



# Reliability of Ultrasonography in the Diagnosis of Morton's Neuroma: A Comparison Study with Histology Results

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## Abstract

**Introduction:** The diagnosis of Morton's neuroma can be difficult with clinical assessment alone and may require further investigation. Radiological investigations add to help further confirm the diagnosis before offer of surgery. However the reliability of ultrasound have been reported quite variable in literature.

**Aim:** The objective of the study was to determine the reliability and effectiveness of Ultrasonography in diagnosis of the presence of Morton's Neuroma (MN) by comparing it against histology findings.

**Materials and Methods:** All consecutive patients diagnosed with Morton's Neuroma (MN) over a period of 5 years were identified using the hospital code. Fifty-five subjects and seventy intermetatarsal spaces were examined via Ultrasonography to detect neuroma. The retrospective ultrasound reports were then compared and correlated to histopathology findings. Both the ultrasound and histopathology reports were then used to evaluate the diameter of the neuroma.

**Results:** Seventy neuromas in 55 patients underwent surgery. All tissues were sent for histopathology examination and 60 were diagnosed positive for MN i.e. around 86% of the cases were correctly diagnosed for the presence of a neuroma using Ultrasonography. The sensitivity and specificity for ultrasound was 1.0 (95% CI range 0.925 to 1) and 0.3 (95% CI range 0.080 to 0.646) respectively. The results show ultrasound being a very sensitive test for the diagnosis of MN. No significant comparison could be made to assess the diameter of each neuroma in both the sonographic and histopathology reports; this was due to inadequate data within the histopathology reports.

**Discussion:** The diagnosis of MN still remains a clinical diagnosis, which can be confirmed using radiological investigations. The sensitivity of Ultrasonography has been reported quite variable in literature and is primarily operator dependant. In our unit ultrasound is quicker to obtain and we anecdotally is quite reliable.

**Conclusion:** Ultrasonography is a reliable and effective method to diagnose the presence and location of a Morton's neuroma; however it is unreliable when assessing the size of a Morton's neuroma.

## Introduction

Morton's Neuroma (MN) or inter digital neuritis is a benign enlargement of the common digital plantar nerve, which occurs in the inter-metatarsal spaces [1]. The aetiology of Morton's neuroma still remains unknown but a popular theory its due to repetitive contact between the metatarsal heads with continuous compression of the digital plantar nerve between the transverse inter-metatarsal ligament contribute to the formation of a Morton's neuroma [2,3].

Majority of these patients usually present with classical symptoms of pain radiating to the toes with clinical findings of a Mulder's 'click' [3]. However some of these patients may present with non-specific clinical symptoms with variable clinical signs and might require further assessment with diagnostic test. Diagnostic imagings with Ultrasonography or magnetic resonance are usually preferred in order to confirm an accurate diagnosis and identify other causes of clinical symptoms [4-6].

Ultrasonography is a useful diagnostic tool to evaluate soft tissue swelling presenting clinicians with real-time imaging of various anatomical structures [6]. However MN is a clinical diagnosis and its role in the management of MN is debatable [7]. With the increasing health economical cost and lack of resources, every investigation has to be justified and should clearly influence the

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management of the clinical condition.

The objective of this study was to assess the reliability of using Ultrasonography as a diagnostic tool in the management of MN.

## Materials and Methods

This is a retrospective study of patients from a single University Hospital over a period of 5 years (University Hospital of South Manchester NHS Foundation Trust, UK). All patients undergoing surgery for MN were included in the study. All Patients having histology specimen requested for Morton's neuroma were identified from pathology department.

These patient clinical notes were then analyzed; for presenting complains, clinical findings and reason for request of pre operative ultrasound test. For the purpose of this study patient who did not have ultrasound investigation prior to surgery were excluded from the study. Details of histology findings were then compared with pre operative ultrasound findings.

## Results

There were a total of 119 patients identified from pathology records however 64 of these subjects were excluded due to exclusion criteria. The remaining fifty-five (55) patient's medical records were assessed: clinical symptoms, examination findings, reason for pre operative ultrasound. There were 10 males and 45 females, with an overall average age of 51.5 (range 19 to 74). The average age of females was 52.3 years (range 19 to 74 years) and male 47.6 years (range 24 to 69) respectively.

Seventy (70) inter-metatarsal spaces were evaluated using Ultrasonography, 33 cases involved the right foot whereas 37 cases included the left foot. Twenty-five (25) surgeries were performed on the second inter digital space (2/3), and 40 operations were performed on the third inter digital space (3/4). Three patients had bilateral neuromas and another three subjects had two Morton's neuromas within the same foot located in both the second and third web-spaces. Surgical results revealed 60 positive Morton's neuromas (Table 1).

Ultrasonography was performed by Radiologist (2 consultant and 1 Specialist Registrar) in dedicated MSK list using either a Siemens 14L5 (14MHZ) or Siemens 12L4 (12MHZ) transducer. Surgery was performed by one of three consultant orthopedic surgeons with special interest in foot and ankle. All surgery was done with dorsal approach as elective day procedures with no overnight stay. There were no reported surgical complications in this study.

Study shows out of the 70 inter-metatarsal spaces which were evaluated by sonography, 67 neuromas were found to be positive with ultrasound however only 60 of them has accurately correlate with histology findings and 7 neuromas was negative for histology findings. Three patients had negative ultrasound but still underwent surgery due to positive clinical findings of which all three patients had negative histology for MN (Table 1).

The sensitivity and specificity for ultrasound was 1.0 (95% CI range 0.925 to 1) and 0.3 (95% CI range 0.080 to 0.646) respectively. The true positive 0.895 (95% CI range 0.790 to 0.953) and false positive 0.104 (95% CI range 0.046 to 0.209); true negative 1 (95% CI range 0.309 to 1) and false negative 0 (95% CI range 0 to 0.69). The results show ultrasound being a very sensitive test for the diagnosis of MN.

All histology examination was done by a Consultant

**Table 1:** Calculation of Sensitivity and Specificity of Ultrasound findings against Histology results.

Ultrasound Results	Histopathology Results		
	Positive	Negative	Total
Positive	60	7	67
Negative	0	3	3
	60	10	70

histopathology's, who recorded the size (mm), location and properties of the tissue sample. Sixteen Morton neuromas were evaluated according to length, width and height, whereas the remaining tissue samples only had widths stated in the histopathology reports. Due to the lack of details on the reports we could not compare histology findings with ultrasound findings.

## Discussion

Many clinicians would advocate Morton's neuroma is a clinical diagnosis and routine pre operative ultrasound as a diagnostic test would not be required. However in cases where there is either poor clinical history or inadequate clinical signs further diagnostic imaging such as ultrasound or MRI would be required. It is known that some patients would get referred pain to the adjacent inter-metatarsal space of the actual inter digital neuroma [4,6,7]. In these cases further imaging maybe required if there are doubts regarding the accuracy of intermetatarsal space [8]. Ultrasound investigation are cost effective and easy available compared to MRI, provided the test results are reliable, would reduce the chances of unnecessary surgery [9]. The results of this study showed Ultrasonography as a diagnostic test for Morton's neuroma have a high sensitivity this study is similar to previous studies, the majority of which had sensitivities ranging from 85% to 100% [4,10,11].

Ultrasonography was performed by two consultant radiologists and one specialist registrar. There were seven false positives and of these two were done by specialist registrar. Accuracy of ultrasound as a diagnostic tool is operator dependant and the level of training has a direct impact on the sensitivity of this test. Although we could not show a statistical significant, it was known that out of the seventy inter-metatarsal spaces which were evaluated via Ultrasonography, eleven out of these were assessed by the specialty registrar. As shown by previous studies-the accuracy of ultrasonography is operator dependent and might be influenced by the type of machine used [9].

The reliability and effectiveness of ultrasound to assess the size of a Morton's neuroma could not be assessed efficiently in this study. Data revealed that only eight percent of the inter-metatarsal tissue that were assessed had the same width in both sonographic reports and histopathology reports. This has been shown in previous study that there was little correlation in size between histopathology reports and sonography reports of a Morton's neuroma. This is most likely a consequence of sonography is incapable to effectively outlining the neuroma from the surrounding tissue. During the acute phase, the size of the neuroma would include an element of inflammation and bursal tissue complex [11,12]. Some of this would not be reflected during histology examination after being preserved in formalin prior processing of the tissue. Although size of the neuroma has less consequence for management, a larger size neuroma excision would be more in favor of better surgical outcome and more likely to be offered surgery.

## Conclusion

We conclude that Ultrasonography is an effective and reliable diagnostic tool for Morton's neuroma with a high sensitivity. The reliability and effectiveness of Ultrasonography in terms of assessing the size of a Morton's neuroma could not be evaluated, since an accurate histopathology correlation was unavailable.

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