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A preliminary exploration of plantar load distributions and foot postures in Taiwanese collegiate athletes with Morton's neuroma

Submission date
07/01/2025

Recruitment status
No longer recruiting

Registration date
09/01/2025

Overall study status
Completed

Last Edited
03/07/2025

Condition category
Nervous System Diseases

[ ] Prospectively registered
[ ] Protocol
[ ] Statistical analysis plan
[X] Results
[ ] Individual participant data

Plain English summary of protocol

Background and study aims
Recent research on Morton’s neuroma (MN) has shown limited progress, resulting in a scarcity of studies examining the foot patterns of affected individuals. The influence of age-related factors on foot bone deformities in elderly patients with MN further complicates the ability to draw definitive conclusions about their foot patterns. This study seeks to analyze plantar load distribution and foot posture in collegiate athletes diagnosed with MN.

Who can participate?
College and university undergraduates or youths who had graduated from college within the last 1-3 years.
Participants in the Morton’s Neuroma (MN) group were current or former collegiate-level athletes competing in Division A or B.
The control group comprised healthy college and university students.

What does the study involve?
This study utilized the JC Mat optical plantar pressure analyzer to examine differences in the arch index, plantar load distributions, the center of gravity and hallux angle between patients with Morton’s neuroma and healthy volunteers during static standing. Additionally, rearfoot postural alignment was assessed to gain insights into foot characteristics and changes in foot shape associated with the condition.

What are the possible benefits and risks of participating?
The findings from the study may contribute to a deeper understanding of foot characteristics in non-athletes while highlighting distinct plantar load distribution patterns and postural deviations in collegiate athletes diagnosed with Morton’s neuroma. These insights provide valuable information on the underlying mechanisms of associated injuries and support the development of targeted injury prevention strategies, rehabilitation protocols, and the design of customized orthotic devices.

Where is the study run from?
Ministry of Science and Technology, Taipei (Taiwan)

When is the study starting and how long is it expected to run for?
June 2015 to May 2016

Who is funding the study?
National Science and Technology Council (NSTC) (Taiwan)

Who is the main contact?
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Contact information

Type(s)
Public, Scientific, Principal investigator

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Study information

Scientific Title
A preliminary exploration of plantar load distributions and foot postures in Taiwanese collegiate athletes with Morton's neuroma

Study objectives
It was hypothesized that the foot posture of the symptomatic foot in participants with Morton’s neuroma exhibits a supinated alignment, with increased plantar loads concentrated on the forefoot or lateral aspect of the foot. Furthermore, the angle of hallux valgus in the symptomatic foot is expected to be increased, while the center of gravity tends to shift compensatorily toward the asymptomatic foot.

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 13/06/2015, National Taiwan University Research Ethics Committee (No.1, Sec. 4, Roosevelt Rd. Taipei, Taiwan 10617, R.O.C., Taipei, 10617, Taiwan; +886 (0)2 2362 9082; ordre@ntu.edu.tw), ref: 201506ES016

Primary study design
Observational

Study design
Observational cross-sectional study

Study type(s)
Prevention, Quality of life, Screening

Health condition(s) or problem(s) studied
Morton’s neuroma

Interventions
A cross-sectional study was conducted involving 36 asymptomatic volunteers and 45 participants diagnosed with Morton’s neuroma. The JC Mat optical plantar pressure analyzer was employed to assess arch index, plantar load distributions, center of gravity and hallux angles during static stances, while also evaluating rearfoot postural alignment.

The statistical analysis was conducted by the same investigator using SPSS software for Windows (IBM SPSS Statistics 23.0, Somers, New York, NY, USA). The Shapiro-Wilk test was employed to assess the normality of the data, with a $p > 0.05$ indicating that the data followed a normal distribution. Furthermore, statistical analyses of foot-related parameters, including the AI, plantar load distribution, center of gravity, hallux angle and rearfoot posture angle were conducted using independent samples t-test. All statistical results are presented as mean ± standard deviation (SD), with $p < 0.05$ (represented by *) and $p < 0.01$ (represented by **) considered statistically significant.

Intervention Type
Other

Primary outcome(s)
Measured at a single timepoint:
1. Plantar load distributions across five regions (forefoot, midfoot, rearfoot, medial foot and lateral foot) and six subregions (medial and lateral metatarsals, medial and lateral longitudinal arches, and medial and lateral heels) of the foot analysed using the JC Mat optical plantar pressure analyzer. The analysis included identifying regions of increased or decreased plantar pressure in participants with Morton’s neuroma (MN).
2. Center of gravity distribution between the symptomatic and asymptomatic feet in participants with MN analysed using the JC Mat optical plantar pressure analyzer.
3. Hallux valgus angles between the groups analysed using color footprint images, determined by the intersection of two lines. Various categories of hallux positions were classified based on angle variations: varus (–1° to –5°), straight (0°), valgus I (1° to 5°), valgus II (6° to 10°), valgus III (11° to 15°), and valgus IV (≥ 16°).
4. Static rearfoot angle for each participant determined using Biomech 2019 Posture Analysis software. Rearfoot postures were classified based on angle variations as varus (< 0°), neutral (0° to 5°), and valgus (> 5°).

Key secondary outcome(s)
Measured at a single timepoint:
1. Arch index (AI) of the foot for each participant classified using the AI ratio method developed by Cavanagh and Rodgers. The AI was calculated as the ratio of the area of the middle third of the footprint divided by the entire footprint area excluding the toes, i.e., AI=B/(A+B+C). According to Cavanagh and Rodgers, an AI ratio of less than 0.21 defines a high-arched foot, 0.21 to 0.26 a normal-arched foot, and greater than 0.26 a flat-arched foot.
2. Static footprint images were visualized and interpreted to identify foot pressure distribution patterns and potential callus formation.
3. Participant demographics and characteristics: The study recorded descriptive statistics, including mean age, height, mass and BMI, among the groups at a 95% confidence level.
4. Soft-tissue pain and skeletal alignment examinations for participants were conducted by an experienced physiatrist at a rehabilitation clinic in Taipei, Taiwan. This procedure objectively confirmed whether participants met the study's recruitment criteria, with assistance from clinical staff, and empirically evaluated their musculoskeletal pain locations and associated physiological symptoms.

Completion date
31/05/2016

Eligibility

Key inclusion criteria
College and university undergraduates or youths who had graduated from college within the last 1-3 years.

Participants in the Morton's Neuroma (MN) group were current or former collegiate-level athletes competing in Division A or B. According to survey records, their sports disciplines included sprinting, marathon running, gymnastics, dance, swimming, volleyball, basketball and rugby. Most participants had experience in specific sports competitions during the National University and College Athletic Games in Taiwan.

The control group comprised 36 healthy college and university students selected from 45 asymptomatic volunteers for comparative analysis.

Participant type(s)
Healthy volunteer, Patient

Healthy volunteers allowed
No

Age group
Adult

Lower age limit
20 Years

Upper age limit
23 Years

Sex
Male

Total final enrolment
88

Key exclusion criteria
1. Incomplete execution of experimental procedures
2. Body mass index (BMI) outside the recommended range established by the World Health Organization (WHO) and Asia-Pacific guidelines, specifically between 18.5 and 23.9 kg/m2
3. Presentation of hospital certificates or self-disclosure of any prior lower limb fractures or surgeries
4. Self-reported instances of persistent or intermittent foot pain symptoms within the preceding 6 months
5. Occurrence of cartilaginous ligament tears or lower extremity dislocations within the past 6 months
6. Documentation provided by school coaches or athletic trainers regarding competition or training-related injuries, including skeletal arthritis, calcaneal spurs, and neuropathies in the lower extremities, excluding MN and metatarsalgia
7. Congenital or acquired deformities of the foot, keratotic lesions on the plantar surface, foot ulcers and/or blisters, skeletal rheumatoid arthritis and pregnancy
8. Received subcutaneous or intramuscular injections (such as hyaluronic acid, steroids and platelet-rich plasma) or had undergone minimally invasive surgery on the foot, ankle and lower extremity within the preceding 6 months

Date of first enrolment
17/06/2015

Date of final enrolment
31/05/2016

Locations

Countries of recruitment
Taiwan

Study participating centre
R.O.C. Military Academy
No.1, Wei-Wu Road, Fengshan District
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Taiwan
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Study participating centre
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Taiwan
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Study participating centre

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632

Sponsor information

Organisation
Ministry of Science and Technology, Taiwan

Funder(s)

Funder type
Government

Funder Name
Ministry of Science and Technology, Taiwan

Alternative Name(s)
Ministry of Science and Technology, R.O.C. (Taiwan), Ministry of Science and Technology of Taiwan, MOST

Funding Body Type
Government organisation

Funding Body Subtype
National government

Location
Taiwan

Results and Publications

Individual participant data (IPD) sharing plan
The datasets generated during and/or analysed during the current study will be published as a supplement to the results publication

IPD sharing plan summary
Available on request, Published as a supplement to the results publication

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article		02/07/2025	03/07/2025	Yes	No