*Pain Medicine*, 0(0), 2019, 1–8
doi: 10.1093/pm/pnz041
Original Research Article





# The Effectiveness of Autologous Platelet-Rich Plasma for Osteoarthritis of the Hip: A Retrospective Analysis

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Funding sources: The authors would like to thank Mrs. Althea Dursten for her generosity in providing funding for this study.

Disclaimer: The funders had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Conflicts of interest: The authors have no proprietary interests or other conflicts of interest with regards to the topic of this manuscript.

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## Abstract

**Background**. Platelet-rich plasma (PRP) is a minimally invasive treatment option to reduce pain and promote tissue healing. At the time this study was performed, there was limited published literature analyzing outcomes for patients treated with PRP for hip osteoarthritis. **Methods**. Thirty-six patients aged 49–85 ($66.0 \pm 12.1$) years with chronic hip pain who met inclusion criteria underwent image-guided intra-articular hip PRP injection. Outcomes were measured at baseline, two weeks, three months, and up to six months using the visual analog scale (VAS) for pain and the Hip Disability and Osteoarthritis Outcome Score (HOOS). The proportion of responders, as defined by a $\geq$50% reduction in VAS pain score, was assessed at three and six months. **Results**. At two weeks, there was a significant improvement ($P < 0.05$) of function in two HOOS subscales: Symptoms and Activities of Daily Living. There was a significant improvement in all HOOS categories at six months. A significant improvement in VAS was observed at six months (baseline VAS $= 6.9 \pm 0.7$ &$\rightarrow 4.3 \pm 1.8$, 95% confidence interval $= 2.0$ to 3.2, $P < 0.05$). Sixty-seven percent (24/36) of the patients reported a $\geq$50% improvement in pain at three months; 58% (21/36) reported a $\geq$50% improvement in pain at six months. Stratification by Kellgren-Lawrence grades revealed that 86% and 82% of the KL grades 1 and 2 were responders at six months, respectively. **Conclusions**. In patients with mild/moderate hip osteoarthritis, PRP may provide pain relief and functional improvement for up to six months.

**Key Words:** Osteoarthritis; Platelet-Rich Plasma; Hip Osteoarthritis; Regenerative Medicine

## Introduction

Osteoarthritis (OA) is a gradually evolving condition that begins with the loss of joint cartilage and eventually extends to the underlying bone. In the United States, OA is considered a leading cause of disability in an estimated 22.7 million adults and accounts for a significant financial burden on the health care system, with expenditures around $128 billion [2]. OA of the hip affects anywhere from 7% to 25% of Caucasians over 55 years of age. In a National Center for Health Statistics Data Brief from February 2015, the Centers for Disease Control reported that >300,000 total hip arthroplasty surgeries are performed annually, and hip OA is the most common reason for surgery [3,23,24]. Based on this information, it is clear that OA of the hip and the economic implications associated with this disease are affecting the health care system at large.

The diagnosis of hip OA includes clinical and radiographic evaluation. Patients often complain of groin pain, decreased hip range of motion (specifically with internal rotation), and associated stiffness [4]. On physical exam, hip provocation maneuvers have relatively high sensitivity for detecting intra-articular hip pathology, but relatively low specificity [5].

Nonsurgical treatment options for OA of the hip include physical therapy (PT), nonsteroidal anti-

inflammatory medications, intra-articular steroid injections, and viscosupplementation with hyaluronic acid products. There is promising evidence demonstrating that supervised land-based physical therapies improve pain and physical function; these improvements appear to last for three to six months [6]. A large meta-analysis that examined research spanning 35 years determined that 150 mg of diclofenac daily improved pain and function, but this regimen carries risks inherent to nonsteroidal anti-inflammatory drugs (NSAIDs) [7]. In a systematic review published in the *Archives of Physical Medicine and Rehabilitation*, viscosupplementation with hyaluronic acid was found to have little effect on pain and disability at three months and no difference at six months post-treatment [25]. Similarly, steroid injections were found to afford patients short-term pain relief but to have the potential to result in significant cartilage volume loss [22].

Platelet-rich plasma (PRP) is a minimally invasive treatment option to promote pain relief and tissue healing in chronic tendinous and cartilaginous injuries [8]. PRP is obtained by concentrating whole blood in a centrifuge to yield a product with a higher concentration of platelets above baseline [9–11]. The mechanism of action through which PRP works is via the release of growth factors (including type I insulin-like growth factor, vascular endothelial growth factor, and platelet-derived growth factor) and cytokines to promote regeneration and angiogenesis [1]. To date, the majority of PRP research has focused on chronic tendinopathies [12], although studies suggest that PRP may be used more broadly as a treatment for osteoarthritis, chronic ligamentous injury, and chronic muscle tears [8].

The use of PRP in cartilaginous injuries is an area of growing interest [13]. The ability of cartilage to heal is limited by its avascular structure and paucity of chondrocytes [14, 15]. Recent in vivo and in vitro studies have shown increased healing capacity when treated with PRP [11]. In an early pilot study, roughly 50% of patients diagnosed with knee OA experienced increased cartilage volume in the lateral and medial femoral condyles six months after receiving monthly PRP injections [2, 26]. Given these data, ongoing research is necessary to evaluate the role for PRP in repairing damaged cartilage or arresting the inflammatory process associated with degenerative OA of the hip. Moreover, further investigation into the anti-inflammatory effects of PRP is warranted. One study (N = 111) indicated that intra-articular injection of PRP resulted in significant functional improvement in patients with hip OA [4]. The aim of this investigation is to report the clinical effectiveness of image-guided PRP injections for the treatment of osteoarthritis of the hip.

## Methods

This study was performed at a single-center outpatient rehabilitation office at a large tertiary care hospital. After institutional review board approval was obtained, the records of patients diagnosed with hip osteoarthritis and treated with PRP between January 2013 and December 2014 were obtained using International Classification of Diseases (ICD-9) codes and Current Procedural Terminology (CPT) codes. Inclusion criteria were age 18 to 99 years, hip pain for at least four months, at least one positive physical exam maneuver(s) including internal rotation over pressure (IROP) and hip flexion adduction and internal rotation (FADIR), diagnosis of hip osteoarthritis on plain radiograph, failure to improve satisfactorily (defined by the patient as intolerable pain and functional limitations) with physical therapy (minimum three months), and oral pain medications +/- intra-articular steroid injections. Exclusion criteria were patients with a prior history of hip surgery and those who refused PRP. In addition, patients who received a steroid injection into the hip within three months, were taking NSAIDs or antiplatelet medications, or had any signs of infection were also excluded from the study. After a thorough review of the medical records, thirty-six patients fulfilled the inclusion criteria.

### Hip Osteoarthritis Classification

The Kellgren and Lawrence system is a method of classifying the severity of knee osteoarthritis (OA) using five grades [16].

- grade 0: no radiographic features of OA are present;
- grade 1: doubtful joint space narrowing (JSN) and possible osteophytic lipping;
- grade 2: definite osteophytes and possible JSN on anteroposterior weight-bearing radiograph;
- grade 3: multiple osteophytes, definite JSN, sclerosis, possible bony deformity;
- grade 4: large osteophytes, marked JSN, severe sclerosis, and definite bony deformity.

### Platelet-Rich Plasma: Preparation

Sixty milliliters of whole blood was drawn from each patient into a vacutainer tube. Two platelet-rich plasma (PRP) collection kits were used in this study, Cascade Fibrinet and Stryker RegenKit THT. Both kits have been shown to consistently isolate platelet concentration and plasma [17]. The sample was concentrated using a centrifuge with a double spin technique at 3,800 rpm for 1.5 minutes in the first cycle, followed by five minutes in the second. Care was taken to prepare a leukocyte-poor platelet-rich plasma injectate. No additive or activating agents were used in preparation of the PRP. The cascade PRP system demonstrates about 67% platelet capture efficiency compared with other commerically available systems including Magellan and Biomet (REF). In addition, this system produces the most leukocyte-poor PRP preparation. Despite tremendous variability of commercially available PRP concentrating systems and differences in the volume of whole blood needed, the cascade system

has demonstrated comparable platelet concentration to other systems including Arteriocyte and Biomet [27]. The Cascade system decreased the PRP white blood cell (WBC) concentration sixfold when compared with whole blood, whereas the GPS III and Magellan systems increased the PRP WBC concentration fivefold and twofold, respectively [27].

### PRP Injection Technique

Injection of PRP was performed using two (fluoroscopic or ultrasound) imaging-guided techniques. For the fluoroscopically guided procedure, the patient was placed in a supine position and prepped and draped in typical sterile fashion. Using antero-posterior fluoroscopic imaging, the skin was marked at a spot over the center of the femoral neck. A skin wheal using a 25-gauge needle was made, and deeper structures were anesthetized using local anesthetic. Once anesthetized, a 22-gauge, 3.5-inch spinal needle was directed toward the junction of the femoral head and neck. Once osseous contact was made, radio-opaque contrast medium was injected to confirm intra-articular flow.

Using ultrasound guidance, the anterior hip joint was directly visualized by placing the transducer longitudinally at the femoral head-neck junction. Following the sterile prep, the skin and subcutaneous tissues were anesthetized, and through this anesthetized track, a syringe containing 3 mL of 1% lidocaine attached to a 3.5-inch 22-gauge spinal needle was inserted approximately 3 cm. Using sterile ultrasound gel, the needle was guided toward the anterior joint capsule. Once the capsule was penetrated, the syringe containing the PRP was attached, and the injectate was delivered. A detailed depiction of the procedural technique with images has been previously described by Yasar et al. [18]. PRP was injected into the intra-articular, subcapsular space until resistance was met; 6 cc of leukocyte-poor PRP was injected into the joint, and the remaining 1 cc was injected into the extracapsular space. Immediately after the procedure, the needle was removed, and a sterile Band-Aid was placed over the injection site.

### Post PRP Protocol

Standard postinjection procedure was used for each patient. Days 0–3 consisted of minimizing activity and avoiding the use of anti-platelet medications, such as nonsteroidal anti-inflammatories and aspirin. Patients were instructed to use a walking aid, such as a single point cane or rolling walker, if necessary, and limit movement to a gentle active range of motion. During days 4–14, patients were instructed to build tolerance to everyday activities and stop using assistive walking devices. Active range of motion exercises could be performed. During weeks 2–8 postinjection, the patients were able to build strength to regain full range of motion and initiate a course of physical therapy. It was recommended to avoid strenuous activity such as running and jumping or any activity that resulted in pain and to continue active range of motion and stretching exercises.

### Outcome Measures

A primary outcome measure of this study was reduction in hip pain, as quantified by the 100-mm visual analog scale (VAS) for pain intensity; lower scores were indicative of less pain. The Hip Disability and Osteoarthritis Outcome Score (HOOS) was chosen as one of the main outcome measures for this study because it was designed as a means to evaluate the opinion of adults with hip disability, regardless of the presence of osteoarthritis [19]. This 40-item questionnaire consists of five subscales: Pain, Other Symptoms, Function in Activities of Daily Living (ADL), Function in Sport and Recreation (Sport/Rec), and Hip-Related Quality of Life (QOL). Scores are summarized for each subscale and transformed to a 0–100 scale (0 indicating extreme disability and 100 indicating no disability) [19]. Other commonly used tests, such as the Harris Hip Score (HHS) and the Oxford Hip Score (OHS), were not used because they were developed specifically to assess patients' results following hip surgery [19].

A secondary outcome measure was to analyze the proportion of responders in this study. Responders were defined as patients who reported a >50% improvement on pain scores assessed at each time interval.

### Statistical Analysis

Descriptive statistics (including mean, standard deviation, median, range, frequency, and percentage) were calculated to characterize the patient population. The one-sample paired *t* test was used to compare VAS and HOOS values between 1) pre-injection (baseline) and two weeks after the procedure, 2) pre-injection (baseline) and 12 weeks after the procedure, and 3) pre-injection (baseline) and six months after the procedure. In addition, patients were stratified by Kellgren/Lawrence classification, and a one-sample paired *t* test was used to compare VAS values between 1) pre-injection (baseline) and two weeks after the procedure, 2) pre-injection (baseline) and 12 weeks after the procedure, and 3) pre-injection (baseline) and six months after the procedure.

For responder analysis, a chi-square test was used to compare the proportion of responders to nonresponder in terms of radiographic grade of knee arthritis, defined by the Kellgren-Lawrence scale. Statistical significance was defined at a *P* value of <5% ($P < 0.05$).

## Results

A total of thirty-six subjects qualified for this study and underwent platelet-rich plasma injections for osteoarthritis of the hip. The average patient age (range) was $66.0 \pm 12.1$ (49 to 85) years, with a female gender

predominance of 66.6%. The average duration of symptoms before PRP intervention (range) was 9.5 (4–18) months. The baseline VAS as a group was 6.9 ± 0.7. Demographic data, along with stratification based on Kellgren-Lawrence scale, can be found in Table 1.

### Visual Analog Scale Scores (Cohort)

The average VAS score for the group was 6.9 ± 0.7 at baseline, and at two weeks, 12 weeks, and six months, it was 6.1 ± 1.4, 4.1 ± 2.2, and 4.3 ± 1.8, respectively. Although there was no significant improvement in pain at two weeks ($P = 0.07$), there was a statistically significant improvement at both 12-week and six-month follow-up ($P < 0.05$) (Table 2).

### Visual Analog Scale Scores (Stratified by Kellgren-Lawrence)

In patients whose radiographic hip arthritis grade was KL grades 1 and 2, there was a significant improvement in pain at both 12 weeks and six months (Tables 3 and 4). Conversely, patients who suffered from moderate/severe knee arthritis (KL grade 3 and 4) did not show a significant improvement in pain at any time interval (Table 5 and 6).

### Responder Analysis

Response to platelet-rich plasma for the treatment of hip arthritis was defined by a ≥50% reduction in pain scores. When analyzing the group as a whole, 67% of the group at 12 weeks and 58% of the group at six months reported ≥50% reduction in pain (Table 7). However, stratifying the proportion of responders by the Kellgren-Lawrence scale revealed more specific subset data. Even though there were more responders in the KL1 and KL2 grades at 12 weeks, there was no statistically significant difference at this time interval (Table 8). More compelling data at six months revealed that 86% and 82% of the patients categorized as KL grades 1 and 2, respectively, were categorized at responders. Yet only 44% and 33% of the patients categorized as KL grades 3 and 4, respectively, responded to the intervention. These findings were both clinically and statistically significant (Table 9).

### Hip Disability and Osteoarthritis Outcome Scale

When analyzing functional outcomes, the HOOS subscales were used. Improvements in both the ADL and Symptoms subscales were statistically significant at two weeks. At 12-week follow-up, all five subscales revealed a statistically improvement in function from baseline. Similarly, at six-month follow-up, all five subscales demonstrated a statically significant improvement from baseline (Table 10).

**Table 1.** Baseline demographic information (N = 36)

| | |
|---|---|
| Age, mean ± SD, y | 66.0 ± 12.1 |
| Gender, No. (%) | |
| Male | 12 (33.4) |
| Female | 24 (66.6) |
| Duration of symptoms, median (range), mo | 9.5 (4–18) |
| Pain at baseline, mean ± SD | 6.9 ± 0.7 |
| Kellgren Lawrence Hip Grading, mean ± SD | 2.6 ± 1.1 |
| Kellgren Lawrence Hip Grading, No. (%) | |
| 0 | 0 (0) |
| 1 | 7 (19) |
| 2 | 11 (31) |
| 3 | 9 (25) |
| 4 | 9 (25) |

## Discussion

The aim of this study was to demonstrate the clinical effectiveness of PRP in relieving pain and restoring function in patients with OA in the hip. All data were complete for 36/36 patients in this retrospective analysis. At two weeks, there was a statistically significant improvement ($P < 0.05$) of function in two HOOS subscales: Symptoms and Activities of Daily Living. There was a statistically significant improvement in all HOOS subscales (Pain, Symptoms, ADLs, Sports/Recreation, Quality of Life) starting at 12 weeks and persisting six months after intra-articular PRP injection. A statistically significant improvement in VAS was also observed at 12 weeks and six months (VAS baseline = 6.9 ± 0.7, 95% confidence interval [CI] = –0.03 to 0.83, $P = 0.07$; VAS 12 weeks = 4.1 ± 2.2, 95% CI = 2.0 to 3.6, $P < 0.05$; VAS six months = 4.3 ± 1.8, 95% CI = 2.0 to 3.2, $P < 0.05$) following PRP injection for hip osteoarthritis. These results also represent a clinically significant improvement in pain symptoms [20, 21]. Although there was no significant reduction in pain at two weeks following PRP injection, there was a clinical improvement in the ability to complete ADLs and a reduction in symptoms, as defined in the HOOS. We suspect that this may be a function of the effects of anti-inflammatory cytokines, such as IL-10 and alpha-2 macroglobulin, which have been implicated with the time-dependent effects of improvement in pain and function in other investigations [2]. The findings from this study indicate that in patients with chronic hip OA, image-guided intra-articular hip PRP injection may result in clinically significant pain reduction and improved function at 12 weeks, with continued effects at six months.

The findings of this investigation have a variety of implications. First, the data demonstrate that autologous injection of PRP may afford patients long-term functional restoration and pain relief—as much as 12 weeks to six months—without the risks associated with surgical intervention. Individuals with Kellgren/Lawrence scale grade 1 or grade 2 demonstrated significant improvements in pain and function, which suggests that early

**Table 2.** Change in VAS from baseline

| Baseline | 2 wk | Baseline vs 2 wk, 95% CI; *P* | 12 wk | Baseline vs 12 wk, 95% CI; *P* | 6 mo | Baseline vs 6 mo, 95% CI; *P* |
|---|---|---|---|---|---|---|
| 6.9 ± 0.7 | 6.1 ± 1.4 | –0.3 to 1.3; 0.07 | 4.1 ± 2.2* | 2.0 to 3.6; <0.05 | 4.3 ± 1.8* | 2.0 to 3.2; <0.05 |

CI = confidence interval; VAS = visual analog scale.
*Statistically significant.

**Table 3.** Change in VAS from baseline (Kellgren/Lawrence grade 1)

N = 7

| Baseline | 2 wk | Baseline vs 2 wk, 95% CI; *P* | 12 wk | Baseline vs 12 wk, 95% CI; *P* | 6 mo | Baseline vs 6 mo, 95% CI; *P* |
|---|---|---|---|---|---|---|
| 7.4 ± 0.5 | 5.6 ± 2.3 | –0.2 to 3.7; 0.07 | 2.6 ± 0.9 | 3.9 to 5.6; <0.05* | 3.2 ± 0.9 | 3.4 to 5.0; <0.05* |

CI = confidence interval; VAS = visual analog scale.
*Paired *t* test.

**Table 4.** Change in VAS from baseline (Kellgren/Lawrence grade 2)

N = 11

| Baseline | 2 wk | Baseline vs 2 wk, 95% CI; *P* | 12 wk | Baseline vs 12 wk, 95% CI; *P* | 6 mo | Baseline vs 6 mo, 95% CI; *P* |
|---|---|---|---|---|---|---|
| 6.6 ± 0.8 | 5.7 ± 1.2 | –0.0 to 1.8; 0.06 | 2.6 ± 0.9 | 3.3 to 4.8; <0.05* | 3.1 ± 1.1 | 2.6 to 4.4; <0.05* |

CI = confidence interval; VAS = visual analog scale.
* statistically significant.

**Table 5.** Change in VAS from baseline (Kellgren/Lawrence grade 3)

N = 9*

| Baseline | 2 wk | Baseline vs 2 wk, 95% CI; *P* | 12 wk | Baseline vs 12 wk, 95% CI; *P* | 6 mo | Baseline vs 6 mo, 95% CI; *P* |
|---|---|---|---|---|---|---|
| 6.9 ± 0.6 | 6.5 ± 0.9 | 0.3 to 1.9; 0.07 | 5.1 ± 2.3 | –0.2 to 3.8; 0.72 | 5.3 ± 2.1 | –0.3 to 3.5; 0.93 |

CI = confidence interval; VAS = visual analog scale.
*Twelve weeks.

**Table 6.** Change in VAS from baseline (Kellgren/Lawrence grade 4)

N = 9*

| Baseline | 2 wk | Baseline vs 2 wk, 95% CI; *P* | 12 wk | Baseline vs 12 wk, 95% CI; *P* | 6 mo | Baseline vs 6 mo, 95% CI; *P* |
|---|---|---|---|---|---|---|
| 6.8 ± 0.7 | 6.2 ± 1.1 | –0.3 to 1.5; 0.19 | 5.7 ± 2.1 | –0.9 to 2.3; 0.36 | 5.2 ± 1.7 | –0.1 to 2.5; 0.07 |

CI = confidence interval; VAS = visual analog scale.
*Twelve weeks.

**Table 7.** >50% VAS reduction from baseline

| | VAS 2 wk, No. (%) | 95% CI | VAS 12 wk, No. (%) | 95% CI | VAS 6 mo, No. (%) | 95% CI |
|---|---|---|---|---|---|---|
| Responders | 3/36 (8) | –2.6 to 8.6 | 24/36 (67) | 10.1 to 38.0 | 21/36 (58) | 7.7 to 24.3 |
| Nonresponders | 33/36 (92) | 17.6 to 48.4 | 8/36 (33) | –0.9 to 16.9 | 15/36 (42) | 3.3 to 26.7 |

CI = confidence interval; VAS = visual analog scale.

intervention with PRP could delay disease progression. Finally, the data presented may shift practitioners toward utilizing PRP in lieu of intra-articular steroid injections, which are known to cause deleterious effects to chondral surfaces [22].

In 2017, Bennell et al. conducted a review of the literature evaluating the effectiveness of PRP for OA of the hip and knee. In the three articles they examined pertaining to OA of the hip, the data suggested that younger patients and those with less structural change (i.e., grade I or II on the Kellgren/Lawrence scale) may be more responsive to PRP. They were unable to identify any randomized controlled trials evaluating the efficacy of PRP in patients with advanced hip OA [1].

**Table 8.** Responder Characteristics Based on K-L Grade at 12 weeks

| | Responders at 12 wk | | | | |
|---|---|---|---|---|---|
| | Kellgren-Lawrence Grade 1 | Kellgren-Lawrence Grade 2 | Kellgren-Lawrence Grade 3 | Kellgren-Lawrence Grade 4 | |
| Responders (<50% reduction on VAS) | 6 | 8 | 5 | 3 | 22 |
| | *4.28* | *6.72* | *5.50* | *5.50* | |
| | (0.69) | (0.24) | (0.05) | (1.14) | |
| Nonresponders | 1 | 3 | 4 | 6 | 14 |
| | *2.72* | *4.28* | *3.50* | *3.50* | |
| | (1.09) | (0.38) | (0.07) | (1.79) | |
| | 7 | 11 | 9 | 9 | 36 |

Expected values are displayed in italics; individual $\chi^2$ values are displayed in parentheses.
$\chi^2 = 5.446$, df = 3, $\chi^2/df = 1.82$, $P(\chi^2 > 5.446) = 0.1419$.
VAS = visual analog scale.

**Table 9.** Responder Characteristics Based on K-L Grade at 6 months

| | Responders at 6 mo | | | | |
|---|---|---|---|---|---|
| | Kellgren-Lawrence Grade 1 | Kellgren-Lawrence Grade 2 | Kellgren-Lawrence Grade 3 | Kellgren-Lawrence Grade 4 | |
| Responders (<50% reduction on VAS) | 6 | 9 | 4 | 3 | 22 |
| | *4.28* | *6.72* | *5.50* | *5.50* | |
| | (0.69) | (0.77) | (0.41) | (1.14) | |
| Nonresponders | 1 | 2 | 5 | 6 | 14 |
| | *2.72* | *4.28* | *3.50* | *3.50* | |
| | (1.09) | (1.21) | (0.64) | (1.79) | |
| | 7 | 11 | 9 | 9 | 36 |

Expected values are displayed in italics; individual $\chi^2$ values are displayed in parentheses.
$\chi^2 = 7.742$, df = 3, $\chi^2/df = 2.58$, $P(\chi^2 > 7.742) = 0.0517$.
VAS = visual analog scale.

**Table 10.** Change in HOOS subscales from baseline

| | Baseline | 2 wk | 12 wk | 6 mo |
|---|---|---|---|---|
| HOOS Pain | 48.3 ± 4.5 | 56.8 ± 8.5 | 71.9 ± 12.8* | 79.1 ± 14.1* |
| HOOS Symptoms | 49.5 ± 5.6 | 52.6 ± 5.2* | 71.8 ± 13.2* | 79.1 ± 14.5* |
| HOOS ADL | 54.9 ± 3.4 | 65.6 ± 8.2* | 75.1 ± 5.9* | 82.6 ± 6.5* |
| HOOS Sports/Rec | 40.2 ± 3.4 | 47.9 ± 3.1 | 63.6 ± 12.5* | 70.0 ± 13.7* |
| HOOS QoL | 57.2 ± 2.9 | 68.2 ± 5.5 | 78.1 ± 11.7* | 85.9 ± 12.8* |

ADL = Activities of Daily Living subscale; HOOS = Hip Disability and Osteoarthritis Outcome Score; QoL = Quality of Life subscale.
*Statistically significant at $P < 0.05$.

Corticosteroid injections are commonly used to restore function and relieve pain in patients with osteoarthritis. Results from eight trials (four randomized controlled trials) examining the efficacy of intra-articular corticosteroid injection for knee OA demonstrated strong evidence to support the use of corticosteroid injections for short-term reductions in pain. In addition, corticosteroid injections were effective in patients whose symptoms were refractory to nonpharmacologic therapy or pharmacologic therapy with analgesic or NSAID therapy [22]. Steroid injections only benefit patients in the short term, and efficacy may decrease with repeat injections. Most compelling is that corticosteroids may contribute to decreases in cartilage volume, thereby perpetuating the disease process [22]. Although these data pertain to the knee, it is reasonable to assume that steroids would have the same effects in the hip. In contrast, the reparative factors theoretically associated with PRP, such as type I insulin-like growth factor, vascular endothelial growth factor, and platelet-derived growth factor, may increase cartilage volume and decrease inflammation.

The retrospective nature of this study prohibited us from having a control group or blinding, which could have introduced recall bias. We recognize that the majority of the patients in this study were female. In an internationally focused review assessing the epidemiology of hip and knee OA, Felson, et al. described a greater predisposition toward men being more commonly afflicted by hip

OA in England and Switzerland and equal rates between genders in other countries [3]. Given this potentially conflicting information, we elected not to make conclusions regarding the efficacy of injections based on gender in this analysis.

Standardizing the concentration of PRP is difficult given the inherent variability of patients' circulating blood products. This is a source of debate when analyzing the efficacy of PRP in the context of any investigation. One sentinel limitation of this paper is that the concentrations of platelets, leukocytes, and red blood cells were not obtained from each patient. Without this information, it is impossible to establish a correlation between dose and response. Both kits used in this paper have been shown to consistently isolate platelet concentration and plasma, so minimal variability would be expected between the two kits used [28]. Ultrasound and fluoroscopy are both commonly utilized modalities for guiding hip injections, and the two different approaches would be unlikely to alter results if the injectate were delivered into the joint capsule in either technique.

A novel element of this investigation was the injection of the residual PRP into the extracapsular space. This represents an area of potential future research, as there is a paucity of investigations evaluating the efficacy of combining intra- and extracapsular injections of PRP in the hip. This treatment could alter the environment within and around the joint and may, consequently, have variable effects on pain relief and function.

Further study is needed to definitively demonstrate the effectiveness of platelet-rich plasma injection for hip OA. In patients with mild/moderate hip osteoarthritis (Kellgren/Lawrence grades 1 and 2), platelet-rich plasma may provide pain relief and functional improvement up to six months, regardless of age. Our data suggest that PRP may be an effective means of treating patients in the early stages of hip OA and could possibly have a preventative effect. In addition, our data demonstrate significant improvement of pain and function from 12 weeks up to six months. A larger heterogeneous patient population is needed to determine the long-term benefits of PRP and the need for repeat hip injections. Therefore, prospective randomized controlled trials of PRP to treat or prevent hip OA warrant exploration.

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