Manipulation in the Treatment of Plantar Digital Neuralgia: A Retrospective Study of 38 Cases

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Received in 17 June 2014; received in revised form 9 April 2015; accepted 15 April 2015

Key indexing terms:

Musculoskeletal
manipulations;
Foot;
Neuroma

Abstract

Objective: The purpose of this retrospective case series is to describe treatment outcomes for patients with plantar digital neuralgia (PDN) (Morton's neuroma) who were treated using foot manipulation.

Methods: Charts were reviewed retrospectively for patients with a diagnosis of PDN and who received a minimum of 6 treatments consisting of manipulation alone. Visual analogue pain scales (VAS) and pressure threshold meter readings (PTM) were extracted as outcome measures.

Results: Thirty-eight cases met inclusion criteria. Mean pretreatment duration of pain was 28 months. Mean pretreatment VAS was 69.5/100 mm. Mean pretreatment PTM was 2.54 Kp. By the sixth treatment, 30 (79%) of the 38 patients scored a VAS of 0 mm and a further 4 (10%) were below 10 mm. Contralateral limb PTM showed a mean pre-treatment score of 5.5 Kp, which rose slightly to 5.85 Kp. This compared to a pre-treatment score of 2.54 Kp rising to 5.86 Kp in the affected limb. This represents a 126% increase in the affected side compared to 6.5% in the unaffected limb. Statistical analysis demonstrated a significant linear trend between decreasing VAS and manipulation ($P < .001$).

Conclusion: The patients with PDN who were included in this case series improved with conservative care that included only foot manipulation.

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Introduction

Morton's neuroma (MN) (plantar digital neuritis, Morton's metatarsalgia and Morton's neuritis) is a common affliction of the forefoot. Affecting 87 in

every 100,000 females and 50 in every 100,000 males in the UK, it is the most common compressive neuropathy after carpal tunnel syndrome.¹ Because the initial description by Durlacher in 1845² and the more widely recognized description by Morton in 1876³ both refer to a lesion of the third inter-metatarsal (IM) space, it can be claimed that the term Morton's neuroma refers specifically to lesions in this locality, to the exclusion of identical lesions at other anatomical locations. For this reason, the term plantar digital

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neuralgia (PDN) as suggested by Hassouna et al is preferred here.⁴ This term allows for the presence of the condition at any of the IM spaces and does not suggest any histological classification of the lesion. Since the same signs and symptoms have been reported in response to the presence of a neuroma and also of neuritis in the absence of a neuroma, it is perhaps more accurate to use the clinical nomenclature plantar digital neuralgia, which aptly covers both scenarios.

While the exact cause of PDN remains unclear,^{5–7} it is most likely a mechanically induced neuropathy^{5,8–11} caused by entrapment of the nerve as it passes inferiorly to the transverse inter-metatarsal ligament (IML).^{7,11–13} The clinical presentation, positive clinical tests, and a good history are usually sufficient to make an accurate diagnosis.^{5,12} Patients who present with this condition will commonly complain of a burning or lancing pain, with or without accompanying paresthesia in the ball of the foot which is relieved by rest and the removal of footwear.^{5,9} Classically, the pain is in the third IM space but is not infrequently found in the second IM space and rarely in the first or fourth spaces. The severity of the pain can fluctuate greatly, both from patient to patient and from time to time in each patient. On examination a mass can be palpated in the affected IM space in one third of cases.⁹

Since its initial description by Durlacher, there have been a myriad of therapeutic interventions suggested for the treatment of PDN.¹⁴ These have included a number of surgical procedures,¹⁵ invasive techniques^{4,16} and a number of conservative therapies.^{11,17} Despite the range of advocated interventions, there is little agreement among clinicians as to the best treatment protocol for PDN.¹⁸ It remains a difficult condition to resolve and is often a limiting factor in the individuals leisure pursuits and work life.^{5,19} There is as yet very little empirical evidence that supports the use of one therapy over another and, despite surgery being generally accepted as the gold standard treatment, there is to date no evidence that it results in better patient outcomes than conservative care. Therefore, the purpose of this retrospective case series is to describe treatment outcomes for patients with PDN who were treated using foot manipulation.

Methods

This is a retrospective investigation of patients who were treated for PDN using manipulation alone. VAS and PTM scores were used to assess changes in the

patients' pain levels. All patients who were treated for PDN within the previous 12 months were included unless they also received additional interventions such as orthoses at the same time as manipulation. In other words, patients included in this retrospective analysis were all treated using manipulation as a stand-alone therapy.

Patients

The files of all patients who, having attended a podiatric clinic complaining of pain in the forefoot from August 2012 to December 2013 were subsequently diagnosed with PDN and then treated using solely manual manipulation for at least six treatments were included for analysis. Each file was checked to ensure that it had a complete record of clinical tests performed as well as VAS and PTM scores for at least 6 treatments. An initial diagnosis was made according to the relevant history provided by the patient and subsequent clinical findings. In all cases a positive Mulder's click test and a positive digital nerve stretch test were required to confirm the diagnosis. These tests were considered primary inclusion criteria for this study. This led to the identification of 59 potential cases. Exclusion criteria included a history of foot surgery, concurrent foot complaints such as plantar fasciitis, painful hallux valgus and onychocryptosis, all of which may have altered their pain score results and therefore made it difficult to reliably assess the effectiveness of treatment. These exclusion criteria eliminated 10 patients. A further 11 patients were eliminated as their notes did not document whether the clinic's standard treatment protocol for MN treatment had been followed. This included eight patients who had incomplete pain scale records and three others were excluded as they failed to complete at least 6 treatments. These criteria reduced the number of cases to 38 (61%) of which 23 were female and 15 male (39%). All patients signed consent forms to have their personal health information included in this study.

Intervention

A positive digital nerve stretch test¹ and a positive Mulder's click test² were recorded for each patient. These tests are extremely straight forward and quick to perform and are valuable indicators for the clinician. Cloke and Greiss have described how to perform the digital nerve stretch test. "Both ankles are held in full dorsiflexion (passively, by the clinician), whilst the lesser toes either side of the

suspected web space are passively fully extended on both feet. The test is positive if the patient complains of discomfort in the web space of the affected foot.”²⁰ The authors of this paper further commented “the digital nerve stretch test was positive in all cases in which lesions of the nerve were found, unlike all other clinical signs recorded. We believe this sign to be sensitive, and have a high positive predictive value.” This test follows a similar rationale to the straight leg raise test but uses the toes, foot, and ankle to stretch the nerve.

The Mulder’s click test is performed by applying pressure to both the medial and lateral borders of the forefoot in the region of the metatarsal heads. Pressure is then applied on the plantar aspect of the foot, directly where the PDN is suspected. As these pressures are alternated, a small mass can be palpated between the metatarsals. Subjectively, this may reproduce the patient’s symptoms but a test is only considered positive if the objective sign of a palpable click is elicited.²¹ It is important to note that what Morton referred to as a click is palpable rather than audible. There is no sound emitted from the area but rather the click is felt inside the foot. Some authors argue that the reproduction of symptoms without the associated palpable click is a sufficiently positive finding to clinically diagnose PDN and refer to this as the Squeeze Test.²²

The care of each patient followed a standard protocol adopted by the clinic which they attended. Each patient was seen once a week for 4 weeks followed by 2 further visits at 14-day intervals. At the first visit an algometer was used to establish which of the four lesser metatarsophalangeal joints (MTPJ) of the affected foot could withstand the least pressure. This was achieved by applying a steadily increasing force from the algometer to the plantar aspect of each joint in turn and instructing the patient to say “stop” at the first sensation of discomfort. In all cases, the joint which could withstand the least pressure was directly adjacent to the area of reported pain in the forefoot. This joint was manipulated in the same manner at all 6 clinic visits. The neighboring lesser metatarsophalangeal joints of the affected foot were also manipulated if there was felt to be a loss of joint motion. These manipulations were performed as directed in Broome’s text on extremity manipulation.²³ The joint was manipulated using the following procedure. With the patient lying supine, the clinician placed his supporting hand gently around the midtarsal of the affected foot, with his thumb running along the plantar surface. He then placed the index finger of his contact hand on the

plantar aspect of the patient’s foot so that the medial aspect of the proximal interphalangeal joint of the finger rested on the plantar aspect of the MTP joint to be manipulated. In order to achieve this position the first interdigital cleft of the clinician’s hand interlocks with the cleft of the patient’s foot in such a way that the toe associated to the joint in question lies snugly in the clinician’s palm, tucked into the thenar eminence. Distraction was then applied to the MTP joint and the proximal phalanx of the affected digit was taken into a position of plantarflexion. Once resistance to this movement was felt, the joint was said to be “in end range tension”. At this point a swift, short thrust was applied to the MTP joint through the contact point of the index finger’s proximal interphalangeal joint by means of a sharp flick from the wrist, accompanied by a further plantar flexion of the toe. The patient’s MTP joint was consequently manipulated in a plantar to dorsal direction. This short, single thrust procedure completed the manipulation and was the only intervention performed during each treatment. This technique is a high velocity low amplitude maneuver and is usually accompanied by cavitation of the joint, producing an audible “pop”.

Application Of Outcome Measures

At the start of each visit and prior to any intervention, patients were asked to rate their foot pain over the last 7 days using a visual analogue pain scale (VAS). An algometric pressure threshold meter (PTM) score was also obtained from the plantar aspect of the affected joint. The same joint was used to obtain the PTM score at each clinic visit. In one half of all subjects, the corresponding joint on the contralateral limb was also measured. All contralateral limbs were asymptomatic and there was no intervention applied to these limbs. The language used by the clinician when asking the subject for these readings was from a set script, ensuring consistency across all clinic visits and across all subjects. Each patient was asked to alert the clinician as soon as the pressure being applied by the PTM elicited the first sensation of discomfort. This meant that the subject’s pressure threshold was measured rather than their pain threshold which would have required them to allow the pressure to be increased until such time as they could not withstand the pain being generated.

Repeated-measures analysis of variance was used to investigate the effect of treatment over a six week period on VAS. In a separate repeated-measures analysis, PTM measures on the affected and unaffected

Table 1 VAS Scores by Treatment

Treatment	Median	Min.	Max.	No.
1	7.0	4.8	10.0	38
2	3.8	0.0	8.0	38
3	2.9	0.0	7.0	38
4	1.5	0.0	7.0	38
5	0.0	0.0	5.3	38
6	0.0	0.0	5.0	38
7	0.0	0.0	4.0	19
8	0.0	0.0	3.0	12
9	0.0	0.0	0.5	5

limbs were compared over the six week treatment period. In each case, the Bonferonni correction was applied to correct for multiple post hoc comparisons.

Results

There were 16 (42%) patients with PDN in the left foot and 22 (58%) where the right foot was affected. In 16 cases (42%), the fourth MTP joint gave the lowest PTM reading and was the primary manipulated joint. The third MTP joint accounted for 14 cases (36%) and the second MTP joint 8 cases (22%). In terms of the pain levels recorded for each patient, two thirds (25 cases and 66%) experienced pain in their third intermetatarsal space, 12 (31%) in their second intermetatarsal space and 1 (3%) in their fourth intermetatarsal space. These findings correlate well with those of other published studies.^{22,24–26} Of the 12 patients with symptoms present in the second interdigital cleft, 8 scored their lowest PTM at the second MTPJ and the remaining 4 scored their lowest at the third MTPJ. Of the 25 patients complaining of pain in the third cleft, 10 scored lowest at the third MTPJ and 15 at the fourth MTPJ. The only case of pain in the fourth cleft had their lowest score at the fourth MTPJ.

The mean duration of pain prior to any manipulative intervention was 28 months with the shortest duration being 2 weeks and the longest being 240 months. The majority of patients had typically been in pain for a year or more and several reported that they had tried a number of previous interventions, including steroid injections, orthoses and footwear modifications, without success.

The range and median VAS scores for each treatment episode are shown in Table 1. The mean VAS score at the outset of treatment was 69.5/100 mm. The total range varied from 50/100 mm to 100/100 mm. Two patients (5%) reported that their pain was

currently the worst pain they had ever experienced, scoring it 100/100 mm. All PTM readings are in kilograms of force per square centimeter (kg/cm²) otherwise known as kiloponds (Kp). The mean pre-treatment pressure threshold score was 2.54 Kp. Scores ranged from 0.7 Kp to 4.9 Kp. Over the 6 treatment interventions all VAS scores fell in a consistent manner while all PTM scores rose with similar consistency. In other words, all patients reported less pain and an increased ability to withstand pressure at the MTPJ adjacent to the affected interdigital cleft as their treatment progressed. On or before treatment 6, 30 (79%) of the 38 patients were reporting a VAS score of 0mm and a further 4 (10%) were scoring below 10 mm. The remaining 3 patients had reduced their scores from 80 to 30 mm, 75 to 25 mm and 90 to 17 mm, respectively.

A subset of the patients had an algometric measurement taken of the corresponding joint on the contralateral limb which served as a control against the foot being manipulated. There were a total of 19 patients in this subset, representing one half of the total patients. The contralateral limb demonstrated a starting PTM score of 5.5 Kp and rose slightly over the six treatments to 5.85 Kp. This compares to a starting score of 2.59 Kp rising to 5.86 Kp in the affected limb. This represents a 126% shift in the affected side as compared to a shift of 6.5% in the unaffected limb. This would suggest that there is a sizeable treatment effect arising from the manipulation.

Statistical Analysis

In the affected limb, there was a highly significant linear trend of decrease in VAS with treatment number ($r = 0.630$, $P < .001$). Pain after each treatment was significantly lower than at the previous treatment (Fig 1). Table 2 compares the mean differences in VAS score week on week. A clear and significant trend can be seen as the mean VAS score decreases with every treatment. This demonstrates a highly significant relationship between the manipulative intervention and a fall in VAS pain scores. There was also a strong linear increase in PTM for the affected limb as compared to the contralateral limb ($P < .001$, Fig 2). At and after Treatment 5, PTM measures in the affected limb were comparable with those in the contralateral limb ($P > .05$). There were no significant between-week differences in the contralateral limb ($P = .256$). Again, this suggests a strong relationship between the manipulative intervention and the joint's improved ability to withstand pressure.

Fig 1. Box plot of VAS during treatment. VAS, visual analogue pain scale.

There was a strong inverse correlation between VAS and PTM measurements ($r = -0.754$, $P < .001$). Almost 60% of the variability in PTM was accounted for by its linear relationship with VAS ($R^2 = 56.8\%$), suggesting that PTM is an equally good measurement of treatment progression as VAS in the foot, specifically in relation to Morton's neuroma (Fig 3). Some heteroscedasticity was observed in the PTM versus VAS data. This is for the most part due to the fact that when there is a greater degree of pain present, represented by a higher VAS score, there is greater scope for that score to fall and therefore greater changes in VAS are likely to be seen at this end of the scale while more modest improvements can be expected as the VAS score approaches zero. Furthermore, the

potential for the PTM score to continue to rise even after VAS has reached zero means that any patient who has achieved a zero VAS score prior to week six can potentially add to the heteroscedasticity of the results by recording a zero VAS score the following week, accompanied by a higher PTM score than the previous week as the affected joint continues to improve its ability to withstand pressure. When comparing the final VAS score to the duration of symptoms no correlation was found ($r = -0.001$, $P = .997$). This would suggest that the duration of pain had no bearing on the final outcome of treatment for the patients involved in this study.

Discussion

This purpose of this retrospective case series was to describe use of manipulation in the treatment of patients with PDN (Morton's neuroma). The outcomes suggest that the role of manipulation warrants further investigation. Given that the patients saw an improvement in their symptoms and the majority had complete resolution, there may be some merit in this course of treatment for PDN. This perceived value of manipulation is reinforced when one considers the relative costs involved in the various alternative treatments available. Further advantages include the relative ease with which such treatments can be performed without the need for specialist equipment and can be done in any clinical environment. This suggests that manipulation may prove to be a readily available and powerful tool in the treatment of PDN.

Complaints of forefoot pain are commonplace in many health care settings and while there is good evidence for the use of ultrasound and magnetic resonance imaging in the diagnosis of PDN, these diagnostic tools are often not readily available to the primary care clinician. There are however 2 simple and effective clinical tests that have been shown to be highly sensitive in the detection of PDN. The Digital Nerve Stretch Test has been reported to have excellent sensitivity to PDN.^{20,24} Mulder's click test has long been established as a reliable test for the presence of PDN.^{20,21,24,27} Most cases of PDN can be diagnosed clinically^{5,8,15} with those being considered for surgical or invasive intervention having the diagnosis confirmed by ultrasound or magnetic resonance imaging (MRI) if necessary.⁹ This said, clinical tests may be just as useful especially in detecting smaller lesions which can be missed by ultrasound and MRI, yet which cause the sufferer just as much discomfort.^{6,28} Indeed,

Table 2 Pairwise Comparison of VAS After Treatment

Treatment	Comparator	Difference	SE	Sig
1	2	3.09	0.301	<.001
	3	4.21	0.349	<.001
	4	5.08	0.367	<.001
	5	6.01	0.285	<.001
	6	6.55	0.241	<.001
2	3	1.12	0.256	.001
	4	1.99	0.355	<.001
	5	2.91	0.291	<.001
	6	3.46	0.292	<.001
3	4	0.87	0.242	.015
	5	1.80	0.236	<.001
	6	2.34	0.287	<.001
4	5	0.93	0.197	.001
	6	1.47	0.289	<.001
5	6	0.55	0.171	.042

SE, standard error; Sig, significance.

Fig 2. Error bar chart of PTM during treatment. PTM, pressure threshold meter readings.

Sharp et al found that clinical tests were more sensitive in the detection of PDN than either ultrasound or MRI. In their study of 29 cases, all of which were confirmed histologically, they found that even imaging with both MRI and ultrasound together could not match the values scored by clinical assessment alone.²⁸ Owens et al also found that a combination of positive clinical tests was a good indicator for the presence of PDN.²² The two clinical tests used in this current study were also found to be the most sensitive tests in a recent comparison of clinical and radiological diagnosis.²⁴ In their study, Pastides et al found that clinical tests were again shown to be more accurate than either MRI or ultrasound.²⁴ While clinical tests have been shown to be highly sensitive, there remains some weakness regarding their specificity for Morton's neuroma. This poor specificity of clinical tests does present a weakness in this paper. While all of the clinical tests and presenting history of the patients in this report point to the diagnosis of MN, this paper is unable to completely rule out the possibility that the symptoms were due to another underlying cause such as an epidermal cyst,³ inter-metatarsal bursa⁴ or rheumatoid nodule.⁵ A future study is planned which will incorporate an ultrasound scan in order to correct for this.

In a retrospective study of surgical intervention Akermark, Saartok and Zuber used VAS to assess pre- and postintervention levels of pain.²⁵ The same measurement has been used in this study. They found that their 55 patients began with a mean VAS score of 74 mm and completed treatment with a mean VAS score of 9 mm. The mean duration of pain prior to surgical intervention was 38 months. In our study of 38

patients the mean VAS score was 69.5 mm prior to treatment and the mean duration of pain was 28 months. These figures are similar to Akermark et al yet the completed VAS score in this study was just 4 mm. This may suggest that manipulation could prove to be at least as successful as surgical intervention in the treatment of PDN. Currently, as many as 70% of those with PDN receive surgical intervention prior to any conservative treatment at all other than a corticosteroid injection⁵ the value of which has been questioned in relation to PDN.^{18,27} Rasmussen reports that 20% of patients experienced no benefit at all from a steroid injection, with a further 54% experiencing a benefit which lasted for less than three months.²⁷ A later study demonstrated that 41% of patients were dissatisfied with the outcome of steroid injection therapy in relation to PDN.⁴ With as many as 59% of surgical patients enduring long term hypoesthesia and 25% of those reporting it as a problem and a further 12% reporting problems at the site of incision,⁵ one must be cautious with patient expectations if the surgical route is to be considered.

Care should be taken to ensure that the pain felt by the patient is in the intermetatarsal space and not on the metatarsal head or on the MTPJ itself. These locations can give rise to similar symptoms to PDN and would suggest a diagnosis of metatarsalgia or synovitis.¹⁵ Furthermore, one must consider the suitability of manipulative intervention on a patient-specific basis. Some patient's find the procedure described in this paper too painful to tolerate initially and alternative interventions should be sought in such cases. These may include interventions which have been shown beneficial in alleviating foot pain such as Activator methods,⁶ mobilization,⁷ massage,⁸ or padding and strapping.⁹ As treatment progresses, the clinician may wish to introduce manipulation at a later stage.

All patients in this case series reported a burning pain in the forefoot and the vast majority related the need to remove their footwear to alleviate pain. This is a very common and typical report from those suffering with PDN.^{11,13,15,20} 100% of the patients in this study reported substantial decreases in their VAS readings, with 81% reporting being entirely pain-free by the conclusion of their 6 treatments. Where the clinician felt there remained a loss of normal motion in the affected joint, the manipulation was repeated even if the patient reported a VAS score of zero. This was done due to the assumption that pain relief was likely to have been temporary if joint dysfunction was still present. The smallest reduction in VAS scores was an improvement of 62% and this patient registered a VAS of 0 mm with 2 further treatments. The average

Fig 3. Scatter plot of PTM and VAS in symptomatic patients (all readings). PTM, pressure threshold meter readings; VAS, visual analogue pain scale.

improvement in VAS was 65.5/100 mm. This is from a starting point of 69.5/100 mm to an end point of 4/100 mm. Broadly speaking, the mean VAS approximately halved with each subsequent treatment. Such decreases in reported pain represent a significant improvement in pain levels and corresponded well with patients reporting of improved quality of life in terms of being able to re-join sporting and social activities that had been curtailed by their foot pain. An earlier study by Waldecker also found a similar approach to be beneficial in the treatment of metatarsalgia.²⁹ In his study of 38 patients, he was able to demonstrate a significant improvement in pain levels after implementing a mobilization and manipulation treatment protocol. Furthermore, Waldecker was also able to demonstrate that the mobilization and manipulation treatment increased the range of motion at the MTPJ by a mean of 34% in one treatment group and 49% in the other. This was measured sonographically, suggesting that manipulation may be able to improve or normalize the physiological range of motion within the joint.²⁹ The findings of this current paper and of Waldecker's study are in broad agreement with a previous series of case studies by Brantingham et al which examined the role of manipulation in the treatment of MN.^{30,31} Brantingham found that 83% of patients experienced a moderate to excellent level of relief of symptoms in response to a variety of interventions which included manipulation of the lower extremity.³⁰ Additionally, Govender et al conducted a randomised controlled trial comparing manipulation to detuned ultrasound in the treatment of MN.³² They were able to demonstrate a significant benefit in the manipulation group despite

the intervention and follow-up lasting only three weeks. However, a potential weakness in this study is the fact that they chose to exclude any sufferers of MN who did not demonstrate palpable restrictions in the mechanical function of their affected foot. This means that their findings cannot be extrapolated to the wider population of MN sufferers and also creates the possibility of discrete restrictions in joint function being missed despite potentially being sufficient to cause symptomology. This serves to highlight the question whether manipulation is indicated in all MN sufferers regardless of findings on palpation. In this current study, the pressure threshold meter readings were used to identify areas of diminished joint capabilities and these joints were manipulated. Further areas of study may include the value of PTM as a diagnostic tool in the foot as well as a measurement of change in joint function. It may be that the device shows to be more sensitive and reliable than manual palpation in relation to identifying manipulable lesions in the extremities.

There is a growing library of low to moderate level evidence in favor of the efficacy of extremity manipulation.^{33–41} For example, a cross-over study of 52 hockey players with ankle sprains demonstrated that ankle manipulation was associated with improved proprioception and better post-injury ankle stability.³⁸ There have also been a number of studies which have highlighted a benefit from manipulation in the treatment of painful hallux abductovalgus.^{35,37,41} Brantingham performed a substantial literature review which synthesized the evidence relating to lower extremity manipulation.³⁶ In his paper he states that “There is a growing number of peer-reviewed, published studies of manipulative therapy for lower extremity disorders. Larger, methodologically improved, and well-funded randomized controlled and clinical trials, as well as observational, clinical, and basic science research, case series, and studies, are both needed and merited.”

A potential area for concern in this paper is the unusually high shifts in VAS score. This may be due to operator bias as measurements were taken by the operating clinician. A further, blinded study is currently underway to establish whether these results are repeatable. While the VAS score changes in this study are dramatic, they are not unprecedented in the treatment of MN. Hughes et al showed similar scores when treating MN with alcohol injection. They reported that “the median (interquartile range) VAS score pre-procedure was 8cm^{7,8} with a range of 6 to 10 cm and had decreased to zero (0-1) after the procedure at follow-up with a range of 0 to 10 cm.” They also

reported that a slightly higher number of their patients, 84% were completely pain-free after treatment, as compared to 80% in our study.⁴²

Limitations and Future Studies

There are a number of limitations with this study. This was a retrospective study, therefore there was no blinding and there is potential bias in the selection of cases. The VAS scores and algometric scores were all taken by the treating clinician, allowing room for treatment expectation bias. Furthermore, although the algometer has been used extensively in various healthcare settings, it has never been validated for use in the foot. This limits the value we can attach to these results. Without a radiologic confirmation of the diagnosis of Morton's neuroma, there may be room to argue against the safety of the clinical diagnosis. However, many authors agree that a clinical diagnosis is adequate for this condition.

A long-term follow-up of these patients is planned in order to establish whether these results hold true for subsequent years. Although these patients were helped by manipulation, it may be that this improvement cannot be generalized for the population at large. To test whether this is the case, a randomized, blinded study is planned to compare the outcomes of manipulation and steroid injection therapy. At this stage, these results appear to strongly support funding and running long term, methodologically strong, fully powered randomized clinical and controlled trials.

Conclusion

The patients with PDN who were included in this case series improved with conservative care that included only foot manipulation.

Funding Sources and Conflicts of Interest

No funding sources or conflicts of interest were reported for this study.

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