A comparison of the length and width of static bare footprints on a hard compared to a soft surface.

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Use of bare footprints in forensic work.

- There has been increasing interest in the potential of bare footprints being an aid to identification (Vernon, 2015)
- Studies have demonstrated that bare footprints are highly individual because of differences in the foot dimensions of the people who created them (inter-subject variations), the potential for footprints to be amended through situational variables (intra-subject variations) is not fully understood.
- **This study considers how actual foot length can be estimated from a static inked foot print.**

Use of bare footprints

- Bodziak (1999) found that there are three types of footprints that can be found at the scene of a crime: (1) the impression left in an insole of a shoe, (2) a true bare footprint, and (3) a foot that had a sock on.
- Bare footprint comparisons have been widely accepted as a method that can assist with the process of identification.
- According to Barker and Scheuer (1998), in the western world, there is a role for the bare footprint in forensic investigations. Crimes of a sexual nature can see the offender removing his or her clothing beforehand; other forensically aware offenders, who believe they know the system well, may remove their footwear prior to committing a crime because they believe that this would protect them from being caught.
- In areas such as India (Kanchan et al 2012), such considerations can have greater relevance because of the high proportion of the population who walk barefoot for a variety of socioeconomic, religious, or climatic reasons.

The bare footprint (individual?)

- Kennedy (1996) considered the uniqueness of bare footprints as an aid to identification in a study which, at the time of publication, had utilized 6000 bilateral bare footprints from 3000 participants. Kennedy assessed these impressions by taking 38 measurements that were entered into a computer database. This database allowed individual footprints to be compared with all other footprints in the database. He concluded that footprints were individual.
- Krishan (2007)]considered the individuality of footprints in the Gujjar's population in North India, particularly considering shape, alignment, creases, size, cuts, cracks, and pits to determine whether these characteristics were individual. The study involved 1040 adult males between 18 and 30 years of age. The footprints were shown to be highly individual and showed a link with personal identity.
- Moorthy and Sulaiman (2015)]conducted a study that involved Malaysians (200 males and 200 females) between 18 and 60 years of age. Eight hundred bilateral prints were collected in total. Participants had to be healthy and free from symptomatic deformities of the foot to participate.

Types of footprint.

- According to Vernon [2017], bare footprints can be static or dynamic.
- Static prints are associated with standing and dynamic prints with walking or running.
- DiMaggio and Vernon [2017] stated that there are two forms of surface at a crime scene these include two dimensional and three-dimensional surfaces. The three-dimensional footprints are made in a softer substrate, for example sand or dirt.

Techniques for Analysis of Bare Footprints

- Vernon (2017) reports that multiple methods have been used as a way of measuring bare footprints to aid the identification process.
- These measurements include the Gunn method, the Optical Centre Method, The Overlay method, and the Reel method.
- As part of her Ph.D. Reel (2012) investigated the concurrent validity and reliability of Gunn, Optical Centre Method and Reel. Reel found the highest reliability occurred with her own Reel method and then the Gunn method.

Study

- **Research question**
- Is there a difference in length and width of static bare footprints on a hard compared to a soft surface.

Participation

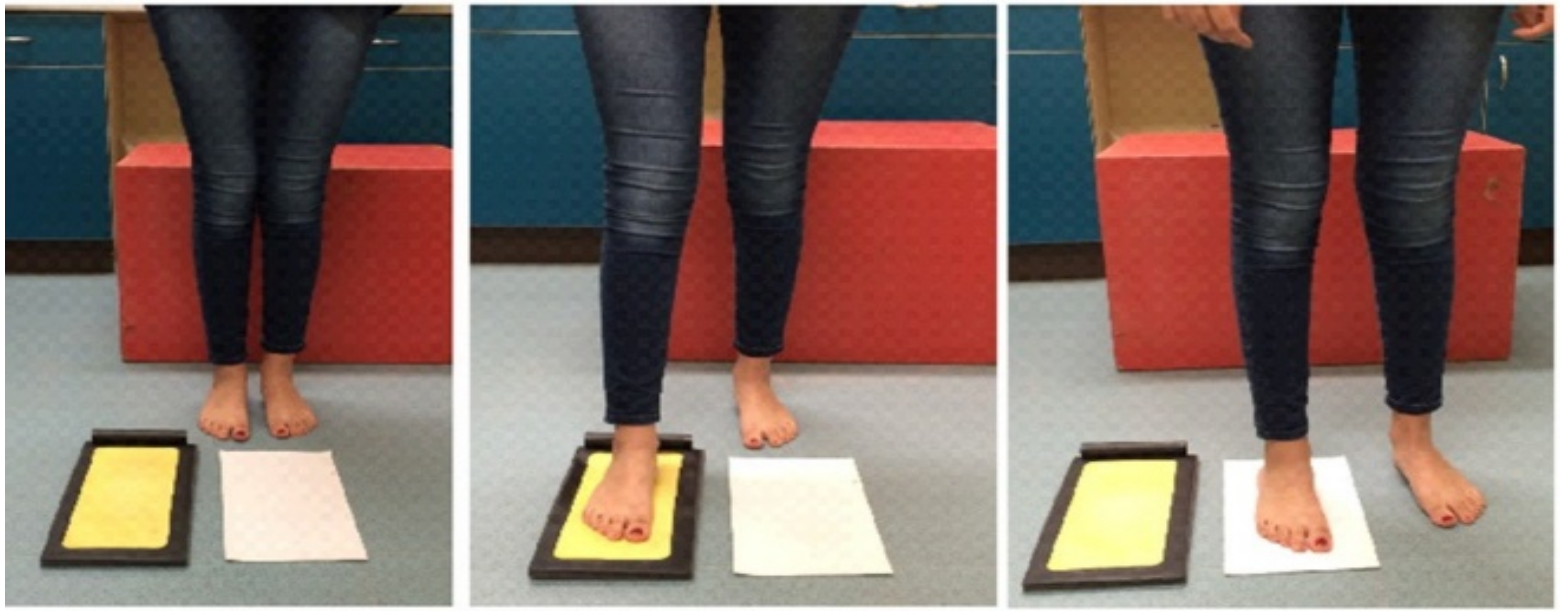
- An opportunistic sample of 30 participants were recruited from the student population of a University in the UK. The sample was made up from 8 males and 22 females, ranging in age from 18 to 50.
- Ethical approval for the study was obtained from the Ethics Committee of the Faculty of Health and Society at the University of Northampton UK.
- Participants were fully informed of the study by one of the authors and each participant gave their consent to participate in the study.

Inclusion and Exclusion criteria

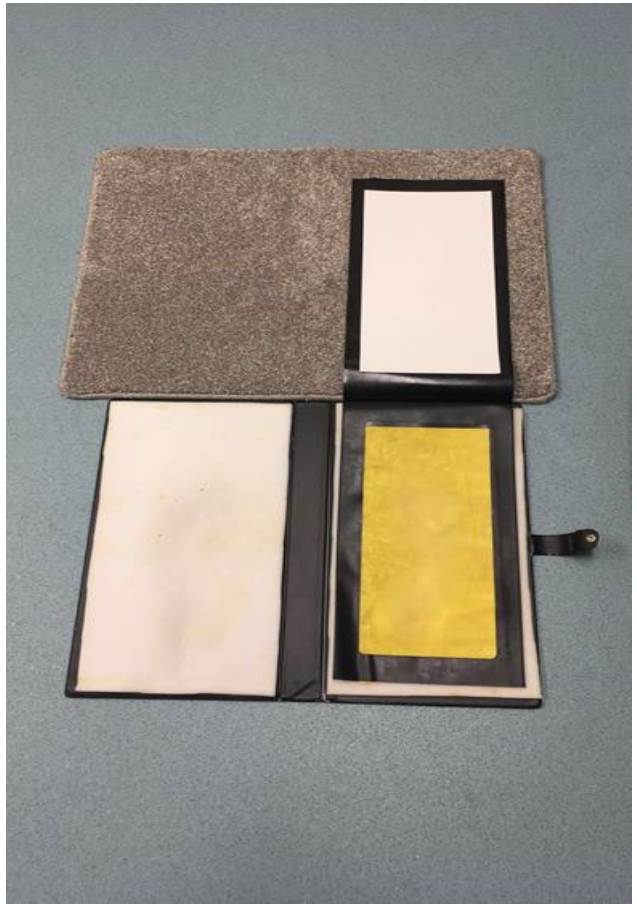
- Participants aged 18 to 50.
- White British ethnicity.
- No self-reported medical or surgical conditions that could affect the participants gait.

Obtaining a standing static footprint

- An inkless pad was placed on the floor. Participants placed their right foot onto the inkless mat in their natural stance position and held it for three seconds. They then transferred their foot onto the reactive paper next to the inkless mat in their natural stance, thus creating a two-dimensional static print.

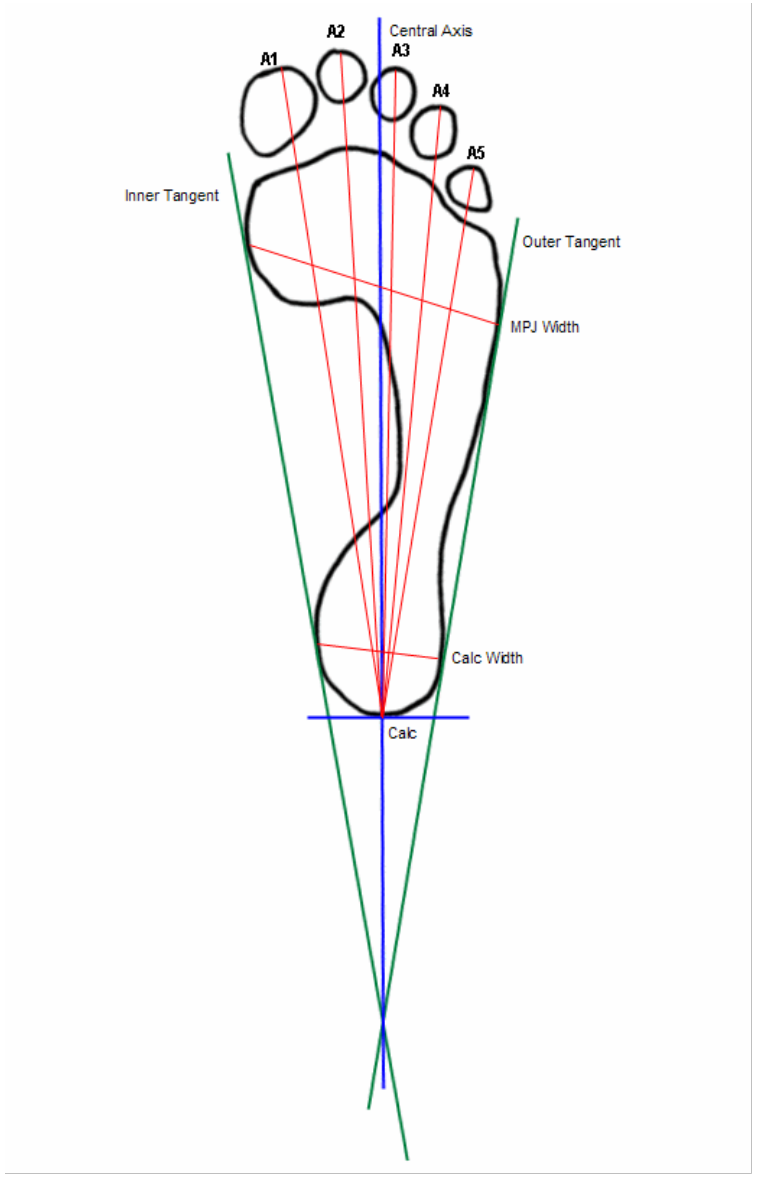


Obtaining a footprint on a soft surface.



Footprint Analysis: Scanning GIMP and Reel Method

- Each static bare footprint was scanned using a HP Photosmart 5524 Scanner and saved as a JPEG file MacBook Air device. Each footprint was analysis using GNU Image Manipulation Program(GIMP) 2.8 software. Each footprint was uploaded into the GIMP software with the DPI (dots per inch) set at 150.
- Following the guidelines set out by Reel the central axis of the footprint was found and then the print was rotated until the central axis was vertical. A line was then drawn skimming the lowest heel pixel and crossing the central axis. The highest pixel of the most distal aspect of the foot, regardless to whether it represented the first or second toe as was marked. A line was then drawn from the central aspect of the calcaneus to the most distal part of the foot that had been marked and thus giving a measurement of longest possible footprint length.


A1
A2
A3
A4
A5
Central Axis
Inner Tangent
Outer Tangent
MPJ Width
Calc Width
Calc

Findings for length at the forefoot

	Mean	N	Std. deviation
Length on hard surface (mm)	233.980	30	14.2803
Length on Soft surface (mm)	239.803	30	14.4737

Findings for width at the forefoot

	Mean	N	Std. deviation
Width at the forefoot on a hard surface (mm)	87.643	30	6.4782
Width at the forefoot on a soft surface (mm)	93.320	30	5.7194

Findings for width at the rearfoot

	Mean	N	Std. deviation
Width at the rearfoot on a hard surface (mm)	48.230	30	4.4426
Width at the rearfoot on a soft surface (mm)	54.530	30	4.7611

Paired t-test.

- The results of a paired t test showed that there was a highly statistical significant difference in the length of the footprint on a soft surface compared to a hard surface (p=.000)

- A paired t test was then repeated for width when measured at the forefoot and then at the rearfoot. Both these showed a highly statistical significant increase in width of the footprint taken on a soft surface compared to a hard surface. (p=.000).

Discussion

- No similar studies to compare the findings with.
- Right foot only.
- Could vary the type of soft surface.
- Dynamic prints.

Conclusion

- This study investigated if the length and width of a footprint changes when measured on a hard compared to a soft surface.
- The findings from this study demonstrated that the length and width of a footprint does change, and this change is statistically significant. The results showed that both the length and width of a footprint increases significantly when the foot is on a soft surface compared to a hard surface.

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