

# Platelet-rich plasma (PRP) treatment of sports-related severe acute hamstring injuries

Yannick Guillodo<sup>1</sup>  
Gwénaelle Madouas<sup>2</sup>  
Thomas Simon<sup>2</sup>  
Hermine Le Dauphin<sup>1</sup>  
Alain Saraux<sup>1</sup>

<sup>1</sup> Service de Rhumatologie, CHU Brest, France

<sup>2</sup> Cabinet de Médecine du sport, ZA Questel, Brest, France

## Corresponding author:

Yannick Guillodo  
Service de Rhumatologie, CHU Brest  
Rue Tanguy Prijent  
29200 Brest, France  
E-mail: docteur.guillodo@gmail.com

## Summary

**Purpose:** hamstring injury is the most common musculoskeletal disorder and one of the main causes of missed sporting events. Shortening the time to return to play (TTRTP) is a priority for athletes and sports medicine practitioners.

**Hypothesis:** platelet-rich plasma (PRP) injection at the site of severe acute hamstring injury increases the healing rate and shortens the TTRTP.

**Study design:** Cohort study.

**Methods:** all patients with ultrasonography and MRI evidence of severe acute hamstring injury between January 2012 and March 2014 were offered PRP treatment. Those who accepted received a single intramuscular PRP injection within 8 days post-injury; the other patients served as controls. The same standardized rehabilitation program was used in both groups. A physical examination and ultrasonography were performed 10 and 30 days post-injury, then a phone interview 120 days post-injury, to determine the TTRTP at the pre-injury level.

**Results:** of 34 patients, 15 received PRP and 19 did not. Mean TTRTP at the pre-injury level was  $50.9 \pm 10.7$  days in the PRP group and  $52.8 \pm 15.7$  days in the control group. The difference was not statistically significant.

**Conclusion:** a single intramuscular PRP injection did not shorten the TTRTP in sports people with severe acute hamstring injuries.

**KEY WORDS:** platelet-rich plasma (PRP), hamstring injury, return to play, muscle injury, management.

## What is known about the subject

Local platelet-rich plasma (PRP) injection was introduced recently to expedite recovery from sports-related injuries. However, little evidence exists to support the effectiveness of PRP in shortening the time to return to play at the previous level after a hamstring injury.

## What this study adds to existing knowledge

Our cohort study of athletes with grade III acute hamstring injuries who accepted or refused PRP therapy (n=15 and n=19, respectively) found no evidence that a single local PRP injection (3 mL) shortened the TTRTP.

## Introduction

Muscle injuries occur chiefly in athletes<sup>1,2</sup>. Among them, hamstring injury is the most common musculoskeletal disorder and is prevalent in many sports, most notably those requiring maximal sprint accelerations<sup>3,4</sup>. An accurate diagnosis is essential to guide treatment decisions. The current first-line treatment is known as RICE (Rest, Ice, Compression, and Elevation)<sup>2,5</sup>. If a bruise develops, its site should be noted. Ultrasonography is often considered a method of choice for confirming the diagnosis and guiding local aspiration or injection if needed<sup>6</sup>. The last treatment phase consists in a rehabilitation program with a gradual return to the previous sporting activity<sup>2,5,7,8</sup>. Platelet-rich plasma (PRP) was introduced recently to expedite recovery from sports-related injuries<sup>9-13</sup>. In rats, autologous PRP significantly decreased the time to recovery of tibialis anterior muscle function, from 21 days to 14 days<sup>14</sup>. In a preliminary study of professional sportsmen reported in 2004, local injection of autologous conditioned serum significantly shortened the time to return to play (TTRTP) at the pre-injury level<sup>13</sup>. These data have created a demand among sports people for PRP therapy although a recent review found no evidence<sup>15</sup>.

Muscle injuries are graded based on physical findings and the results of ultrasonography and/or magnetic resonance imaging (MRI)<sup>16,17</sup>. The standard grading system has three levels (grade I, II, III)<sup>17</sup>. But, in athletes with hamstring injuries, the baseline physical examination has been shown to predict return-to-play at the pre-injury level within 40 days<sup>18</sup>. Most patients with minor injuries had TTRTPs shorter than 25 days. Severe hamstring injuries, in contrast, may require up to 60 days to heal fully. Thus, treatments designed to expedite healing are most relevant among patients with severe injuries (grade III).

Here, our objective was to determine whether a single PRP injection at the site of severe acute hamstring injury in sports people, used in addition to standard RICE and rehabilitation therapy, decreased the TTRTP at the previous level.

## **Materials and method**

The study was approved by the appropriate ethics committee (Brest University, France) and by the French data protection authority (Ref Pro RB 12.034, ID RCB 2012-A00388-35).

### **Population**

Consecutive patients who presented at the teaching hospital in Brest, France with severe acute hamstring injury between January 2012 and March 2014 were considered for the study. The clinical inclusion criteria were a baseline visual analog scale pain score greater than 6, pain during everyday activities for more than 3 days, a popping sound during the injury, and greater than 15° motion-range limitation compared to the uninjured side<sup>18</sup>. Patients were also required to have ultrasonographic evidence of an intramuscular or intermuscular hematoma and an MRI injury grade of III<sup>17</sup>. We excluded patients with a history of injury to the same muscle group within the last 12 months or a history of direct impact at the site of injury.

### **Baseline data collection**

Within 5 days after the injury, all patients were examined by the same sports medicine physician (more than 20 years of experience), who performed a standardized physical examination and an ultrasound scan (Sparq, Philips Electronics, Amsterdam, The Netherlands) using a 5- to 12-MHz probe.

The following data were recorded: sports practiced, level of practice (non-league, district, regional, national, or international), whether the injury occurred during training or a competition, type of activity during which the injury occurred (e.g., sprinting), and whether the injury was preceded by warning signs.

## **Treatments**

At the end of the visit, PRP treatment was offered to all patients. Those who accepted received oral and written information about the study and signed a written consent form. As we had funding for 15 PRP injections (300 €/injection), we stopped including patients when we had 15 patients in the PRP group.

All patients followed the same standardized rehabilitation program consisting of physiotherapy, stretching, and strengthening exercises with progression from isometric to concentric to eccentric; followed by sports training with progression from cycling to jogging to sprinting<sup>18</sup>.

### **Platelet-rich plasma**

A single intramuscular injection of autologous PRP was performed in each patient in the invasive-procedures room of the rheumatology department of the teaching hospital in Brest, France. All injections were administered by the same sports medicine physician. Ultrasonography was used to identify the site of injury, which was marked on the skin, and to measure the depth of the lesion. A registered nurse drew an 18-mL venous blood sample. PRP was prepared in the same room using an Ortho. Pras 20 kit (Proteal, Barcelona, Spain).

Each patient received a single PRP injection within 8 days after the injury and 3 days after the baseline visit. The volume injected was 3 mL. Ultrasonography with sterile gel and a sterile sleeve around the probe was used to guide the injection. The patient then rested for 1 hour before leaving the hospital.

### **Outcome assessment**

Each patient underwent a physical examination and ultrasonography by the same physician (YG) 10 and 30 days after the injury. We were looked for adverse events, fibrous scarring especially.

The patient was then contacted by telephone to determine the TTRTP at the pre-injury level, defined as the time in days from the injury to full resumption of previous sporting activities.

## **Statistics**

Statistical analyses were done using SPSS v. 17.0 software (IBM, Armonk, NY). The data were described as mean±SD. We compared the TTRTP, defined as the resumption of previous sporting activities at the same level, between the PRP-treated patients and the controls. To look for factors potentially associated with TTRTP, we compared the two groups using the chi-square or Fisher's exact test for discrete variables and the Mann-Whitney test for continuous variables. *P* values <0.05 were considered significant.

## Results

### Population

We included 34 patients, of whom 15 agreed to PRP therapy and 19 did not. All 34 patients were males. Mean age was 26.3±3.7 years in the PRP group and 28.8±7.4 years in the control group (NS).

Of the 34 patients, 9 (26%) competed at the national or international level and only 1 was not a league member (Tab. 1). The PRP-treated patients practiced at a significantly higher level than did the controls ( $P=0.01$ ). We found no significant differences between the two groups for sports practiced (Tab. 2), time from injury to the baseline visit (5.7±1.2 days in the PRP group and 6.1±2.4 days in the control group), proportion of injuries located in the muscle body (73.3% in the PRP group and 63.2% in the control group), or sites of injury (e.g., biceps femoris, 66.7% in the PRP group and 57.9% in the control group) (Tab. 3). The groups were also comparable for the features listed in Table 4.

### Time to return to play

TTRTP was not significantly different between the two groups: 50.9±10.7 days in the PRP-treated patients and 52.8±15.7 days in the controls.

### Adverse events

No adverse events were recorded.

## Discussion

In our study, a single ultrasound-guided PRP injection at the site of severe acute hamstring muscle injury failed to shorten the TTRTP at the pre-injury level. We studied only patients with severe hamstring injuries as determined using clinical and ultrasound criteria<sup>6, 18</sup> together with grade III injury by MRI<sup>17</sup>. In clinical practice, MRI is not always necessary but is wide-

**Table 1. Level of sports practice before muscle injury in patients treated with platelet-rich plasma (PRP) and controls.**

Level of practice	Controls N=19	PRP N=15	Total
Non-league	1 (5.3%)	0	1
District	6 (31.6%)	0	6
Regional	11(58.0%)	7 (46.7%)	18
National	1 (5.3%)	4 (26.7%)	5
International	0	4 (26.7%)	4

**Table 2. Sports practiced by the patients treated with platelet-rich plasma (PRP) and by the controls.**

Sport	Controls N=19	PRP N=15	Total
Running	2 (10.5%)	0	2
Basketball	1 (5.3%)	1 (7.7%)	2
Soccer	14 (73.7%)	13 (86.7%)	27
Handball	1 (5.3%)	0	1
Thai boxing	0	1 (7.7%)	1
Weight-lifting	1 (5.3%)	0	1

**Table 3. Sites of muscle injury in patients treated with platelet-rich plasma (PRP) and controls.**

Injury site	Controls N=19	PRP N=15	Total
Biceps	11 (58.0%)	10 (66.7%)	21
Semimembranosus	5 (26.3%)	4 (26.7%)	9
Semitendinosus	3 (15.8%)	0	3
Proximal tendon	0	1 (7.7%)	1

**Table 4. Characteristics of the hamstring injury in the patients treated with platelet-rich plasma (PRP) and the controls.**

	Controls N=19	PRP N=15	P value
Injury during a competition	13 (68.4%)	13 (86.7%)	0.20
Injury while running	9 (47.3%)	10 (66.7%)	0.22
Pain before the injury	8 (42.1%)	8 (53.3%)	0.38
Injury on the right side	8 (42.1%)	9 (60.0%)	0.24

ly performed in high-level athletes (9 patients in our study)<sup>19</sup>. To obtain an uniform population, we excluded patients with minor hamstring injuries or injuries to other sites, in contrast to another study, which suggested efficacy of PRP therapy<sup>13</sup>. We believe that PRP to expedite recovery is not warranted in patients with minor hamstring injuries, as full recovery is usually achieved rapidly without PRP. Thus, in an earlier study, we found that patients with minor hamstring injuries resumed jogging within 13.7±5.8 days and returned to their pre-injury level of sporting activity (including competitions) within 24.0±7.9 days<sup>18</sup>.

Limitations of our study include the small sample size and absence of randomization<sup>20</sup> to determine the treatment received<sup>21</sup>. The higher level of sporting activity among the patients who chose PRP therapy indicates selection bias. Our population included both professional and nonprofessional athletes, whereas an earlier study of factors predicting TTRTP enrolled only professionals<sup>22</sup>.

A single PRP injection was used in our study. Other studies used two or three injections with saline injections in the control group<sup>21,23</sup>. PRP preparation methods, which affect PRP composition<sup>24</sup>, have varied across studies. We chose the Ortho.Pras 20 kit Proteal system.

Our outcome criterion was TTRTP at the pre-injury level. Shortening the TTRTP decreases the number of missed games, which has major financial benefits in elite athletes. Skeletal muscle regeneration after injury is extremely complex<sup>25</sup>. Despite experimental data indicating that PRP might enhance the regeneration process, we found no therapeutic benefits of a single PRP injection added to standard RICE and rehabilitation therapy.

We are aware of a single randomized controlled trial supporting the efficacy of a single PRP injection in decreasing the TTRTP in patients with acute hamstring injuries<sup>26</sup>. Compared to rehabilitation alone, rehabilitation plus PRP therapy decreased the TTRTP from 42.5±20.6 days to 26.7±7.0 days ( $P=0.02$ ). All patients had grade II injuries, *versus* grade III injuries in our study. In a rat model of muscle contusion due to a direct impact, PRP therapy failed to improve functional or histological outcomes<sup>27</sup>. A randomized double-blind placebo-controlled trial in 80 athletes with acute hamstring injuries showed that two PRP injections 5 to 7 days apart failed to shorten the TTRTP<sup>21</sup>. Finally, a 2014 Cochrane systematic review found no evidence that PRP therapy was beneficial in patients with musculoskeletal soft tissue injuries<sup>28</sup>.

In conclusion, in our study, a single local PRP injection failed to decrease the TTRTP at the pre-injury level in athletes with grade III acute hamstring injuries. This result indicates that the current popularity of PRP injections to treat muscle injuries, particularly among elite athletes, deserves to be challenged.

## References

1. Ekstrand J, Hägglund M, Waldén M. Epidemiology of muscle injuries in professional football (soccer). *Am J Sports Med.* 2011;39:1226-1232.

2. Järvinen TA, Järvinen M, Kalimo H. Regeneration of injured skeletal muscle after the injury. *Muscles, Ligaments and Tendons J.* 2014;3(4):337-345.
3. Malliaropoulos N, Papacostas E, Kiritsi O, Papalada A, Gougoulas N, Maffulli N. Posterior thigh muscle injuries in elite track and field athletes. *Am J Sports Med.* 2010;38:1813-1819.
4. Verrall GM, Slavotinek JP, Barnes PG, et al. Diagnostic and prognostic value of clinical findings in 83 athletes with posterior thigh injury: comparison of clinical findings with magnetic resonance imaging documentation of hamstring muscle strain. *Am J Sports Med.* 2003;31:969-973.
5. Heiderscheidt BC, Sherry MA, Silder A, Chumanov ES, Thelen DG. Hamstring strain injuries: recommendations for diagnosis, rehabilitation and injury prevention. *J Orthop Sports Phys Ther.* 2010;40:67-81.
6. Guillodo Y, Bouttier R, Saraux A. Value of sonography combined with clinical evaluation to evaluate muscle injury severity in athletes. *J Athl Train.* 2011;46:500-504.
7. Maffulli N, Oliva F, Frizziero A, et al. ISMuLT Guidelines for muscle injuries. *Muscles Ligaments Tendons J.* 2014;3(4):241-249.
8. Malliaropoulos N, Isinkaye T, Tsitas K, Maffulli N. Reinjury after acute posterior thigh muscle injuries in elite and track athletes. *Am J Sports Med.* 2011;39:304-310.
9. Dohan Ehrenfest DM, Andia I, Zumstein MA, Zhang CQ, Pinto NR, Bielecki T. Classification of platelet concentrates (Platelet-Rich Plasma-PRP, Platelet-Rich Fibrin-PRF) for topical and infiltrative use in orthopedic and sports medicine: current consensus, clinical implications and perspectives. *Muscles, Ligaments and Tendons J.* 2014;4(1):3-9.
10. Fader RR, Mitchell JJ, Traub S, Nichols R, Roper M, Dan OM, McCarty EC. Platelet-rich plasma treatment improves outcomes for chronic proximal hamstring injuries in an athletic population. *Muscles, Ligaments and Tendons J.* 2015;4(4):461-466.
11. Redler LH, Thompson SA, Hsu SH, Ahmad CS, Levine WH. Platelet rich plasma therapy: a systematic literature review and evidence for clinical use. *Phys Sportsmed.* 2011;39:42-51.
12. Sanchez M, Anita E, Orive G, Mujika I, Andia I. Platelet-rich therapies in treatment of orthopaedic sport injuries. *Sports Med.* 2009;39:345-354.
13. Wright-Carpenter T, Klein P, Schaferhoff P, Appell HJ, Mir LM, Wehling P. Treatment of muscle injuries by local administration of autologous conditioned serum: a pilot study on sportsmen with muscle strains. *Int J Sports Med.* 2004;25:588-593.
14. Hammond JW, Hinton RY, Curl LA, Muriel JM, Lovering RM. Use of autologous platelet rich plasma to treat muscle strain injuries. *Am J Sports Med.* 2009;37:1135-1142.
15. Hamid MS, Yusof A, Mohamed Ali MR. Platelet-rich plasma (PRP) for acute muscle injury: a systematic review. *Plos One.* 2014;9:e90538.
16. Hamilton B, Whiteley R, Almusa E, Roger B, Geertsema C, Toi JL. Excellent reliability for MRI grading and prognostic parameters in acute hamstrings injuries. *Br J Sports.* 2014;48:1385-1387.
17. Pollock N, James SLJ, Lee JC, Chakraverty R. British athletics muscle injury classification: a new grading system. *Br J Sports Med.* 2014;48:1347-1351.
18. Guillodo Y, Here-Dorignac C, Thoribé B, Madouas G, Dauty L, Tassery F, Saraux A. Clinical predictors of time to return to competition following hamstring injuries. *Muscles, Ligaments and Tendons J.* 2014;4:386-390.
19. Orchard J, Best TM, Verrall GM. Return to play following muscle strains. *Clin J Sport Med.* 2005;15:436-441.
20. Padulo J, Oliva F, Frizziero A, Maffulli N. *Muscles, Ligaments and Tendons Journal. Basic principles and recommendations in clinical and field science research.* MLTJ. 2013;4:250-252.

21. Reurink G, Goudswaard GJ, Moen MH, et al. Dutch Hamstring Injection Therapy (HIT) Study Investigators. Platelet-rich plasma injections in acute muscle injury? *N England J Med.* 2014; 370:2546-2547.
22. Moen MH, Reurink G, Weir A, Tol JL, Maas M, Goudswaard GJ. Predicting return to play after hamstring injuries. *Br J Sports Med.* 2014;48:1358-1363.
23. Hamid A, Yusof A, Razif M, Ali M. Platelet-rich plasma for acute muscle injury: a systematic review. *Plos One.* 2014;9.
24. Kaux JF, Le Goff C, Renouf J, Peters P, Lutteri L, Gothot A, Crielaard JM. Comparison of the platelet concentrations obtained in the platelet-rich plasma (PRP) between the GPS™ II and GPS™ III systems. *Pathol Biol (Paris).* 2011;59:275-277.
25. Dimauro I, Grasso L, Fittipaldi C, et al. Platelet-rich plasma and skeletal muscle healing: a molecular analysis of the early phases of the regeneration process in an experimental animal model. *PLoS One.* 2014;9:e102993.
26. Hamid MS, Mohamed Ali MR, Yusof A, George J, Lee LP. Platelet-rich plasma injections for the treatment of hamstring injuries: a randomized controlled trial. *Am J Sports Med.* 2014;42:2410-2418.
27. Delos D, Leineweber MJ, Chaudhury S, Alzoobae S, Gao Y, Rodeo SA. The effect of platelet-rich plasma on muscle contusion healing in a rat model. *Am J Sports Med.* 2014;42:2067-2074.
28. Moraes VY, Lenza M, Tamaoki MJ, Faloppa F, Belloti JC. Platelet-rich therapies for musculoskeletal soft tissue injuries. *Cochrane Database Syst Rev.* 2014;4:CD010071.