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Understanding Tarsal Tunnel Syndrome: Causes, Diagnosis, and Management

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Abstract

Tarsal Tunnel Syndrome (TTS) is a relatively underdiagnosed entrapment neuropathy caused by compression of the posterior tibial nerve or its branches as they traverse the tarsal tunnel, a fibro-osseous space located posteromedial to the ankle. Clinically analogous to carpal tunnel syndrome in the upper extremity, TTS manifests with a range of sensory disturbances including burning pain, tingling, and numbness in the plantar aspect of the foot and toes. The syndrome can be idiopathic or secondary to a variety of etiologies, including biomechanical abnormalities, trauma, systemic inflammatory conditions, and space-occupying lesions. Given its overlapping symptoms with other foot and ankle pathologies, the diagnosis of TTS remains challenging and frequently delayed, often requiring a combination of clinical evaluation, electrodiagnostic studies, and advanced imaging techniques for confirmation. Management strategies range from conservative approaches such as physical therapy, orthotics, and anti-inflammatory medications to surgical decompression for refractory cases. Despite advances in diagnostic modalities and surgical techniques, outcomes remain variable and are heavily dependent on the accuracy and timeliness of diagnosis as well as the underlying cause. This review aims to provide a comprehensive overview of the pathophysiology, clinical presentation, diagnostic criteria, and both non-operative and operative treatment options for TTS. Emphasis is placed on emerging diagnostic tools, the role of ultrasound-guided interventions, and patient selection criteria for surgery to improve prognostic accuracy and optimize clinical outcomes.

Keywords: Tarsal Tunnel Syndrome; Posterior tibial nerve compression; Foot and ankle neuropathy; Entrapment neuropathy; Compression syndromes; Tarsal tunnel anatomy; Medial ankle pain; Tingling and numbness in foot; Causes of tarsal tunnel syndrome; Flatfoot and tarsal tunnel; Ankle trauma and nerve compression; Electromyography (EMG)

Introduction

Tarsal Tunnel Syndrome (TTS) is a relatively underrecognized but potentially debilitating condition caused by compression of the posterior tibial nerve as it travels through the tarsal tunnel a narrow space found on the inside of the ankle, next to the ankle bones [1]. Analogous to carpal tunnel syndrome in the wrist, TTS affects the lower extremities and may result in pain, numbness, tingling, and even muscular dysfunction in severe cases.

Understanding the etiology, risk factors, clinical presentation, and available treatment modalities is crucial for timely diagnosis and optimal management of this condition [2]. This article aims to provide a comprehensive overview of TTS for healthcare professionals, patients, and those interested in foot and ankle pathologies. Tarsal Tunnel Syndrome (TTS) is a peripheral neuropathy involving the posterior tibial nerve, or one of its terminal branches, as it passes through the anatomical tarsal tunnel located posterior to the medial malleolus [3]. First described in the mid-20th century, TTS remains a clinically significant but often overlooked cause of chronic foot and ankle pain. The tarsal tunnel is an osteofibrous canal formed by the flexor retinaculum on the medial aspect of the ankle, housing critical neurovascular and tendinous structures [4,5]. Any condition that reduces the volume of this tunnel or increases the pressure within it can lead to nerve entrapment, resulting in a constellation of sensory and sometimes motor symptoms. The prevalence of TTS is difficult to determine due to underreporting, frequent misdiagnosis, and its symptom overlap with other neuropathic or musculoskeletal foot disorders such as plantar fasciitis, radiculopathy, or peripheral neuropathy [6]. It may present unilaterally or bilaterally and affects individuals across a wide age spectrum, although certain populations such as athletes, individuals with flatfoot deformity, and those with systemic diseases like diabetes or rheumatoid arthritis may be at greater risk. The diagnosis of TTS remains primarily clinical, based on patient-reported symptoms such as paresthesia, burning, or shooting pain along the medial ankle and plantar surface of the foot [7]. Provocative maneuvers such as the Tinel's sign at the tarsal tunnel may aid in diagnosis, but their specificity and sensitivity are limited. Electrodiagnostic studies, although useful, may yield false negatives, especially in early or mild cases. In recent years, imaging modalities like high-resolution ultrasound and magnetic resonance imaging (MRI) have played a growing role in identifying structural causes such as ganglion cysts, varicosities, or tenosynovitis [8]. Management of TTS involves a stepwise approach beginning with non-operative treatments aimed at reducing inflammation and relieving mechanical pressure on the nerve. These may include activity modification, custom orthotics to correct biomechanical issues, corticosteroid injections, and physical therapy focusing on nerve gliding and soft tissue mobilization. Surgical decompression is considered in refractory cases where conservative treatment fails and significant functional impairment persists.

Despite being a well-defined anatomical and clinical entity, TTS continues to challenge clinicians due to its insidious onset, diagnostic ambiguity, and variable response to treatment. This review seeks to

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consolidate current knowledge on the etiology, diagnostic approach, and therapeutic strategies for TTS, with a focus on enhancing clinical recognition and improving patient outcomes through evidence-based practices and multidisciplinary care.

Anatomy of the tarsal tunnel

The tarsal tunnel is a fibro-osseous passage located posterior to the medial malleolus. It is bordered by:

Medially by the flexor retinaculum (a strong fibrous band)

Laterally by the medial surface of the talus and calcaneus bones

Structures that pass through the tarsal tunnel include:

1. Posterior tibial tendon
2. Flexor digitorum longus tendon
3. Posterior tibial artery and vein
4. Tibial nerve
5. Flexor hallucis longus tendon

TTS is caused by anything that leads to compression or irritation of the tibial nerve. Common causes include:

Trauma or injury: Sprains, fractures, or soft tissue injuries in the ankle can cause inflammation or scar tissue formation, narrowing the tunnel.

Overuse or repetitive Stress: Especially in runners or people who walk long distances.

Anatomical anomalies: Such as ganglion cysts, varicose veins, lipomas, or accessory muscles.

Biomechanical abnormalities: Flat feet (pes planus) can cause the heel to tilt outward, increasing strain on the tibial nerve.

Systemic conditions: Diabetes and arthritis may contribute to nerve compression through tissue swelling or neuropathic mechanisms.

Signs and symptoms

Symptoms of TTS can be vague and are often misdiagnosed. Key clinical features include:

Pain: Burning or aching pain in the medial ankle or sole of the foot.

Paresthesia: Tingling, numbness, or electric shock sensations in the toes, heel, or sole.

Worsening with activity: Especially prolonged standing or walking.

Night Pain: Some patients report pain that worsens at night.

Muscle Weakness: In severe or chronic cases, atrophy or weakness of the intrinsic foot muscles may develop.

Symptoms often radiate into the arch and heel, sometimes mimicking plantar fasciitis.

Diagnosis

A thorough history and clinical examination are the cornerstones of diagnosis. Investigations may include:

Tinel's Sign: Percussion over the tarsal tunnel reproduces symptoms.

Electromyography (EMG) and Nerve Conduction Studies (NCS): To detect delayed nerve signal transmission.

MRI: Useful to identify soft tissue causes such as cysts or tumors.

Ultrasound: Dynamic imaging to evaluate nerve entrapment during movement.

Differential diagnoses include plantar fasciitis, peripheral neuropathy, radiculopathy (S1 nerve root), and complex regional pain syndrome.

Most cases can be managed non-surgically in the early stages:

- Rest and Activity Modification
- Ice Therapy: To reduce inflammation.
- NSAIDs: Non-steroidal anti-inflammatory drugs for pain management.
- Orthotics: Custom insoles to correct foot biomechanics.
- Ankle Braces: To reduce excessive pronation and support the foot arch.

Nerve gliding exercises

Strengthening of intrinsic foot muscles

Manual therapy to mobilize soft tissue and joint restrictions

Corticosteroid injections, for temporary relief of inflammation.

Neuropathic pain medications, Such as gabapentin or pregabalin.

If conservative measures fail over a 6-month period, surgery may be indicated.

Tarsal tunnel release surgery, Involves decompression of the tibial nerve by releasing the flexor retinaculum.

Microsurgical decompression, Preferred in certain cases for more precise intervention.

Post-operative rehabilitation includes gradual weight bearing, physical therapy, and monitoring for complications such as infection or nerve damage.

Prognosis

Early diagnosis and intervention lead to a favorable prognosis. However, chronic compression can result in irreversible nerve damage. Therefore, patients with longstanding symptoms may not fully recover even after surgery. Compliance with rehabilitation and modification of biomechanical risk factors significantly enhances outcomes.

- Use supportive footwear, especially for individuals with flat feet.
- Warm up adequately before exercise.
- Avoid prolonged standing or walking on hard surfaces.
- Maintain a healthy body weight.
- Regular foot assessments for diabetic individuals.

Conclusion

Tarsal Tunnel Syndrome, while less well-known than other neuropathies, can severely impact mobility and quality of life if left untreated. Awareness among clinicians and patients is key to early recognition and effective management. A multidisciplinary approach involving physical therapists, podiatrists, and orthopedic specialists ensures the best possible outcomes.

References

1. Alvarez CM, De Vera MA, Heslip TR, Casey B (2007) Evaluation of the anatomic burden of patients with hereditary multiple exostoses. Clin Orthop Relat Res 462: 73-79.
2. Faiyaz-Ul-Haque M, Ahmad W, Zaidi SH (2004) Novel mutations in the EXT1 gene in two consanguineous families affected with multiple hereditary exostoses (familial osteochondromatosis). Clinical Genetics 66: 144-151.
3. Zak BM, Crawford BE, Esko JD (2002) Hereditary multiple exostoses and heparan sulfate polymerization. Biochim Biophys Acta-Gen Subj 1573: 346-355.
4. Irie F, Badie-Mahdavi H, Yamaguchi Y (2012) Autism-like socio-communicative deficits and stereotypies in mice lacking heparan sulfate. Proc Natl Acad Sci 109: 5052-5056.
5. Kaim AH, Hugli R, Bonél HM, Jundt G (2002) Chondroblastoma and clear cell chondrosarcoma: radiological and MRI characteristics with histopathological correlation. Skeletal Radiol 31:88-95.
6. Breen JD, Karchmer AW (1995) Staphylococcus aureus infections in diabetic patients. Infect Dis Clin North Am 9: 11-24.
7. Lipsky BA, Berendt AR, Cornia PB, Pile JC, Peters EJ, et al. (2012) 2012 Infectious Diseases Society of America clinical practice guideline for the diagnosis and treatment of diabetic foot infections. Clin Infect Dis 54: 132-173.
8. Rome K, Gow PJ, Dalbeth N, Chapman JM (2009) Clinical audit of foot problems in patients with rheumatoid arthritis treated at Counties Manukau District Health Board, Auckland, New Zealand. J Foot Ankle Res 2: 16-36.