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Original Article

THE ROLE OF MRI IN DIAGNOSIS OF MORTON NEUROMA

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ABSTRACT:

Objective: The main aim of this work is to evaluate the role of MRI in patients suspected to have Morton Neuroma (Intermetatarsal Neuroma) and to assess the importance of the various MRI sequences in this disease.

Material and Methods: 30 Patients with a clinical suspicion of Morton Neuroma were examined with a 1.0 Tesla MRI scanner. T1W axial, T2W axial, fat suppression and T1W post contrast images were obtained. 16 patients out of 30 underwent surgery.

Results: Twelve patients out of 16, Morton Neuroma was proven surgically. 11 true positive, 1 false negative, 4 true negative and no false-positive MRI diagnosis were given. 5 of 12 proven Morton Neuroma, the clinician was unable to localize the exact intermetatarsal space. The MR results of the 14 remaining patients who did not undergo surgery were Morton Neuroma (n=4), stress fracture (n=1), non-specific fibrosis (n=2), and no abnormality (n=7).

Conclusion: MRI is accurate in diagnosis and localization of Morton Neuroma. TIW images is the most important sequence, T2W images is included to define cystic lesions and bursa. STIR images are of some value while post Gad TIW images was excluded from the routine sequences and reserved for when other pathology is suspected.

KEY WORDS: Morton Neuroma, MRI.

INTRODUCTION

Morton Neuroma is a pseudotumour of nerve and defined as a focal mass characterize by perineural fibrosis and neuronal degeneration. The lesion is believed to be traumatic and is often attributed to some sort of compression of the intermetatarsal nerves between the intermetatarsal ligaments, which may sometimes be exacerbated by an enlarged intermetatarsal bursa[1,2]. The most commonly involved site is the second and third intermetatarsal spaces, followed by the fourth space; involvement of the first and fifth space is rare.

Diagnosis is clinically based; the most common presentation is pain radiating from the middle part of the foot to the tip of the toes with localized tenderness over the lesion[3]. Morton Neuroma is also presented with numbness of the distal part of the foot especially during walking which will disappear after rest.

As the clinical diagnosis may be equivocal, imaging modalities has been suggested for both diagnosis and localizing the lesion. Ultrasound has been used for this purpose; however, ultrasound is operator dependent and adequate results may not be obtained by every radiologist[1]. CT is of limited use in diagnosing

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Morton Neuroma however it is of great value in excluding other pathologies in that region like stress fracture or bone tumors[4]. The main aim of this work is to evaluate the role of MRI in patients suspected to have Morton Neuroma and to assess the importance of the various MRI sequences in this disease.

PATIENTS AND METHODS

Thirty patients with a clinical diagnosis of Morton Neuroma were studied from the period of July 99 till August 2001. Their ages range from (27-68) with a mean age of 45.1 years. Twenty-six were females and four male. All attended either to the orthopedic or Neurosurgery clinic. Morton Neuroma was suspected and then they were all referred to the MRI scan for better localization of the tumor prior to the surgery.

MRI was obtained on a 1.0 Tesla GE scanner. Images were done with the patient in a prone position to decrease the motion artifact. Circular polarized extremity coil was used. Saggital T1W spin-echo images (600/20 {TR/TE}) were initially done and then used for the planning of images perpendicular to the axis of the metatarsal bones. The field of view varied between 120 to 180 mm, slice thickness 3-4 mm. Image matrix 256 x 256. The following sequences were then obtained: T1W spin-echo (600/20); T2W turbo spin-echo (5000/120); STIR images (5200-5450/15; inversion time, 150 second); and T1W post Gad. All patients were examined with the same sequences.

Surgery was done on 16 patients. The planter intermetatarsal nerves were excised in all patients and sent for histology. The patients who did not have surgery were followed clinically after MRI examination.

In patients with surgically proven Morton Neuroma, the signal of the lesion in relation to the surrounding sub-cutaneous fat was evaluated qualitatively (high, intermediate, low signal). Size of the lesion was also measured.

RESULTS

A Morton Neuroma was found in 12 of 16 surgically explored intermetatarsal spaces. 11 true positive, 1 false negative, 4 true negative and no false-positive MRI diagnosis were given. The missed neuroma was caused by a reading error and the lesion was visible on the last images only! Based on these results MRI had a sensitivity of 89%, a specificity of 100%, and accuracy of 93%. The positive predicted value was 100%, and negative predicted value was 80%. 9 out of 12 proven Morton Neuroma were located in the third intermetatarsal space and three in the second space. All patients improved dramatically after surgery.

The qualitative evaluation indicated that signal intensity in surgically proven Morton Neuroma were iso-intense in 86% on T1W images, hyper-intense in 75% on STIR images, and only 15% showed enhancement after IV contrast. The size of the neuroma varied between 5x5 mm and 10x10 mm, with the dorsoplanter diameter larger than the transverse diameter in all neuromas.

The MRI results of the 14 remaining patients who did not undergo surgery is as follows:

Morton Neuroma:	(n=4)
Stress fracture:	(n=1)
Non-specific fibrosis:	(n=2)
No abnormality:	(n=7)

Among the four patients who were reported as Morton Neuroma and did not undergo surgery, three of them refused the surgery and the fourth was not fit for anesthesia.

DISCUSSION

In 1876 Thomas Morton presented 12 cases of patients with symptoms consistent with interdigital neuroma. The lesions were found in the second and third intermetatarsal spaces[5].

Histologically, Morton Neuroma consists of thickening of epineural fascicles, fibrosis of epineural blood vessels and loss of the myelinated fibers. Affected neurons showing disordered orientation of the nerve fiber bundle

intermixed with connective tissue[6], Fig-1. These findings may represent local inflammation of the affected nerve and explain the MRI appearance with variable degrees of signal inhomgenecity of the neuroma and the variability in perifocal edema.

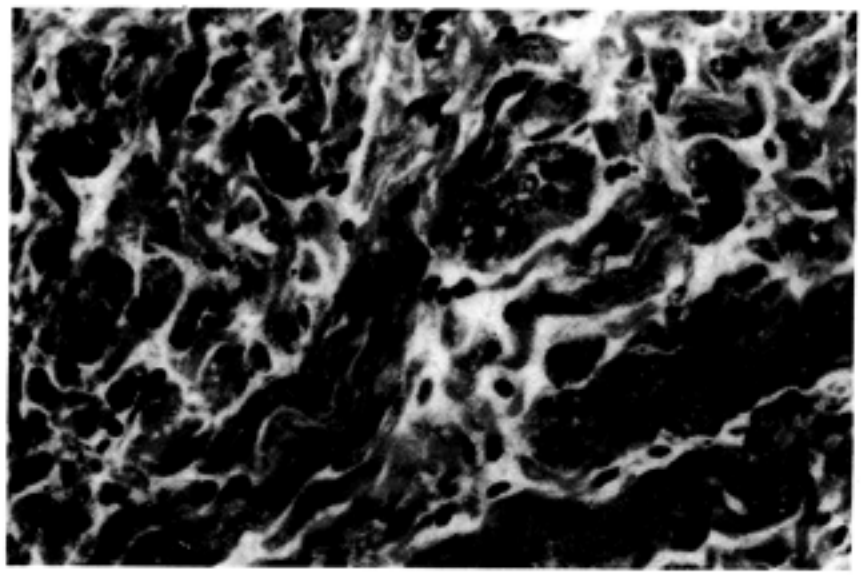

Fig. 1: Disordered orientation of the nerve fiber bundles Intermixed with connective tissue This is the typical histological appearance of Morton Neuroma.

Interdigital neuroma arises from the planter digital nerve of the foot. This nerve lies in the intermetatarsal space, just deep to transverse metatarsal ligament and distal to the intermetatarsal ligaments.

Patients present with planter foot pain with tenderness of the external planter nerves between the metatarsal heads. Mulder's sign (a palpable and painful click within the involved interspaced, when the foot is compressed laterally) is highly suggestive of neuroma. A palpable mass is usually not identified.

This non-neoplastic lesion is postulated to be secondary to impingement of the external planter nerve between the metatarsal heads. Neuroma refers to nodule formed by axonal and

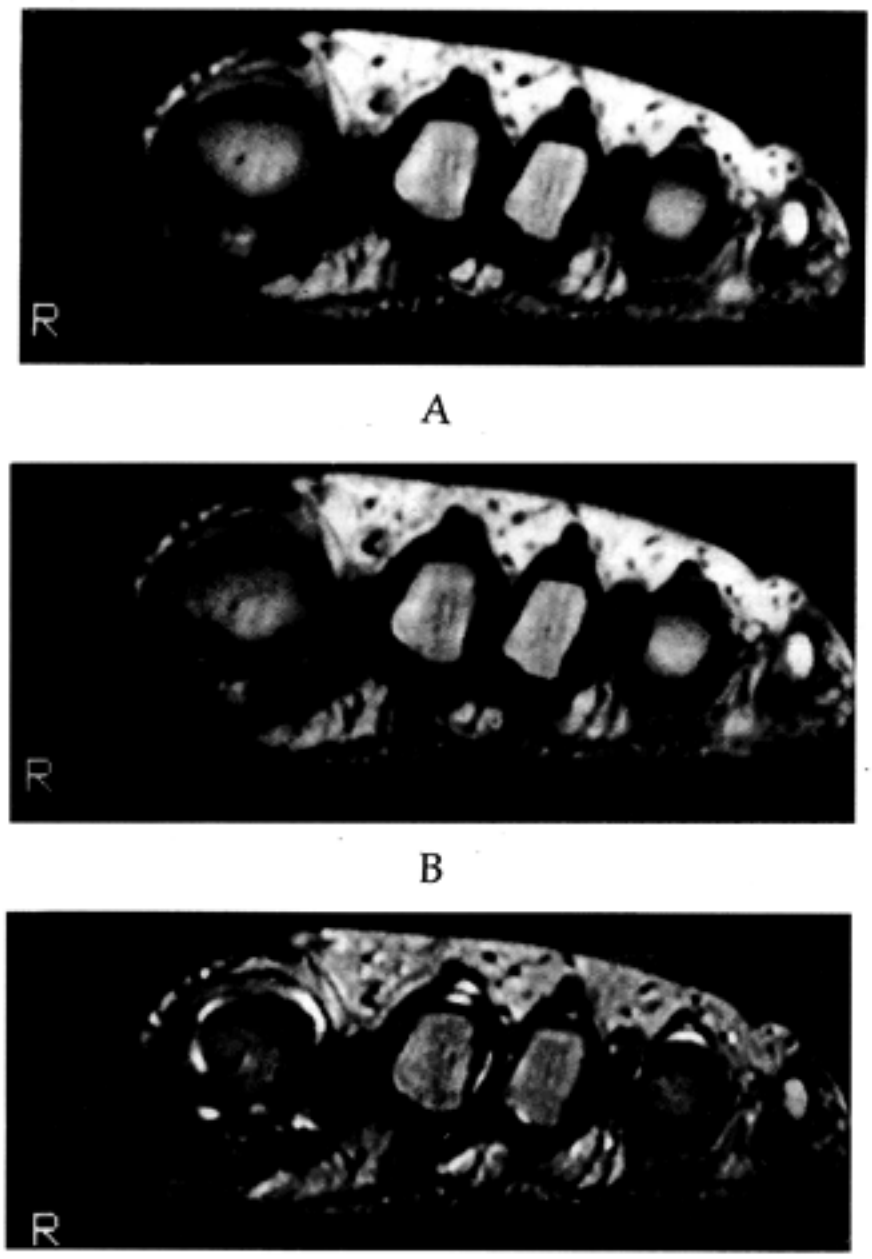

Fig. 2 (A): T1W spin-echo Sequence shows a well-defined isointense mass in the 3rd interspace (arrow). (B) Post Godolinium image shows no enhancement of the lesion. (C) STIR sequence shows increase signal centrally within the lesion (curved arrow).

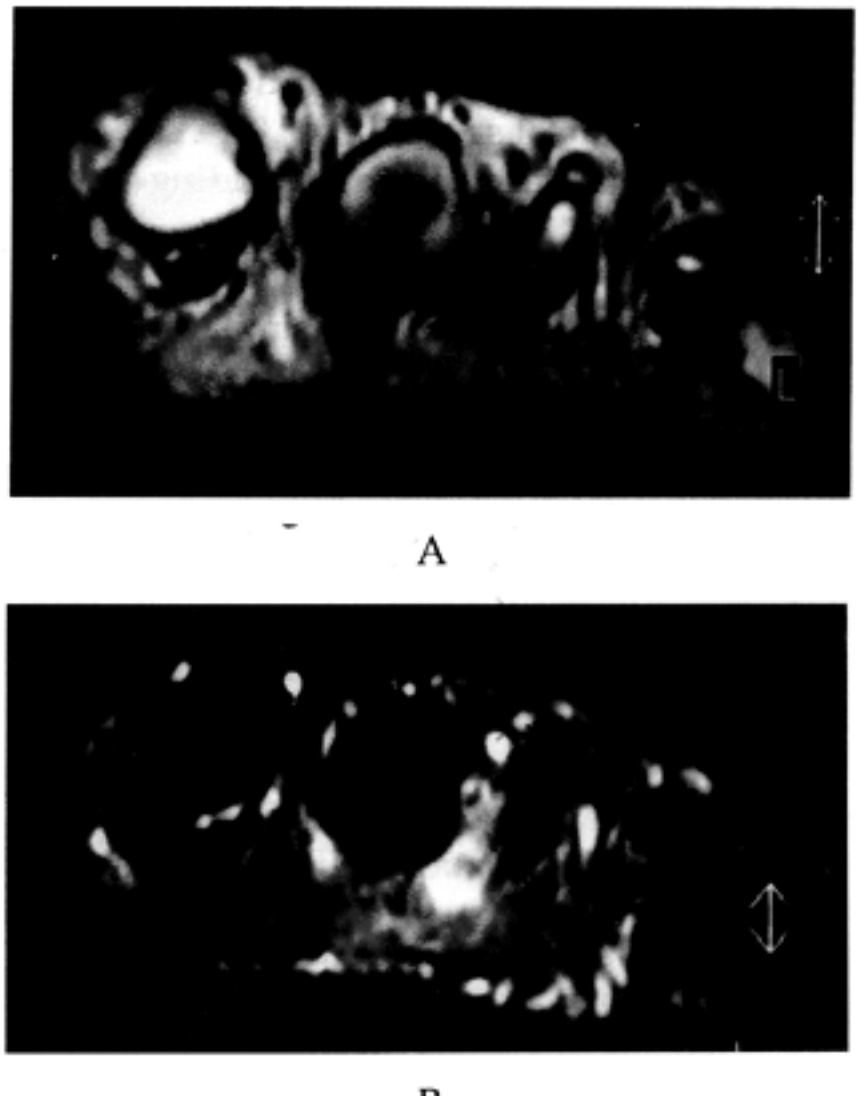

Fig. 3 (A): T1W spin-echo sequence shows a well-defined isointense mass in the 2nd interspace (arrow). (B): Post Gadolinium image shows a strong peripheral enhancement with lower signal centrally (arrow) A finding which is seen in 15% only.

epineural hyperplasia. The type of shoes worn by women is thought to be the cause of the female predominance. It's commonly seen in the age group (40-60 years old).

Treatment of Morton Neuroma is usually initially directed at modifying the patient's foot wear. Other modes of therapy include neurolysis, steroid injection, ultrasound therapy and surgical release of the transverse metatarsal ligament for decompression. Surgical excision of the neuroma in the involved nerve segment appears to be the most successful mode of treatment.

The diagnosis is often made on clinical grounds. Radiological evaluation is reserved for localizing the site of the lesion and sometime to confirm the diagnosis. MRI of Morton Neuroma was previously compared with surgery in relatively small group, in this study 12 surgically proven MN may allow more general conclusion. Zanetti ET all suggest three MRI criteria for the diagnosis of Morton Neuroma[7]:

1. The lesion is centrally located in the region of the neurovascular bundle within the intermetatarsal space.
2. Well-demarcated lesion (excluding partial volume artifact from the adjacent joint space).
3. Signal intensity should be similar to that of skeletal muscles on T1W and less than that of fat on T2W.

Based on these criteria all images were reviewed carefully and all the intermetatarsal spaces were searched for Morton Neuroma. Correlation between MRI and surgical findings was encouraging in this research. MRI was able to localize the lesion and it's relation to the surrounding structures as well as the size of the neuroma.

In previous publications, STIR and post contrast sequences were considered as most useful[8,9]. However, we found them time consuming and the post contrast sequences may be reserved for when other pathology is suspected. The standard T1W spin-echo images were considered as the best images to determine the Morton Neuroma. This finding is explained by the fact that Morton Neuroma usually is surrounded by subcutaneous fat that provide high contrast.

The diagnosis of Morton Neuroma can usually be made on axial T1W spin-eco images on the basis of signal intensity and location. Additional sequences may be reserved in narrowing the differential diagnosis.

Because Morton Neuroma is largely composed of tightly packed fibrous tissue, it commonly has relatively low signal intensity on T2W images[7]; however, fluid accumulation in intermetatarsal bursa, ganglia and synovial cysts may mimic Morton Neuroma, but all of these differential diagnoses show high signal intensities on T2W images, Fig (2), Fig (3)."

CONCLUSION

We conclude that when MRI showed evidence of MN it was both accurate in its diagnosis and localization of the lesion – hence an excellent positive predictive value. A limited MR examination employing axial T1W spin-echo images may be adequate with additional sequences reserved for differential diagnosis...

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