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Literature Review

A Literature Review of Extracorporeal Shockwave Therapy as a Treatment Modality for Morton's Neuroma

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Abstract

Morton's neuroma (MN) is a relatively common cause of chronic forefoot pain with a prevalence of around 30 - 33% [1]. Extracorporeal Shockwave Therapy (ESWT) is a non-invasive minimal risk treatment option for patients experiencing chronic musculoskeletal pain. This paper highlights the current literature investigating the efficacy of ESWT as a treatment option for MN. Concisely stated, there are currently not enough high-quality studies to make an evidence-based claim that ESWT is an effective treatment modality for MN.

Keywords: *Morton's Neuroma (MN); Extracorporeal Shockwave Therapy (ESWT); Chronic Musculoskeletal Pain*

Background

What is Morton's neuroma?

MN is a chronic pain, secondary to a nerve deformity, felt typically between the 3rd and 4th metatarsal heads. It is often characterised as a sharp, burning, or shooting pain that may radiate to the toes. This pain is a result of compression to a branch of the common plantar digital nerves. Said compression is not due to a true nerve tumour as the "-oma" would imply but likely perineural fibrosis brought about following the inflammation from nerve damage or injury [2]. Causes of this nerve damage are anything from congenital foot deformities, footwear choice such as wearing high heels [3], a fact which might explain why the conditions sees a much higher prevalence in women [4]. Patients will often liken the sensation of the neuroma to having a" pebble" in their shoe. Such a condition can occur as a result of ill-fitting or overly tight shoes that force the toes together in a way that may compress the nerves [5]. Athletes may also develop this debilitating condition after an injury [6]. The potential financial costs of such a burden on the health care system might not seem as large as other conditions, but on an individual basis patients suffer immensely.

How is Morton's neuroma diagnosed?

After establishing a good patient history, an initial clinical assessment can be carried out by performing the Mulder's sign and Tinel's sign test. As shown in figure 1, Mulder's sign can be tested by applying a compression force on the two sides of the forefoot while applying pressure intermetatarsally on the affected area; it is considered a positive test if pain is felt by the patient [7]. Whereas figure 2 demonstrates Tinel's sign, it involves direct percussion of the metatarsal space; it is considered a positive test if paraesthesia is felt by the patient [4]. If the patient is positive for the aforementioned clinical tests, they can be further investigated using ultrasound or MRI [8]. On ultrasound of

the dorsal aspect of the foot, a Morton's Neuroma can be identified as a hypoechoic region in the web-space of pain origin [9]. Whereas an MRI may convey an enhancing mass in the inter-metatarsal space of pain origin [10]. For a full clinical diagnosis, imaging may not be entirely necessary [11]. Sources also suggest that the use of MRI poses the problem of misidentifying the MN, since radiological features of this condition can be found in one-third of asymptomatic individuals [12].

Figure 1: *A photograph depicting how to elicit Mulder's sign.*

Figure 2: *A photograph depicting how to elicit Tinel's sign.*

What are the current treatment options for Morton's neuroma?

Treatment options range from conservative to surgical. Initially patients can undergo manipulative treatment such as orthotics or corrective insoles, along with other holistic treatment practices [13]. If symptoms do not yet resolve, further minimally invasive options may include injections of glucocorticoids with local anaesthetics, injections of alcohol, and as of the subject of this review - shockwave therapy [13]. If after repeated unsatisfactory results from the aforementioned treatment options, patients may undergo surgical treatment such as neurectomy [4].

What is shockwave therapy?

Extracorporeal Shockwave Therapy (ESWT) involves using a device that creates acoustic waves that can be targeted to specific areas of the body [14]. It's initial use was in lithotripsy, as treatment for kidney stones, however it's application in tendinopathies and other chronic musculoskeletal conditions is becoming more prevalent. The exact mechanism behind how ESWT can manage these conditions is not yet fully understood, however it is thought that neovascularization, tenocyte proliferation, and growth factor and protein synthesis stimulation could play a role. This in conjunction with breakdown of scarring associated with chronic inflammation is thought to bring about improvement in symptomatology [15]. ESWT appears to be void of severe complications - with only pain during the therapy as well as local soft tissue damage and hematoma at the site of therapy seeing an incidence of 1% [5] - making it an attractive non-operative treatment option for condition management. The two types of shockwaves that can be emitted are focused and radial. The former allows focused shockwave with deeper tissue penetration, while the latter is more diffuse and shallower in effect [5]. Devices also have settings regarding the frequency of the shockwaves and their power, with the number of shockwaves delivered being counted as "cycles".

Methods

Scientific articles written in English were searched for by the authors of this paper in between the 5th and 11th of August 2023. The search term used was: "Morton's neuroma" AND "shockwave therapy" The included papers are listed in table 1. The databases used were PubMed, Google Scholar & HyDi (see table). Combined this yielded a total of 14 papers that meet the inclusion criteria. Papers not found in these databases, not matching this search term, or written in a different language were excluded.

Discussion

There are two main randomized control trials (RCT) labelled as Fridman., *et al*. (2009) and Seok., *et al*. (2016), which form the basis of all claims as to the efficacy of ESWT as a treatment modality for MN in the remaining included studies in table 1.

Database	Article Title	Article Type	Label
PubMed	ESWT for Interdigital Neuroma [16]	RCT	(Fridman., *et al*. 2009)
PubMed	ESWT for Patients with Morton's Neuroma [17]	RCT	(Seok., *et al*. 2016)
HyDi[1]	Morton's Interdigital Neuroma of the Foot [2]	Literature Review	(Di Caprio., *et al*. 2018)
PubMed	Morton's interdigital neuroma: instructional review [4]	Instructional Review	(Gougoulias., *et al*. 2019)
PubMed	The effectiveness of non-surgical interventions for common plantar digital compressive neuropathy (Morton's neuroma): a systematic review and meta-analysis [13]	Systemic Review	(Matthews., *et al*. 2019)
PubMed	Non-surgical treatments for Morton's neuroma: A systematic review [18]	Systemic Review	(Thomson., *et al*. 2020)
Google Scholar	Morton's neuroma - Current concepts review [19]	Literature Review	(Bhatia., *et al*. 2020)

Google Scholar	Treating Morton's neuroma by injection, neurolysis, or neurectomy: a systematic review and meta-analysis of pain and satisfaction outcomes [20]	Systematic Review	(Lu., *et al*. 2020)
Google Scholar	The effects of a combined physical therapy approach on Morton's Neuroma. An N-of-1 Case Report [21]	Case Report	(Pérez-Domínguez., *et al*. 2020)
Google Scholar	First webspace Morton's neuroma case report with literature review [22]	Case Report	(Ettehadi., *et al*. 2020)
Google Scholar	Minimally invasive neurectomy for Morton's neuroma with interdigital approach. Long term results [23]	Case Report	(Masaragian., *et al*. 2021)
HyDi[1]	A Systematic Review of the Management of Multiple Adjacent Morton's Neuromas in the Same Foot [24]	Systemic Review	(Arshad., *et al*. 2022)
PubMed	Extracorporeal Shockwave Therapy for Foot and Ankle Disorders: A Systematic Review and Meta-Analysis [15]	Systemic Review	(Yusof., *et al*. 2022)
Google Scholar	A Literature Review on Physical Therapy in Morton's Neuroma [25]	Literature Review	(Vasa., *et al*. 2023)

Table 1: *The included studies in order of publication date.*

[1]*University of Malta Search Tool: https://hydi.um.edu.mt/.*

Fridman., *et al*. (2009) includes n = 23 patients with Visual Analogue Scale (VAS) greater than 4 and having had conservative treatment for 8 months. Patients had a single unilateral neuroma. No information as to the ethnicity, age, sex, or commodities of the patients are provided. The authors use 2,000 pulses at 21 kV directed inferior to the neuroma - the energy level was not stated. One double-blind treatment is provided with several follow ups, which reveal a VAS score improvement of 50% in the treatment group. Seok., *et al*. (2016) includes n = 27 patients provides an exclusion criteria of: any prior ESWT, comorbid foot pathologies, pregnancy, and any prior treatment for the MN for 6 months. Race and sex are not specified, though the authors point out that there is no statistically significant result difference between the two sexes in their study. The study also specifies the diagnosis test (Mulder's sign) and uses confirmatory ultrasound. One double-blind treatment was provided with several follow ups. The authors follow a protocol of 1,000 shocks at 3 Hz, with the maximum tolerated energy level by the patient. Patients in the treatment group saw a statistically significant improvement in VAS score and American Orthopaedic Foot and Ankle Society lesser toes (AOFAS) score.

The authors of Matthews., *et al*. (2019), Thomson., *et al*. (2020) and Yusof., *et al*. (2022) go on to compare ESWT to other treatment modalities whose research is relatively more rigorous and well documented.

Their conclusions point to the therapeutic benefit demonstrated in Fridman., *et al*. (2009) and Seok., *et al*. (2016) as statistically insignificant and in need of further studies. Some authors did suggest it could be effectively used as an adjunct treatment option for those who do not wish to undergo surgical treatment. This leaves clinicians with an unclear guide on how to proceed with using ESWT for Morton's Neuroma.

The other included papers in the table above only mention ESWT as a treatment option or quote the previously discussed RCT without giving any further insight or contributions.

There are as such several reasonable points to be made about the state of the literature:

1. More large cohort studies, that are better representation of the population are needed. There are only two RCT's with a combined total of n = 50 participants in addition to 3 case reports. More participants are needed with further exploration into other demographics, and age groups. This would also help distinguish any rare side effects not yet encountered.
2. More high calibre studies with long term follow up is required. A valid criticism of the RCT's is that they do not convey the long-term pain management of ESWT. One of the studies also highlights that long-term following up on sham treatment would be ethically questionable.
3. ESWT protocol needs to be standardized. With no further RCTs since 2016 there has been no progress on the effect of different frequencies, shock wave types, and power affect patients' pain and foot functionality.

Conclusion

Since last reviewed the literature has changed very little over the past year with no clear evidence based guidance for clinicians to practice ESWT safely on MN.

Conflict of Interest

None.

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