

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	<input type="checkbox"/> Prospectively registered
		<input type="checkbox"/> Protocol
Registration date 09/01/2025	Overall study status Completed	<input type="checkbox"/> Statistical analysis plan
		<input checked="" type="checkbox"/> Results
Last Edited 03/07/2025	Condition category Nervous System Diseases	<input type="checkbox"/> 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?
Prof. Tong-Hsien Chow, thchowma@gmail.com

Contact information

Type(s)
Public, Scientific, Principal Investigator

Contact name
Prof Tong-Hsien Chow

ORCID ID
<https://orcid.org/0000-0002-7013-2979>

Contact details
No.1, Wei-Wu Road
Fengshan District
Kaohsiung
Taiwan
830208
+886 (0)77462151
thchowma@gmail.com

Additional identifiers

EudraCT/CTIS number
Nil known

IRAS number

ClinicalTrials.gov number
Nil known

Secondary identifying numbers
Nil known

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

Study design

Observational cross-sectional study

Primary study design

Observational

Secondary study design

Cross sectional study

Study setting(s)

Fitness/sport facility, Laboratory, School

Study type(s)

Prevention, Quality of life, Screening

Participant information sheet

Not applicable

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 \pm standard deviation (SD), with $p < 0.05$ (represented by *) and $p < 0.01$ (represented by **) considered statistically significant.

Intervention Type

Other

Primary outcome measure

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 ($\geq 16^{\circ}$).
4. Static rearfoot angle for each participant determined using Biomech 2019 Posture Analysis software. Rearfoot postures were classified based on angle variations as varus ($< 0^{\circ}$), neutral (0° to 5°), and valgus ($> 5^{\circ}$).

Secondary outcome measures

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.

Overall study start date

01/06/2015

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

Age group

Adult

Lower age limit

20 Years

Upper age limit

23 Years

Sex

Male

Target number of participants

114

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

Kaohsiung

Taiwan

830208

Study participating centre**National Taiwan Normal University**

162, Section 1, Heping E. Rd

Taipei

Taiwan

106

Study participating centre**National Taiwan University of Sport**

No. 16, Sec. 1, Shuangshi Rd, North Dist.

Taichung

Taiwan

404401

Study participating centre**University of Taipei, National United University**

No.1,Ai-Guo West Road

Taipei

Taiwan

100234

Study participating centre**National United University**

No.1, Lienda

Miaoli

Taiwan
360301

Study participating centre
National University of Tainan
33, Sec. 2, Shu-Lin St.
Tainan
Taiwan
700301

Study participating centre
National Taitung University
369, Sec. 2, University Rd
Taitung
Taiwan
369

Study participating centre
National Formosa University
No.64, Wunhua Rd., Huwei Township
Yunlin
Taiwan
632

Sponsor information

Organisation
Ministry of Science and Technology, Taiwan

Sponsor details
106, Sec. 2, Heping E. Rd
Taipei
Taiwan
106214
+886-2-2737-7992
misservice@nstc.gov.tw

Sponsor type
Government

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

Publication and dissemination plan

Planned publication in a peer-reviewed journal

Intention to publish date

30/06/2025

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