DISSERTATION ORBIT

ДИССЕРТАЦИОННАЯ ОРБИТА

Original article / Оригинальная статья
УДК:616.7
DOI: https://doi.org/10.38025/2078-1962-2022-21-5-116-121

Efficacy of Platelet-Rich Plasma in the Rehabilitation of Athletes with Peroneal Tendinopathy: a Prospective Non-randomized Study of 60 Patients

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ABSTRACT

INTRODUCTION. Peroneal tendons pathology is an underestimated cause of pain in the lateral part of the foot in athletes, which is difficult to distinguish from lateral ankle ligament injuries. As a result, the athlete's training and participation in competitions may be restricted for a long time. Platelet-rich plasma (PRP) injections have been suggested as a promising method for the treatment of peroneal tendinopathy.

AIM. To evaluate the effectiveness of the use of PRP in the complex rehabilitation of athletes with peroneal tendinopathy by comparing the time to return to play (RTP) and the evaluation of pain symptoms. To develop a model for pain evaluation and physical activity dosingin athletes with this pathology, in order to objectify the transition from one rehabilitation stage to another.

MATERIAL AND METHODS. This prospective, non-randomised study analyzed the treatment outcomes of 60 male patients, aged 21.0±1.4 years with peroneal tendinopathy. Depending on the treatment, two groups of patients were identified. Group I (30 athletes), in addition to complex rehabilitation (physiotherapy and physical therapy), had percutaneous PRP injections under the ultrasound guidance. Group II (30 athletes) received only physiotherapy and exercise therapy.

RESULTS AND DISCUSSION. A statistically significant difference in pain symptoms between the groups was observed starting from the 28th day of treatment. The average time for the athletes in group I to return to regular training activities was on average 10 days shorter than for those in group II ($p<0.001$).

CONCLUSION. The use of PRP, in the rehabilitation of athletes with peroneal tendinopathy is more effective than a comprehensive programme. The developed model of pain evaluation makes it possible to determine the degree of physical activity at various stages of the rehabilitation process, as well as to adequately estimate readiness to RTP.

KEYWORDS: sports injury, ankle joint, tendonitis, tendinopathy, peroneal tendons, platelet-rich plasma, rehabilitation

For citation: Repetyuk A.D., Achkasov E.E., Sereda A.P. Efficacy of Platelet-Rich Plasma in the Rehabilitation of Athletes with Peroneal Tendinopathy: a Prospective Non-randomized Study of 60 Patients. *Bulletin of Rehabilitation Medicine. 2022; 21 (5): 116-121.* https://doi.org/10.38025/2078-1962-2022-21-5-116-121

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Received: Jun 07, 2022
Revised: Aug 17, 2022
Accepted: Sep 13, 2022

Эффективность использования тромбоцитарно-обогащенной плазмы в реабилитации спортсменов с перонеальной тендинопатией: проспективное нерандомизированное исследование 60 пациентов

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РЕЗЮМЕ

ВВЕДЕНИЕ. Патология малоберцовых сухожилий является недооцененной причиной боли в латеральной части стопы у спортсменов, которую трудно отличить от повреждений латеральных связок голеностопного сустава. В связи с этим, соревновательный процесс спортсмена может быть ограничен в течение длительного времени. Было высказано предположение, что инъекции обогащённой тромбоцитами плазмы являются перспективным методом лечения тендинопатии.

ЦЕЛЬ. Оценить эффективность использования обогащённой тромбоцитами плазмы в комплексной реабилитации спортсменов с тендинопатией малоберцовых сухожилий при помощи сравнения сроков начала регулярной тренировочной деятельности и оценки болевой симптоматики. Разработать модель оценки боли и дозирования физической нагрузки у спортсменов при данной патологии, с целью объективизации перехода от одного реабилитационного этапа к другому.

МАТЕРИАЛ И МЕТОДЫ. В данном проспективном нерандомизированном исследовании проанализированы результаты лечения 60 пациентов, мужчин в возрасте 21,0±1,4 года, с тендинопатией малоберцовых сухожилий. В зависимости от тактики лечения были выделены две группы. В I группе (30 спортсменов), помимо комплексной реабилитации (физиотерапия и лечебная физкультура), применялись паратеноциальные инъекции обогащённой тромбоцитами плазмы под контролем УЗИ. II группе пациентов (30 спортсменов) назначали только физиотерапию и лечебную физкультуру.

РЕЗУЛЬТАТЫ И ОБСУЖДЕНИЕ. Статистически значимую разницу между показателями болевой симптоматики между группами наблюдали, начиная с 28-ого дня лечения. Среднее время возвращения спортсменов I группы к регулярной тренировочной деятельности было в среднем на 10 дней короче, чем у спортсменов II группы ($p<0,001$).

ЗАКЛЮЧЕНИЕ. Использование обогащённой тромбоцитами плазмы в реабилитации спортсменов с тендинопатией малоберцовых сухожилий более эффективно по сравнению с комплексной программой. Разработанная модель оценки боли позволяет определить степень физической нагрузки на различных этапах реабилитационного процесса, а также адекватно оценить готовность к регулярной тренировочной деятельности.

Для цитирования: Repetyuk A.D., Achkasov E.E., Sereda A.P. Efficacy of Platelet-Rich Plasma in the Rehabilitation of Athletes with Peroneal Tendinopathy: a Prospective Non-randomized Study of 60 Patients. *Bulletin of Rehabilitation Medicine. 2022; 21 (5): 116-121.* https://doi.org/10.38025/2078-1962-2022-21-5-116-121

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Статья получена: 07.06.2022
Поступила после рецензирования: 17.08.2022
Статья принята к печати: 13.09.2022

INTRODUCTION

The ankle joint is one of the most common injuries in athletes. In clinical practice, injuries of the lateral ankle are diagnosed as damage to the talo-fibular (anterior et posterior) and calcaneo-fibular ligaments, often ignoring the pathology of the peroneal tendons [1,2]. In a study conducted by Dombek et al., only 60% (24 out of 40) of peroneal tendon disorders were diagnosed at the first clinical examination [3]. Research papers have not yet sufficiently addressed the pathology of the peroneal tendons [4]. There are critical avascular areas in the peroneal tendons that impair blood supply and metabolism in the tendon [5]. And, when combined with overuse, it leads to the development of tendinopathy. In case of incorrect treatment and rehabilitation tactics, this can lead to reinjury. For this reason, the athlete cannot participate in training and competitions for a long time [6, 7].

In sports medicine and traumatology, the use of (PRP) is rapidly gaining popularity in the treatment of tendinopathy of various localization. Growth factors contained in platelets (PDGF), transforming growth factor beta (TGF-β), vascular endothelial growth factor (VEGF) and epithelial growth factor (EGF) play an important role in tissue regeneration, promoting mitogenesis and angiogenesis in the damaged area. PRP contains adhesion molecules (fibrin, fibronectin and vitronectin) that promote the regeneration of tenocytes [8]. Calcium-activated PRP increases the synthesis of decorin activating the fibrillogenesis of type II collagen fibers. [9,10]. The anabolic effect of PRP is closely related to stimulating the production of TGF-β, a catabolic cytokine that reduces the expression of the type I collagen gene, contributing to accelerated recovery [11,12].

Currently, there is a limited number of high-quality clinical studies devoted to the treatment of tendinopathy. According to the results of a meta-analysis by Liddle et al., there was no significant difference in recovery time

in the treatment of patellar tendinopathy with PRP compared with the control group [13]. According to the studies of Barman A. et al. and Maffulli N. et al. the use of PRP in the treatment of calcaneal tendinopathy does not lead to an improvement in VISA-A and ultrasound criteria after a year of follow-up compared with the control group [14,15]

The U.S. Department of Health estimates that approximately 86,000 athletes undergo PRP treatment annually [17]. Despite the growing popularity of the method its true effectiveness is not fully established. This becomes an even more serious problem because the cost of PRP treatment is relatively high. Given the contradictory data and the high cost of treatment, it is crucial to find a more accurate answer regarding its effectiveness [16].

Adequate and objective evaluation of pain in athletes is an important aspect in the rehabilitation process. Pain symptoms evaluation is most often carried out with the help of subjective sensations based on the developed generally accepted NRS and VAS scales. While their main disadvantage is the assessment of pain at rest or with a normal patient load, which is not an indicator of positive dynamics of recovery for athletes, and much less recovery, since a limiting pain may appear already during or after a certain sport activity [17].

AIM

To evaluate the effectiveness of the use of PRP in the complex rehabilitation of athletes with peroneal tendinopathy.

MATERIAL AND METHODS

The study was conducted at the Clinic of sports medicine "Locomed" (Russia, Moscow) from 2016 to 2021. The study involved 60 patients (46 runners, 14 football players). All the patients were male. The average age was 21.0±1.4 years, diagnosed with peroneal tendinopathy, verified on the basis of complaints, the mechanism of injury, anamnesis and ultrasound (US) examination.

In group I (30 athletes), in addition to the complex therapy (physiotherapy and exercise therapy), PRP was used (two peritendinous injections under US guidance, with an interval of 7 days). The II group of patients (30 athletes) was prescribed only the complex therapy.

The complex rehabilitation consisted of four stages. Stage I – anti-inflammatory, which included compression cryotherapy (in the first 3 days after the injury, 3 times a day for 20 minutes), starting from day 5 after the injury, a magnetic therapy was prescribed according to the "Tendinitis" program (10 procedures, daily, 1 time a day) and electromyostimulation according to the "Capillarization" program (10 procedures, daily, 1 time per day) of peroneus longus et brevis muscles. At this stage, a therapeutic exercise therapy was used, aimed to increase the range of motion (ROM) in the ankle joint, to improve the trophic tendons and microcirculation in the tissues. Stage II – recovery, the main exercises were aimed to improve a proprioception in the ankle joint, as well as to restore the muscle strength and tolerance to physical exertion. Stage III – preparation for re, speed-strength, difficult coordination and plyometric exercises were used, as well as running load was commenced.

Group I patients, in addition to the described complex of therapeutic and rehabilitation measures, were prescribed two peritendinousinjections under ultrasound control on the 1st and 7th day of observation (Fig. 1).

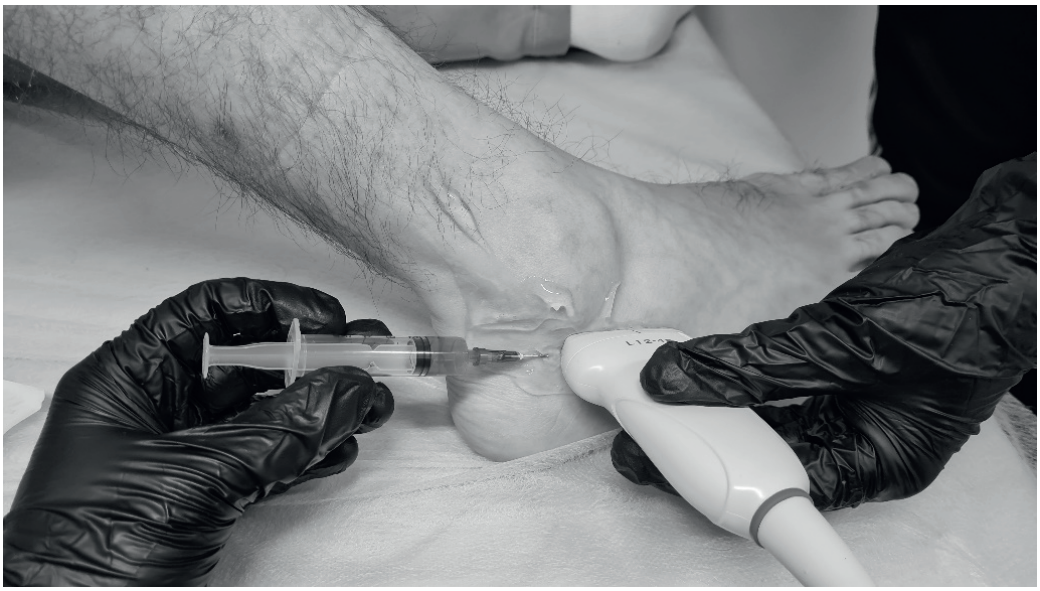

Fig. 1. *Injection of PRP into the peroneus brevis tendon under the ultrasound guidance*

PRP was obtained according to the method recommended by the manufacturer of the centrifuge PRGF-Endoret (BTI Biotechnology Institute UK Ltd, Colchester, England). The skin in the injection area was cleaned three times with an antiseptic agent and then a sterile gel for US guidance was applied. To provide US navigation, a Mindray 7 diagnostic system with a 7.5 MHz linear sensor was used, which was installed in the sagittal plane of the tendon. The injection was performed with a 22G needle under parathenon, an aseptic and pressure bandage was applied. Then a compression cryotherapy was performed for 20 minutes. Next, the patient was instructed to minimize the weigh bearing for 24 hours.

In order to objectify the control of pain symptoms and optimal dosing of physical activity at various stages of the rehabilitation process, the model "Monitoring of pain and dosing of physical activity with injuries of the peroneal tendons in athletes" was proposed (Fig. 2).

Scores	Physical activity		
	Slight	Medium	High
During exercises NRS	0 – 3	3 – 6	6 – 10
After exercises (24 hours) NRS	0 – 3	3 – 6	6 – 10
During exercises BORG (CR-10)	0 – 3	3 – 6	6 – 10
Optimal loading	RTP	Physical rehabilitation	Load reduction

Fig 2. *The model "Monitoring of pain and dosing of physical activity with peroneal tendinopathy in athletes"*

Pain analysis was performed using a modified NRS on the day of the patient's examination, during the exercise session and within 24 hours after it. The control of pain symptoms was carried out starting from the day of diagnosis verification and then with an interval of 1 week to 8 weeks inclusively (Fig. 3).

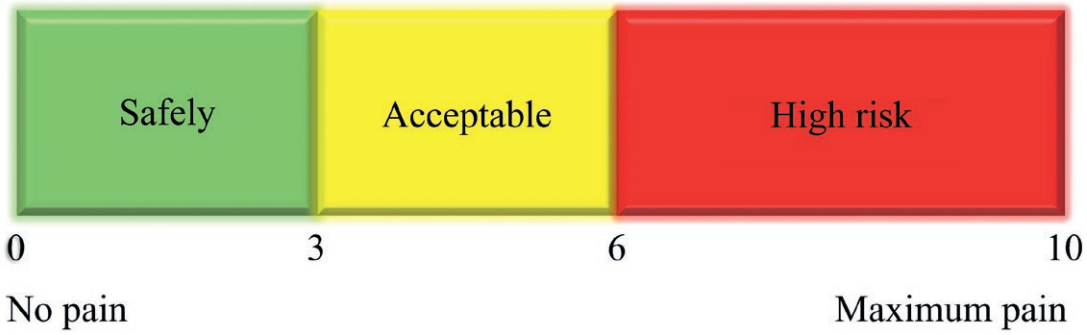

Fig. 3. *A modified numeric rating scale with stratification zones during the rehabilitation process in athletes*

For evaluation load level during exercises session and before RTP, the Borg rating of perceived exertion (CR-10) was used (Fig. 4).

Scores	Level of exertion
0	No Exertion
1	Very Slight
2	Slight
3	Moderate
4	
5	Severe
6	
7	Very severe
8	
9	Very very severe
10	Maximal

Fig. 4. *Borg's scale (CR-10)*

A statistical analysis of the results was carried out using the SPSS program for Windows (version 22), as well as the Excel program.

RESULTS AND DISCUSSION

To compare the effectiveness of the complex rehabilitation programs of groups I and II of this study, the model "Monitoring of pain and dosing of physical activity in athletes with injuries of the peroneal tendons" was used.

Before the treatment, there was no statistically significant difference between the indicators in both groups (group I 7.07±0.78 points, group II 6.73±0.69) ($p>0.05$). Whereas on the 7th (group I 5.97±1.16 points, group II 5.47±1.14), 14th day (group I 5.87±1.14 points, group II 5.2±1.2) and 21st day of the treatment 1) there was a significant difference in scores in the absence of pain ($p>0.05$), then from the 28th day of the treatment (group I 3.1±0.66 points, group II 4.33±1.09), there was a significant decrease in scores according to the pain pattern ($p<0.05$). At this stage, group I patients, who reached the score of 3 points or less, according to the developed model, were able to start regular training activities. On the 35th day, there was a significant decrease in pain symptoms (group I 1.67±0.92 points, group II 3.53±0.9). At this stage, group I patients, who reached the score of 3 points or less, according to the developed model, were able to start regular training activities. On the 42nd day, the score for group I were 1.03±0.61 points, for group II 2.97±0.56 ($p<0.05$). On the 49th day, the score for group I were 0.93±0.87 points, for group II 2.1±0.48 ($p<0.05$). The dynamics of pain symptoms is shown in Figure 5.

Group	0 day	7 day	14 day	21 day	28 day	35 day	42 day	49 day
I	7,07 ±0,78	5,97 ±1,16	5,87 ±1,14	4,07 ±0,64	3,10 ±0,66	1,67 ±0,92	RTP	RTP
II	6,73 ±0,69	5,47 ±1,14	5,2±1,21	4,6 ±1,1	4,33 ±1,09	3,53 ±0,9	2,97±0,56	2,1 ±0,48
p	>0.05	>0.05	>0.05	>0.05	<0.05	<0.05	<0.05	<0.05

Fig. 5. *The results of the assessment of pain symptoms using the model "Monitoring of pain and dosing of physical activity in athletes with peroneal tendinopathy"*

The patients of both groups, who took part in the study completed the treatment and rehabilitation activities in accordance with the proposed protocol and began to return to training. The use of PRP injections in the complex rehabilitation of the athletes with peroneal tendinopathy helped to reduce the time for the athletes to return to play. Thus, the average time for athletes to RTP in group I, where 2 peritendinous injections of PRP were used, was 32.0±2.0 days (min – 28 days, max. – 35 days), which was less than the average period of RTP in the control group II (without the use of PRP), which was 42±4 days (min. – 35 days, max. – 49 days).

The duration of the treatment in group I was significantly less than in group II (p<0.001) (fig. 6).

	Group I	Group II
Average value (days)	32±2	42±4
Average value (days)	28	35
Average value (days)	35	49
p	p<0,001	

Fig. 6. *The timing of returning to play*

The results of our study coincided with the study of Dallaudiere et al. (2014), where we observed a significant improvement in pain symptoms on a VAS and the functional state of the ankle joint on a WOMAC scale at the end of week 6 after performing a single injection of PRP US guidance [19].

In the study of Unlu et al. the pain scores for VAS at the end of 6 weeks after injection did not have a significant difference compared to the indicators before the start of treatment [18]. However, in this study, PRP injections were used as monotherapy, unlike this study, where PRP injections were used as part of a complex therapy of exercise therapy and physiotherapy treatments, which probably affected the difference in pain scores.

CONCLUSION

The use of PRP in a complex treatment program for athletes with peroneal tendon tendinopathy has reduced the time to RTP. Further studies are recommended to determine the effect of PRP on the number of relapses in the long term.

The developed model of pain assessment made it possible to objectify pain symptoms and optimal dose physical activity throughout the rehabilitation process, as well as minimize the risk of reinjury at the stage of RTP.

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Authors' contribution:
All authors confirm their authorship according to the ICMJE criteria (all authors contributed significantly to the conception, study design and preparation of the article, read and approved the final version before publication).
Special contribution:
Repetyuk A.D. – review of publications on the topic of the article, selection, examination and treatment of patients, analysis and interpretation of data, writing the text of the manuscript;
Achkasov E.E. – development of research design, scientific editing of the text of the manuscript, approval of the manuscript for publication;

Sereda A.P. – development of research design, verification of critical content, approval of the manuscript for publication.

Acknowledgments:
Not applicable.
Funding Source:
This study was not supported by any external sources of funding.
Disclosure:
The authors declare no apparent or potential conflicts of interest related to the publication of this article.
Data availability statement:
Not applicable.
Ethics Approval:
The authors state that all the procedures used in this paper comply with the ethical standards of the institutions that carried out the study and comply with the Helsinki Declaration as revised in 2013.
Consent for Publication:
Consent of patients (their representatives) to the processing and publication of non-personalized data was obtained.
Conflict of interest:
The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

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