Biologic Orthopedic Journal

Review Article
DOI: 10.22374/boj.v7i1.75

THE ORTHOBIOLOGICS USE IN KICKING ATHLETES: A REVIEW PAPER

Haruki Ishii, MD[1], Justin Dzierzawski, MD[2], Oluseun A. Olufade, MD[3]

[1]Department of Rehabilitation Medicine, NYU Grossman School of Medicine, New York, USA;
[2]Department of Rehabilitation Medicine, MedStar National Rehabilitation Hospital, Washington, D.C.;
[3]Department of Orthopedics, Emory University School of Medicine, Atlanta, Georgia; Department of Rehabilitation Medicine, Emory University School of Medicine, Atlanta, Georgia; and Emory Sports Medicine Center, Brookhaven, Georgia

Author for correspondence: Haruki Ishii: haruki.ishii@nyulangone.org

Submitted: 25 November 2024. Accepted: 27 September 2025. Published: 31 October 2025

Abstract

Background: In recent years, orthobiologics have gained substantial interest for the treatment of various sports-related musculoskeletal injuries. However, their use and effectiveness remain controversial.

Objectives: In this focused review, the current literature on the use of orthobiologics for sports-related injury among kicking athletes was reviewed. The primary goal of this study is to provide an evidence-based resource for clinicians on the orthobiologics treatment of sports-related lower extremity injury among kicking athletes at all athletic levels.

Data Sources: Eligible studies were identified through searches of PubMed, ScienceDirect, and Embase up to May 22, 2024. The search terms included "orthobiologics," "platelet-rich plasma," "platelet-poor plasma," "PRP," "PPP," bone-marrow aspirate concentrate," "mesenchymal stem cell," "BMAC," "MSC," "ultrasound guided hydrodissection," "ultrasound guided hydrodilatation," "ultrasound guided percutaneous tenotomy," "barbotage," "ultrasound guided ablation," "kicking sport athletes," "soccer player," "placekicker," "futsal," "football," and "soccer."

Main Results: The initial literature search yielded 2264 articles after duplicates were excluded. After screening titles and abstracts, 138 articles were assessed for eligibility. Following the full-text evaluation, a total of 20 articles were included in the final analysis. Of the 20 studies, 2 were randomized controlled trials, 1 was a retrospective cohort study, 4 were case series, and 13 were case reports. The average Coleman Methodology Score modified for conservative therapy for all included studies was 30.30 (range 18–74), and overall, the quality was in the poor range.

Conclusions: While results appear to be mixed due to the nature of heterogeneity of the platelet-rich plasma (PRP) protocols and pathologies reported among reviewed studies, PRP and prolotherapy appear to be a safe and effective adjunctive treatment among those who are refractory to other conservative management before proceeding to surgical intervention, except for hamstring strain. Future studies are warranted to assess orthobiologics treatment, focusing on the timing, dosing or concentration, and number of injections, to allow clinicians to understand the utility of orthobiologics treatment when treating kicking athletes.

Keywords: *kicking athletes; orthobiologics; PRP; return to play; soccer*

BACKGROUND

Soccer is one of the most popular sports worldwide,[1] leading to an increased volume of injuries suffered by players. For instance, more than 9000 injuries were recorded among the Major League Soccer players between 2014 and 2019, with a mean of 1.1 injuries yearly for each player.[2] During the study period, hamstring strains were the most frequently observed injuries, followed by ankle sprains and adductor strains.[2] On average, 8.1 injuries were reported in professional male soccer players for every 1000 h of exposure.[3] The three common kicking techniques in soccer include the instep, the curved, and the side-foot kicks.[4] Though high-speed sprinting is the most common mechanism for hamstring injuries even in soccer,[5] kicking results in more severe hamstring injuries.[6] When performing kicking tasks, athletes are in positions with their hip flexed and knees extended, which lengthen the hamstring muscles, especially in instep and cutoff kicking, leading to injury.[7]

Orthobiologics have been gaining popularity for the treatment of musculoskeletal pathology, and some of the examples include platelet-rich plasma (PRP), bone marrow aspirate concentrate (BMAC), and mesenchymal stem cells (MSCs). A recent survey demonstrated that orthobiologics, PRP being the most popular type, are utilized by many sports medicine clinicians.[8] The National Basketball Association (NBA) presented a consensus statement in 2020, which acknowledged the potential utility of PRP, but its use remains controversial given a paucity of data.[9] A recent systematic review evaluated clinical outcomes of orthobiologics in professional soccer players;[10] however, to our knowledge, there is a lack of literature on orthobiologics treatment among kicking athletes at all levels. Additionally, there is a lack of universally accepted orthobiologics formulation or criteria for return to sports following orthobiologics treatment.

Therefore, we evaluated the current literature on the use of orthobiologics for sports-related lower extremity pathology among kicking athletes at all levels. The primary goal of this focused review is to be used as a resource for clinicians when treating sports-related lower extremity injury among kicking athletes at all athletic levels using various orthobiologic modalities.

METHODS

A broad literature search was completed to identify all articles exploring the use of kicking in athletes with various pathologies. Eligible studies were identified through searches of PubMed, ScienceDirect, and Embase up to May 22, 2024, by one author (H.I.). The search terms included "orthobiologics," "platelet-rich plasma," "platelet-poor plasma," "PRP," "PPP," bone-marrow aspirate concentrate," "mesenchymal stem cell," "BMAC," "MSC," "ultrasound guided hydrodissection," "ultrasound guided hydrodilatation," "ultrasound guided percutaneous tenotomy," "barbotage," "ultrasound guided ablation," "kicking sport athletes," "soccer player," "placekicker," "futsal," "football," and "soccer."

Two authors (H.I. and J.D.) independently reviewed titles, abstracts, and full-text articles, using Covidence (Veritas Health Innovation, Melbourne, Australia) for eligibility. Inter-reviewer disagreements were resolved by discussion between the two authors, and/or by a third author (O.O.) for unresolved discrepancies.

The quality of the methodological assessment was assessed by two authors (H.I. and J.D.) using the validated modified Coleman Methodology Score (mCMS) (Table 1).[11] For this study, the score was modified for conservative therapy (Table 1). Studies were graded as "excellent" if they scored >90 points, "good" between 80 and 90, "fair" between 70 and 80, and "poor" when <70 points.[12] Inter-reviewer disagreements were resolved by discussion between the two authors.

RESULTS

The initial literature search yielded 2264 articles after duplicates were excluded. After screening titles and abstracts, 138 articles were assessed with full-text evaluation for eligibility. Following the full-text evaluation, a total of 20 articles were included in the final analysis. The flow diagram is shown in the Figure.

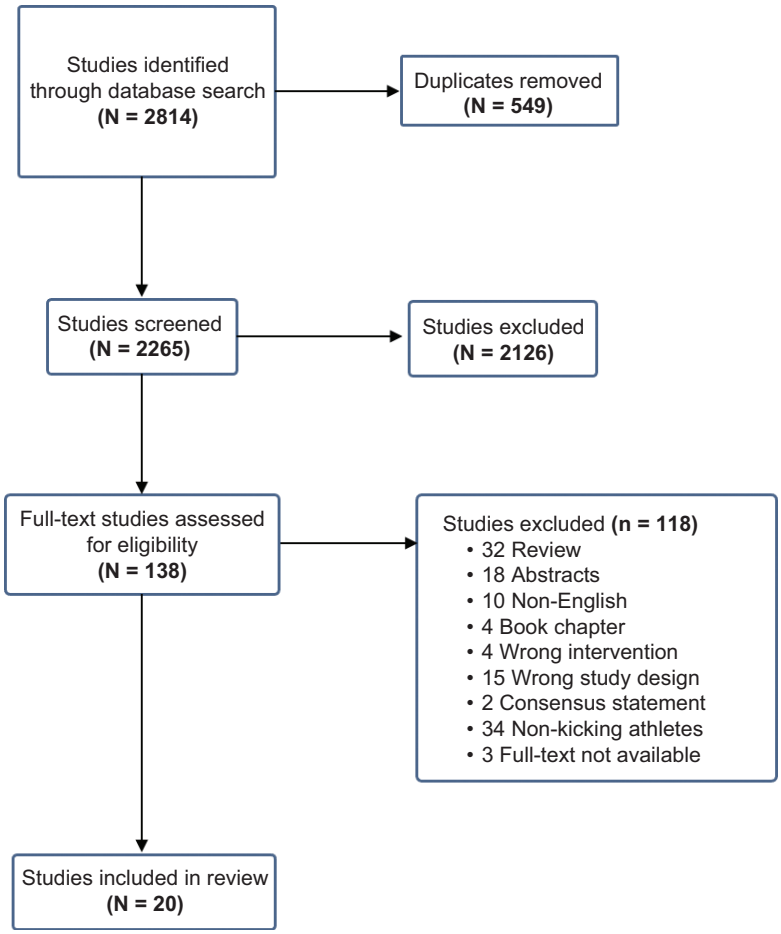

Figure 1: Flowchart of the studies involved.

Of the 20 studies, there were 2 randomized controlled trials, 1 retrospective cohort study, 4 case series, and 13 case reports. The average Coleman Methodology Score modified for conservative therapy for all included studies was 30.30 (range 18–74), and the overall quality was in the poor range. Only two studies were graded as "fair." The majority of the studies had fewer than 20 patients, and the follow-up was less than 12 months. Though descriptions of nonoperative interventions or procedures were at least fairly described in all the studies, post-intervention rehabilitation was only described in seven studies. The outcome criteria, assessment, and subject selection process were optimal in only two randomized control studies and fair in one case series.

A single randomized controlled trial assessed VAS, KOOS, and IKDC scores. The remainder of the studies looked at return to play (RTP) as a primary endpoint. The athletes included in these articles were predominantly soccer players; however, two studies included rugby players and an American football placekicker. The athletes ranged from non-professional to elite professional levels, with only two studies not specifically stating the athletes' level of competition. Two of the studies assessed RTP following prolotherapy, with the remaining papers evaluating RTP following PRP therapy. A patient in one case report was treated with BMAC injections in addition to PRP injections. The number of PRP injections varied from a single therapeutic injection to as many as four, and the protocols for the timing

Table 1. Modified Coleman Methodology Scores for the Conservative Therapy of Included Studies

Title	Study Size	Follow-up	Number of different non-operative interventions or procedures	Type of Study	Diagnostic Certainty (use of pre-operative US, MRI)	Description of non-operative interventions or procedures	Description of post-intervention rehabilitation	Outcome Criteria	Procedure for assessing outcomes	Description of the subject selection process	Total Score
Gonzalez-Iglesias et al.[10] (2023)	4	2	10	15	5	5	0	10	9	10	70
Papalia et al.[11] (2016)	7	2	10	15	5	5	0	10	15	5	74
Bezuglov et al.[12] (2022)	10	0	10	0	5	3	10	0	4	5	47
Bezuglov et al.[13] (2022)	0	0	10	0	5	3	10	2	0	0	30
Topol et al.[14] (2005)	4	2	10	0	0	5	10	10	5	5	51
Yoshida et al.[15] (2019)	0	2	10	0	5	5	0	2	0	0	24
Zanon et al.[16] (2016)	0	5	0	0	5	5	0	4	0	0	19
Campbell et al.[17] (2023)	0	0	0	0	5	3	0	2	0	0	10
Dauty et al.[18] (2014)	0	2	10	0	5	3	0	0	0	0	20
Dragoo et al.[19] (2021)	0	0	10	0	5	3	0	0	0	0	18
Olmo et al.[20] (2018)	0	5	10	0	5	5	10	0	0	0	35
Pogliacomi et al.[21] (2019)	0	0	10	0	5	3	0	0	0	0	18
Eirale et al.[22] (2013)	0	2	10	0	5	5	10	0	0	0	32
Schroeder et al.[23] (2020)	0	0	10	0	5	5	0	0	0	0	20
Redler et al.[24] (2020)	0	0	10	0	5	3	0	0	0	0	18
Gözübüyük et al.[25] (2018)	0	2	10	0	5	3	10	0	0	0	30
Mathieu et al.[26] (2020)	0	0	10	0	5	3	0	0	0	0	18
Park et al.[27] (2022)	0	2	10	0	5	5	10	0	0	0	32
Iyengar et al.[28] (2023)	0	0	10	0	5	5	0	0	0	0	20
Suzue et al.[29] (2014)	0	0	10	0	5	5	0	0	0	0	20

of the injections varied among the studies. Nine of the studies specified the brand of PRP system utilized for the preparation of the concentrate, and four of the studies reported the estimated platelet cell counts. Each of the studies evaluating prolotherapy reported the specific injectate composition. Narrative analysis of the included studies is summarized in Table 2.

Randomized Controlled Trial

Gonzalez-Iglesias et al.[13] evaluated the RTP timeline for professional soccer athletes with an acute Grade 3B hamstring injury after two PRP injections in comparison to two Traumeel injections. A total of 40 athletes were included in the final analysis. The study found that the PRP group had an average RTP of 27.2 ± 6.5 days, compared to the Traumeel group, which averaged 32.6 ± 12.4 days ($P = 0.13$).

Papalia et al.[14] assessed PRP use in professional soccer athletes with evidence of osteoarthritis of the knee. Athletes were randomized to the control group receiving three hyaluronic acid (HA) injections and the experimental group receiving three PRP injections. They found the IKDC scores from baseline to 12-month follow-up for HHA versus PRP to be 38.8 versus 39.8 ($P = 0.286$), 53.1 versus 51.4 ($P = 0.001$), 60.4 versus 56.3 ($P = 0.180$), and 59.8 versus 57.3 ($P = 0.125$), respectively. The KOOS scores across all time points comparing HHA versus PRP were 43.4 versus 43.1 ($P = 0.579$), 52.1 versus 50.1 ($P = 0.002$), 53.1 versus 51.7 ($P = 0.006$), and 52.8 versus 51.9 ($P = 0.099$). Finally, the reported VAS scores between the HHA versus PRP groups were 7.5 versus 7.4 ($P = 0.841$), 3.8 versus 5.0 ($P = 0.000$), 2.9 versus 3.3 ($P = 0.043$), and 3.2 versus 3.4 ($P = 0.570$).

Retrospective Cohort

Bezuglov et al.[15] assessed the effectiveness of PRP on Grade 2A and 2B muscle injuries involving the adductors (65.8%), hamstring (19%), calf (11.4%), and quadriceps (3.8%) in professional soccer players. The study compared 33 athletes in the control group who received rehabilitation alone with the 34 athletes in the PRP intervention cohort. For the athletes who received PRP therapy, they fell into one of the three treatment plans: "(i) single PRP injection of 8–10 mL (n = 12); (ii) three PRP injections of 3–5 mL (n = 6) with an interval of 5–7 days between injections; amd (iii) three PRP injections of 8–10 mL (n = 16) with an interval of 5–7 days between injections." The PRP group treatment length was significantly longer compared to the rehabilitation alone group, 21.5 ± 15.7 days versus 15.3 ± 11.1 days, respectively ($P < 0.05$).

Case Series

Bezuglov et al.[16] reported on seven professional soccer players who suffered a fifth metatarsal fracture and received subsequent PRP injection. Each athlete received a total of three PRP injections. Time to return to activity ranged from 43 to 54 days.

Topol et al.[17] assessed 22 elite rugby and 2 elite soccer players diagnosed with adductor tendinosis and osteitis pubis. Each athlete underwent anywhere between one and six prolotherapy treatments. Following treatment, 22 out of 24 athletes were able to return to play by 17.2 months from injury. The athletes who received 1–2 treatments were reportedly able to return to play by 6 weeks posttreatment.

Three soccer athletes, of an unspecified competitive level, received PRP injections for treatment of MCL ligament injuries, as described by Yoshida et al.[18] Two of the athletes received a single PRP injection, and one athlete received two injections. The average RTP was 10 weeks, with a range of 8–12 weeks.

Zanon et al.[19] evaluated 18 professional soccer players with Grade 2A, 2B, and 2C hamstring injuries. Athletes with a Grade 2A injury received two PRP injections, and the Grade 2B and 2C injuries received three PRP injections each. For all athletes, the average amount of time absent from sports participation was 36.7 ± 19 days.

Case Reports

A professional soccer athlete with an anterolateral hip capsule defect received total three PRP and two BMAC injections, as described by Campbell et al.[20] The athlete was able to return to play in 8 weeks.

Dauty et al.[21] treated a professional soccer player with an oblique muscle strain with a single PRP

Table 2. Summary of Included Studies in the Final Analysis

Author and Year	Study Design	Pathology	Athletes/Sport	# of athletes	Orthobiologics Injection Characteristics	Control Injection Characteristics	Adjunctive Treatments	Primary Outcome Measures	Time to Return to Play/Competition	Additional Information
Gonzalez-Iglesias et al.,[10] 2023	RCT	3B hamstring muscle injury	Soccer (professional)	40	2 PRP injections	2 Traumeel injections	Progressive strengthening program	Return to Play	Control: 32.6 ± 12.4 days Intervention: 27.1 ± 6.5 days ($P = 0.13$)	3 recurrent injuries in the PRP group; 3 recurrent injuries in the control group
Papalia et al.,[11] 2016	RCT	Knee OA (KL grade 1 or 2)	Soccer (professional)	57	3 PRP Injections	3 hyaluronic acid injections	N/A	VAS/KOOS/ IKDC scoring	IKDC (P = 0.125); KOOS ($P = 0.099$); VAS ($P = 0.570$)	No adverse outcomes
Bezuglov et al.,[12] 2022	Retrospective Cohort	Grade 2A-2B Muscle injuries	Soccer (professional)	67	1–2 PRP injections	N/A	POLICE, NSAIDs, and soccer-specific rehabilitations	Return to play	Control: 15.3 ± 11.1 days Intervention: 21.5 ± 15.7 days ($P < 0.05$)	10.1% injury recurrence rate
Bezuglov et al.,[13] 2022	Case Series	5th Metatarsal Fracture	Soccer (professional)	7	3 PRP Injections	N/A	POLICE and PT	Return to play	43 to 54 days	N/A
Topol et al.,[14] 2005	Case Series	Adductor Tendinosis and Osteitis Pubis	22 Rugby and 2 Soccer (Elite)	24	1–6 Prolotherapy (12.5% Dextrose and 0.5% Lidocaine)	N/A	N/A	Visual Analog Scale (VAS) for pain	6.3 ± 1.4 vs 1.0 ± 2.4 ($P < 0.001$)	22/24 returned to play by 17.2 months
Yoshida et al.,[15] 2019	Case Series	MCL Ligament Injuries	Soccer (doesn't specify level)	3	1–2 PRP Injections	N/A	N/A	Return to play	10 weeks (8–12)	NWB × 1 week. ROM with gradual weight bearing. Full weight-bearing at 3 weeks postinjection.
Zanon et al.,[16] 2016	Case Series	Grade 2a-c hamstring tears	Soccer (professional)	18 athletes (25 injuries)	2 PRP (2a lesions) vs 3 PRP (2b & 2c lesions) injections	N/A	N/A	Return to play	36.7 ± 19 days	N/A
Campbell et al.,[17] 2023	Case Report	Anterolateral hip capsule defect and gluteus minimus tear	Soccer (professional)	1	3 PRP Injections and 2 BMAC injections	N/A	N/A	Return to play	8 weeks	N/A
Dauty et al.,[18] 2014	Case Report	Oblique muscle strain	Soccer (professional)	1	1 PRP injection	N/A	N/A	Return to play	21 days	N/A
Dragoo et al.,[19] 2021	Case Report	Grade 2 Quadriceps strain	American Football (placekicker, DI college)	1	1 PPP Injection	N/A	N/A	Return to play	Within 2 months	Remained on Indomethacin for 1 week for heterotopic ossification prevention
Olmo et al.,[20] 2018	Case Report	Avulsion of proximal rectus femoris tendons	Soccer (professional)	1	2 PRP Injections	N/A	PT	Return to play	101 days (Return to competition at 115 days)	N/A
Pogliacomi et al.,[21] 2019	Case Report	Proximal rectus femoris tendon rupture	Soccer (non-professional)	1	3 PRP injections	N/A	N/A	Return to play	90 days	N/A
Eirale et al.,[22] 2013	Case Report	Grade 3 MCL tear	Soccer (professional)	1	3 PRP injections	N/A	N/A	Return to play	18 days to full practice; 25 days to competition	N/A

(Continues)

Schroeder et al.,[23] 2020	Case Report	PCL Sprain with adjacent PCL cyst	Soccer	1	1 prolotherapy injection (50% Dextrose, sterile water, 1% lidocaine)	N/A	Cyst fenestration	Return to play	Unable to determine due to coinciding ankle injury	N/A
Redler et al.,[24] 2020	Case Report	Patellar tendinopathy	Soccer (former semi-pro)	1	4 PRP injections	N/A	N/A	Return to play	RTS at the lower level after PRP; 6 months after surgical repair	Patellar tendon rupture ~4 months after PRP series
Gözübüyük et al.,[25] 2018	Case Report	Adductor longus proximal tendon rupture	Soccer (professional)	1	4 PRP injections	N/A	N/A	Return to play	9 weeks full return to practice; 11 weeks return to competition	N/A
Mathieu et al.,[26] 2020	Case Report	Arcuate pubic ligament rupture	Soccer (competitive)	1	1 PRP injection	N/A	N/A	Return to play	Within 4 weeks	N/A
Park et al.,[27] 2022	Case Report	Osteitis pubis	Soccer	1	1 PRP Injection	N/A	N/A	Return to play	8 weeks	N/A
Iyengar et al.,[28] 2023	Case Report	Partial thickness tear of the accessory tibionavicular muscle	Soccer	1	1 PRP Injection	N/A	Dry needling	N/A	N/A	N/A
Suzue et al.,[29] 2014	Case Report	Plantar fascia rupture	Soccer (professional)	1	2 PRP injections	N/A	N/A	Return to play	5 months	N/A

injection. The athlete returned to play 21 days following the treatment.

An American football placekicker who suffered a Grade 2 longitudinal tear in the rectus femoris and myotendinous junction was treated by Dragoo et al.[22] with a single PPP injection. The athlete returned to baseline 1 month following the treatment.

Similarly, a professional soccer athlete with a severe or subtotal avulsion of the proximal left rectus femoris tendon received two PRP injections in the study by Olmo et al.[23] The athlete returned to full training and competition 101 days and 115 days post-injury, respectively.

Pogliacomi et al.[24] used a series of three PRP injections to treat a nonprofessional soccer player with a proximal rectus femoris tendon rupture. The athlete returned to the pre-injury level of activity 90 days after the injury, 45 days after the treatment.

Eirale et al.[25] treated a professional soccer player with a complete MCL tear with a series of three PRP injections. The athlete returned to full participation in practice at 18 days and competition at 25 days after the injury.

Another soccer player was treated by Schroeder et al.[26] for a PCL sprain with an adjacent PCL cyst. They completed cyst fenestration along with injection of a prolotherapy injectate, leading to improvement. Unfortunately, they suffered a coincident ankle injury, which prevented accurate evaluation for return to play criteria.

Alternatively, Redler et al.[27] treated a former semiprofessional soccer athlete with patellar tendinopathy with a series of four PRP. Following the injection series, the athlete was only able to return to sports at a lower level. Subsequently, the athlete suffered a complete patellar tendon rupture, requiring surgical treatment.

Gözübüyük et al.[28] treated a professional soccer player with an adductor longus proximal tendon rupture with PRP. A total of four injections were administered. The player was able to return to full training at 9 weeks and competition at 11 weeks post-injury.

Mathieu et al.[29] treated a competitive soccer player with an arcuate pubic ligament rupture with a single PRP injection. The athlete returned to competition within 4 weeks of the treatment.

Park et al.[30] treated a soccer athlete with osteitis pubis with a single PRP injection, and the athlete returned to their previous level of play at 8 weeks.

Iyengar et al.[31] treated a soccer athlete with a partial thickness tear of an accessory tibionavicular muscle with a single PRP injection. The athlete reported significant improvement. However, no specific time to return to play was recorded.

Suzue et al.[32] treated a professional soccer athlete with a plantar fascia rupture using a series of two PRP injections. The athlete was able to return to their original level of training at 5 months post-injury.

DISCUSSION

Orthobiologics have gained significant attention as a treatment modality for various musculoskeletal conditions, providing a novel approach to promote healing and improve treatment outcomes. The primary goal of our study was to review the use of various orthobiologic modalities and their effectiveness in treating sports-related lower extremity injuries in kicking athletes and to thereby provide an evidence-based resource for clinicians to use when treating kicking athletes at all athletic levels. Despite broad searching criteria, PRP was the main orthobiologic treatment reported in this population. It was interesting to see the paucity of literature on other orthobiologics in this specific population, despite the increased popularity of orthobiologics. Of the 20 studies, about two-thirds of the studies were case series or reports, which are considered the lowest evidence tier. Additionally, two randomized controlled trials had a small number of subjects. As such, it is difficult to make definitive recommendations given the lack of high-quality scientific evidence. Additionally, comparison and outcome interpretation are limited due to heterogeneity of the PRP protocols, postinjection protocols, and pathology included in this review.

A study by Gonzalez-Iglesias et al.[13] illustrated no significant difference between PRP and Traumeel injections when treating hamstring injury. Similarly, a systematic review by Sheth et al.[33] did not find any difference in return to sport with the use of PRP for Grade I or II hamstring strain. On the other hand, a more recent systematic review by Seow et al.[34] demonstrated that in the short term, there is statistically nonsignificant evidence of decreased duration to return to sport or recurrence rates with PRP ± PT when compared to no treatment or PT alone. To the best of our knowledge, there is no consensus on the PRP protocol when treating hamstring injuries. Furthermore, there may be confounding variables that could alter the recovery process of the hamstring injury, including the injury location, the athlete's age, and the timing.[13] Although a quantitative count of platelets is not often evaluated or reported in either research studies or in clinical settings, a recent narrative review did find that a greater platelet dose was generally associated with positive outcomes based on several orthobiologic studies.[35] Thus, standardization of the protocol is warranted, focusing on the timing, PRP dosing or concentration, and number of PRP injections based on the degree and location of the injury.

When treating athletes, it is crucial to understand the potential clinical impact of time to return to play, as quicker recovery will likely allow an athlete to play additional games during a season. The majority of the included studies reported time to return to play, ranging from 18 days to 516 days.[13,15,17–25,28–30,32] Of note, a study by Bezuglov et al.[15] found a significant increase in time to return to sport in athletes treated with PRP. However, they stated, "this may reflect the tendency to use PRP in higher-degree injuries," as the team physician from each team independently selected the athletes for PRP injection.[15] As PRP was used in "higher-degree injuries," this may have confounded return to play outcomes. In fact, though limited, the current evidence suggests that the treatment of acute Grade I or II muscle strains, except for hamstring strains, with PRP may lead to a shorter return to play without a significant increase in risk of recurrence at 6-month follow-up.[33] However, not all the studies included in this review provided explicit return to play definitions, including objective criteria such as isokinetic strength testing and pain-free kicking drills, and thus it is warranted to create more definitive return to play criteria when conducting studies looking at the effectiveness of orthobiologics in this patient population in the future.

Though PRP is generally considered safe, it is important to understand the potential adverse events

associated with the treatment. Redler et al.[27] reported a patellar tendon rupture following a series of four PRP injections, requiring surgical intervention. On the other hand, studies included in a recent systematic review by Barman et al.[36] did not show a significant adverse effect, demonstrating the safety of PRP use in patellar tendinopathy. Regardless, studies on the utilization of PRP for patellar tendinopathy have reported mixed outcomes.[36–40] There was no significant benefit of leucocyte-rich or poor PRP over control when treating patellar tendinopathy. In fact, a worsening of symptoms was reported for those who received leucocyte-rich PRP, probably due to a localized inflammation in the setting of the introduction of WBCs.[39] However, it appears that multiple PRP injections yield greater long-term improvement when treating chronic patellar tendinopathy.[37] Compared to other available literature,[38,41,42] the athlete in this case report received a greater number of injections, possibly leading to increased mechanical stress on the tendon from intratendinous injection, resulting in tendon rupture. There was also no mention of a specific postinjection rehabilitation protocol, which could have affected the outcome of the case. In fact, only 7 out of 20 studies described a postinjection rehabilitation protocol. This case highlights the need for agreement on who is the ideal athlete to be treated with orthobiologics and what are the effective PRP and postinjection rehabilitation protocols when treating athletes with patellar tendinopathy to avoid potential devastating complications.

In recent years, there has been a growing body of evidence supporting a potential benefit of PPP over PRP for the treatment of muscle injuries, which are common in kicking sports. Although evidence is limited, it has been suggested that PPP may provide faster healing potentials without increased risk of recurrence of muscle injuries.[43] Further high-quality studies are warranted in determining the usefulness of orthobiologics for muscle injury in kicking athletes.

CONCLUSIONS

In this focused review, we have provided the state of orthobiologics in kicking athletes with various pathologies. Though evidence is limited, and results appear to be mixed, the authors suggest that PRP and prolotherapy are likely safe and effective treatment alternatives for those who are refractory to other conservative treatments before proceeding with surgical intervention, except for hamstring strain. Future studies should evaluate orthobiologics interventions, focusing on the timing, dosing or concentration, and number of injections, allowing clinicians to make better evidence-based recommendations when treating kicking athletes.

ACKNOWLEDGMENTS

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

The authors declare that there are no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

No financial disclosure.

The current address for Haruki Ishii, MD, is 55 East 55th Street, 4th Floor, New York, NY 10022.

The current address for Justin Dzierzawski, MD, is 102 Irving Street NW, Washington, DC 20010.

AUTHORS' CONTRIBUTION

Conception and design: All authors.
Collection and assembly of data: H.I. and J.D.
Data Analysis and Interpretation: All authors.
Manuscript Writing: All authors.
Final Approval of Manuscript: All authors.

REFERENCES

1. Hulteen RM, Smith JJ, Morgan PJ, Barnett LM, Hallal PC, Colyvas K, et al. Global participation in sport and leisure-time physical activities: A systematic review and meta-analysis. Prev Med. 2017;95:14–25. https://doi.org/10.1016/j.ypmed.2016.11.027
2. Forsythe B, Knapik DM, Crawford MD, Diaz CC, Hardin D, Gallucci J, et al. Incidence of injury for professional soccer players in the United States: A 6-year prospective study major league soccer. Orthop J Sports Med. 2022;10(3):23259671211055136. https://doi.org/10.1177/23259671211055136

3. López-Valenciano A, Ruiz-Pérez I, Garcia-Gómez A, Vera-Garcia FJ, De Ste Croix M, Myer GD, et al. Epidemiology of injuries in professional football: A systematic review and meta-analysis. Br J Sports Med. 2020;54(12):711–8. https://doi.org/10.1136/bjsports-2018-099577
4. Arundale A, Silvers H, Logerstedt D, Rojas J, Snyder-Mackler L. An interval kicking progression for return to soccer following lower extremity injury. Int J Sports Phys Ther. 2015;10(1):114–27.
5. Gabbe BJ, Finch CF, Bennell KL, Wajswelner H. Risk factors for hamstring injuries in community level Australian football. Br J Sports Med. 2005;39(2):106–10. https://doi.org/10.1136/bjsm.2003.011197
6. Brooks JHM, Fuller CW, Kemp SPT, Reddin DB. Incidence, risk, and prevention of hamstring muscle injuries in professional rugby union. Am J Sports Med. 2006;34(8):1297–306. https://doi.org/10.1177/0363546505286022
7. Zhang L, Li H, Garrett WE, Liu H, Yu B. Hamstring muscle-tendon unit lengthening and activation in instep and cut-off kicking. J Biomech. 2020;99:109482. https://doi.org/10.1016/j.jbiomech.2019.109482
8. Noback PC, Donnelley CA, Yeatts NC, Parisien RL, Fleischli JE, Ahmad CS, et al. Utilization of orthobiologics by sports medicine physicians: A survey-based study. J Am Acad Orthop Surg Glob Res Rev. 2021;5(1):e20.00185. https://doi.org/10.5435/JAAOSGlobal-D-20-00185
9. Cole BJ, Gilat R, DiFiori J, Rodeo SA, Bedi A. The 2020 NBA Orthobiologics Consensus Statement. Orthop J Sports Med. 2021;9(5):232596712110 02296. https://doi.org/10.1177/23259671211002296
10. Marín Fermín T, Papakostas E, Macchiarola L, Zampeli F, Kalifis G, De Girolamo L, et al. Injectable orthobiologics in professional football (soccer) players: A systematic review. J Cartil Joint Preserv. 2022;2(2):100050. https://doi.org/10.1016/j.jcjp.2022.100050
11. Coleman BD, Khan KM, Maffulli N, Cook JL, Wark JD. Studies of surgical outcome after patellar tendinopathy: Clinical significance of methodological deficiencies and guidelines for future studies. Victorian Institute of Sport Tendon Study Group. Scand J Med Sci Sports. 2000;10(1):2–11. https://doi.org/10.1034/j.1600-0838.2000.010001002.x
12. Abdul-Wahab TA, Betancourt JP, Hassan F, Thani SA, Choueiri H, Jain NB, et al. Initial treatment of complete rotator cuff tear and transition to surgical treatment: Systematic review of the evidence. Muscles Ligaments Tendons J. 2016;6(1):35–47. https://doi.org/10.11138/mltj/2016.6.1.035
13. Gonzalez-Iglesias J, Lekue JA, Larruskain J, Calleja-Gonzalez J, Burgos-Alonso N, Andia I. Platelet-rich plasma injections for acute hamstring muscle injuries: A randomized controlled trial in soccer players. Sports Orthopaedics and Traumatology. 2023;39(3):292–303. https://doi.org/10.1016/j.orthtr.2023.03.082
14. Papalia R, Zampogna B, Russo F, Vasta S, Tirindelli MC, Nobile C, et al. Comparing hybrid hyaluronic acid with PRP in end career athletes with degenerative cartilage lesions of the knee. J Biol Regul Homeost Agents. 2016;30(4 Suppl 1):17–23.
15. Bezuglov E, Khaitin V, Shoshorina M, Butovskiy M, Karlitskiy N, Mashkovskiy E, et al. Sport-specific rehabilitation, but not PRP injections, might reduce the re-injury rate of muscle injuries in professional soccer players: A retrospective cohort study. J Funct Morphol Kinesiol. 2022;7(4):72. https://doi.org/10.3390/jfmk7040072
16. Bezuglov E, Zholinsky A, Chernov G, Khaitin V, Goncharov E, Waśkiewicz Z, et al. Conservative treatment of the fifth metatarsal bone fractures in professional football players using platelet-rich plasma. Foot Ankle Spec. 2022;15(1):62–6. https://doi.org/10.1177/19386400211017368
17. Topol GA, Reeves KD, Hassanein KM. Efficacy of dextrose prolotherapy in elite male kicking-sport athletes with chronic groin pain. Arch Phys Med Rehabil. 2005;86(4):697–702. https://doi.org/10.1016/j.apmr.2004.10.007
18. Yoshida M, Marumo K. An autologous leukocyte-reduced platelet-rich plasma therapy for chronic injury of the medial collateral ligament in the knee: A report of 3 successful cases. Clin J Sport Med. 2019;29(1):e4–e6. https://doi.org/10.1097/JSM.0000000000000515
19. Zanon G, Combi F, Combi A, Perticarini L, Sammarchi L, Benazzo F. Platelet-rich plasma in the treatment of acute hamstring injuries in professional football players. Joints. 2016;4(1):17–23. https://doi.org/10.11138/jts/2016.4.1.017
20. Campbell KJ, Boykin RE, Wijdicks CA, Erik Giphart J, LaPrade RF, Philippon MJ. Treatment of a hip capsular injury in a professional soccer player with platelet-rich plasma and bone marrow aspirate concentrate therapy. Knee Surg Sports Traumatol Arthrosc. 2013;21(7):1684–8. https://doi.org/10.1007/s00167-012-2232-y

21. Dauty M, Menu P, Dubois C. Uncommon external abdominal oblique muscle strain in a professional soccer player: A case report. BMC Res Notes. 2014;7:684. https://doi.org/10.1186/1756-0500-7-684
22. Dragoo J, Hwang CE. Use of platelet-poor plasma in acute quadriceps muscle strain in a Division I football placekicker: A case report. Curr Sports Med Rep. 2021;20(11):572–4. https://doi.org/10.1249/JSR.0000000000000901
23. Olmo J, Aramberri M, Almaraz C, Nayler J, Requena B. Successful conservative treatment for a subtotal proximal avulsion of the rectus femoris in an elite soccer player. Phys Ther Sport. 2018;33:62–9. https://doi.org/10.1016/j.ptsp.2018.07.004
24. Pogliacomi F, Visigalli A, Valenti PG, Pedrazzini A, Bernuzzi G, Concari G, et al. Rectus femoris myotendinous lesion treated with PRP: A case report. Acta Biomed. 2019;90(12–S):178–83. https://doi.org/10.23750/abm.v90i12-S.8932
25. Eirale C, Mauri E, Hamilton B. Use of platelet rich plasma in an isolated complete medial collateral ligament lesion in a professional football (soccer) player: A case report. Asian J Sports Med. 2013;4(2):158–62. https://doi.org/10.5812/asjsm.34517
26. Schroeder A, Onishi K. Vague posterior knee discomfort in a soccer player: A clinical vignette. Am J Phys Med Rehabil. 202;99(4):e46–9. https://doi.org/10.1097/PHM.0000000000001248
27. Redler A, Proietti L, Mazza D, Koverech G, Vadala A, De Carli A, et al. Rupture of the patellar tendon after platelet-rich plasma treatment: A case report. Clin J Sport Med. 2020;30(1):e20–e22. https://doi.org/10.1097/JSM.0000000000000703
28. Gözübüyük ÖB, Moen MH, Akman M, Ipseftel I, Karakuzu A. Successful return to play following adductor longus proximal tendon rupture in professional soccer without re-injury at 12 months: A case report. J Back Musculoskelet Rehabil. 2018;31(3):583–7. https://doi.org/10.3233/BMR-170857
29. Mathieu T, Gielen J, Vyncke G, Stassijns G. Arcuate pubic ligament injury—An unknown cause of athletic pubalgia. Clin J Sport Med. 2020;30(5):e175–e177. https://doi.org/10.1097/JSM.0000000000000771
30. Park DJ, Sussman WI. Osteitis pubis treated with platelet-rich plasma: A case report. Clin J Sport Med. 2022;32(2):e172–e174.https://doi.org/10.1097/JSM.0000000000000875
31. Iyengar KP, Sharma GK, Botchu R. Accessory tibionavicular muscle: An unusual cause of medial ankle pain. Indian J Radiol Imaging. 2023;33(4):555–9. https://doi.org/10.1055/s-0043-1769472
32. Suzue N, Iwame T, Kato K, Takao S, Tateishi T, Takeda Y, et al. Plantar fascia rupture in a professional soccer player. J Med Invest. 2014;61(3–4):413–6. https://doi.org/10.2152/jmi.61.413
33. Sheth U, Dwyer T, Smith I, Wasserstein D, Theodoropoulos J, Takhar S, et al. Does platelet-rich plasma lead to earlier return to sport when compared with conservative treatment in acute muscle injuries? A systematic review and meta-analysis. Arthroscopy. 2018;34(1):281–288.e1. https://doi.org/10.1016/j.arthro.2017.06.039
34. Seow D, Shimozono Y, Tengku Yusof TNB, Yasui Y, Massey A, Kennedy JG. Platelet-rich plasma injection for the treatment of hamstring injuries: A systematic review and meta-analysis with best–worst case analysis. Am J Sports Med. 2021;49(2):529–37. https://doi.org/10.1177/0363546520916729
35. Everts PA, Lana JF, Onishi K, Buford D, Peng J, Mahmood A, et al. Angiogenesis and tissue repair depend on platelet dosing and bioformulation strategies following orthobiological platelet-rich plasma procedures: A narrative review. Biomedicines. 2023;11(7):1922. https://doi.org/10.3390/biomedicines11071922
36. Barman A, Sinha MK, Sahoo J, Jena D, Patel V, Patel S, et al. Platelet-rich plasma injection in the treatment of patellar tendinopathy: A systematic review and meta-analysis. Knee Surg Relat Res. 2022;34(1):22. https://doi.org/10.1186/s43019-022-00151-5
37. Andriolo L, Altamura SA, Reale D, Candrian C, Zaffagnini S, Filardo G. Nonsurgical treatments of patellar tendinopathy: Multiple injections of platelet-rich plasma are a suitable option: A systematic review and meta-analysis. Am J Sports Med. 2019;47(4):1001–18. https://doi.org/10.1177/0363546518759674
38. Zayni R, Thaunat M, Fayard JM, Hager JP, Carrillon Y, Clechet J, et al. Platelet-rich plasma as a treatment for chronic patellar tendinopathy: Comparison of a single versus two consecutive injections. Muscles Ligaments Tendons J. 2015;5(2):92–8.
39. Scott A, LaPrade RF, Harmon KG, Filardo G, Kon E, Della Villa S, et al. Platelet-rich plasma for patellar tendinopathy: A randomized controlled trial of leukocyte-rich PRP or leukocyte-poor PRP versus saline. Am J Sports Med. 2019;47(7):1654–61. https://doi.org/10.1177/0363546519837954
40. Liddle AD, Rodríguez-Merchán EC. Platelet-rich plasma in the treatment of patellar

tendinopathy: A systematic review. Am J Sports Med. 2015;43(10):2583–90. https://doi.org/10.1177/0363546514560726

41. Filardo G, Kon E, Di Matteo B, Pelotti P, Di Martino A, Marcacci M. Platelet-rich plasma for the treatment of patellar tendinopathy: Clinical and imaging findings at medium-term follow-up. Int Orthop. 2013;37(8):1583–9. https://doi.org/10.1007/s00264-013-1972-8
42. Charousset C, Zaoui A, Bellaiche L, Bouyer B. Are multiple platelet-rich plasma injections useful for treatment of chronic patellar tendinopathy in athletes? A prospective study. Am J Sports Med. 2014;42(4):906–11. https://doi.org/10.1177/0363546513519964
43. Raum G, Kenyon C, Bowers R. Platelet-poor versus platelet-rich plasma for the treatment of muscle injuries. Curr Sports Med Rep. 2024;23(6):222–8. https://doi.org/10.1249/JSR.0000000000001173