

The Effect of Platelet-Rich Plasma Therapy on Unresolved Wrist Pain

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Abstract

Platelet-Rich Plasma (PRP) is a minimally invasive surgical alternative that uses components from a patient's own blood to regrow tissue and relieve pain. This study investigated the clinical effect of PRP on unresolved wrist pain as wrist injuries have become leading workplace impairment. Six patients and seven wrists underwent a series of two to four PRP injections for unresolved wrist pain. Outcomes of resting pain, active pain, upper functionality scale, and overall improvement percentage were measured and compared to baseline. The final follow-up was performed a mean of 6.57 months after injection. All patients included in the study experienced decreases in pain and improvement in functionality score at final follow-up. In addition, patients reported a mean of 56.43% total overall improvement. While these results should be considered with caution, this study provides preliminary evidence to warrant further randomized-controlled studies to validate these results.

Keywords: Platelet-rich plasma; Wrist pain; Regenerative medicine; Surgical alternative; Sports medicine

Introduction

Wrist and hand injuries have been one of the most common upper extremity injuries in the workplace [1]. This is due to the repetitive, hand-intensive movements that contribute to the development of injuries of the wrist [1]. Continued exposure to these highly repetitive tasks can lead to chronic inflammation and to a chronic fibrotic state. Fibrotic changes within tissues may subsequently increase the risk of those tissues to further injury [2-5]. These injuries tend to arise with acute ligament instability and eventually lead to early wrist osteoarthritis [6,7]. With conventional non-surgical wrist treatments lacking reliability [8,9], this study will focus on how Platelet-Rich Plasma (PRP) may be an effective treatment modality in alleviating unresolved musculoskeletal wrist pain.

It is hypothesized that the avascular nature of the wrist bones and ligaments renders injuries of the carpus amenable to blood-derived therapies such as Platelet-Rich Plasma. PRP is a concentrate derived from whole blood through centrifugation for the isolation of platelets in a small volume of plasma [10,11]. These platelets secrete growth factors that promote tissue regeneration and suppressed inflammation [10-14]. This synergistic effect has been shown to promote tendon and ligament healing in addition to demonstrating a therapeutic benefit for osteoarthritic patients [15,16]. The combination of these factors has led researchers to explore the potential benefit of PRP for wrist ligament and chondral injuries.

In the very first study of the effects of PRP on scaphoid fracture, Namazi and Kayedi administered PRP to a series of patients before applying a long scaphoid cast [17]. This phase III randomized controlled clinical trial found that all patients administered PRP prior to casting for scaphoid fracture experienced statistically significant improvement in both resting and active pain [17]. The authors also observed earlier scaphoid union in the PRP group, albeit at a non-statistically significant level [17]. In another study of 10 patients who

underwent PRP therapy for Basal Thumb Arthritis, demonstrated significant improvements in pain and in the Mayo Wrist Score when compared to baseline [18]. These studies provide encouraging evidence that PRP may be an effective treatment for hand and wrist injuries.

To our knowledge, there has been an absence of literature observing the clinical effect of PRP for unresolved wrist pain. The objective of this study was to report the pain and functionality outcomes of 6 patients and 7 wrists who underwent PRP injections to the ligaments and joints of the wrist. We hypothesize that by strengthening the ligaments and regrowing tissue within the wrist joints, we may provide patients improved quality of life and pain relief.

Methods

Patients

This is an observational study of private clinical practice patient outcomes in which variables were tracked prospectively and data was analyzed retrospectively. Patients included in this study underwent a series of two to four PRP treatments for wrist pain at a solo practitioner private practice from November 2016 through May 2018. MRI findings were used when available and all treatments were prescribed on an individual basis, as recommended by a physician. Written informed consent was obtained prior to each treatment.

As stated in our previous publications [19] when a patient at our clinic requires multiple treatments, we direct them to receive injections approximately fourteen days apart. Due to scheduling conflicts, however, injection intervals tend to be greater than fourteen days. At the fourteen day mark following treatment, there is a growth factor secretion from various cell types that participate in the late phases of wound healing [20,21]. Patients were also instructed not to use non-steroidal anti-inflammatory drugs during treatment, as they impede platelet function [22]. For patients who underwent bilateral wrist treatment, each wrist was given a separate survey and thus considered separately. Patients characteristics can be found in Table 1.

Case Number	Side	Sex	Age	BMI	Pain Duration	Follow (mo.)	Up	# of Tx.	Pathology
1	R	F	28	19.19	2 years	4		4	Unresolved Wrist Pain
2	R	M	42	27.26	4 months	15		2	ECU tendonitis or lunate triquetral ligament tear
3	L	F	31	22.04	2 years	5		2	TFCC Tear
4	B	F	45	20.98	9 years	3		2	Advanced arthritis of the radiocarpal joints
5	R	M	38	22.95	1 year	9		2	dorsal intercarpal ligament sprain, intercarpal joint OA
6	R	F	59	25.92	1 year	7		3	Radioscaphoid OA

Table 1: Patient characteristics.

Procedure

Patients were sitting upright and 10cc of blood was drawn into an 8.5 mL ACD solution A tubes. These tubes of blood were spun in a centrifuge and the top layer containing PRP was isolated. 2.5 cc of PRP was mixed with 0.5 cc of Lidocaine in each 3 cc syringe to minimize post-injection stiffness. Prior to the injection, the skin was sterilized with 4% Hibiclens. The PRP was then injected into painful joint spaces and ligaments, depending on the patient's pathology. Often, the TFCC was injected, if painful or torn.

Outcomes

The outcomes of interest for this study were changes to resting pain and active pain (Numerical Pain Scale [NPS]), overall improvement (percentage scale), and joint function (scored questionnaire). Data were collected at baseline and preceding each treatment (Figure 1). The functionality portion of the questionnaire, which assessed the degree of difficulty in performing daily activities, was based on 10 of 20 activities assessed in the Upper Extremity Functional Index, 19 but also included a "not applicable (N/A)" response option. This scale has shown to be a valid and reliable functionality questionnaire for upper extremity limbs. The NPS to assess resting and active pain used a scale of 0 (no pain) to 10 (extreme pain). Lastly, the form included a subjective measure of how much overall improvement the patient experienced following treatment on a scale of 0% to 100%.

Cases

Case 1

The first patient was a 28-year-old Caucasian female with 2 years of left wrist pain, most prominent when in flexion. The injury occurred when the patient fractured her left humerus in a snowboarding accident. She had tried pain medications and heat to relieve pain which provided minimal relief. The patient's baseline characteristics were a resting pain of 3/10, an active pain of 7/10, and a functionality score of 4/20. The patient received 4 PRP treatments over the course of four months. During the course of treatment, the patient steadily improved feeling 50% overall improvement after the third treatment. After her final treatment, she reported an 80% overall improvement with a 0/10 resting pain, a 0/10 active pain, and a functionality score of

32/40. The patient stated that the pain was not as frequent nor as intense as it was prior to treatment.

Case 2

The second patient was a 42-year-old Caucasian male with four months of right wrist pain. The pain was described as an achy feeling on the lateral aspect of his right wrist, typically elicited during his daily activities. The patient had previously received a Celestone injection three months prior to his first PRP treatment, which provided no relief. He had also tried dry needling, NSAIDs, ice, and stretching with no relief of symptoms. An MRI displayed right wrist tendonitis and ulnar-sided right wrist pain that may represent Extensor Carpi Ulnaris (ECU) tendonitis and a lunate triquetral ligament tear. The patient's baseline characteristics were a resting pain of 0/10, an active pain of 3/10, and a functionality score of 33/40. The patient was treated with two PRP treatments within four days of each other. Shortly after the first treatment, the patient stated that the wrist continued to be tender but feeling significant better compared to prior to treatment. He then felt 100% improvement at a short follow-up after the second PRP treatment. A year after the second PRP treatment, the patient stated that he had sustained his 100% improvement, and reported 0/10 resting pain, 0/10 active pain, and a 40/40 functionality score.

Case 3

The third patient was a 31-year-old Caucasian female with two years of left wrist pain. The patient had felt a "pop" when she fell when lifting a heavy box. The patient saw a hand specialist who prescribed a splint and recommended arthroscopic surgery. She reported wrist edema and had a sharp pain when lifting heavy objects or doing bicep curls. She had undergone heat, massage, and Arnica gel to relieve pain in addition to wearing a wrist brace. An MRI showed findings consistent with partial tears of the ulnar attachment of the triangular fibrocartilage. Her baseline characteristics were 7/10 resting pain, 9/10 active pain, and a 16/40 functionality score. The patient received a series of two PRP treatments approximately two weeks apart. After her first PRP treatment, she noticed her resting pain had improved compared to prior to treatment. She continued to use heat four times a day, which momentarily helped to relieve pain. Five months after her last treatment, she reported a 20% improvement, a 5/10 resting pain, a 7/10 active pain and a functionality score of 21/40.

Upper Extremity Functionality Questions

Please describe the degree of difficulty you have while performing these activities with your injured upper body part.

	Activities	Extreme Difficulty	Quite a Bit of Difficulty	Moderate Difficulty	A Little Bit of Difficulty	No Difficulty	N/A
1	Job, housework, or school activities	0	1	2	3	4	N/A
2	Hobbies, recreational, or sport activities	0	1	2	3	4	N/A
3	Lifting a heavy box	0	1	2	3	4	N/A
4	Opening a door	0	1	2	3	4	N/A
5	Washing dishes	0	1	2	3	4	N/A
6	Rolling over in bed	0	1	2	3	4	N/A
7	Carrying a heavy object	0	1	2	3	4	N/A
8	Combing/brushing your hair	0	1	2	3	4	N/A
9	Raising your arm over your head	0	1	2	3	4	N/A
10	Putting on and taking off a shirt	0	1	2	3	4	N/A

Total: _____

Resting Pain Level: 0 1 2 3 4 5 6 7 8 9 10
 (No pain) (Extreme pain)

Active Pain Level: 0 1 2 3 4 5 6 7 8 9 10
 (No pain) (Extreme pain)

Improvement Since Date of First Treatment (%) 0 10 20 30 40 50 60 70 80 90 100

Figure 1: Patient questionnaire.

Case 4

The fourth patient was a 45-year-old Hispanic female with bilateral wrist pain for nine years. The patient had treated her wrist with deep tissue massage, acupuncture, ice, heat, and numbing cream, however, he felt only temporary relief. An X-ray of the right wrist showed advanced arthritis of the radiocarpal joint. It also showed possible erosions involving the triquetral bone, and a probable zone of subchondral cystic change involving the distal radius. Her baseline characteristics for both wrists were 3/10 resting pain, 7/10 active pain, and 20/40 functionality score. The patient received two PRP treatments a month apart. After treatment, she stated a 25% improvement to both wrists. The patient's final outcome scores for her right wrist were a 2/10 resting pain, a 3/10 active pain, and a 24/40 functionality score. The

patient's final outcomes for her left wrist were a 2/10 resting pain, 5/10 active pain and functionality score was a 23/40.

Case 5

The fifth patient was a 38-year-old Hispanic male with one year of left wrist pain. The patient stated that he heard his wrist "pop" while moving an object at work. He described the pain as sharp with numbness that was progressively worsening. He also stated that his primary doctor recommended surgery. An MRI on the left wrist showed a sprain of the dorsal intercarpal ligament and degenerative changes in the intercarpal joint between the distal scaphoid and trapezium. His baseline characteristics were a 0/10 resting pain, 4/10 active pain, and 31/40 functionality score. The patient received 2 PRP treatments over a 3 week period. After the first treatment, he noticed

an 80% improvement and stated that he was able to drive without as much discomfort compared to prior to treatment. He also noticed a decrease in the amount of clicking in his left wrist. Nine months after the second PRP treatment, he experienced additional benefit, including a 95% overall improvement, with a 0/10 resting pain, a 1/10 active pain, and a 40/40 functionality score.

Case 6

The sixth patient was a 59-year-old female with right wrist pain lasting the course of one year. A radiograph of his right wrist showed a Scapholunate Advanced Collapse (SLAC) wrist with radioscaphoid OA. The patient had a limited range of motion and felt achy pain when supinating her wrist. She had previously received five cortisone

injections, which had no improvement of pain and caused her to wear a brace daily. The pain had been so severe that it had prevented her from sleeping. Her baseline characteristics were 3/10 resting pain, 8/10 active pain, and 22/40 functionality score. The patient received a series of 3 PRP treatments over a two month period. After the first treatment, the patient noticed a decrease in pain and a slight increase in the range of motion. She continued to have difficulties opening jars and performing daily tasks. Six months after her third PRP treatment, she reported a 50% overall improvement and noticed a substantial decrease in active pain and was able to perform her daily activities with less difficulty. Her final pain outcomes were a 2/10 resting pain, a 4/10 active pain, and a 33/40 functionality score.

Case Number	Resting Pain		Active Pain		Improvement Percentage		Upper Functionality Score	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	3	0	7	0	0%	80%	4	32
2	0	0	3	1	0%	100%	33	40
3	7	5	9	7	0%	20%	16	21
4	3	2	7	3	0%	25%	20	24
	3	2	7	5	0%	25%	20	23
5	0	0	4	1	0%	95%	31	40
6	3	2	8	4	0%	50%	22	33
Averages	2.71	1.57	6.43	3	0%	56.43%	20.86	30.43

Table 2: Patient pre and post treatment outcomes.

Discussion

We found that all patients included in this study experienced improvements in resting pain, active pain, improvement percentage, and functionality score compared to baseline outcomes. It is also encouraging that none of these patients reported any adverse effects. On average, patients reported a 42.11% decrease in resting pain, a 53.33% decrease in active pain, a 55.64% total overall improvement and a 45.89% increase in functionality score. Our results indicated improvement in all measurable outcomes for wrist pain and function after a minimum of two PRP treatments and continued improvement after a series of three or more treatments. To that end, patients in Cases 2 and 5 experienced the most notable results, with 100% and 95% overall improvement respectively following two rounds of PRP treatment. However, patients in Cases 3 and 4 experienced milder total improvements, at 20% and 25% respectively, under the same protocol of two PRP treatments.

These findings are of clinical relevance as they suggest that PRP operates through several physiologic pathways of wrist pain. Based on the results of our study, we hypothesize that while PRP works additively, the results are also pathology-dependent. This is reflected in the fact that the extent of each patient's improvement did not respond monotonically to the number of treatments. To that end, we observed that patients with different underlying sources of wrist pain responded dissimilarly. This is demonstrated by way of Cases 3 and 4 who presented with more severe pathology and experienced milder improvements after two treatments compared to Cases 2 and 5.

However, we hypothesize that Cases 3 and 4 may have reported increased clinical benefit with additional treatments.

Our primary approach to treating chronic wrist pain is to strengthen the ligamentous laxity in addition to the pathology itself. Weak ligaments result in an unstable wrist joint, in which interosseous friction can lead to cartilage wear and osteoarthritis in the carpus [25]. As a result, in both ligamentous and chondral sources of chronic wrist pain, PRP is an exciting treatment pathway that can induce healing responses in stalled cases [26]. The increased vascularity and cellularity of the carpal region can ultimately improve healing times through the delivery of growth factors directly to the site of injury [27-29]. A recent study observed the effect of dextrose prolotherapy on lax ligaments and how it related to unresolved wrist pain [30]. The patients in the dextrose prolotherapy study experienced reduced pain levels, increased range of motion, and the extended ability to exercise. Since PRP has been shown to be more therapeutic than dextrose prolotherapy in other chronic musculoskeletal disorders, there is a great promise that PRP could provide even more benefit [31].

The major limitations of our study were the limited sample size and lack of a control group. Additionally, pre-treatment radiographic studies were not available for all patients. Finally, the subjectivity of the measured variables may have introduced response bias. Additional randomized controlled studies with larger sample sizes and longer follow-ups are warranted to further validate these results.

Conclusion

All patients who participated in this study experienced an improvement in pain and function compared to their prior condition. These results provide encouraging preliminary evidence of the effectiveness of PRP for unresolved wrist pain.

Conflicts of Interest

M.D. is the primary physician at Darrow Stem Cell Institute, where all study procedures were performed.

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