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***Current approaches to surgical treatment of plantar fasciitis
(literature review)*****L.B. Reznik, S.A. Erofeev, V.N. Silantiev, M.A. Turushev, N.K. Kuznetsov**

Omsk State Medical University, Omsk, Russian Federation

There is no general consensus among experts regarding terminology, pathogenesis and treatment of heel spurs. Surgical treatment of heel spur is considered for patients who have not responded adequately after 6-12 months of conservative therapy. Although there is no evident association between the presence of osteophyte in the heel and plantar heel pain removal of exostosis is still viewed by many experts as the main purpose of surgical management. Another option includes plantar fascia release surgery aimed to relieve tension of plantar aponeurosis and improve pain. Surgical treatment of the proximal plantar fasciosis is reserved for degenerative, non-inflammatory cases to increase collagen regeneration and plantar fascia vascularity.

Keywords: heel pain syndrome, plantar fasciitis, plantar fasciosis, plantar fascia release, radiofrequency microtenotomy

Tenderness over the plantar calcaneus tuberosity and proximal fascia suggests classical proximal plantar fasciitis [1]. Anatomical term *plantar aponeurosis* is often used instead of the term *plantar fascia*. According to V.V. Kovanov and T.I. Anikina there is no big difference between cellular tissue, fasciae and aponeuroses [2] although *fasciitis* is an established term to denote a pathological condition of plantar aponeurosis. International Classification of Diseases ICD-10 code M77.3 for calcaneal spur is a medical classification as listed by WHO under the range soft tissue disorders, code range (M00-M99), diseases of the musculoskeletal system and connective tissue, other soft tissue disorders (M70-M79) contain medial and lateral epicondylitis, wrist periarteritis, metatarsalgia and other enthesopathies of the foot. Radiologically detected heel spur has long been a matter of debate in diagnosis and treatment of plantar heel pain. S.S. Tanz reported [3] calcaneal spurs being recorded in 50 % of patients with plantar fasciitis [4, 5]. As opposed to earlier opinions, the spurs do not actually occur within the plantar fascia but most commonly more dorsally, at the origin of the flexor digitorum brevis or abductor digiti minimi muscles [6]. In a randomly chosen sample of 1000 patients, R.L. Shmokler and colleagues [4]

found a 13.2 % incidence of heel spurs but only a 5.2 % incidence of heel pain. Since most of the cases spontaneously resolve regardless of the presence of the heel spur there was a conclusion that mechanism of pain was associated with 'concentrated tension' in plantar fascia [7].

Proximal plantar fasciitis is the second common reason of foot pain due to injury to the ligaments of the ankle joint and also a common cause of plantar heel pain [8]. More than 2 million individuals undergo treatment of plantar fasciitis annually in the United States [9] and approximately 1 in 10 people are predicted to develop heel pain during their lifetime [10], with 1 % of all visits to orthopaedic surgeons being attributed to heel pain [11]. It is a very common orthopaedic problem and mainly affects individual between the ages of 20 to 34 years [12]. Proximal plantar fasciitis is tendonitis that is characterized by chronic tendon pain due to excessive loads, poor vascularity and absence of inflammatory cells [13]. Histologic findings from 50 cases of heel spur surgery were reviewed for chronic plantar fasciitis. Findings included myxoid degeneration with fragmentation and degeneration of the plantar fascia and bone marrow vascular ectasia. Histologic findings were presented to support the thesis that

“plantar fasciitis” was a degenerative fasciosis without inflammation, not a fasciitis [14].

Normal healthy tendons are composed of parallel arrays of closely packed collagen fibers. The fibers are mostly collagen type I, but some collagen type III fibers are also present. Healthy tendons appear glistening white to the naked eye and microscopy reveals collagen fibers that have a characteristic reflectivity under polarized light. Symptomatic appear grey in tendinosis and microscopy reveals collagen fibers that lack reflectivity under polarized light. So, tendinosis is characterized by disorganized collagen fibers that make up the tendon, hypercellularity and vascular hyperplasia [15, 16].

B. Kraushaar and R.P. Nirschl [16] detected collagen fibers from the area of tendinosis being of variable diameter, with an uneven mixture of thin and thick fibrils on cross section. In the regions of severe tendinosis, collagen fibers did not connect with each other to provide a tendinous structure. They suggested that the ultrastructure of collagen in tendinosis was unable to sustain a tensile load. N. Maffulli et al. [17] confirmed the thesis and found that tendinosis site contained a significantly greater proportion of type III collagen, whereas type I collagen was the main collagen in healthy tendon. Accumulation of type III and a possible decrease in type collagen could result in a critical point where the resistance of the tissue to tensile forces was compromised and tendon rupture occurred. The cellular component in tendinosis is represented by tenocytes and myofibroblasts that are characteristic

of degeneration rather than inflammation based on humoral immune response.

The pathogenesis of the proximal plantar fasciitis is believed to be associated with excessive strain on the plantar fascia that fails to recover and entails low collagen and matrix production, destruction of tenocytes, progressive collagen degeneration and matrix impairment that results in greater sensitivity to injury and hinders complete recovery [18].

Heel pain caused by plantar fasciitis is usually a chronic condition with symptoms persisting over a year prior to a treatment. The average plantar heel pain episode lasts longer than 6 months [19–23]. Patients may present with pain in the plantar medial heel after a period of inactivity [24] or with the first steps early in the morning. As the person begins to move around, the pain level usually improves but never resolves completely during the day [21]. The pain often increases with long-distance walking, standing, putting an abnormal load on the feet on hard surfaces, in particular [24].

The clinical examination of a person with heel pain takes under consideration a patient’s medical history including therapies received, occupation, changes in body weight, physical activity, and foot pain symptoms [24, 25]. Imaging studies like radiographs (standard views and additional views if needed), diagnostic ultrasound, MRI can be used. Diagnostic efficacy of podography which demonstrates distribution of the pressure on the foot in statics and dynamics is a prospective trend in the study of the functional condition of the foot before and after conservative or operative treatment [26].

TREATMENT

Control of pain is one of major goals in treatment of plantar fasciosis. Conventional treatment options include local application of ice, nonsteroidal anti-inflammatory drugs (NSAIDs) and corticosteroid injections. Surgical treatment of the proximal plantar fasciosis is considered in patients with persistent symptoms refractory to nonsurgical intervention for at least 6 to 12 months.

Realignment of the os calcis with correcting osteotomy was offered by A. Steindler and A.R. Smith [27] in 1938 to protect the soft tissues. Bone

spur removal surgical procedure is another option for painful heel syndrome [28]. The technique was evolved to improve traumatic surgery [29, 30] by developing navigators and guides for less traumatic removal procedure [29]. Exostoses can be percutaneously removed under image intensifier control using a minimally invasive access to the plantar tuberosity of the calcaneus and a special bur [30].

A plantar fascia release is performed to address mechanical cause of the heel pain in the proximal plantar fasciosis refractory to conservative treatment.

The procedure is often combined with exostectomy. Surgical procedures to release plantar fasciitis include open surgery, percutaneous release and endoscopic surgery. A retrospective comparison of open and percutaneous surgical methods showed that both techniques provided identical long-term follow-ups in the treatment of heel pain but percutaneous practice involved less surgical time, less postoperative wound related complications, less postoperative pain and a faster return to full activity [31]. Percutaneous release does not allow the plantar fascia to be viewed; the procedure is done “blind” and there is a high risk of complete or excessive release and injury to nerves and muscles. Endoscopic surgery is believed to be a safe and reliable procedure for plantar fascia release as it offers an improvement on the recovery and complications of open surgery [32, 33, 34]. Two-incision endoscopic plantar fasciotomy is an accepted surgical technique in the treatment of plantar fasciitis. Single-incision plantar fasciotomy is a relatively new technique in the surgeons' armamentarium [35]. Limitations of endoscopic surgery include poor visualization and a high risk of unintended complete release.

G.J. Sammarco et al. [36] reported postoperative complication including superficial wound infection, deep venous thrombosis and superficial phlebitis following partial plantar fasciectomy. A. Manoli et al. [37] reported several cases of calcaneal fractures soon after bone removal from the undersurface of the calcaneus.

A.M. Brugh et al. [38] suggested that regardless of surgical technique (endoscopic or open release), lateral column symptoms (lateral column overload, pain on the outside of the foot) were more likely to result when more than 50 % of the plantar fascia was released. To avoid this complication, W. Miyamoto et al. [28] performed calcaneal osteotomy from 1 cm anterior of the calcaneal attachment of the plantar fascia to 1 cm anterior of the calcaneal attachment of

the Achilles tendon, and the proximal fragment was displaced approximately 5 mm in the plantar direction. The patients with a hyperpronated foot underwent an additional approximately 5 mm medial displacement of the proximal fragment. The procedure showed good results in patients who did not have severe pes planus. Proximal medial gastrocnemius release provided far better results than partial proximal fasciotomy with less morbidity and better patient satisfaction [39].

X. Yanbin et al. [40] offered minimally invasive technique of plantar fasciitis with percutaneous latticed fasciotomy that showed no complications and fast return to previous activities. With the publications describing the proximal plantar fasciitis as degenerative and non-inflammatory condition microtenotomy coblation using a radiofrequency (RF) probe primarily applied for myocardium and aimed at local ablation of tissues appeared to be an efficacious method in treatment of plantar fasciitis [41]. Radiofrequency microtenotomy was shown to promote secretion of fibroblastic growth factor, vascular endothelial growth factor and vascular cells [42]. The technology was studied in Achilles tendinopathy. Biomechanical studies showed no compromise in elasticity, strength or deformity with maximal tendon loading after radiofrequency microtenotomy [43]. Radiofrequency microtenotomy demonstrated good early results in the treatment of plantar fasciitis [42] associated with histologically confirmed mucoid degeneration [14]. Histological findings revealed increase in free nerve endings [44]. Patients report substantial pain relief at 1 to 2 weeks of bipolar radiofrequency treatment.

Additional studies have shown that radiofrequency induced afferent nerve fiber degeneration acutely but with complete regeneration by 90 days posttreatment [45, 46]. Longer term relief may be due to tissue healing and regeneration of healthy collagen, which have peaked at the time of the nerve endings have repaired [47].

CONCLUSION

Treatment of chronic plantar heel pain requires further investigation since there are many people affected by the condition and the treatment modalities

available fail to ensure quick and effective recovery of painless support on the involved foot. Understanding and the efficacy of the existing surgical modalities

for the treatment of the pathology is controversial. Surgery remains the single option for longstanding and recurrent cases of plantar fasciitis. It provides the possibility with less invasive procedures based on the principles of highly precise application of physical factors aimed at functional transformation

of biomechanics in decompensated parts of the foot. Further studies of the effectiveness of the treatment modalities are needed to ensure early rehabilitation and reduced disability period. The literature review presented in the work has shown the current state of the problem and prospects for their solution.

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Information about the authors:

1. Leonid B. Reznik, M.D., Ph.D., Professor,
Omsk State Medical University, Omsk, Russian Federation,
Email: leo-reznik@yandex.ru
2. Sergey A. Erofeev, M.D., Ph.D., Professor,
Omsk State Medical University, Omsk, Russian Federation,
Email: esa_rncvto@mail.ru
3. Vadim N. Silantiev, M.D.,
Omsk State Medical University, Omsk, Russian Federation,
Email: silantjev@yandex.ru
4. Mikhail A. Turushev, M.D., Ph.D.,
Omsk State Medical University, Omsk, Russian Federation,
Email: mturush20@mail.ru
5. Nikolay K. Kuznetsov,
Omsk State Medical University, Omsk, Russian Federation,
Email: nikkon.link@gmail.com