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### Recommended Citation

Elliott S, Hoskins J. Platelet rich plasma vs. corticosteroid injections in treatment of tendinopathies. JMU Scholarly Commons Physician Assistant Capstones. <http://commons.lib.jmu.edu/pacapstones/2/>.  
Published August 1, 2016.

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# **Platelet Rich Plasma vs. Corticosteroid Injections in the Treatment of Tendinopathies**

**James Madison University Physician Assistant Program**

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**December 4, 2015**

## **Abstract**

This paper is a systematic review that compares corticosteroid injections and platelet rich plasma as possible treatments for lateral epicondylitis as well as plantar fasciitis. Studies were found through PubMed utilizing the terms platelet rich plasma and corticosteroids. Articles that did not compare the two treatments modalities or that included patients younger than 19 were excluded from the review. The results from the chosen studies were interpreted and compared to deduce the best treatment for lateral epicondylitis and plantar fasciitis. In conclusion, this research will provide valuable evidence for why platelet rich plasma is equivalent to if not better than corticosteroid injections for treatment of patients suffering pain from lateral epicondylitis or plantar fasciitis.

## **Introduction**

A tendinopathy is a painful condition that occurs within a tendon in response to repeated overuse. Tendon pain can be debilitating for many working adults, as well as recreational and competitive athletes. Plantar fasciitis and lateral epicondylitis are two of the most common tendinopathies in adults. Plantar fasciitis is estimated to be responsible for about one million annual patient visits to a medical provider in the United States. Lateral epicondylitis is seen in 1 to 3 percent of the general population<sup>1,2</sup>. These conditions are thought to be a result of overuse of the respective tendons, which leads to micro tears or trauma in the tendon, causing pain. However the complete mechanism causing plantar fasciitis and lateral epicondylitis is not fully understood.

Corticosteroid injections are currently one of the treatments of choice for each of these ailments. The injections are used to suppress inflammation and decrease erythema, swelling, heat and tenderness<sup>3</sup>. By limiting the capillary dilation, inflammation is decreased, and by restricting the macrophages and leukocytes, vasoactive kinins are reduced<sup>4</sup>. However, corticosteroids are known to cause tendon damage and can even cause tendons to rupture<sup>3</sup>. These injections often do not provide total relief for the patient or a good long-term outcome. Many patients who have tried this treatment have had higher incidences of reoccurrence and worsening symptoms with repeat onset<sup>5</sup>.

Another treatment option is platelet rich plasma (PRP). PRP was developed in the 1970s and is autologous, meaning that it comes from your own body. It is blood plasma that has been concentrated with platelets 5-10 times the normal amount found in a person's blood<sup>6,7</sup>. Platelets, small disk-shaped components of blood, are known for their importance in clotting. However, they also have growth factor proteins, which are important for injuries to heal. These growth factors include connective tissue growth factor (CTGF), platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-beta), vascular endothelial growth factor (VEGF), basic fibroblast growth factor (bFGF), epidermal growth factor (EGF), interleukin-8 (IL-8), keratinocyte

growth factor (KGF), and insulin-like growth factor-1 (IGF-1)<sup>8</sup>. These proteins promote the healing of bone and soft tissue and can be used to treat a multitude of injuries and disease processes by assisting in cellular repair. The healing properties of PRP include decreasing inflammation, improving cell growth, and acting as a signal to the body's immune system<sup>7</sup>. Some of the main conditions treated by PRP are joint pain, tendonitis, and early partial tendon tears.

The first step in using PRP is to draw the patient's blood<sup>9</sup>. Platelet rich plasma cannot be derived from coagulated blood because the platelets become part of the clot formation. Therefore, citrate is added to the whole blood in order to stop the clotting cascade from occurring<sup>9</sup>. Next, the platelets, white blood cells, and red blood cells, are separated from the plasma via centrifugation. The platelet concentration is then combined with the plasma, which must now be clotted in order to restart the clotting cascade so that the growth factors are released with the injection. Adding either bovine thrombin or calcium chloride can do this<sup>9</sup>. Finally, the PRP can be injected into the site of injury to ultimately speed up the healing process. The injection is done by using ultrasound guidance or by injecting at the point of maximum tenderness found on physical exam<sup>10</sup>. Within 1 hour, nearly 100% of the growth factors are released into the injection site<sup>9</sup>. The three stages of healing are inflammation, proliferation, and remodeling. The cytokines released from the PRP are able to ultimately speed up recovery by increasing healing time and decreasing overall time to complete these phases.

PRP injections are generally safe and cost effective. Since the platelets are harvested from the patient's own blood, there is little risk of any adverse reaction occurring or disease transmission<sup>11</sup>. Although there may be a reaction to the additive used to start the clotting cascade again, such as the bovine thrombin, these reactions are very rare<sup>9</sup>. Another downside to the use of this treatment is that there is no set optimal dose. This brings about the question that growth factors out of control may lead to cancer. However, there is no evidence to support this yet. The injection procedure can be done in an outpatient facility, so no hospital costs are involved. The therapy is also quick, usually lasting about 60 minutes in the office with little to no down time for daily activities that aren't affected by the injury being treated<sup>12</sup>. Most patients who have received a PRP injection find that they can return to most or all activities they were doing before the pain started within 3 months of having the injection<sup>13,14</sup>. Other pros to using this treatment for lateral epicondylitis and plantar fasciitis include improved healing time, less post-op narcotic use, better long term outcomes, and less relapse<sup>5,10</sup>. PRP injections vary in price, costing anywhere from \$500-\$800<sup>15</sup>. Due to the high cost and lack of clinical longevity showing efficacy, PRP injections are not routinely covered by insurance companies. However, with decreased pain and less risk of tendon rupture as seen with corticosteroid injections, this is likely a one time cost that may be more cost effective in the long run. With less risk of tendon rupture, less treatment side effects, less chance of relapse, and less overall pain, platelet rich plasma appears to be a superior

treatment to using corticosteroid injections when treating a tendinopathy such as lateral epicondylitis or plantar fasciitis.

### **Case**

J.S. is a 52-year-old male who presents to his primary care physician with a complaint of pain in the bottom of his left foot. The pain started about 3 weeks ago and has progressively worsened since. He states that the pain is worse in the morning when he first gets out of bed, and nothing seems to make the pain better except rest. He is a medical assistant, on his feet all day, and after a long day at work the pain is unbearable. On physical exam, the pain is reproduced with palpation of the plantar fascia with dorsiflexion that pulls the plantar fascia taut. He states that he had a buddy who received a corticosteroid injection for similar pain, but he read an article about platelet rich plasma injections and he wants to know which treatment will provide the most relief for his condition.

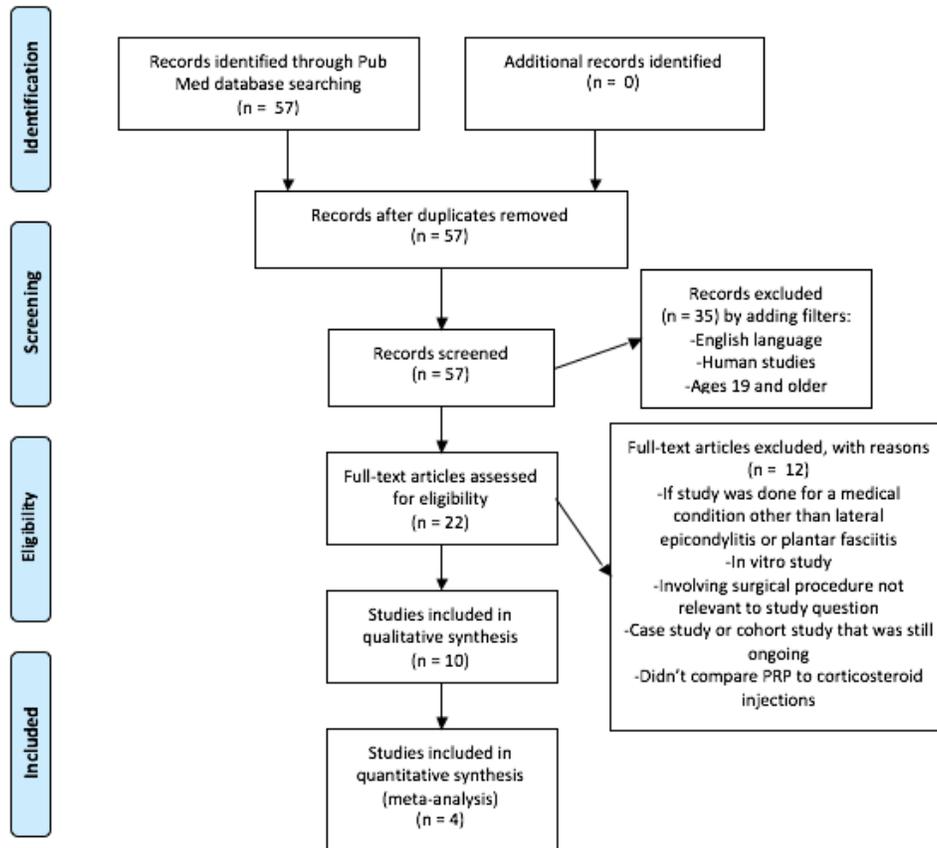
### **Clinical Question**

Among adults age 19 years old and older, considering treatment for plantar fasciitis and lateral epicondylitis (tennis elbow), do platelet rich plasma injections provide more relief from pain, faster healing, and longer duration of relief compared to corticosteroid injections?

### **Methods**

Pub Med was searched in September 2015 using the terms “corticosteroid” and “platelet rich plasma”. The results were then filtered to only include human studies on patients ages 19 and older that were published in the English language, which narrowed down the results to 22.

Next, the 22 results were screened for eligibility. Articles were excluded if the study was done using PRP on a medical condition other than lateral epicondylitis or plantar fasciitis, if it involved a surgical procedure, or if it didn't compare PRP to corticosteroid injections. They were also excluded if it was an in vitro study, a case study, or a cohort study that was still in process. This led to 12 articles being removed from consideration. Out of the remaining 10 articles, 4 articles were chosen. These studies had the most participants and had the longest follow up periods compared to the other remaining articles.



Some of the articles chosen for review used t-tests to analyze their data. T-tests are used to compare two sets of data to see if their means differ from each other. In these studies, they used the scores calculated by various grading systems, such as Disabilities of Arm, Shoulder, and Hand (DASH) scores and American Orthopedic Foot and Ankle Society (AOFAS) scores, in order to compare the means. This value is then used to calculate the *P*-value to determine if the differences are statistically significant<sup>16</sup>. The student's t-test is a type of t-test that is used to compare small, randomly assigned populations by assuming that they are normally distributed and have similar standard deviations. The paired t-test, also called the repeated measurements test, is a specific kind of student's t-test used to compare data that is paired, which, in the case of these studies, means comparing a measurement taken from a patient at one follow up interval against the measurement taken from the same patient at another follow up interval<sup>17</sup>. Another statistical test used by one of the reviewed articles was the Mann-Whitney U test, which is similar to the student's t-test but doesn't assume that the data is normally distributed<sup>18</sup>.

## Results

### Study #1:

*Ongoing Positive Effect of Platelet-Rich Plasma Versus Corticosteroid Injection in Lateral Epicondylitis. Gosens et. al<sup>19</sup>.*

### Study Objective:

To determine the effectiveness of PRP compared with corticosteroid injections in patients with chronic lateral epicondylitis with a 2-year follow up.

### Study Design:

This study was a double blind, randomized control trial that included 100 participants with lateral epicondylitis needing injection therapy in 2 Dutch training hospitals. Patients were randomly assigned to either receive a PRP injection or a corticosteroid injection via a randomizing computer program. See table 1.1 for inclusion and exclusion criteria.

**Table 1.1**

Inclusion	Exclusion
<ul style="list-style-type: none"><li>• Patients with lateral epicondylitis for longer than 6 months</li><li>• Pain of at least a 50 on a visual analog score (VAS) or 0, no pain to 100, maximum pain)</li></ul>	<ul style="list-style-type: none"><li>• Age &lt; 18 years old</li><li>• Pregnancy</li><li>• History of carpal tunnel syndrome, or cervical radiculopathy</li><li>• Systemic disorders such as diabetes, rheumatoid arthritis, and hepatitis</li><li>• Previous treatment for lateral epicondylitis with surgical intervention or with a corticosteroid injection in the past 6 months</li></ul>

An orthopedic consultant or an orthopedic resident performed the injections. Prior to treatment, all elbows were screened with radiography to rule out any additional bony pathology. Blood was collected from each patient from the uninvolved arm and 3mL of PRP was obtained. The injections were given with a 22-gauge needle using a peppering technique, which is when the needle is injected and moved up and down trephinating the tendon to induce bleeding and therefore initiate the healing process. Any PRP that was left over was injected into the common extensor tendon. After the injection, patients were kept in a supine position without moving the arm for 15 minutes. Discharge instructions included resting the arm for at least 24 hours. If necessary, participants were allowed to use acetaminophen, but not non-steroidal anti-

inflammatory drugs (NSAIDs). 24 hours after the injection, patients were given a standardized stretching protocol to follow for 2 weeks with a physiotherapist. Next, an eccentric muscle and tendon-strengthening program was initiated. 4 weeks post-procedure, patients were allowed to continue with normal activities and sports as tolerated. Before the injection as well as at 4, 8, 12, 26, 52, and 104 weeks after the injection, Visual Analog Score (VAS) and Disabilities of the arm, shoulder and hand (DASH) function scores were measured. The DASH is a self-reported questionnaire designed to evaluate upper limb function as well as symptoms in people with severe musculoskeletal disorders in the upper limbs. After the study, complications involving side, sex, age, and intervention type were all retrieved from medical files for evaluation.

### **Study results:**

For this study, successful treatment was defined as a 25% reduction on the VAS pain score and the DASH total scores with no need for a reintervention (repeat injection, or surgery) after 2 years. Student t-tests were used to determine significance for both the corticosteroid group and the PRP group. The intention-to-treat principle and the as-treated principle were both taken into account, and any missing value was replaced by the last observed value for the individual. After an analysis of the participant's baseline VAS and DASH scores was done, a  $P$ -value  $> 0.5$  was calculated, showing that there was no difference between the baseline characteristics (age, sex, side with pain, and hand dominance) or sociodemographics of the PRP group and the corticosteroid group.

The baseline values of the VAS pain score for corticosteroid injections were higher ( $P > 0.0001$ ) than they were at each subsequent follow-up, except for the 26-week follow-up ( $P = .029$ ), and from 8 weeks to 26 weeks, the pain scores worsened. However, for the PRP group the VAS scores improved during the entire duration of the study. At the 4-week follow up, the PRP group was in more pain than the corticosteroid group. At the 26, 52, and 104-week follow-up after treatment, the PRP group reported less pain than the corticosteroid group. There was no difference found between groups at the 8 and 12-week follow-ups. Since 60 out of 100 patients had a reduction in VAS scores with no need for re-intervention after 2 years, there was a 25% reduction, which is considered successful. Of the 11 patients who had worse VAS scores, 9 of them received a corticosteroid injection and 2 of them received a PRP injection.

For the results of the DASH scores, the baseline scores of the corticosteroid group were significantly higher compared to the scores at the 8 and 12-week follow-ups. After 12 weeks, the scores deteriorated. In the PRP group, the DASH scores significantly improved during the entire duration of the study with a  $P$ -value  $< .002$ . When the two group scores were compared from baseline to 4 weeks, the PRP group DASH scores were significantly worse than the corticosteroid injection group. However, for the rest of the follow-ups throughout the trial, the scores of the PRP group were significantly higher. Based off of the DASH scores, 56 out of the 100 participants were successfully treated, meaning that there was no need for reintervention after 2 years and a

reduction in pain. Of the 56 patients successfully treated, 37 of these received PRP, and 19 receive corticosteroid injections. There were a few reinterventions that occurred in the study. A reintervention was defined as a patient who failed the original treatment and either had a second injection of the original treatment choice, or a participant who failed original treatment and switched treatments all together. There were 6 reinterventions in the PRP group, and there were 14 reinterventions in the corticosteroid group. The patients in the corticosteroid group who switched to the PRP group saw significant improvement in both VAS and DASH scores. Overall, this study shows that a single injection of PRP improved pain and function of lateral epicondylitis more than a corticosteroid injection.

### **Study critique**

One of the strengths of this article is that it is a double blind randomized control trial. This eliminated some of the population bias, and also allows the investigators to objectively analyze the study. The study used a randomizing computer system to place participants blindly into a study group, which is another way that bias was eliminated.. The charts and tables that they included and referenced frequently throughout were easy to follow and made it easier to understand the article. However, since both the DASH and VAS scores are subjective and self-reported, there is some patient bias present. Although the study mentioned the injection technique used, it did not discuss who handled the injections for each group. If the technique of the person giving the injections was different for each group then that would allow for error. The study also did not mention if the same person interpreted each outcome, so this could have caused observational bias.

### **Study #2:**

*The Comparison of the effect of corticosteroid and platelet-rich plasma (PRP) for the treatment of plantar fasciitis. Aksahin et. Al<sup>20</sup>.*

### **Study Objective:**

To compare the results of local injections of platelet rich plasma and corticosteroids in the treatment of plantar fasciitis.

### **Study Design:**

This study was a prospective cohort that included 60 patients who were diagnosed with plantar fasciitis and treated conservatively for 3 months with no response to conservative treatment. The first 30 patients were treated with injections of methylprednisolone and the second 30 patients were treated with injections of PRP. Each patient was blind to the injection agent of treatment. Patients were then evaluated at 3 weeks and 6 months following the injections. See table 2.1 for inclusion and exclusion criteria.

**Table 2.1**

Inclusion	Exclusion
<ul style="list-style-type: none"><li>• Patients diagnosed with plantar fasciitis</li><li>• Patients treated conservatively for 3 months</li><li>• Patients with no response to conservative treatment modalities.</li></ul>	<ul style="list-style-type: none"><li>• History of any prior injection treatment or surgery for heel pain</li><li>• Having any other associated pathology involving the lower limb (tarsal tunnel syndrome, intra-articular disease, calcaneal fractures, calcaneal bone cysts, bone tumor, osteomyelitis, Achilles tendinopathy, or an abnormal Erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP)</li><li>• Any systemic disorders (diabetes, rheumatoid arthritis, gout, pregnancy, or hematologic disease)</li></ul>

The first 30 consecutive patients were treated by a local injection of 2mL of 40 mg methylprednisolone with 2 mL of 2% prilocaine. The second 30 patients were injected with 3 mL of PRP after being injected with 2 mL of 2% prilocaine. The age range of all of the patients in the study was 22-68 years, the average body mass index (BMI) was 31.1 +/- 4.55 kg/m<sup>2</sup>, and the average duration of symptoms for the entire study was 9.02 +/- 5.28 months.

The double centrifuge technique was used to concentrate platelets from autologous blood and were then activated using calcium. 25 cc of venous blood was centrifuged at 1800 rpm for 15 minutes to first separate the erythrocytes out. Then, a second centrifuge cycle was completed to concentrate enough platelets to get 3 mL of platelet rich plasma. The same person performed each injection by palpating the point of maximum tenderness. After receiving the injection, patients were told to apply ice to the injected area as well as elevate the leg. Patients were given standard stretching plans, and were not allowed to bear weight for 3 days after the injection. They were also advised to wear comfortable shoes and avoid high impact activities, such as running, for 10 days. No additional treatment was permitted including taking non-steroidal anti-inflammatory drugs, night splint, and orthoses.

Patients were required to follow up at 3 weeks and 6 months post treatment. They were evaluated by the same person, who was also blind to the injection type used. Patient evaluations included patient-assessed pain on a visual analog scale of 0 to 10, with 0 being no pain present, and 10 being the worst imaginable pain or stiffness. A subjective pain scoring system called the Roles and Maudsley scoring system was used for participants to rate their symptoms on a scale

of 1 to 4, with 1 being excellent, 2 as good, 3 as acceptable, or 4 as poor. Statistical analyses were performed using software, and correlation analyses were used to compare visual analog scale (VAS) score changes before and after local injections along with patient characteristics. A Mann-Whitney U test was also used to compare the scores of the Roles and Maudsley scores from each follow-up visit at 3 weeks and 6 months. A *P*-value lower than 0.05 was considered statistically significant.

#### **Study Results:**

In both studies, the *P*-values for patient characteristics were  $> 0.05$ , meaning that there were no significant differences between the two groups receiving each injection. The VAS score compared to the pretreatment score of each group was significantly lower with a *P*-value of 0.001. However, the 6 month follow up VAS heel pain scores in the steroid group were 3.4 compared to 3.93 in the PRP group which were both lower when compared to pre-treatment scores. When comparing the Roles and Maudsley satisfaction scores at the 6-month follow-up, only 4 people in each group had poor satisfaction. A *P*-Value  $> 0.05$  was calculated from these satisfaction scores, which shows that there was no significant difference between the two. There were also no complications from either treatment observed.

Overall this study shows that there is not a significant difference in the outcome of the two treatments. Although there were no cases of tendon rupture reported in the study, corticosteroid injections do have the potential to cause this. Therefore, PRP injections appear to be a safer alternative with the same efficacy as corticosteroid injections.

#### **Study critique:**

This study was a prospective cohort study, which allows for the participants to be followed over a period of time to compare the outcome. This was beneficial because the events of the study could be followed in a timely sequence, therefore allowing the analyzers to determine the cause and effect the injections had on the tendinopathies. The study also did a good job of explaining the method of their treatment plans. They gave specific dosing and techniques, which makes the study more appealing for possible clinical application. They also made the participants, as well as the follow-up evaluators, blind to the treatments and previous scores. This is good because it decreases the chances of bias. The study also did a good job of comparing different types of ratings such as pain and treatment satisfaction, as well as patient characteristics. This takes a lot into account to also try and eliminate any factors that may make a difference in the outcome.

Although conducting a prospective cohort study has benefits, it also has the flaw of confounding variables being a problem as well as loss to follow up. These could have influenced the study outcomes in a negative way by altering the true results or causing selection bias or random error between the two groups. This type of study also uses observed group placement, so the investigators were not able to be as objective with their interpretations. The authors also

did not talk about the patient compliance with the post injection treatment. If there was a difference in how many people actually used ice and elevation, then this might make a difference in the overall end result that the patient experienced. They also state that at each follow-up visit, a detailed interview was conducted. However, they do not go into what the interview consisted of. Another problem with this study is that pain is a subjective finding, so it is hard to really distinguish a true measurement scale for results.

**Study #3**

*Platelet-Rich Plasma Efficacy Versus Corticosteroid Injection Treatment for Chronic Severe Plantar Fasciitis. RR Monto<sup>21</sup>.*

**Study Objective:**

To compare PRP and corticosteroid injections in the treatment of chronic plantar fasciitis

**Study Design:**

This was a randomized control study with 40 participants, ranging from age 21 to 74, with chronic plantar fasciitis. Each patient was screened for plantar fasciitis by plain film and MRI prior to starting the study. 20 of the patients were randomly assigned to receive PRP and the other 20 to receive a corticosteroid injection. The inclusion and exclusion criteria are outlined in table 3.1.

**Table 3.1**

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> <li>• At least 4 months of heel pain</li> <li>• Failed nonoperative treatment, including:               <ul style="list-style-type: none"> <li>○ Rest</li> <li>○ At least 6 weeks of physical therapy</li> <li>○ At least 4 weeks of silicone heel lifts</li> <li>○ At least 4 weeks of controlled ankle movement (CAM) walker bracing or cast immobilization</li> <li>○ At least 4 weeks of night splinting</li> </ul> </li> <li>• Nonsteroidal medications</li> </ul>	<ul style="list-style-type: none"> <li>• Bilateral involvement</li> </ul>

The autologous PRP for the assigned group was prepared using the Accelerate Sport Platelet Concentration System. 27 ml of venous blood was drawn from the patient and mixed with 3 ml of anticoagulant citrate dextrose solution formula A. This mixture was then centrifuged at 2,400 rpm for 12 minutes. After being centrifuged, 3 ml of PRP was taken from the buffy coat.

For both groups, the injection zone was cleansed using 2% chlorhexidine gluconate/70% isopropyl alcohol. A local anesthetic field block was performed using 6 ml of 0.5% Marcaine with

a 23-gauge needle. 2 ml was injected into the skin, 2 ml into the fascia, and 2 ml into the periosteum of the medial calcaneal tubercle. Then, using ultrasound guidance, 40 mg of DepoMedrol was injected into those patients assigned to the corticosteroid group and the autologous PRP was injected into the patients assigned to the other group.

After receiving the injection, each patient was put into a CAM walker brace for 2 weeks. They could return to activities as tolerated and were instructed to do daily home eccentric exercises and a calf/arch-stretching regimen. They were prohibited from using NSAIDs for the first 2 weeks after receiving the injection and were discouraged from using NSAIDs after that time.

Response to the treatment was measured using the American Orthopedic Foot and Ankle Society (AOFAS) hindfoot scoring scale. This scoring system ranges from 0-100, with a higher score indicating fewer signs and symptoms of disease. A blinded investigator did the objective portion of this scoring system, which required a physical examination. This score was assessed just prior to the injection, and then again at 3, 6, 12, and 24 months after treatment.

A Pearson chi-square test was then used to analyze the data and calculate a *P*-value. The chi-square test looks at multiple sets of categorical data to determine if they are homogenous and therefore comparable. A *P*-value of <0.05 was considered statistically significant. Pretreatment continuous variables were compared with a Student t-test and AOFAS scores were compared with a repeated measurements test.

#### **Study Results:**

The group assigned to receive a corticosteroid injection consisted of 9 males and 11 females with an average age of 59 years. These patients had an average of 5.4 months of symptoms prior to starting the study but they ranged from 4 months to 24 months. The average AOFAS score initially increased after treatment, peaking at 3 months post-treatment, but then steadily declined in the months following.

The group assigned to receive a PRP injection consisted of 8 males and 12 females with an average age of 51 years. They had symptoms of plantar fasciitis for an average of 5.7 months prior to the study starting but they averaged from 4 to 26 months. The average AOFAS score for this group improved greatly after receiving treatment and stayed elevated for the duration of the study (24 months).

The AOFAS scoring differences between the corticosteroid group and the PRP group was  $P = 0.001$  over the 24 month period. The differences in height, weight, and BMI between the two groups were not found to be statistically significant.

#### **Study Critique:**

There were various strengths of this study. It was a randomized control trial, which takes out any bias from assigning participants to a certain therapy. The investigators were also blinded to the treatment so the physical exam measurements were not affected by their opinion. A single

investigator did all the physical exams for the parameters used in the AOFAS scoring, so they were standardized across both groups. There was also a large range of patient ages involved in the trial.

However, there were also some weaknesses to the study. There were only 40 patients involved in the study, which is a small sample size and thus increases the chances of a type II error. They did not disclose whether the subjects were blinded to treatment or not, and part of the AOFAS scoring involving subjective reporting by the patient, so there might have been bias in the scoring. The treatment was also only evaluated based on one scoring system.

**Study #4**

*Platelet-rich plasma versus corticosteroid injection for recalcitrant lateral epicondylitis: clinical and ultrasonographic evaluation. Gautam et. Al<sup>22</sup>.*

**Study Objective:**

To compare the effects of PRP with corticosteroid injections in recalcitrant lateral epicondylitis

**Study Design:**

This was a randomized control trial involving 30 participants, ranging from 18 to 60 years old, with recalcitrant lateral epicondylitis. The patients were chosen based on the inclusion and exclusion criteria listed in table 4.1. Half of the participants were randomly assigned to the corticosteroid injection group and half to the PRP injection group.

**Table 4.1**

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> <li>• Lateral epicondylitis for more than 6 months</li> <li>• Not responding to oral medication or non-invasive treatment</li> </ul>	<ul style="list-style-type: none"> <li>• Bilateral involvement</li> <li>• Pregnant patients</li> <li>• Patients with symptoms of carpal tunnel syndrome or cervical radiculopathy</li> <li>• Patients with systemic disorders (such as diabetes, rheumatoid arthritis, or hepatitis)</li> <li>• Those who had undergone surgery or has any corticosteroid injections in the last 6 months</li> </ul>

In order to prepare the PRP, 20 ml of blood was drawn in an acid citrate dextrose vacutainer. The blood was then centrifuged at 1,500 RPM for 15 minutes. A 2 ml sample of PRP was then taken and platelet counts were calculated for the PRP and the unprocessed blood.

A 2 ml injection of PRP or an 80 mg injection of methylprednisolone were then administered to the patient, depending on which group they were assigned to, using a peppering

technique. The injection was administered at the point of maximal tenderness over the lateral epicondyle of the humerus. Each patient rested for 30 minutes after the injection. The patients were instructed not to massage the area or use hot fomentation over the injection site or to take NSAIDs. They were also advised not to use ice packs or paracetamol (acetaminophen).

The patients were assessed just prior to treatment, and then at 2 weeks, 6 weeks, 3 months, and 6 months after treatment using the VAS for pain, DASH score, Oxford Elbow Score, Modified Mayo Clinic performance index for the elbow, and hand grip strength. The VAS score and DASH scores were previously explained in the methods section of the first study. The Oxford Elbow Score is a subjective score that is calculated by patients answering questions on how their pain is affecting their lives. The Modified Mayo score is calculated by subjective reporting of pain and measurements of range of motion and stability done by an examiner. They were also evaluated using ultrasound just prior to treatment and 3 and 6 months after treatment by a blinded musculoskeletal ultrasonologist. The ultrasound was assessing for any tears or edema at the common extensor origin, cortical erosion, tenderness elicited by the probe, and thickness of the tendon. At each assessment point, the data was compared using a paired t-test. A *P*-value of <0.05 was considered statistically significant.

#### **Study Results:**

The scores for the VAS for pain, DASH, Oxford Elbow score, modified Mayo score, and handgrip strength all improved for both the PRP and the corticosteroid groups when pre-treatment scores were compared to 6 months after treatment. However, the corticosteroid scores were the highest at 3 months post-injection and started to decline by 6 months. Positive ultrasound findings also decreased for both groups at 6 months post-treatment. However, investigators saw that the number of participants with reduced thickness of the common extensor tendon increased in the corticosteroid group. They also saw an increase in the number of patients in the corticosteroid group with cortical erosion at the lateral epicondyle. Calculations were not done on the qualitative data obtained from the ultrasounds to determine if there was statistical significance.

The *P*-value was <0.05 at all times after receiving the injections except for at the 3 months assessment for VAS for pain, DASH, and Modified Mayo scores. The *P*-value was <0.05 at all times for the Oxford Elbow score. The *P*-value stayed >0.05 at all times for the handgrip strength.

#### **Study Critique:**

This study had numerous strengths. It was a randomized control trial and the investigators were blinded to the treatment the participants were receiving. Instead of simply evaluating response to treatment based on numerical scores, this study evaluated physiologic changes via ultrasound to look for healing brought on by the treatment and damage done by the

corticosteroid injections. They also used multiple scoring systems to assess improvement instead of simply relying on one method.

In addition to the strengths, this study had some weaknesses. It was a very small study and therefore had a higher chance of a type II error. They did blind the patients to the treatment they were receiving, which could have accounted for some biases in the subjective portions of the scoring criteria. They also only evaluated the patients for 6 months, which is a very short time compared to the previous study. There might have been further declines in scores after that time that were not picked up in the study.

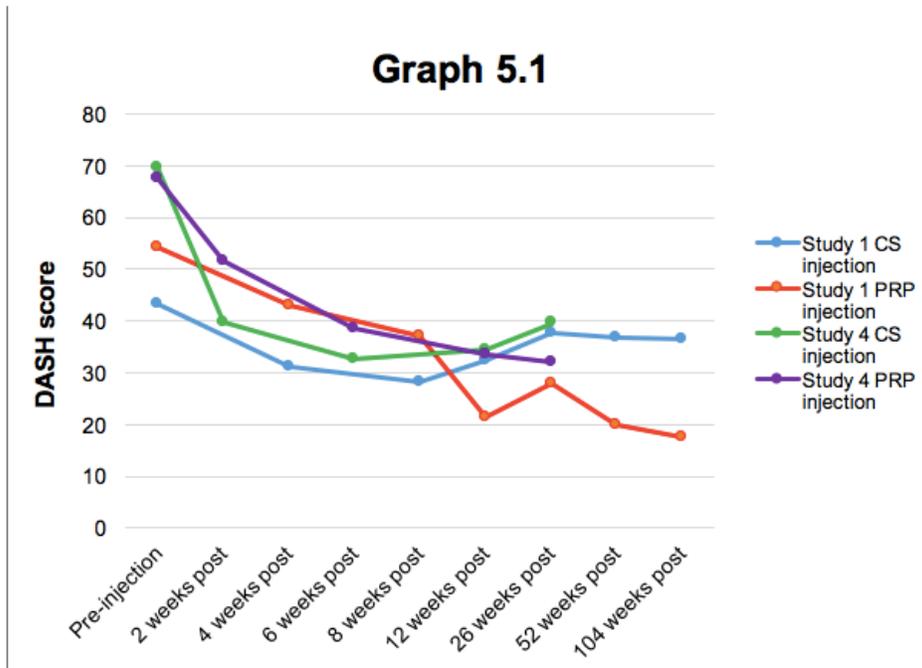
### **Discussion**

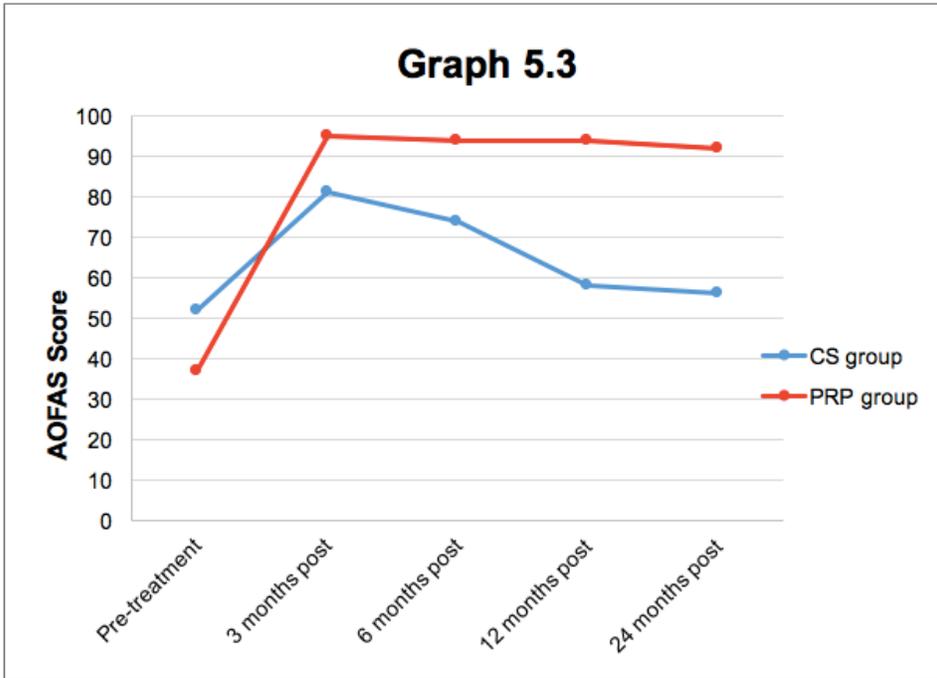
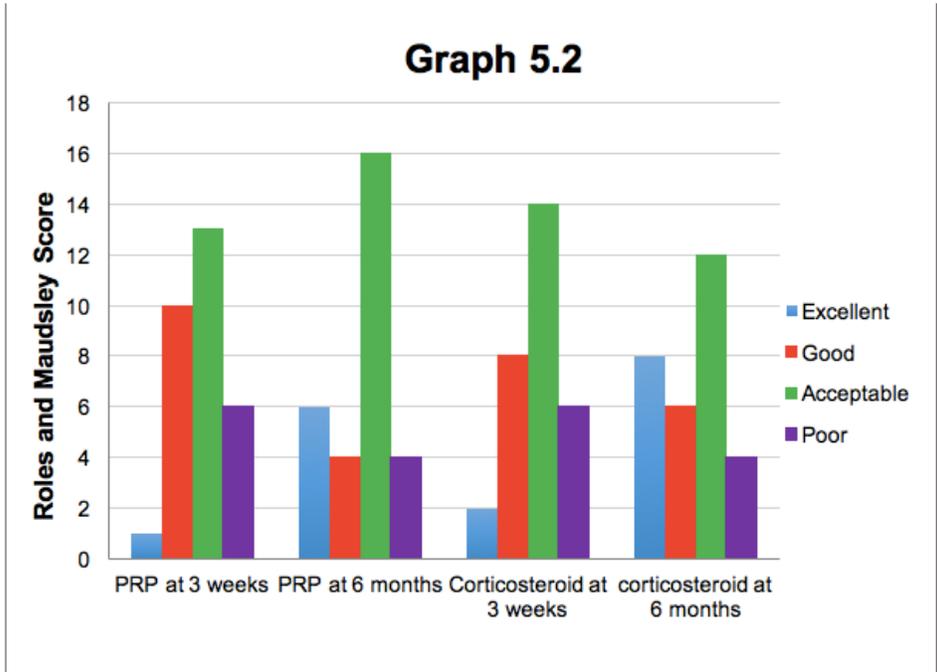
All of the studies analyzed concluded that PRP injections are equal to or better than corticosteroid injections for the treatment of both lateral epicondylitis and plantar fasciitis. By using different pain scale scores, along with calculated *P*-values, the studies were able to compare the outcome of the treatments. For lateral epicondylitis, each study incorporated a DASH score from each participant at follow up visits. Graph 5.1 compares the follow-up DASH scores from each article for both corticosteroid injections and platelet rich plasma. This graph shows that, in both studies, PRP injections led to lower DASH scores and therefore lower disabilities than corticosteroid injections. Although both studies on plantar fasciitis cannot be compared because of different assessment tools, tables 5.2 and 5.3 show the outcomes of PRP injections versus corticosteroid injections. In table 5.2 it shows that PRP is equally effective in treating plantar fasciitis as corticosteroid injections. However, due to the risks associated with corticosteroid injections, such as fat atrophy, osteomyelitis of the calcaneus, and iatrogenic rupture of the plantar fascia, PRP injections would be a safer option given that none of these side effects were seen or associated with PRP injections in the study. Table 5.3 shows that the AOFAS scores greatly increased in the PRP group and stayed elevated, while the AOFAS scores in the corticosteroid group didn't increase as much and dropped after the 3 month follow up.

One of the strengths of the Gosens et. al. article was that it was a double blind study. Since both the participants and the examiners were blind, this reduced bias or error in the study methods and the results. Each of the other studies was single-blind. Therefore, any biases the patients might have had about the treatment methods may have affected their ability to objectively report results. 3 of the 4 articles discussed participant characteristics such as weight, gender, age, body-mass-index (BMI), as well as duration of pain. This was helpful for making the study more specific for people who might want to use these treatments for specific patient populations in the future, and also for looking for any confounding variables.

When comparing all of the studies, one of the major limitations is the small sample size of each. The sample sizes ranged from 30 participants to 100 participants. This means that there could be type II error present since the sample size is so small. In order to decrease this error, it

would be best to increase the overall sample size of the studies. Another limitation in these studies is the subjectivity of the scoring methods used for results. All of the studies incorporated subjective pain scales into their results. This can cause bias because pain cannot effectively be measured accurately from person to person. In some of the studies, the same examiner performed the physical exams used to calculate the assessment scores. This could have led to intra-observer variability.





#### Application to the patient

Each study analyzed used subjective pain scales before and after the injection to determine which treatment had the best outcome. S.A. is a symptomatic patient experiencing pain with many of the symptoms of the patients in these studies. Since he is employed and works to earn a living, cost would be a factor. The average cost of platelet rich plasma with no insurance

ranges from \$300 to \$800, and the average cost of a corticosteroid injection for an uninsured patient is \$50-\$200<sup>12</sup>. Although this price might seem like a big difference, the studies showed more people needing other treatment or future injections after corticosteroid injections. However, those who received PRP injections were less likely to need future treatment. Therefore, the cost might be equal to or higher when the additional treatment needed after a corticosteroid injection is considered compared to the better long-term outcome and less likely risk of needing additional treatment after a PRP injection. Another important factor to take into consideration is the downtime. After receiving a PRP injection, there is no down time for work. However, it is recommended that they do not exercise or put stress on the injected area for a few days<sup>13</sup>.

### **Conclusion**

Among adults age 19 years old and older, considering treatment for plantar fasciitis and lateral epicondylitis (tennis elbow), do platelet rich plasma injections provide more relief from pain, faster healing, and longer duration of relief?

Platelet rich plasma is a reasonable alternative to treating tendinopathies such as lateral epicondylitis as well as plantar fasciitis. There is a low risk of complications such as tendon rupture, and the treatment is shown to provide long-term relief from pain without the need to repeat therapy. Although the cost might be a deterrent, the benefit will outweigh this in the long run. The treatment can be used for the average adult patient as well as for athletes seeking specific treatment from a sports related injury. Platelet rich plasma should be considered at least as an alternative treatment, if not the mainstay of therapy for patients with lateral epicondylitis and plantar fasciitis. Other tendinopathies that might benefit from platelet rich plasma include Achilles tendonitis and jumper's knee, although more studies need to be done on these specific conditions before that conclusion can be made.

### **Acknowledgements**

We would like to acknowledge Dr. Erika Kancler, Jerry Weniger, Carolyn Schubert, and The JMU Communications Center for their help and support in this project.

Nicely done! ☺

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