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Corticosteroid Versus Platelet-Rich Plasma Injection in Epicondylitis

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Lateral epicondylitis (LE) is often considered an inflammatory disease characterized by tendon microtears that are followed by an incomplete reparative response that leads to chronic pain and decreased function on the upper extremity. A modality that is commonly used for the treatment of LE is the injection of corticosteroids. Evidence supports corticosteroid injections to be an effective short-term intervention that lacks intermediate and long-term relief as well as having negative effects on tenocyte proliferation, which is essential in the tissue healing process. Platelet-rich plasma (PRP) has been shown to be more effective, providing longer positive results with a lower recurrence rate. PRP's powerful growth factor stimulates tissue repair and protects tenocytes from the cytotoxic effects caused by corticosteroids. Unfortunately, the efficacy of PRP has been questioned because of past study designs. Nevertheless, recent studies provide practice-changing evidence that supports the use of PRP for the treatment of LE.

In the United States, more than 100 million office visits a year are directly related to musculoskeletal injuries and impairment (Mishra, Woodwall, & Vieira, 2009). Epicondylitis, commonly known as tennis or golfer's elbow, is one of the most common soft tissue injuries in adults between 30 and 50 years of age. It was originally thought to be an inflammatory process but "epicondylitis has been shown histologically to result from tendonous microtearing, followed by an incomplete reparative response" (Ciccotti, Schwartz, & Ciccotti, 2004, p. 693). Corticosteroid injection has been the most common pharmacological approach in the treatment of *tennis elbow* and has shown superior short-term effects in the relief of pain and grip strength. Unfortunately, studies revealed no intermediate or long-term beneficial effects when treating epicondylitis with corticosteroid injection treatment (Szabo, 2008) and their association with decreased cell viability (Wong, Lui, Fu, & Lee, 2009).

Platelet-rich plasma (PRP) injection could be a potential replacement and/or complemen-t to steroid injection for the treatment of epicondylitis. Platelet-rich plasma has been used to treat wounds since the 1980s, but it was not until recently that it became the treatment of choice for many musculoskeletal injuries, including epicondylitis (Mishra et al., 2009). Although the concept of utilizing PRP injection appears to exceed the positive effect of corticosteroid injections even after 2 years (Gosens, Peerbooms, Van Laar, & Den Oudsten, 2011), the efficacy of PRP continues to be debated in the literature when compared with other pharmacological treatments.

Clinical Practice Issue

Lateral Epicondylitis

Epicondylitis commonly affects the lateral or medial part of the elbow and is often called *tennis elbow* or *golfer's elbow*, depending on the site of injury. Lateral epicondylitis (LE) or *tennis elbow* is seven to 10 times more common than medial epicondylitis or *golfer's elbow* (Walz, Newman, Konin, & Ross, 2010) and is basically a degenerative syndrome that affects the origin of the extensor tendons at the lateral elbow (Tosti, Jennings, & Sewards, 2013). "Because inflammation is not a significant factor in epicondylitis, the term tendinosis is preferred over epicondylitis or tendinitis" (Walz et al., 2010, p. 170).

Lateral epicondylitis occurs as a result of repetitive stress and overuse of the wrist, which, in turn, leads to tendinosis microtrauma and partial tearing or full-thickness tendon tear (Walz et al., 2010). The essential and universal lesion of LE involves the extensor carpi radialis brevis (ECRB) (see Figure 1, which illustrates the extensors of the arm) (Wikipedia, 2014), which is part of a strong common tendon that includes the extensor digitorum communis and extensor carpi ulnaris (Walz et al., 2010). The location of the ECRB within this common tendon is deep and anterior, and the undersurface of it slides along the lateral edge of the capitellum during extension and flexion of the elbow (Walz et al., 2010). It is believed that repetitive wear and abrasion due to contact with the capitellum may play a role on the pathophysiology of LE (Walz et al., 2010).

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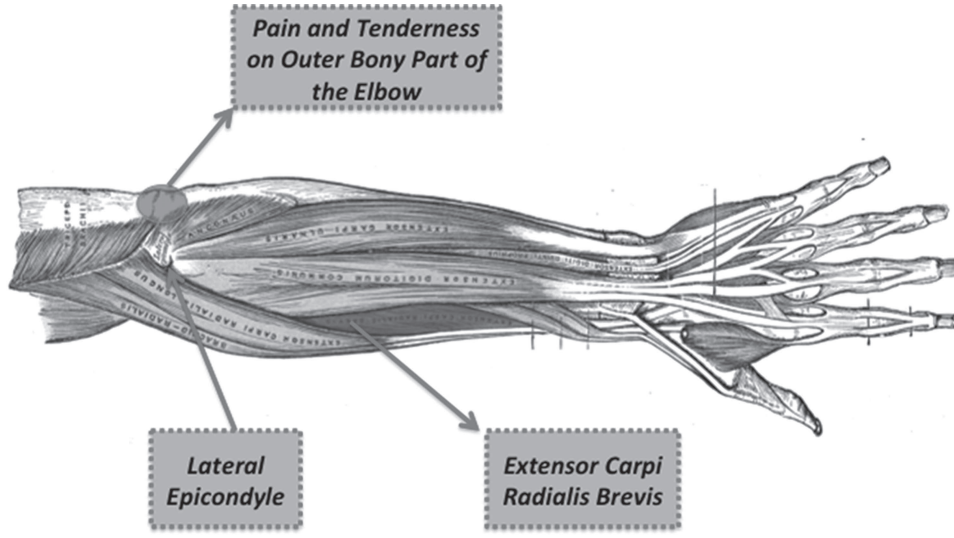

Figure 1. Extensor carpi radialis brevis. Adapted From Gray, Henry. (1918). *Anatomy of the Human Body*. Philadelphia: Lea & Febiger.

Diagnosis

Upon presentation to the clinic, patients with LE report lateral elbow pain that is exacerbated by grabbing objects while having the elbow in the extended position (Tosti et al., 2013). "Patients often report a unique discomfort while shaving, shaking hands, lifting luggage or groceries with an extended elbow" (Tosti et al., 2013, p. 357). This complaint often coincides with recent changes in occupational or sporting activities. During physical examination, focal tenderness is present at the origin of the ECRB. Reduced "strength with resisted gripping and with supination and extension of the wrist are also commonly seen" (Walz et al., 2010, p. 171). Ranges of motion of the elbow and wrist are usually not affected in patients with LE. If a decrease in range of motion is present upon examination, further assessment of the joint is indicated and should be performed to rule out other injuries that could mimic LE. The *chair test* or *coffee mug test*, which elicits pain while lifting a chair or a full coffee mug while the elbow is in the extended position, is often performed to evaluate and/or diagnose patients with possible LE (Walz et al., 2010) (see Figures 2 and 3, which illustrate two of tests used to diagnose LE).

Radiographic views of the elbow are also part of the diagnostic process. Although anteroposterior and lateral radiographs are usually normal or may show mild soft tissue calcification, these are standard diagnostics tests that are ordered mainly to exclude other pathologies (Tosti et al., 2013). This information is supported by a study conducted by Faro and Wolf (2007) where radiographs were obtained in 294 consecutive patients with possible epicondylitis and only 16% had positive findings, most in the form of calcification along the lateral epicondyle. Furthermore, the treatment course for two of the 294 patients was altered because of additional findings (Faro & Wolf, 2007). Similarly, a magnetic resonance imaging is usually unnecessary, but it may be valuable if concomitant intra-articular pathology is suspected (Tosti et al., 2013). Other diagnoses to be considered in a patient with a chief complaint of lateral elbow pain may include radicular cervical spine disease, radial nerve compression, intra-articular loose bodies, and chondral lesions (Tosti et al., 2013). Tumors, avascular necrosis, and osteochondritis dessicans of the capitellum are less common but may also be considered (Tosti et al., 2013).

Figure 2. The Chair Test.

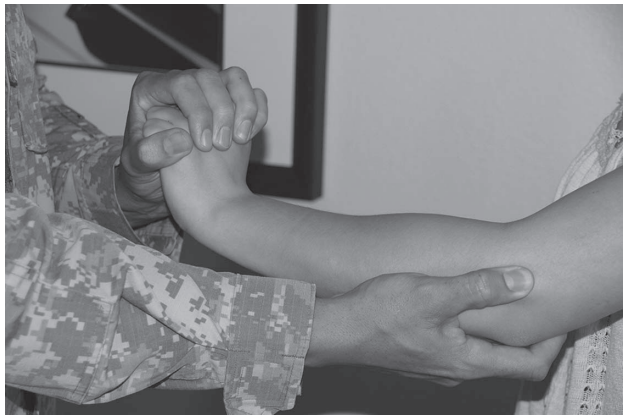

Figure 3. The Cozen's Test.

Nonoperative and Operative Management

Physical therapy such as deep massage and stretching, activity modification, nonsteroidal anti-inflammatory drugs, and injections such as corticosteroids, autologous whole blood, PRP, and botulinum toxin are considered some of the primary nonoperative methods for the treatment of epicondylitis (Tosti et al., 2013). A combination of physical therapy sessions, activity modifications, a 10- to 14-day course of oral anti-inflammatory, and corticosteroid injections or other solutions like the ones mentioned previously are common interventions prescribed to a patient diagnosed with this syndrome (Tosti et al., 2013). Nonoperative treatments of LE have shown to have a well-documented success rate. Accounting for 95% improvement on LE cases, nonoperative treatments are known as the mainstay treatment for this type of injury and will always precede any surgical approach. Nonoperative treatment is usually conducted over a period of 6–12 months. When nonoperative measures fail, surgical treatment is usually indicated. It is important to mention that other causes of lateral elbow pain such as cervical spondylosis, radial tunnel syndrome, tumors, chondral lesions, and avascular necrosis must be ruled out before surgical intervention is considered (Tosti et al., 2013).

At a military community hospital on the East Coast, similar actions are taken but in a shorter time frame. Although the literature states that surgical management is usually carried out after nonoperative treatment options have failed over a period of 8–12 months, at this community hospital, surgical options are presented to the patients after 3–5 months of unsuccessful nonoperative treatment and as the last resort in trying to repair the injury. In addition, this facility does not have a formal policy or clinical pathway to support a standardized approach to treating epicondylitis. However, individual practice is strongly supported by evidence-based practice while considering the unique situations within the active duty military population such as expediting the surgical process to achieve medical readiness. There is also a consensus among providers that if positive results are not achieved within a 3-month period after starting nonsurgical treatment, surgical approach should be contemplated as a potential next step with percutaneous release of the ECRB and open release and repair being the most common surgical approaches in treating LE (Tosti et al., 2013).

Clinical Question

In orthopaedic patients with LE, does having PRP injection treatment compared with corticosteroid injection treatment speed the tissue healing process?

Search Strategy

A systematic search of the literature investigating the effectiveness of PRP and corticosteroid injections in the treatment of LE was completed using two search engines, the Public/Publisher Medical Literature Analysis and Retrieval System Online (PubMed) and Cumulative Index to Nursing and Allied Health Literature (CINAHL). The PubMed and CINAHL search terms used in this process were injection therapies, platelet-rich plasma, autologous blood, PRP, corticosteroids, glucocorticosteroids, epicondylitis, lateral epicondylitis, tennis elbow, and tendinopathy. Both search engines utilized Boolean connectors "AND" and "OR" and included the limiters: published in the last 10 years, meta-analysis, systematic reviews, randomized control trials (RCTs), and language (English and Spanish). The PubMed search yielded 24 articles and CINAHL yielded an additional eight. After reviewing the results of both databases, three duplicates were found and subsequently discarded. An ancestral search of the 29 articles was also conducted and netted another six articles. Of the 35 articles, 21 articles were discarded because they were not relevant to the clinical question. The remaining 14 articles were retained for synthesis.

Literature Synthesis

All 14 articles met three to four elements of the clinical question. Thirteen (93%) of the articles had hierarchy-level evidence ratings of II or higher and supported research inclusive of criteria to minimize bias that addressed clinical outcomes. The remaining article was rated Level IV, which provided useful data but lacked randomization. Of the 14 articles, 10 (71%) had a quality-level rating of A, which indicated that the studies had consistent results, sufficient sample size, and adequate controls and yielded definitive conclusions. The remaining four articles (29%) had a quality-level rating of B, which indicated that the studies had reasonably consistent results, sufficient sample size, and some control, and yielded fairly definitive conclusions. Seven of the 14 articles (50%) directly compared PRP with corticosteroid injection, three (21%) compared PRP with interventions other than corticosteroid injection, and four (28%) compared corticosteroid injection with interventions other than PRP. All 14 articles examined the effects of PRP and corticosteroid injection on pain, function, and adverse effects in patients with LE.

All of the articles that met the inclusion criterion for this literature synthesis included interventions of PRP and corticosteroid injection. In addition to PRP and corticosteroid injection, many of these articles discussed additional interventions for LE that were also compared with PRP and/or corticosteroid injection. Seven of the 14 articles (50%) directly compared PRP with corticosteroid injection in the treatment of LE. Out of the remaining seven articles, three compared PRP with treatments other than corticosteroids whereas four

compared corticosteroid injection with treatments other than PRP (see Table 1).

Platelet-Rich Plasma Compared With Corticosteroid Injections

Of the seven articles that directly compared PRP with corticosteroid injection, four had an evidence level rating of I (Coombes, Bisset, & Vicenzino, 2010; Krogh et al., 2012; Priteo-Lucena et al., 2012; Sheth et al., 2012) and three had an evidence level rating of II (Gosens et al., 2011; Krogh et al., 2013; Peerbooms et al., 2010). Both Krogh et al. (2012) and Sheth et al. (2012) conducted systematic reviews and meta-analyses in which the outcome of 40 RCTs and 10 prospective cohort studies compared PRP, corticosteroid injection, and other interventions. The authors analyzed their effectiveness on pain and adverse effects in patients diagnosed with LE and other orthopaedic indications; however, they arrived at different conclusions. A longitudinal study by Krogh et al. (2012) concluded that all interventions, including PRP, were effective when compared with placebo (corticosteroid injection) on decreasing pain and function. It is important to mention that the authors were unable to confirm positive short-term effects of corticosteroid injection treatments. This was due to the fact that this systematic review only included data at the final end point of each trial excluding data reported at multiple time points, which could be considered a major limitation of this study. Only one PRP study in this review (Peerbooms et al., 2012), was considered to be at low risk of bias. Although it showed PRP to be superior to corticosteroid injection, the author pointed out that not having a direct placebo control was a limitation. Sheth et al. (2012) concluded that there was no significant difference in pain ($p = .10$ on RCTs and $p = .36$ on PCSs) between PRP and corticosteroid injection at 6 weeks, 6 months, and 1 year. In the studies conducted by Krogh et al. (2012) and Sheth et al. (2012), variability in terms of dosage preparation and measuring tools was reported as a limitation in these studies.

The systematic reviews conducted by Coombes et al. (2010) (41 RCTs) and Priteo-Lucena et al. (2012) (seven RCTs and four cohort studies) reviewed the effects of corticosteroid injection and PRP on pain and function in various tendinopathies, including LE. The authors of these studies reported that corticosteroid injection treatment had better short-term outcomes in pain and function than PRP; however, PRP had better intermediate and long-term outcomes in the treatment of tendinopathies.

Coombes et al. (2010) reported several limitations in their systematic review. One of these limitations was the author's conclusion that a small effect in pain reduction, which favored corticosteroid injection over PRP, was based on one RCT that directly compared the two treatment options for LE. Another limitation identified by the authors was that the exclusion criterion was narrow in focus and could have excluded useful information from similar studies that were rejected because of quality ratings. In regard to limitations in the systematic review conducted by Priteo-Lucena et al. (2012), the authors noted a potential limitation where the inclusion criterion was too broad and could possibly have allowed patients with systemic inflammatory conditions and/or with history of trauma to participate in some of the studies.

The remaining three articles (Gosens et al., 2011; Krogh et al., 2013; Peerbooms et al., 2010) evaluated the effectiveness of PRP and corticosteroid injection on pain and physical disability in patients with LE. Gosens et al. (2011) and Peerbooms et al. (2010) showed long-term benefits of PRP over corticosteroid injection on pain ($p = .014$ and $p < .001$) and function ($p < .002$ and $p < .005$), whereas Peerbooms et al. (2010) reported short-term benefit of corticosteroid injection over PRP. On the contrary, Krogh et al. (2013) reported no significant short-term benefits in pain ($p = .717$) and function ($p = .649$) from PRP or corticosteroid injection.

A limitation reported by Gosens et al. (2011) and Peerbooms et al. (2012) was the inability to include placebo as an independent variable as directed by the Netherlands Institutional Review Board. Krogh et al. (2013) reported several limitations, including the following: inability to implement an ideal recovery period to allow proper healing; the use of local anesthetics near the location of PRP injection that could interfere with PRP action; the use of saline injection as placebo that could be more than an inactive comparator; and the inclusion of patients previously treated with corticosteroid in the control (corticosteroid) group.

PRP Injections Compared With Other Treatments

Of the three that individually compared PRP injection with interventions other than corticosteroids, one had an evidence level rating of I (De Vos et al., 2010), one had an evidence level rating of II (Mishra et al., 2013), and one had an evidence level rating of IV (Mishra & Pavelko, 2006). All three articles individually explored the effects that PRP has on pain and function when compared with autologous blood, bupivacaine, and epinephrine. De Vos et al. (2010) conducted a systematic review where five RCTs and six control clinical trials compared the effectiveness of PRP and autologous blood. Mishra et al. (2013) conducted an RCT with a population of 225 and compared the effectiveness of PRP and bupivacaine. And finally, Mishra and Pavelko (2006) conducted a cohort study with a population of 20 and compared the effectiveness of PRP and bupivacaine with epinephrine. In the systematic review conducted by De Vos et al. (2010), the authors concluded that, although limited, there is evidence supporting the effectiveness of PRP. Mishra et al. (2013) concluded that PRP significantly improved pain ($p = .027$) when compared with control groups. While there were no major differences in functionality scores between the active and control groups, the effects PRP had on pain showed more improvement when compared with their respective baselines. Finally, Mishra and Pavelko (2006) reported significant improvement in pain and function when compared with control groups at 4 and 8 weeks posttreatment.

There were no limitations reported in any of the articles described previously; however, Mishra and Pavelko (2006) used a small sample size for the study and experienced a high dropout rate. Mishra et al. (2013) also suffered from a high dropout rate and did not meet the sample size requirement determined from having conducted a power analysis.

Table 1. Systematic Evidence Evaluation Table

Citation	Coombes et al. (2010)	De Vos et al. (2010)	Gaujoux-Viala, Dougados, & Gossec (2009)	Krogh et al. (2012)	Priteo-Lucena et al. (2012)	Sheth et al. (2012)	Gosens et al. (2011)
Evidence Level	I	I	I	I	I	I	II
Platelet-rich plasma							
Pain	✶↓ Short-term ↓ Long-term	↓ Limited level III evidence	Not evaluated in this study	↓ Long-term	✶↓ Short-term ↓ Long-term	↔ Short-term ↔ Long-term	↓ Long-term
Functionality	↑ Short-term ↓ Long-term	↑ Limited level III evidence	Not evaluated in this study	↑ Long-term	↑ Short-term ↑ Long-term	↔ Short-term ↔ Long-term	↑ Long-term
Glucocorticosteroids							
Pain	✶↓ Short-term ↑ Long-term	Not Applicable	↓ Short-term ↑ Long-term	↑ Long-term	✶↓ Short-term ↑ Long-term	↔ Short-term ↔ Long-term	↑ Long-term
Functionality	↑ Short-term ↓ Long-term	Not Applicable	↑ Short-term ↓ Long-term	↓ Long-term	↑ Short-term ↓ Long-term	↔ Short-term ↔ Long-term	↓ Long-term

Citation	Krogh et al. (2013)	Lewis et al. (2005)	Lindenhovious et al. (2008)	Mishra et al. (2013)	Peerbooms et al. (2010)	Tonks et al. (2006)	Mishra & Pavelko (2006)
Evidence Level	II	II	II	II	II	II	IV
Platelet-rich plasma							
Pain	↔ Short-term	Not evaluated in this study	Not evaluated in this study	↓ Short-term	✶↓ Short-term ↓ Long-term	Not evaluated in this study	↓ Short-term
Functionality	↔ Short-term	Not evaluated in this study	Not evaluated in this study	↑ Short-term	✶↑ Short-term ↑ Long-term	Not evaluated in this study	↑ Short-term
Glucocorticosteroids							
Pain	↔ Short-term	↓ Short-term	↔	Not evaluated in this study	↓ Short-term ↑ Long-term	↓ Short-term	Not evaluated in this study
Functionality	↔ Short-term	Not evaluated in this study	↔	Not evaluated in this study	↑ Short-term ↓ Long-term	↑ Short-term	Not evaluated in this study

Note. ↓ Statistically significant positive decrease; ↓ Statistically significant negative decrease; ✶↓ Positive decrease, but not statistically significant; ↑ Statistically significant positive increase; ↑ Statistically significant negative increase; ↔ No statistically significant difference between groups or baseline; ✶↑ positive increase, but not statistically significant.

Corticosteroid Injection Compared With Other Treatments

Of the four (29%) articles that focused on the comparison of corticosteroid injection with other interventions other than PRP, one had an evidence level rating of I (Gaujoux-Viala, Dougados, & Gossec, 2009) and three had an evidence level rating of II (Lewis, Hay, Paterson, & Crofit, 2005; Lindenhovious et al., 2008; Tonks, Pai, & Murali, 2006). Gaujoux-Viala, Dougados, and Gossec (2009) conducted a meta-analysis of 20 RCTs that compared the effectiveness of corticosteroid injection, placebo, physiotherapy, and nonsteroidal anti-inflammatory drugs on pain, function, and adverse effects in patients with LE. They concluded that corticosteroid injection was more effective at improving pain and function short-term when compared with placebo. However, the authors reported no difference between corticosteroid injection and nonsteroidal anti-inflammatory drugs.

Lewis et al. (2005), Lindenhovious et al. (2008), and Tonks et al. (2006) conducted RCTs with an average of 92 patients and compared the effectiveness of corticosteroid injection with placebo, physiotherapy, dexamethasone, naproxen and methylprednisolone on pain, function, strength, and the number of painkillers taken. Both Lewis et al. (2005) and Tonks et al. (2006) concluded that benefits from corticosteroid injection therapy were significant ($p < .05$ and $p < .0001$) in the short-term period (≤8 weeks) when compared with placebo. Lindenhovious et al. (2008) reported no significant difference in pain, grip strength, and function when compared with placebo for a long term (≥6 months).

Gaujoux-Viala et al. (2009) and Lindenhovious et al. (2009) reported no limitations in their studies. Lewis et al. (2005) mentioned one limitation related to inconsistency in the identification of baseline and follow-up time points for data collection. In addition, the authors did not discuss how the self-report tool used to collect data and the inclusion criterion that allowed patients with history of LE treatment to be involved in the study could affect the response rate (compliance with diary) and the validity of the results, respectively. Limitations on Tonks et al. (2006) were small sample size, high dropout rate, and the lack of power analysis.

Corticosteroids, PRP, and Tenocytes

Although not a part of this synthesis, it is important to mention the positive and negative effects that PRP and corticosteroids have had on tenocytes during laboratory control trials. As mentioned earlier, corticosteroids have been associated with decreasing tenocytes' viability, which plays an important role in the tissue healing process (Carofino et al., 2012; Han et al., 2012). In a laboratory control study, Wong et al. (2009) utilized human tendon explant cultures to test the effect of dexamethasone and triamcinolone on tenocytes. The authors' findings identified suppression of cell viability of human tendons when using dexamethasone ($p = .01$) and triamcinolone ($p = .07$).

Platelet-rich plasma seems to have an opposite effect on tenocytes. According to a laboratory study conducted by Tohidnezhad et al. (2011), where rat's tenocytes were isolated and injected with platelet-released growth factor, tenocyte proliferation was increased when injected with PRFG ($p < .05$). Other studies such as those by Zhang and Wang (2010) and Baboldashti, Poulsen, Franklin, Thompson, and Hulley (2011) yielded findings comparable with those of Tohidnezhad et al. (2011).

Clinical Application to Practice

Lateral epicondylitis or tennis elbow is a common problem often treated by primary care physicians, physiatrists, and orthopaedic surgeons. This condition is often self-limiting or effectively treated with nonoperative measures such as rest, anti-inflammatory medication, physical therapy, and activity modification. However, in 10%–15% of patients with LE, "local elbow tenderness and pain with resisted wrist extension persist" (Mishra et al., 2013, p. 6). It is in this group of patients that corticosteroid injections are often considered and extensively used. A survey of 400 members of the American Academy of Orthopedic Surgeons found that 93% have administered a corticosteroid injection in patients diagnosed with LE (Mishra et al., 2013).

Once considered the *go to* medication for the treatment of LE, corticosteroid injection has gone from being the number one treatment of choice to a controversial-preferred drug. This is mainly due to recent studies that have debated its long-term effectiveness and the comparison of corticosteroids with newly advanced drugs, which have shown to be superior. When considering short-term intervention options to decrease pain and/or improve function, corticosteroid injections are considered the best option when compared to physiotherapy and wait-and-see policies (Gosens et al., 2011). In a study by Peerbooms et al. (2010), the authors concluded that a corticosteroid injection was better than PRP within the first 12 weeks postinjection but was unable to show continuous improvement and actually showed signs of decreased effectiveness at or around this 12-week period (Peerbooms et al., 2010). Another study by Krogh et al. (2013) also concluded that corticosteroid injection showed significant short-term reduction in pain and disability at 1 month, but at 3 months, there were no long-term benefits. Krogh et al. also concluded that the effects of corticosteroid injection and saline injection were equal after 3 months postinjection. Given these findings, it is clear that short-term effects of corticosteroid injection cannot be denied. There is a plethora of data from numerous studies that demonstrate the effectiveness of corticosteroid injection treatment in the reduction of pain and increased function when compared to other advanced drugs such as PRP. The question is, at what cost?

Several limitations for the use of corticosteroid injections in the treatment for LE have been identified. Corticosteroid injection is limited to a short-term treatment option because it becomes ineffective over time. Another notable limitation is the high frequency of relapse and recurrence of LE in patients treated with corticosteroid injection. This could be attributed to the permanent adverse changes that occur to tenocytes, which in turn may have a damaging effect on the structure of the tendon. This, in combination with the potential overuse of "the arm after injection as a result of

direct pain relief," (Gosens et al., 2011, p. 1205) could result in reinjury. In addition, Lindenhovious et al. (2008) stated after having documented pain relief 6 weeks after injection, a high recurrence rate and worsening of symptoms were seen with corticosteroid injections that were not seen with other injection treatments. Szabo (2008), Coombes et al. (2010), and Han et al. (2012) all made similar conclusions from their studies.

The negative effect that corticosteroids could have on tenocytes viability is probably the second biggest drawback of corticosteroids. Tenocytes are the major cell type found in tendons in the human body and any activity suppression may affect normal healing response resulting in altered matrix synthesis and modulation (Wong et al., 2009). While corticosteroid injection provides symptomatic short-term relief for LE by effectively inhibiting neuropeptides and cytokines, the possibility that tissue cells are damaged in the process is significant (Han et al., 2012). This, in turn, could explain the high frequency of relapse and recurrence rate (Gosens et al., 2011). Although many laboratory-controlled studies have reported the negative effects that corticosteroid injections have on tenocytes, they are often not referenced in pain and function studies. Baboldashti et al. (2011) found that when tenocyte cells are exposed to therapeutically relevant doses of dexamethasone, which are commonly used for the treatment of tendinopathies and inflammatory conditions, cell death and reduction of viable cell numbers occur. Wong et al. (2009) also conducted laboratory-controlled studies on explants of human tendon and found that dexamethasone and triamcinolone have a suppressive effect on cell viability, which is consistent with Wong's previous studies conducted in 2003 and 2004 using human tenocyte cell cultures (Wong et al., 2003; Wong, Tang, Lee, Fu, & Chan, 2004).

In lieu of the possible negative effects of corticosteroid injections, a variety of other treatment options, including PRP, are now being examined as possible alternative therapies for patients with LE. Platelet-rich plasma contains powerful growth factors, prepared from the patient's own blood that can stimulate tissue repair in addition to protecting tenocytes from the cytotoxic effects caused by corticosteroids (Baboldashti et al., 2011). A significant number of studies have reported the effectiveness of PRP on the treatment of common tendinopathies. One of these studies conducted by Peerbooms et al. (2010) concluded that PRP significantly reduced pain and disability in patients with LE, having obtained results that exceeded the effects of corticosteroid injections. A follow-up study by Gosens et al. (2011) supported these findings and reported that PRP continued to exceed corticosteroid injection even after a 2-year follow-up, a milestone that corticosteroids have not being able to achieve. In a systematic review, Priteo-Lucena et al. (2012) also concluded that PRP is superior to corticosteroid injection in the treatment of LE. According to the authors, this superiority is seen in pain levels and functionality as supported by other RCTs and systematic reviews. In addition to reporting that PRP significantly reduced pain in chronic elbow tendinosis, Mishra and Pavelko (2006) recommended that PRP should be considered before surgical intervention. Finally, PRP is characterized by having a low frequency of relapse and recurrence of LE. This could be attributed to proliferation and protection of tenocytes, which are damaged when exposed to standard treatment dosages of corticosteroid (Coombes et al., 2010; Gosens et al., 2011; Mishra et al., 2013; Wong et al., 2009).

Like corticosteroid injections, PRP also has limitations. The first and probably the main limitation is the lack of significant short-term effect. The regeneration of tendon tissue is a process that can take more than 3 months (Krogh et al., 2013) and although PRP progressively decreases pain and disability, it is not as effective as corticosteroid injection within the first 3 months of treatment (Coombes et al., 2010; Peerbooms et al., 2010; & Priteo-Lucena et al., 2012). In other words, it is an effective treatment where positive results are seen overtime with longer lasting results.

Another PRP limitation is cost. Platelet-rich plasma treatments are estimated to cost $1,200, and although it is significantly higher than the short-term corticosteroid injection treatment, it is a fraction of the $10,000 cost incurred with surgical treatment (Mishra et al., 2013). It is important to mention that although PRP treatments involve higher cost when compared with corticosteroid injections, when the cost of failed corticosteroid injection treatment is considered, the difference in cost-effectiveness will level out. In addition, the financial impact associated with missing work and the need for additional medical interventions cannot be discounted (Gosens et al., 2011).

Finally, the methods used to measure pain and functionality in both PRP and corticosteroids studies could be considered a limitation. A variety of tools used to assess pain and function such as the Disability of Arm and Shoulder, visual analog score, Patient-Rated Tennis Elbow Evaluation, Mayo Elbow Score, and Patient Related Forearm Evaluation Questionnaire for Pain and Function were not consistently used across studies. In addition, there was a marked variability among the studies with respect to preparation and dosage of blood concentrates and outcomes measures (Sheth et al., 2012). As a result, this variability could lead to uncertainty related to the evidence obtained to support the clinical use of PRP as a treatment option for LE (Sheth et al., 2012).

Outcomes Evaluation

So, knowing what we know today, why has there not been a change in practice toward PRP when it comes to LE treatment? One reason could be, as mentioned earlier, the lack of standardization of study protocols, techniques, and measures used to evaluate the effectiveness of PRP (Sheth et al., 2012). Another reason could be the lack of knowledge that both primary care providers and patients have in regard to the advantages of PRP and/or disadvantages of corticosteroid injection on the treatment of LE. This lack of knowledge may have an effect on limiting treatments options for LE. A demand for a fast-acting treatment could also play a role, automatically ruling out PRP as an option for LE. Finally, cost was mentioned earlier as one of the PRP

limitations, which makes corticosteroid injections the best short-term cost-effective treatment for LE. Without a pharmacological standard protocol to follow, clinicians need to be informed of evidence supporting treatment options to effectively manage patients with LE.

Gaps in Literature

Although numerous injection therapies are currently available to treat LE, their efficacies have yet to be demonstrated probably because current treatments are directed to suppress an inflammatory response that does not exist in LE (Priteo-Lucena et al., 2012). Several new treatment options such as PRP and autologous blood have been studied in humans and rats with the purpose of finding an effective standard treatment. These studies have yielded mixed outcomes. Some of these treatments such as PRP and autologous blood have shown not only positive results but also superiority against the use of corticosteroid injections, which had historically been one of the most popular treatment choices for LE. Unfortunately, previous study designs may have compromised research results that have challenged the credibility and/or efficacy of these treatment options.

The utilization of standard tools, while evaluating different interventions, is important to avoid heterogeneity. Although current evidence in the literature supports positive results of PRP and confirmed poor and damaging effects of corticosteroids, different tools to assess pain and disability and injection techniques have been used. To facilitate the ability to generalize the results in future studies to LE populations, standardized tools and techniques need to be identified. In addition, a comparison of platelet preparation systems is necessary to eliminate variations in platelet activation prior to injection, which can directly impact the growth factor release profile (Halpern, Chaudhury, & Rodeo, 2012). Finally, studies need to be conducted utilizing a standardized process for the injection of the desired solution into the extensor carpis radialis. It is recommended that future studies adopt computer-guided injection technique to improve needle placement and avoid variability during the injection process (Mishra et al., 2013).

Once studies have been conducted to address the design issues presented earlier, the question still remains as to whether research results obtained from animal or in vitro studies can be effective in the treatment of acute traumatic lesions. Future studies should focus on the effectiveness of available treatments for LE patients in the early phase of an acute injury and the duration of their effect (Sheth et al., 2012).

Summary Statement

Epicondylitis, commonly known as tennis or golfer's elbow, is one of the most common soft tissue injuries in adults between 30 and 50 years of age (Ciccotti et al., 2004). Corticosteroid injection, once considered the treatment of choice for LE due to its rapid action effect against pain and disability, has been associated with a high recurrence rate and decreased cell viability (Wong et al., 2009). As a result, PRP has emerged as a potential solution to LE and has shown its superiority over corticosteroid injections, not only by decreasing pain and disability for a longer period, but also by protecting against the negative effect of corticosteroids and stimulating the tissue healing process in acute lesions. However, study design issues focused on PRP treatments for LE have put into question the credibility and/or efficacy of PRP as a promising treatment option. As a result, future studies to address these design issues are necessary to develop a standardized, evidence-based protocol supporting the use of PRP in the treatment of LE.

Clinical nurse specialists (CNSs), as well as other practitioners with prescriptive authority, should carefully consider available treatment options for LE. To support an informed decision by the patient, both practitioners and their patients need to be educated about the pros and cons of corticosteroid injections, PRP, or any other treatment options. As the CNS clinical role continues to evolve and expand, it is crucial to challenge old practices not supported by evidence and to advocate for changes that have proven to be effective to improve practices and achieved better patient outcomes. It is the CNS duty, in collaboration with other providers, to assess and participate in the development of institutional standards of practice, education, and future research studies.

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