PJSS Vol. 67, No. 1, January-March, 2012

PJSS PHILIPPINE JOURNAL OF SURGICAL SPECIALTIES

Plantar Fascia Specific Stretching Exercise vs. Corticosteroid Injection for the Treatment of Chronic Proximal Plantar Fasciitis: A Prospective, Randomized Study

Emiliano B. Tablante, M.D. and Chauncey Kester L. Lim, M.D.

Institute of Orthopedics and Sports Medicine

A randomized trial was conducted to determine whether tissue-specific plantar fascia-stretching program has a better functional outcome than corticosteroid injection in the management of patients with chronic proximal plantar fasciitis.

Methods: Fifty four patients who had chronic proximal plantar fasciitis for the duration of at least ten months were randomized into one of two treatment groups. The patients received instructions for a plantar fascia tissue-stretching program (Group A) or a dose of corticosteroid injection (Group B). All patients completed the pain subscale of the Foot Function Index and a subject-relevant outcome survey.

Results: Overall, group A has lower pain levels and better improvement of function compared to Group B after treatment, $P<0.0001$.

Key words: plantar fasciitis, corticosteroid

Proximal plantar fasciitis is a common problem in the adult population with heel pain. The disorder is seen relatively frequent in athletically active individuals as well as those with sedentary lifestyles. Although the etiology of plantar fasciitis is poorly understood, the most common theory is repetitive microtrauma and chronic inflammation of the plantar fascia at its insertion on the medial tubercle of the calcaneus.[1,2] Non-operative treatments for plantar fasciitis vary widely, and include shoe modifications, use of prefabricated and custom inserts, stretching exercises, physical therapy, non-steroidal anti-inflammatory medications, cortisone injections, night splints, application of a cast, or any combination of the foregoing modalities.[3,4] In our institution, the most common conservative treatment is giving a dose of corticosteroid injection directly on the origin of the plantar fascia (medial calcaneal tubercle).

Resolution of the symptoms occur in the majority of patients within 10 months, but approximately 10% develop persistent and often disabling symptoms.[5] In an initial study by DiGiovanni, et al.[6], 82 patients with chronic proximal plantar fasciitis for a duration of at least 10 months completed a randomized, prospective eight-week clinical trial. The patients were divided into a group managed with a plantar fascia-specific stretching protocol and a group managed with an Achilles tendon-stretching protocol. Although improvement was noted in both groups at the time of the eight-week follow-up, the group managed with the non-weight-bearing plantar fascia-stretching protocol was found to have superior results with regard to pain, function and overall satisfaction compared with those managed with the Achilles tendon-stretching protocol. The major goal of the tissue-specific plantar fascia-stretching protocol was to optimize tissue tension through a controlled stretch of the plantar fascia by recreation of the windlass mechanism (metatarsophalangeal joint dorsiflexion and ankle dorsiflexion). This study was conducted to determine whether the tissue-specific plantar fascia-stretching protocol has a better functional outcome compared to that of a dose of corticosteroid injection.

Methods

Between November 2008 to August 2009, 54 patients (22 men and 32 women) who had chronic heel pain for at least 10 months were included in the study. The mean age was 43 years (range, 32 to 60 years). All patients complained of maximum pain upon palpation of the origin of the plantar fascia on the medial calcaneal tubercle and worst during the first step in the morning, consistent with a diagnosis of proximal plantar fasciitis.[1,3] They had

failed to respond to previous non-operative treatments including non-steroidal anti-inflammatory medications, heel inserts, shoe and/or activity modifications. Patients were excluded if they had a history of any systemic disease, prior heel surgery, or heel pain that was not consistent with proximal plantar fasciitis. Verbal and written instructions regarding the study were given to the patients.

Initially, patients completed a self-administered questionnaire that provided background information and a history profile of the heel pain which included age, gender, height and weight, hours spent standing during the day, and duration of symptoms. All patients exhibited maximal tenderness with palpation at the origin of the plantar fascia on the medial calcaneal tubercle, confirming a diagnosis of proximal plantar fasciitis. Patients who met the inclusion criteria for the study were then randomized into one of two treatment groups. The sequence of random allocation was concealed until interventions were assigned. Patients in both groups were advised to wear a prefabricated full-length inserts and prescribed a non-steroidal anti-inflammatory medication. Patients who were randomized to treatment Group A received instructions in a plantar fascia tissue-stretching program. While patients who were randomized into treatment Group B received a dose of corticosteroid (depo-medrol and lidocaine) injected directly over the origin of the plantar fascia (medial calcaneal tubercle).

To perform the plantar fascia stretch, the patient was instructed to first cross the affected leg over the contralateral leg while seated. The patient then applied force distal to the metatarsophalangeal joints on the affected side, pulling the toes upward toward the shin until a stretch was felt in the sole of the foot (Figure 1). Tension in the plantar fascia was palpated with the contralateral hand while performing the stretch. Patients were instructed to hold each stretch for a count of ten and to repeat it ten times. They were asked to perform the stretching program three times per day wherein the first stretch was to be done before taking the first step in the morning.[6]

Before treatment, the patients completed the pain subscale of the Foot Function Index[3]. At four weeks, the patients were advised to follow-up to monitor compliance to stretching program. Patients then returned at eight weeks for a follow-up examination and completion of the pain subscale of the Foot Function Index and a subject-relevant outcome measures questionnaire that incorporated generic and condition-specific outcome measures related to pain, function and satisfaction. Questions from the pain subscale of the Foot Function Index were used to generate the primary numeric outcome scores. The questions were scored from 0 (no pain) to 10 (worst pain imaginable), depending on the location marked by the patients on the visual analog scale. Similar to a previous heel pain study that had comparable outcome measures, only the first 7 items were used to generate an overall score. The remaining two items on the pain subscale were related to orthotic use and were not relevant to all subjects. The sum of the scores on the first 7 items was then expressed as a percentage of the maximum possible score. The difference in the overall pain score (the score after 8 weeks minus the baseline score) was used for subsequent analysis. It is important to note that a negative change in the visual analog scale score signifies patient improvement. Additionally, as part of the study protocol, the changes in the numeric scores for the first 2 items on the pain subscale were selected a priority to be evaluated separately, as they were considered to represent the primary concerns articulated by patients with chronic heel pain.[6]

Table 1. Summary of baseline measures for treatment groups.

Measurement	Group A (n = 27)	Group B (n = 27)
Age (yr)	43.8 (32-61)	43.2 (34-56)
Gender (F/M)	17/10	15/12
Weight (kg)	74 (48-107)	76.5 (57-102)
Body-mass index (kg/m^2)	27.2 (21-33)	28.1 (30.2-30.6)
No. of hours standing	4.9 (0.50-14.0)	5.2 (1.0-11.0)
Duration of symptoms		
10-12 mo	20	18
13-18 mo	4	5
>18 mo	3	4

Statistical Analysis

Descriptive statistics such as frequency, percentage, mean and standard deviation was used to describe the

demographic characteristics of patients. Comparison of Foot Function Index and SROM between the two groups was tested using Independent T test. Improvement within groups was computed using Paired T test. Analyses were two tailed, with P < 0.05 considered significant. Analysis was done using SPSS (Statistical Package for Social Sciences) 16.0 for Windows. Power estimates based on the change in the end point for the visual analog scale score and a standard error estimate obtained from a recent study with a similar design revealed that a sample size of 50 subjects would result in a test power of approximately 80% in detecting differences of 18% or more between the groups with respect to the change in the visual analog scale scores.[8]

Results

The study consists of 54 subjects which were randomized to the 2 treatment groups. The mean age for treatment group A was 43.8 years and had a greater number of female subjects. Likewise, treatment group B has a greater number of female subjects with a mean age of 43.2 years old. There is no significant difference in the demographic data between the two groups. Table 1 shows the summary of the demographic data for both groups. There was no significant difference in the pre-treatment Foot Function Index between the two groups. (Table 2)

Significant difference in the post-treatment Foot Function Index between the two groups were 3 out of 7 questions and the overall post-op FFI. Group A has lower heel pain "at its worst" (P<0.0001), after getting up in the morning with the first few steps (P<0.0001),and at the end of the day (P=0.007), compared to group B. The two groups had equal pain level when standing barefoot after treatment. Overall, group A has lower pain levels compared to Group B after treatment, (P<0.0001). (Table 3)

Table 2. Comparison of two groups in terms of pre-treatment foot function index.

FFI	Group A	Group B	P value
1	8.81 ± 0.68	8.56 ± 0.70	0.173
2	8.70 ± 0.61	8.56 ± 0.70	0.410
3	5.26 ± 0.71	5.30 ± 0.78	0.856
4	5.33 ± 0.55	5.22 ± 0.70	0.520
5	2.81 ± 1.04	2.74 ± 0.59	0.749
6	2.15 ± 0.82	2.15 ± 0.66	1.000
7	1.67 ± 0.78	1.67 ± 0.55	1.000
Overall	34.30 ± 2.02	34.11 ± 2.15	0.746

Table 3. Comparison of two groups in terms of post-treatment foot function index.

FFI	Group A	Group B	P value
1	0.93 ± 0.47	2.07 ± 1.17	< 0.0001
2	0.85 ± 0.36	2.33 ± 0.78	< 0.0001
3	0.19 ± 0.40	0.59 ± 0.64	0.007
4	0.11 ± 0.32	0.26 ± 0.45	0.167
5	0.07 ± 0.27	0.07 ± 0.27	1.000
6	0.04 ± 0.19	0.00 ± 0.00	0.322
7	0.04 ± 0.19	0.00 ± 0.00	0.322
Overall	2.22 ± 1.60	5.33 ± 2.67	< 0.0001

Though significant differences were observed in the post-treatment between the two groups, comparison within groups all showed significant difference in all aspects of Foot Function Index, pre- and post treatment, P<0.0001. (Table 4)

For the subject relevant outcome measures, more patients in group A felt better than before the treatment (96 vs 63) (P =0.009) while 100 percent of patients in group A have no or less heel pain compared to initial visit as opposed to only 78 percent in group B (P = 0.015). Rating the heel pain since the start of the treatment, 70 percent of group A patients felt all or much better pain compared to only 45 percent in group B (P = 0.017). Assessing the overall daily function, more than half of the group A patients (78%) had 51 percent or more improvement compared to only 22 percent in group B. (P=0.025). (Table 5)

Discussion

Outcome for individuals with acute plantar fasciitis has provided typically favorable results. Davis, et al.[9] noted that approximately 90 percent of patients with plantar fasciitis have resolution of their symptoms within 10 months. The fate for the other 10 percent with chronic

Table 4. Summary of improvement in foot function index in the two groups.

FFI	Group A		Group B	
	Mean Change	P value	Mean Change	P value
1	7.89 + 0.75	< 0.0001	6.48 + 1.28	< 0.0001
2	7.85 + 0.66	< 0.0001	6.22 + 0.97	< 0.0001
3	5.07 +0.83	< 0.0001	4.70 + 1.03	< 0.0001
4	5.22 + 0.58	< 0.0001	4.96 + 0.94	< 0.0001
5	2.74 + 0.94	< 0.0001	2.67 + 0.62	< 0.0001
6	2.11 + 0.75	< 0.0001	2.15 + 0.66	< 0.0001
7	1.63 + 0.69	< 0.0001	1.67 + 0.55	< 0.0001
Overall	32.07 + 2.51	< 0.0001	28.78 + 3.60	< 0.0001

Table 5. Descriptive summary for subject-relevant outcome measures (SROM).

SROM	Group A	Group B	P value
SROM 1: Compared to your initial visit:			
I feel BETTER OFF than before treatment	26 (96)	17 (63)	0.009
I feel THE SAME as before treatment	1 (4)	8 (30)	
I feel WORSE than before treatment	0 (0)	3 (7)	
SROM 2: Compared to your initial visit, describe your heel pain now:			
I have NO PAIN	9 (33)	2 (7)	0.015
I have LESS PAIN than before the treatment regimen	18 (67)	19 (71)	
I have SAME PAIN than before the treatment regimen	0 (0)	4 (15)	
I have MORE PAIN than before the treatment regimen	0 (0)	2 (7)	
SROM 3: What percent improvement in heel pain have you experienced since the start of the study?			
None	0 (0)	0 (0)	0.112
1% to 25%	0 (0)	2 (7)	
26% to 50%	5 (19)	8 (30)	
51% to 75%	12 (44)	6 (22)	
76% to 99%	6 (22)	10 (37)	
100%	4 (15)	1 (4)	
SROM 4: How do you rate your heel pain since that start of the study treatment?			
All better	10 (37)	2 (8)	0.017
Much better	9 (33)	10 (37)	
Slightly better	7 (26)	6 (22)	
Unchanged	1 (4)	9 (33)	
Worse	0 (0)	0 (0)	
SROM 5: What percent improvement in overall daily function including work and/or recreational activities have you experienced since starting the study?			
None	0 (0)	0 (0)	0.025
1% to 25%	0 (0)	5 (19)	
26% to 50%	6 (22)	16 (59)	
51% to 75%	8 (30)	4 (15)	
76% to 99%	13 (48)	2 (7)	
100%	0 (0)	0 (0)	
SROM 6: Regarding the treatment you received:			
I am TOTALLY SATISFIED	12 (44)	2 (7)	0.169
I am SATISFIED with MINOR RESERVATIONS	12 (44)	13 (48)	
I am SATISFIED with MAJOR RESERVATIONS	3 (12)	10 (37)	
I am DISSATISFIED with the treatment	0 (0)	2 (7)	

plantar fasciitis is not well understood. Surgical intervention may be appropriate for patients who do not respond to traditional non-operative approaches. However, recent studies have noted that, despite improvement in the symptoms, a prolonged recovery time and persistent pain were not uncommon. Although Conflitti and Tarquinio[10] noted a high satisfaction rate, only 57 percent of their patients had no functional limitation postoperatively. This is why we believe that it is important to further optimize non-operative treatments prior to considering surgical options.

The majority of the non-operative treatments for plantar fasciitis have demonstrated positive or encouraging results. These modalities include night splints, prefabricated and custom-made inserts, shoe modifications, stretching exercises, non-steroidal anti-inflammatory medications, cortisone injections, application of a cast, shock wave therapy, or any combination of these modalities. In our institution, corticosteroid injection is the most common non-operative treatment used for plantar fasciitis.[3,4,11]

Although steroid injection is the mainstay for the management of many hyper inflammatory disorders, little is known about the steroid effect at the cellular level and the etiology of the risks of connective tissue rupture after the same. Fascial rupture, which can be likened to tendon rupture, was investigated by Kennedy and Willis[2], who found that failing strengths decreased by 35 percent after administration of steroid in vitro to Achilles tendons. Cystic spaces and collagen necrosis were appreciated in their steroid group. This result continued through to 7 days. However, at 2 and 4 weeks following injection, these cystic spaces were replaced by an eosinophillic staining material and fibroblast proliferation was noted. Disordered collagen deposition was appreciated under scanning electron microscope. In addition, the failing strength returned to that of the control subjects. By 6 weeks, full biomechanical integrity was reestablished as evidenced by reorganization of collagen into parallel fibers. Hence, Kennedy and Willis[12] concluded that physiologic dose steroid injection weakens normal tendons for up to 14 days through collagen necrosis.

As evidenced by Crawford and Gudeman[13,14] steroid therapy in plantar fasciitis plays a significant role in short-term therapy. However, a number of complications were noted including plantar fascial rupture, plantar fat pad atrophy, lateral plantar nerve injury secondary to injection, and calcaneal osteomyelitis. Fascial rupture and fat pad atrophy are especially serious complications as they can lead to intractable complications. In addition, plantar fat pad atrophy diminishes subcalcaneal cushioning, availing the plantar fascia to further insult and, hence, more pain. Acevedo, et al.[15] appreciated symptomatic rupture in approximately 10 percent of subjects. Their retrospective chart review showed that approximately two-thirds of the patients (29/44) developed sudden onset rupture with a subsequent inability to weight bear, whereas one-third did not have acute onset. All of the ruptured patients presented with new additional symptoms including long arch pain, and lateral mid foot pain.

In light of these findings, we believe that attempts to further optimize the other non-operative treatment modalities in patients with chronic heel pain are warranted. DiGiovanni, et al.[6] assessed the role of Achilles tendon stretching versus plantar fascia stretching in a randomized study of 101 patients. Both Achilles stretching groups and plantar fascia stretching groups appreciated a decrease in pain upon first steps in the morning as well as increased function; however, the plantar stretchers appreciated a statistically significant improvement in activity function and first step pain as compared to the Achilles stretchers. DiGiovanni further assessed the improvement of plantar fascia versus Achilles tendon stretching by directly comparing the two in a crossover study of the same patient pool with a 2-year follow up. DiGiovanni, et al.[16] switched Achilles tendon group to plantar fascia stretching after the initial 8 weeks of the trial. After 2 years, the Achilles tendon patient pool was reassessed for maximum pain level and pain on first steps in the morning. While there was a significant difference between the two groups at 8 weeks, there was no statistical difference between the two at 2 years, with further improvement in pain in both groups.

The evaluation criteria were patterned with the aforementioned study. The pain subscale of the Foot Function Index was chosen because it is a validated instrument. It is chosen to target specifically the effects of the protocols on pain and overall daily function

(including work and/or recreation) as well as patient satisfaction. The investigators also chose to evaluate measures with a questionnaire that generated feedback with regard to the patient's perceptions of the outcome, that is, the subject-relevant outcome measures. This was used as an adjunct to the Foot Function Index to provide an additional measurement tool that concentrated on function and satisfaction.[8]

Although improvement from the baseline symptoms was noted in both groups, the group managed with the tissue-specific plantar fascia-stretching program was found to have superior results. The investigators believe that corticosteroid injection has a beneficial effect, especially with regards to pain in a short term period. However, with the potential risk of plantar fascia rupture and fat pad atrophy, one should be cognizant that overuse of steroid injection can lead to these complications.

In addition to the prospective, randomized design, an additional strength of this study is the method of patient selection. In order to minimize confounding variables, specific attention was paid to the inclusion of only patients who clearly had classic proximal plantar fasciitis. If they did not exhibit signs and symptoms of classic proximal plantar fasciitis, including tenderness localized to the medial tubercle of the calcaneus and pain with the first step in the morning, they were not enrolled in the study. The limitation of the study is that the duration of follow-up was limited to eight weeks only. While the investigators were encouraged by the changes in a relatively short period of time, the long-term effects on pain and activity limitations are not known.

Conclusion

The major goals of the plantar fascia-stretching protocol were to recreate the windlass mechanism and limit repetitive microtrauma and associated chronic inflammation by performing the exercises prior to the first steps in the morning or after any prolonged sitting or inactivity. After eight weeks of treatment, the group managed with plantar fascia-stretching exercises exhibited enhanced outcomes with regard to pain, function, and overall satisfaction compared with those of the group managed with corticosteroid injection. Thus, the investigators would like to recommend this protocol, for it provides a less costly, non-operative and non-invasive treatment option that resulted in a rate of improvement of symptoms that surpassed the responses to more traditional treatment methods for patients with chronic, disabling proximal plantar fasciitis.

References

1. Bordelon RL. Subcalcaneal pain. A method of evaluation and plan for treatment. Clin Orthop 1983; 177: 49-53.
2. Snider MP, Clancy WG, McBeath AA. Plantar fascia release for chronic plantar fasciitis in runners. Am J Sports Med 1983; 11: 215-219.
3. Furey JG. Plantar fasciitis. The painful heel syndrome. J Bone Joint Surg Am 1975; 57: 672-673.
4. Gill LH, Kiebzak GM. Outcome of nonsurgical treatment for plantar fasciitis. Foot Ankle Int 1996; 17: 527-532.
5. Davis PF, Severud E, Baxter DE. Painful heel syndrome: results of non-operative treatment. Foot Ankle Int 1994; 15: 531-535.
6. DiGiovanni BF, Nawoczenski DA, Lintal ME, Moore EA, Murray JC, Wilding GE, Baumhauer JF. Tissue-specific plantar fascia-stretching exercise enhances outcomes in patients with chronic heel pain. A prospective, randomized study. J Bone Joint Surg Am 2003; 85: 1270.
7. Budiman-Mak E, Conrad KJ, Roach KE. The Foot Function Index: a measure of foot pain and disability. J Clin Epidemiol 1991; 44: 561-570.
8. Pfeffer G, Bacchetti P, Deland J, et al. Comparison of custom and prefabricated orthoses in the initial treatment of proximal plantar fasciitis. Foot Ankle Int 1999; 20: 214-221.