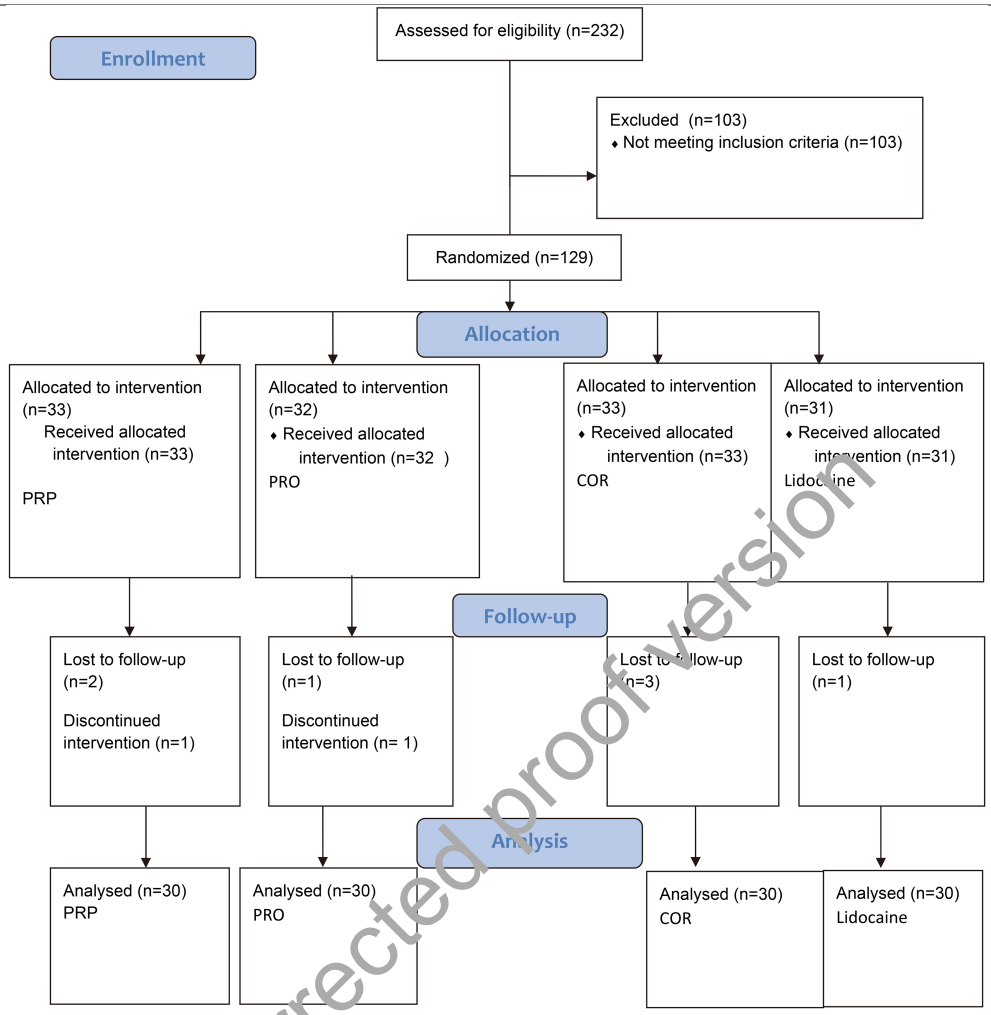

Fig. 2. Flow diagram of the study.

cation other than paracetamol. Patients were included in the study if they met the following criteria: they were aged 18–75 years; had experienced shoulder pain for at least 3 months; had RC pathology (bursitis, RC tendinosis, or partial tears grade I) treated with non-invasive treatments, including NSAIDs and/or at least 2 months of regular exercise and/or physical therapy agents (TENS, ultrasound, etc.); and their condition had been evaluated via clinical and physical examination and confirmed with recent magnetic resonance imaging (MRI). Exclusion criteria are; RC total or > grade 1 partial rupture, treatment with NSAID within the last week, allergic reactions to disinfectants, local anesthetics, sodium citrate and calcium chloride, thrombocytopenia, acute and chronic infections, anticoagulation or anti-aggregation therapy, any previous shoulder injection, glaucoma, hypertension, systemic allergy or hypersensitivity, severe renal or hepatic insufficiency, within 6–12 weeks of surgery at the treatment site, malignancy, pregnancy, uncontrolled diabetes, prosthetic joint, age < 18 y/o, significant skin breakdown at the proposed injection site, the presence of a joint prosthesis, joint instability, adjacent superficial skin lesions or abrasions, severe osteoporosis of bones adjacent to the joint or if the patient is unable to provide informed consent.

Among 232 volunteers, 129 met the eligibility criteria and were included in the study. During the study period, 9 people were excluded from the study due to reasons such as refusal of treatment and failure to adapt to the study. The flow diagram of the study is shown in Fig. 2. All injections were done with sterile 5 mL solutions using a 21 G 38 mm needle. The PRO group was given 5 mL of prolotherapy solution (a mixture of 4 mL

20% dextrose and 1 mL lidocaine); the COR group was given 2 mL 40 mg triamcinolone acetonide (Artropan), 2 mL 1% lidocaine and 1 ml saline. For the control group, a 5 mL solution containing 3 mL 1% lidocaine and 2 mL saline solution was applied. PRP was prepared using the literature-based double spin method. A total of 100 mL of blood containing 15 mL of sodium citrate for clotting inhibition was collected for PRP under aseptic conditions.

Two centrifugations were performed to obtain 10 mL of PRP (first at 1500 rpm for 6 minutes and second at 3500 rpm for 12 minutes). The PRP unit was divided into 2 sections, each 5 mL; the first part was sent to the laboratory for platelet count and concentration, and the second part was used for injection after 30 minutes. Prior to injection, the PRP was activated by adding 1 mL 10% calcium chloride. The preparation method used showed that the platelet count per mL increased 5-fold on average relative to baseline blood values [12].

Patients were evaluated at baseline and then at 3 weeks, 12 weeks and 24 weeks after treatment. The VAS, ASES and the WORC scores were used. The patients scored their pain during abduction and adduction movements on the VAS (0 = no pain; 10 = worst pain). The ASES, one of the most recent evaluations for the shoulder, consists of two parts in which pain (50 points) and function (50 points) are evaluated. For pain, a 0–50 mm scale is used where 0 is unbearable pain and 50 is pain. Function is evaluated as follows: 0 unable; 1 with help; 2 with difficulty; 3 mild impact and 4 normal. The WORC is an assessment scale developed by the World Health Organization (WHO) that includes 21 items representing 5 subscales (physical symptoms, sporting activity, work, lifestyle and emotions) to measure the quality of life of patients with rotator cuff lesions. Each question is evaluated on a scale of 0–100 mm and patients score between 0 and 2100. In this study, volunteers were asked to evaluate each question on a scale of 0–10 mm instead of 0–100 mm.

2.1. Statistics

The Number Cruncher Statistical System 2007 (NCSS; Kaysville, UT, USA) was used for statistical analysis. Descriptive statistical methods (mean, standard deviation, median, first quarter, third quarter, frequency, percentage, minimum and maximum) were used to evaluate the study data. The normal distribution of quantitative data was tested with the Shapiro-Wilk test and graphical investigations. In the comparison of more than 2 groups of quantitative variables showing normal distribution, one-way analysis of variance and the Bonferroni correction were used. For comparison of the Friedman test and the paired comparisons, the Bonferroni Corrected Wilcoxon signed-ranks test was used. The Pearson chi-squared test and Fisher-Freeman-Halton exact test were used to compare the qualitative data. Statistical significance was accepted as $p < 0.05$.

Table 1
Demographic characteristics and clinical features

Age (years)	
Min-max (median)	27–75 (54)
Mean ± SD	52.11 ± 10.78
Sex	
Female	77 (64.2)
Male	43 (35.8)
Height (cm)	
Min-max (median)	145–190 (165)
Mean ± SD	166.77 ± 9.63
Weight (kg)	
Min-max (median)	48–100 (79)
Mean ± SD	77.39 ± 10.64
Dominant hand	
Right hand	114 (95.0)
Left hand	6 (5.0)
Affected hand	
Right hand	88 (73.3)
Left hand	32 (26.7)
Duration of complaints (month)	
Min-max (median)	3–10 (4)
Mean SD	4.87 ± 1.76
MRI findings	
Rotator cuff tendinosis	77 (64.2)
Rotator cuff tendinosis + partial rupture	37 (30.8)
Rotator cuff tendinosis + bursitis	6 (5.0)

3. Results

Demographic and clinical features of the patients are shown in Table 1.

No statistically significant difference was found between the age, sex, height, weight and BMI distributions of the cases or affected hand distributions, duration of complaints and distribution of MRI findings ($p > 0.05$).

Evaluation of VAS scores according to injection groups are shown in Table 2 and distribution of VAS scores by injection types are shown in Fig. 3. The VAS score at 3 weeks was significantly lower in the COR group than the PRP, PRO and lidocaine group ($p = 0.001$; $p = 0.001$; $p = 0.001$; $p < 0.01$).

In the PRP group, the decrease in VAS scores at 12 and 24 weeks, according to baseline VAS scores, were statistically significant ($p = 0.001$; $p = 0.001$; $p <$

Table 2
Evaluation of VAS scores according to injection groups

VAS	Injection types				Test value
	PRP ($n = 30$)	PRO ($n = 30$)	COR ($n = 30$)	Lidocaine ($n = 30$)	p
Baseline					
Min-max (median)	4–7 (6)	4–8 (6)	4–8 (6)	4–7 (5.5)	
Mean ± SD	5.63 ± 1.00	5.9 ± 0.88	5.63 ± 0.93	5.47 ± 0.86	[d]0.386
3rd week					
Min-max (median)	2–6 (5)	1–6 (4.5)	0–6 (2.5)	0–6 (5)	
Mean ± SD	4.83 ± 0.95	4.37 ± 1.16	2.43 ± 1.81	4.23 ± 1.48	[d]0.001**
12th week					
Min-max (median)	2–5 (4)	2–7 (4)	0–6 (4)	1–6 (4)	
Mean ± SD	3.9 ± 0.99	4.27 ± 1.36	3.53 ± 1.41	3.87 ± 0.97	[d]0.367
24th week					
Min-max (median)	0–5 (3)	0–6 (3)	0–6 (4)	1–6 (3)	
Mean ± SD	2.57 ± 1.19	3.1 ± 1.52	3.77 ± 1.41	3.2 ± 1.19	[d]0.005**
p	0.001**	0.001**	0.001**	0.001**	
Baseline – 3rd week	–	0.001**	0.001**	0.002**	
Baseline – 12th week	0.001**	0.001**	0.001**	0.001**	
Baseline – 24th week	0.001**	0.001**	0.001**	0.001**	
3rd week – 12th week	–	–	–	–	
3rd week – 24th week	0.001**	0.014*	0.022*	–	
12th week – 24th week	0.004**	0.014*	–		

[d]Kruskal Wallis Test, [e]Friedman Test, $^{*}p < 0.05$, $^{**}p < 0.01$.

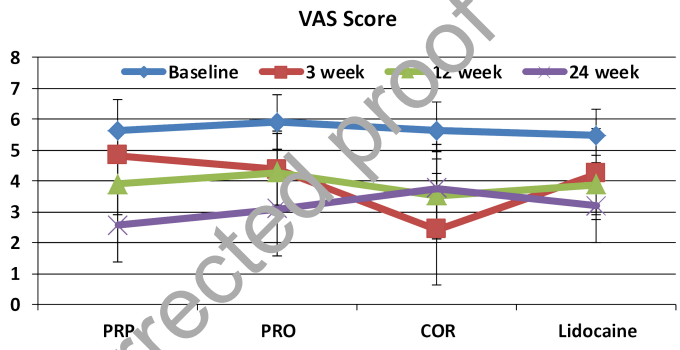

Fig. 3. Distribution of VAS scores by injection types.

0.01). Similarly, decreases in VAS scores were found to be statistically significant at 12 and 24 weeks ($p = 0.001$; $p = 0.004$; $p < 0.01$). In the PRO group, the decrease in VAS scores at 3, 12 and 24 weeks were statistically significant ($p = 0.001$; $p = 0.001$; $p = 0.001$; $p < 0.01$). Similarly, decreases in VAS scores at 24 weeks, compared to 3 and 12 weeks, were found to be statistically significant ($p = 0.014$; $p < 0.05$). In the COR group, the decrease in VAS scores at 3, 12 and 24 weeks were statistically significant according to baseline VAS scores ($p = 0.001$; $p = 0.001$; $p = 0.001$; $p < 0.01$). In addition, the increase in VAS scores at 24 weeks, compared to 3 weeks were found to be statistically significant ($p = 0.022$; $p < 0.05$). In the lidocaine group, the decrease in VAS scores at 3, 12 and 24 weeks were statistically significant according to the baseline VAS scores ($p = 0.002$; $p = 0.001$; $p = 0.001$; $p < 0.01$).

Evaluation of ASES scores according to injection groups are shown in Table 3 and distribution of ASES scores by injection types are shown in Fig. 4. A statistically significant difference was found between the baseline ASES scores of the patients according to the injection type ($p = 0.007$; $p < 0.01$). According to Bonferroni test results, the baseline ASES score of the patients with a steroid injection type was significantly lower than the lidocaine group ($p = 0.034$; $p = 0.008$; $p < 0.05$).

The ASES score of COR group at 3 weeks was significantly higher than the PRP and PRO groups ($p = 0.001$; $p = 0.019$; $p < 0.05$). The lidocaine group ASES score at 3 weeks was significantly higher than the PRP group ($p = 0.003$; $p < 0.01$). Additionally, the

Table 3
Evaluation of ASES scores according to injection types

ASES	Injection type				Test value
	PRP ($n = 30$)	PRO ($n = 30$)	COR ($n = 30$)	Lidocain ($n = 30$)	p
Baseline					
Min-max (median)	24–60 (47.75)	24–62 (46)	22–61 (41)	33–62 (47.75)	
Mean ± SD	46.28 ± 8.61	45 ± 9.42	40.13 ± 8.18	47.27 ± 7.44	[a]0.007**
3rd week					
Min-max (median)	34–61 (44.5)	22–65 (56.5)	34–89 (61)	34–89 (55.5)	
Mean ± SD	46.17 ± 7.9	52.6 ± 11.25	60.7 ± 11.49	55.67 ± 10.5	[a]0.001**
12th week					
Min-max (median)	40–69 (55.75)	31–69 (60)	35–80 (60)	40–80 (61)	
Mean ± SD	55.78 ± 7.9	56.1 ± 9.62	58.1 ± 9.03	58.85 ± 8.88	[d]0.511
24th week					
Min-max (median)	34–87 (64)	34–82 (62)	38–77 (55)	34–80 (61.5)	
Mean ± SD	63.87 ± 11.96	60.37 ± 11.4	55.63 ± 11	60.27 ± 11.92	[a]0.059
p	0.001**	0.001**	0.001**	0.001**	
Baseline – 3rd week	–	–	0.001**	0.016*	
Baseline – 12th week	0.002**	0.001**	0.001**	0.001**	
Baseline – 24th week	0.001**	0.001**	0.001**	0.001**	
3rd week – 12th week	0.001**	–	–	–	
3rd week – 24th week	0.001**	0.001**	–	–	
12th week – 24th week	–	–	–		

[a]Oneway ANOVA, [d]Kruskal Wallis Test, [e]Friedman Test, **$p < 0.01$.

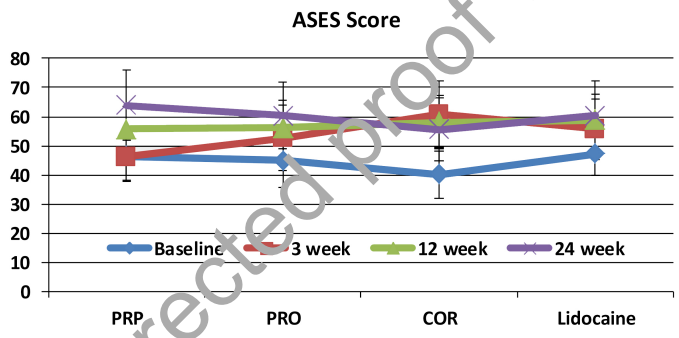

Fig. 4. Distribution of ASES scores by injection types.

ASES scores of the COR group were not significant but were remarkably low ($p = 0.059$; $p > 0.05$).

In the PRP group, the increase in ASES scores according to baseline was statistically significant at 12 and 24 weeks ($p = 0.002$; $p = 0.001$; $p < 0.01$). Similarly, the increase in ASES scores at 12 and 24 weeks, according to ASES scores at 3 weeks, was statistically significant ($p = 0.001$; $p = 0.001$; $p < 0.01$). In the PRO group, the increase in ASES scores were found to be statistically significant at 12 and 24 weeks, according to baseline ($p = 0.001$; $p = 0.001$; $p < 0.01$). Similarly, the increase in ASES scores at 24 weeks, according to ASES scores at 3 weeks, were statistically significant ($p = 0.001$; $p < 0.01$). In the COR group, the increase in ASES scores at 3, 12 and 24 weeks, according to baseline ASES scores, were found to be statistically significant ($p = 0.001$; $p = 0.001$; $p = 0.001$; $p < 0.01$). In the lidocaine group, the increase in ASES scores at 3, 12 and 24 weeks, according to baseline ASES scores, were found to be statistically significant ($p = 0.016$; $p = 0.001$; $p = 0.001$; $p < 0.05$).

Evaluation of WORC scores according to injection groups are shown in Table 4 and distribution of WORC scores by injection types are shown in Fig. 5. The WORC scores of the COR group at 3 weeks were significantly lower than the PRP, PRO and lidocaine groups ($p = 0.011$; $p = 0.002$; $p = 0.002$; $p < 0.05$). The WORC scores at 24 weeks were significantly lower than the COR and lidocaine groups ($p = 0.047$; $p = 0.013$; $p < 0.05$).

In the PRP group, the decrease in the WORC scores at 12 weeks and 24 weeks, according to the baseline WORC scores, were statistically significant ($p = 0.001$; $p = 0.001$; $p < 0.01$). Similarly, the decrease

Table 4
Evaluation of WORC scores according to injection types

WORC	Injection type				Test value
	PRP ($n = 30$)	PRO ($n = 30$)	COR ($n = 30$)	Lidocain ($n = 30$)	p
Baseline					
Min-max (median)	34.29–61.9 (51.9)	31.43–64.76 (55.24)	38.57–68.1 (52.86)	35.71–65.24 (53.33)	
Mean ± SD	50.79 ± 6.48	53.67 ± 8.43	51.4 ± 7.73	52.13 ± 7.92	[a]0.505
3rd week					
Min-max (median)	42.38–61.9 (50.95)	33.33–60.48 (54.52)	24.76–60.95 (41.19)	26.67–63.33 (55.95)	
Mean ± SD	51.65 ± 5.79	52.03 ± 7.79	41.97 ± 11.05	51.71 ± 9.71	[d]0.001**
12th week					
Min-max (median)	24.76–61.9 (44.29)	26.19–64.29 (47.86)	27.14–65.24 (47.86)	33.33–61.9 (48.57)	
Mean ± SD	42.83 ± 9.63	46.38 ± 9.01	46.14 ± 9.64	48.27 ± 7.38	[a]0.131
24th week					
Min-max (median)	34–130 (82)	42–130 (93)	60–126 (92)	60–132 (91)	
Mean ± SD	79.46 ± 24.09	91.27 ± 21.79	93.90 ± 17.94	96.55 ± 20.43	[a]0.012*
p	0.001**	0.001**	0.001**	0.001**	
Baseline – 3rd week	–	–	0.001**	–	
Baseline – 12th week	0.001**	0.001**	**	–	
Baseline – 24th week	0.001**	0.001**	0.001**	0.001**	
3rd week – 12th week	0.001**	0.048*	–	–	
3rd week – 24th week	0.001**	0.001**	0.001**	0.001**	
12th week – 24th week	0.001**	0.001**	0.001**	0.001**	

[a]Oneway ANOVA, [d]Kruskal Wallis Test, [e]Friedman Test, $^{**}p < 0.01$.

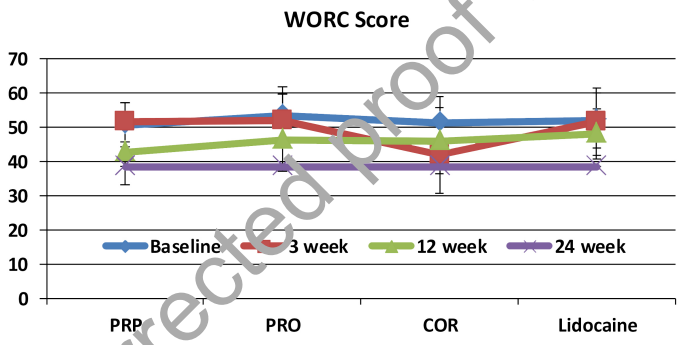

Fig. 5. Distribution of WORC scores by injection types.

in the WORC scores at 12 and 24 weeks, compared to the scores at 3 weeks, were found to be statistically significant ($p = 0.001$; $p = 0.001$; $p < 0.01$). The increase at 24 weeks from 12 weeks was statistically significant ($p = 0.001$; $p < 0.01$). In the PRO group, the decrease in WORC scores at 12 weeks and the increase in WORC scores at 24 weeks, according to baseline scores, were statistically significant ($p = 0.001$; $p = 0.001$; $p < 0.01$). Similarly, the increase in WORC scores at 12 weeks and the decrease at 24 weeks compared to scores at 3 weeks, were statistically significant ($p = 0.048$; $p = 0.001$; $p < 0.05$). In the COR group, the decrease in WORC scores at 3 weeks and the increase in WORC scores at 24 weeks, according to baseline scores, were statistically significant ($p = 0.001$; $p = 0.001$; $p < 0.01$). The increase in WORC scores at 24 weeks, compared to WORC scores at baseline, 3 weeks and 12 weeks, were statistically significant ($p = 0.001$; $p < 0.05$). The increase at 24 weeks, from 12 weeks, was statistically significant ($p = 0.001$; $p < 0.01$). In the lidocaine group, the increase in WORC scores at 24 weeks, compared to WORC scores at baseline, 3 weeks and 12 weeks, were statistically significant ($p = 0.001$; $p < 0.01$).

4. Discussion

This study was the first to compare short-term and long-term effects of three different injection applications on patients with a rotator cuff lesion with a control group for more than 3 months. According to the results, in rotator cuff lesion cases, corticosteroid injection showed a more significant improvement com-

pared to the other injections at 3 weeks, according to the VAS, ASES and WORC scores. At 24 weeks, however, PRP application showed a more significant improvement. No differences were observed between the results of the injection types used in patient evaluations at 12 weeks.

Resting, NSAIDs, physical modalities (therapeutic ultrasound, laser, tens, etc.) and training rotator cuff muscles with force and stretching exercise programs are recommended for patients complaining of shoulder pain [13]. Despite the advances in conservative treatment, cases of use injuries and tendinosis are difficult to treat successfully in the long term. Recently, injection-based therapies have been applied for musculoskeletal problems and rotator cuff tendinopathies, including steroid injection, PRP injection, dry needling, prolotherapy and sodium hyaluronate. All of these injection methods are controversial, and a complete agreement has not been reached by the various authors studying these methods [14,15].

Corticosteroid administration is applied in various shoulder problems [16,17] and is known to provide effective pain control in the short term [18,19]. The use of corticosteroids should be applied at the end of a careful evaluation due to the potential risks of collagen collapse, muscle weakness and tendon rupture [20]. For these reason we excluded partial ruptures higher than grade I and total RC ruptures. In this study, corticosteroid treatment was observed to be superior to other methods in the short term, but not for the long term.

PRP has been a treatment method that has gained popularity recently due to the role of growth factors released from platelets in tissue healing. Additionally, serious side effects of this treatment method have not yet been reported [21–23]. This study demonstrated that the effectiveness of PRP administration was less effective than the corticosteroid application at the early evaluation stage at 3 weeks. In a placebo-controlled study conducted in 22 cases with subacromial impingement syndrome, PRP was evaluated to be effective on shoulder range of motion (ROM) and VAS scores in the same way as exercise [24]. According to the results of 20 cases of chronic rotator cuff tendinopathy, the VAS and WORC scores showed no superiority to a placebo [25]. In another study of 17 cases comparing dry needling with 2-dose PRP at 4-week intervals, the superiority of PRP in patient complaints and pain scores compared to dry needling was demonstrated in bursal and articular tendinopathies [26]. Since this study was a randomized controlled blinded study, the optimal administration dose and duration of the PRP activity could not be evaluated as a single injection was performed. However, single-dose PRP application was shown to have a statistically significant contribution to pain scores at the 24 week evaluation.

Prolotherapy application has shown to be effective for lateral epicondylitis, achilles tendinopathy, plantar fasciitis, hand osteoarthritis, hip adduction tendinitis and rotator cuff problems [27–29]. This method has advantages that include easy application, cheapness, success of treatment and shortening of the rehabilitation process [30]. Although different agents like sodium morrhuate and phenol glycerin are used, hyperosmolar dextrose is the most common irritant solution used [31]. First investigated by Lee, prolotherapy application was used retrospectively for non-traumatic rotator cuff patients with complaints lasting longer than 3 months, and patients were evaluated between 3 and 8 sessions at intervals of 2–4 weeks [32]. In another study using prolotherapy in cases of rotator cuff tendinopathy, improvements in long-term pain and patient satisfaction were made, but no significant advantage was shown when comparing prolotherapy patients with the control group [33].

In this study, local anesthetic injection in the control group was beneficial in rotator cuff lesions, although not superior to other methods. There are similar studies in the literature, which may be due to the carryover effect of local anesthesia, the placebo effect shown in many treatments in medicine, and the distension effect of a subacromial 5 mL injection or the natural course of the disease [34]. In the review, steroids were found to be effective in the short term compared to local anesthetics; no significant difference was found between them in the long term. This confirmed that local anesthetics were effective as well [35].

The most important limitations of this study were the small sample size, the use of prolotherapy and PRP as a single injection and the relatively short duration of follow-up. Therefore, studies with more than one injection of the same injection type with a longer follow-up period are needed. According to the results of the ASES, WORC and VAS scores, steroid injection was more effective for pain, function and quality of life in patients with rotator cuff problems, whereas PRP injection was prominent in this study compared to other injections for long-term well-being. Prolotherapy application at 3, 12 or 24 weeks compared to other methods did not show significant superiority. In all types of injections, improvement in pain, function and quality of life were observed.

5. Conclusion

No clear consensus can be found on the frequency with which an injection is preferred. As reported by some authors, the efficacy of multiple injections of the same injection on rotator cuff pathologies may also be a matter of future studies [36]. While the short-term results of corticosteroid injection for the treatment of rotator cuff lesions did not respond to conservative treatment and were significantly superior to those of PRP, this study concluded that the long-term success of PRP injection was high, but all methods used, including lidocaine, could be beneficial for treatment.

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Conflict of interest

None to report.

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