



## Original article

# The effect of platelet-rich plasma on the repair of muscle injuries in rats<sup>☆</sup>



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## ABSTRACT

**Objective:** The need for therapeutic options for muscle injuries, which are increasingly frequent among sports practitioners, was the motivation for this experimental study, which had the aim of evaluating the histological effects of platelet-rich plasma (PRP) on repairs to muscle tissues of rats.

**Methods:** PRP was obtained by means of double centrifugation of blood from five animals. In 30 rats, an injury was produced in the middle third of the belly of the gastrocnemius muscle of each hind limb. These injuries did not receive any treatment in six rats (12 legs). In 24 rats, 0.9% physiological serum was injected into the injury in the left leg and PRP into the injury in the right leg. Samples from the treated and untreated tissue were evaluated histologically 7 and 21 days after the procedures.

**Results:** The quantity of collagen in the injuries treated with PRP was significantly lower than that in the other injuries, in the evaluation made 7 days after the procedure, but it became equal to the other groups in the evaluation done on the 21st day. There was a significant increase ( $p < 0.001$ ) in the quantity of collagen from the 7th to the 21st day in the injuries treated with PRP, but this was not seen in the injuries treated using other methods. The inflammatory process was shown to be more intense in the injuries treated with PRP than in the injuries of the other treatment groups, in the evaluation done 7 days after the procedure. However, the morphological aspects of these injuries were seen to be similar to those of the untreated injuries, 21 days after the procedure.

**Conclusion:** PRP promoted complete tissue restitution between the 7th and 21st days in experimental muscle injuries.

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## O efeito do plasma rico em plaquetas no reparo de lesões musculares em ratos

### R E S U M O

**Palavras-chave:**  
Músculos/lesões  
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**Objetivo:** A necessidade de opções terapêuticas para lesões musculares, cada vez mais frequentes entre os esportistas, fundamentou este estudo experimental, cujo objetivo foi avaliar os efeitos histológicos do plasma rico em plaquetas (PRP) no reparo do tecido muscular de ratos.

**Métodos:** O PRP foi obtido por dupla centrifugação do sangue de cinco animais. Em 30 ratos, foi produzido um trauma no terço médio do ventre do músculo gastrocnêmio de cada membro traseiro. Essas lesões não receberam tratamento em seis ratos (12 patas). Em 24 ratos, injeções intralesionais de soro fisiológico a 0,9% e de PRP foram aplicadas nas patas esquerdas e direitas, respectivamente. Amostras do tecido tratado e não tratado foram avaliadas histologicamente sete e 21 dias após os procedimentos.

**Resultados:** A quantidade de colágeno nas lesões tratadas com PRP foi significativamente menor do que a das demais lesões na avaliação feita sete dias após o procedimento, mas se equiparou à dos demais grupos na avaliação feita no 21º dia. Houve aumento significativo ( $p < 0,001$ ) na quantidade de colágeno do sétimo para o 21º dia nas lesões tratadas com PRP, o que não ocorreu nas lesões tratadas de outra forma. O processo inflamatório se mostrou mais intenso nas lesões tratadas com PRP em comparação com as lesões dos outros grupos de tratamento na avaliação feita sete dias após o procedimento; todavia, os aspectos morfológicos dessas lesões se mostraram similares ao das lesões não tratadas 21 dias após o procedimento.

**Conclusão:** O PRP promoveu completa restituição tecidual entre o sétimo e o 21º dia em lesões musculares experimentais.

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## Introduction

Muscle injuries are defined as morphological or histochemical alterations that cause dysfunction of the locomotor system.<sup>1</sup> They can be caused by two mechanisms: direct trauma such as bruises and lacerations, and indirect trauma such as ischemia, denervation and strain.<sup>2</sup>

Approximately 30% of injuries diagnosed by doctors are related to the muscle system,<sup>3</sup> and muscle injury is one of the most common forms of trauma that occur during sport practice, causing 10–55% of all injuries.<sup>2</sup> Sport injuries appear to be a result of exercises performed in a strenuous, inadvertent or inappropriate manner. The prevalence and incidence of these episodes are underestimated because of the absence of notifications within the world of sports.<sup>4</sup> The reported incidence of injuries to hamstring muscles is of the order of 12% in soccer players,<sup>5</sup> 50.9% in sprint athletes<sup>6</sup> and 42% in breast-stroke swimmers.<sup>7</sup>

Depending on the severity and location of the injury, different forms of therapeutic management are used, from conservative and drug treatment to surgical treatment.<sup>8</sup> Except for cases of complete muscle tearing, avulsion and myositis ossificans, the standard treatment used for acute muscle injuries consists of resting, protection, ice, compression and elevation. Beyond these principles, there is no clear consensus about treatments for acute muscle injuries.<sup>9</sup> Thus, questions still remain, especially regarding the effects and

results of various commonly used treatments for stimulating the process of muscle repair.

Platelet-rich plasma (PRP) is a product from autologous blood that, since 1990, has been proposed for treatments because it promotes strong stimulation to tissue repair.<sup>10</sup> It is obtained through centrifugation of peripheral blood and the platelet concentration should ideally be higher than 338%, in comparison with that of the peripheral blood.<sup>11</sup> PRP has healing properties that have been attributed to the increased concentrations of autologous tissue growth factors and proteins at cellular level. These factors, when introduced to the area of the injury, are expected to increase recruitment, proliferation and differentiation of cells involved in tissue repair, and to promote accelerated repair with better tissue differentiation.<sup>12</sup>

Various clinical uses of PRP have been studied, including the repair of chondral<sup>13</sup> and tendon injuries,<sup>14</sup> repair of injuries and bone regeneration,<sup>15</sup> and treatment of plantar fasciitis<sup>16</sup> and severe diabetic foot ulcers.<sup>17</sup> The repair of chronic Achilles tendinopathy with intralesional injection of PRP has shown promising results from histological and morphological evaluation of the neoformed tissue.<sup>18</sup> Both experimental and clinical studies have revealed the effects of intralesional injection of PRP in muscle injuries and, generally, these studies have reported better muscle regeneration, increased neovascularization and reduced fibrosis.<sup>19–25</sup>

In view of the growing incidence of muscle injuries and the need for therapeutic options that promote faster and more

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