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EFFECTIVENESS OF DIFFERENT FOOT ORTHOTIC DESIGN ON THE FOOT KINEMATIC AND PLANTAR LOADING OF PATIENTS WITH HALLUX LIMITUS

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KU LEUVEN

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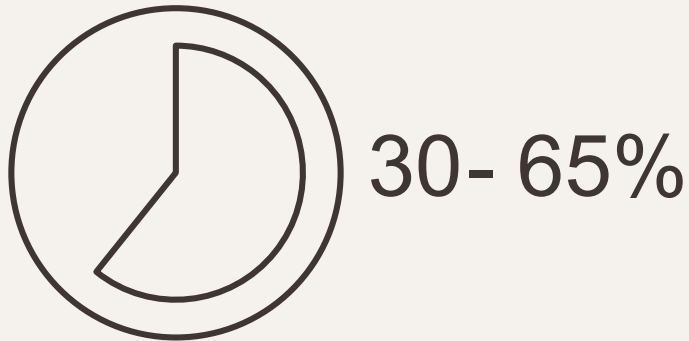
Introduction

Hallux limitus



1. INTRODUCTION

Hallux limitus is a condition characterised by a limitation of the mobility of the metatarsophalangeal joint or first ray when the patient is walking



(Mal) adaptative compensation

- Alteration of the sagittal plane joint kinematic
- Hip and midtarsal joint kinematic
- Alteration of plantar pressure distribution
- Foot progression angle

What is already known about it?

A literary review

ARTÍCULOS

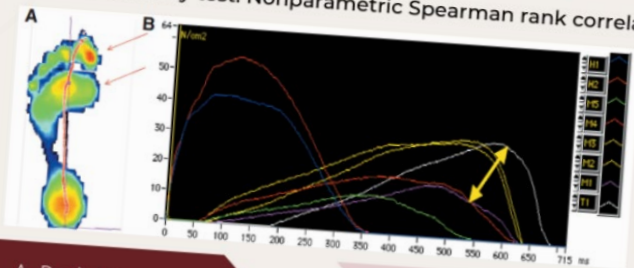
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Analysis

The Mann-Whitney test. Nonparametric Spearman rank correlation.



A- Peak pressure during stance

- TIME HISTORY OF PLANTAR PRESSURE FOR THE HALLUX (T), THE METATARSAL HEAD (M1-M5) AND THE MEDIAL (H) AND THE LATERAL (L) HEEL (PART B) FOR A SUBJECT WITH HALLUX LIMITUS

PATIENTS
N=679

- ✓ Pain
- ✓ NoPain
- ✓ Normal

Divided into 10 anatomical regions:

Hallux (T), the second to fifth toe (T2-5), metatarsal joints 1-5 (M1 to M5), middle foot (MF), medial heel (HM) and lateral heel (HL).

Plantar pressure measuring plate (RsScan Inc), in the middle of a 10 m long carpet. Plate was 1m x .4m in dimension with a sensor density of about 2,7/cm² and a sensor size of 5 mm (lateral) x 7 mm (anterior-posterior)

Barefoot on the carpet at self-selectes speed.

BIOMECHANICAL VARIABLES

Maximal dorsiflexion of the first metatarsophalangeal joint. *
Time from first foot contact to maximal dorsiflexion of the first metatarsophalangeal joint (in percentage of stance duration)
Range of dorsiflexion of the first metatarsophalangeal joint,
Minimal navicular height
Time to minima navicular height

PRESSURE VARIABLES

Peak pressure
Time to peak pressure (in percentage of stance duration)
Loading rate*
Significantly increased.
Time to maximal loading rate (in percentage of stance duration)
Ratios between peak pressure of the hallux and the first metatarsal head* between the first and fifth metatarsal head, and between the first + second metatarsal heads and the fourth + fifth metatarsal heads.

PATIENTS
N=90

- ✓ 30 normal subjects
- ✓ 30 with hallux limitus
- ✓ 30 with hallux valgus.

THEY DIVIDED THE FOOT INTO 10 REGIONS OR MASK USING EMED AUTO MASK SOFTWARE

-A platform dimension of 420 x 417 mm and sensor dimension of 360 x 190 mm, mounted flush with the floor surface at the centre of a 10 m raised walkway.
The platform comprised of 2736 individual sensors at a density of 4/cm² and acquired data at a sampling rate of 50 Hz. EMED-F system.
Two-step method.



MOST STUDIED VARIABLES

(ordered from the most studied to the least)

1 PEAK PRESSURE
2 MAXIMUM FORCE
3 CONTACT TIME
4 FORCE-TIME INTEGRAL
5 CONTACT AREA

5 PRESSURE-TIME INTEGRAL
6 MEAN PRESSURE
7 PEAK FORCE
8 TIME TO PEAK PRESSURE
9 LOADING RATE

10 TIME TO MAXIMAL LOADING RATE
11 TIME OF PEAK FORCE
12 COP (X-Y COORDINATES)
13 MAXIMUM VERTICAL FORCE
14 CENTER OF PRESSURE EXCURSION INDEX

REGIONS OF INTEREST
(Ordered from most to less common)

8 ROMS
7 ROMS
10 ROMS
6 ROMS
11 ROMS
5 ROMS

- In the power each of the zones is specified

HALLUX LIMITUS/RIGIDUS

Van Gheluwe et al
2006

A. Bryant et al 1999

Gerard V. Zammit et
al 2008

Hallux Valgus

Hida, Takashi et al
2017

Koller, Ulrich et al
2014

Kwan, M. Y et al 2021

Andrew M Galica et
al 2013

Verdu-Roman et al
2019

Ute Waldecker et al
2002

Farzadi, M. et al 2015

Jianmin Wen et al
2012

Chopra, S et al 2015

Kernozeck, Thomas W
et al 2013

Clarke, Gregory R et
al 2020

Hofmann, Ulf Krister
et al 2019

2. Objective

- Only 3 papers studied Hallux limitus, the majority studied Hallux valgus
- Most of the article study only 1 condition, they do not compare between other insoles



01

Assess the effectiveness of three different types of foot orthoses in improving the range of motion of hallux in patients with hallux limitus

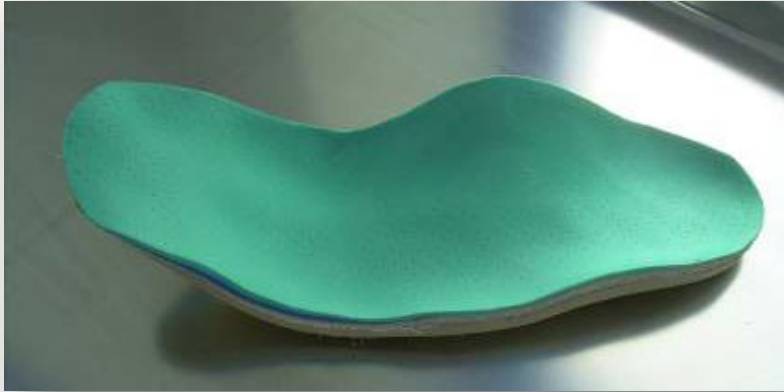
02

Assess the effectiveness of three different types of foot orthoses in altering the forefoot plantar pressure distribution patients with hallux limitus

in

3. METHODOLOGY

- Three types of insole



Picture 1. Self-made



Picture 2. Self-made

* All the imagen that have shown in this presentation are self-made

3. METHODOLOGY

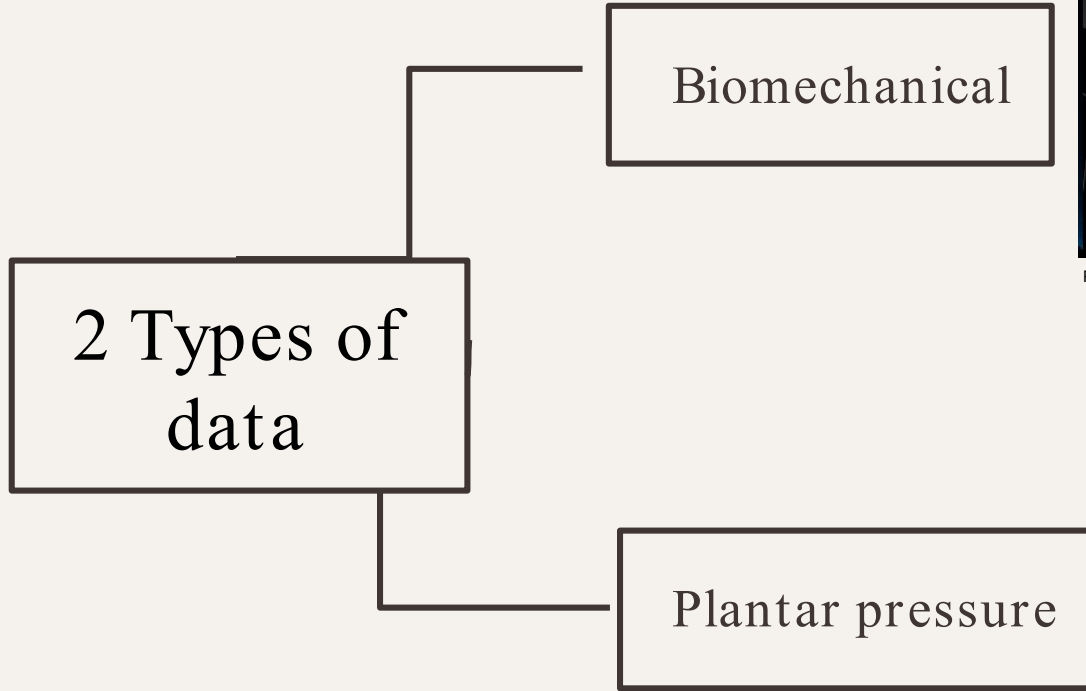
- **Inclusion criteria**

- Patients between 18 and 65 years.
- Presence of a functional hallux limitus
- A positive Jack test: Will be taken as values:
 - Resistance when raising the finger
 - Don't recreate the foot arch
- Test de Lunge tested with inclinometer.
- Foot Posture Index > 6
- Patients who have signed an informed consent

- **Exclusion criteria.**

- Patients with neurological, systemic or orthopedic disease.
- Those subject who have suffered trauma of the foot and lower limb prior the study.
- Patients who are unable to walk without walking aid

3. METHODOLOGY



Picture 3. Self-made



Picture 4. Self-made

3. METHODOLOGY.

25 patients between 30 -45 years

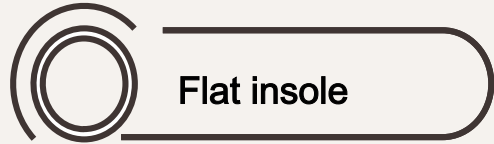
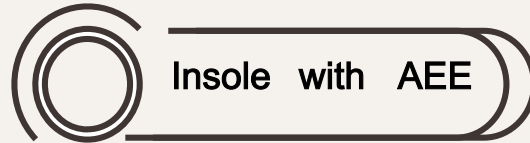
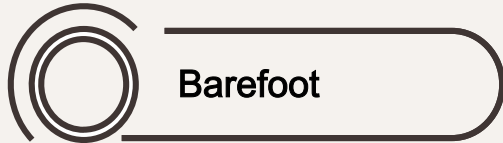
1. Informed consent.
2. Anthropometric characteristics of the patients' foot.
3. Place all markers at the anatomical landmarks following the bruening model.
4. A first measure is taken with the patient in standard position
5. Both biomechanical data and data relating to plantar pressures were taken at the same time and 3-step protocol was followed



Picture 5. Self-made

3. METHODOLOGY

- Patients were measured in 4 different conditions:



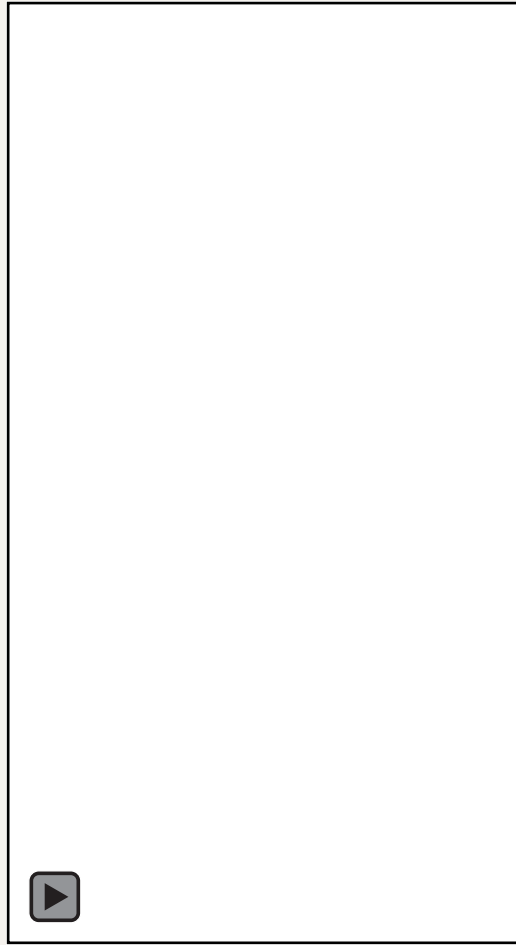
25 patients- 4 different conditions - 5 trials

* All the images that have been shown in this presentation are self-made

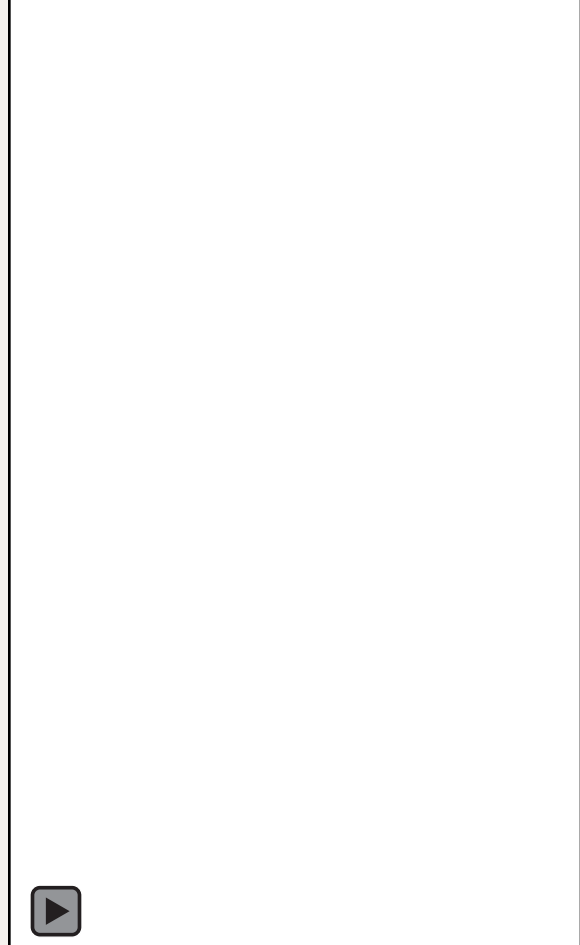
Picture 7. Self-made



Video 1. Self-made



Video 2. Self-made



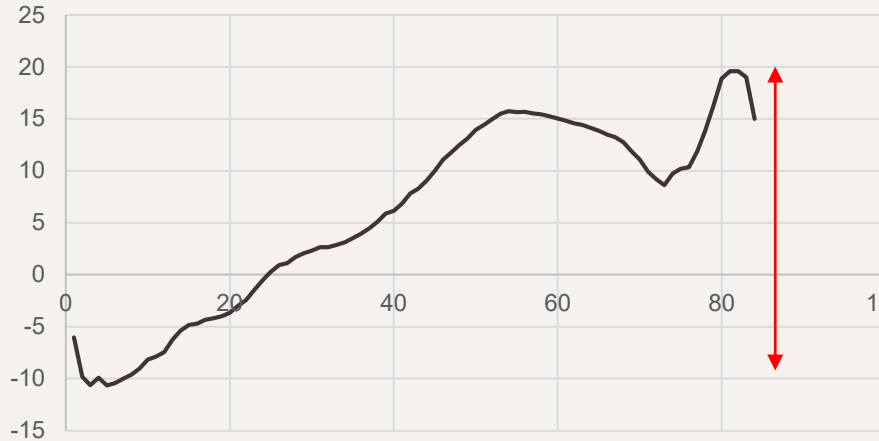
* All the imagen that have shown in this presentation are self-made

PLANTAR PRESSURE DATA

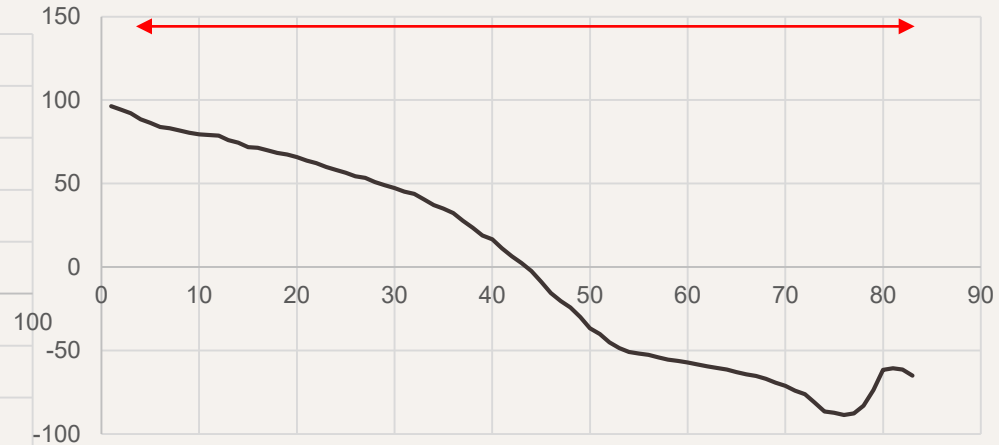
O-D data

- Medio lateral displacement
- Anteroposterior displacement

Medio-lateral Displacement



Anteroposterior displacement



	Barefoot 1	Barefoot 5	Barefoot 6	Barefoot 7	Barefoot 9
Desviacion M-L	16,89	19,314	21,067	33,949	15,109
Desviacion M-L (con formula) [mm]	16,89	19,32	20,07	35,00	13,73

*** FOR EACH CONDITION AND PATIENTS**

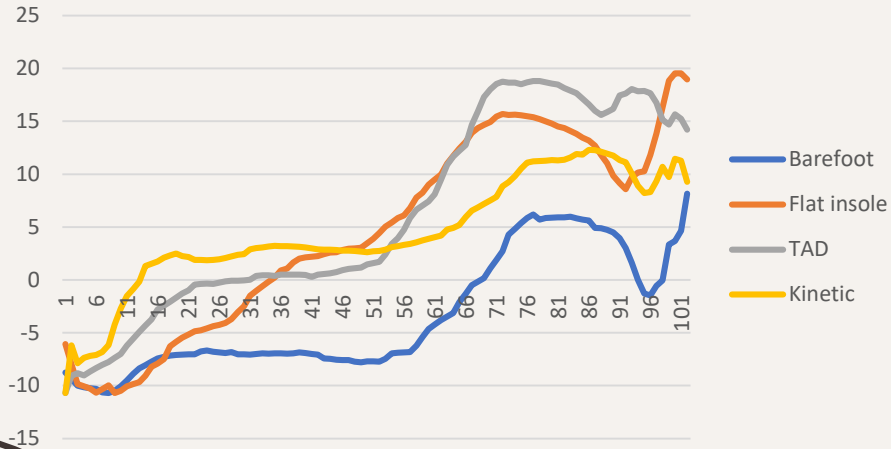
	Barefoot 1	Barefoot 2	Barefoot 3	Barefoot 5	Barefoot 6
Desviacion A-P	193,419	178,77	180,476	186,02	188,904
Desviacion A-P (con formula) [mm]	194,06	185,66	185,85	186,02	189,42

RESUMEN				
	Barefoot	Flat insole	TAD	Kinetic
Desviacion M-L	20,19	27,58	24,56	26,99
Desviacion A-P	188,20	186,56	183,91	189,50

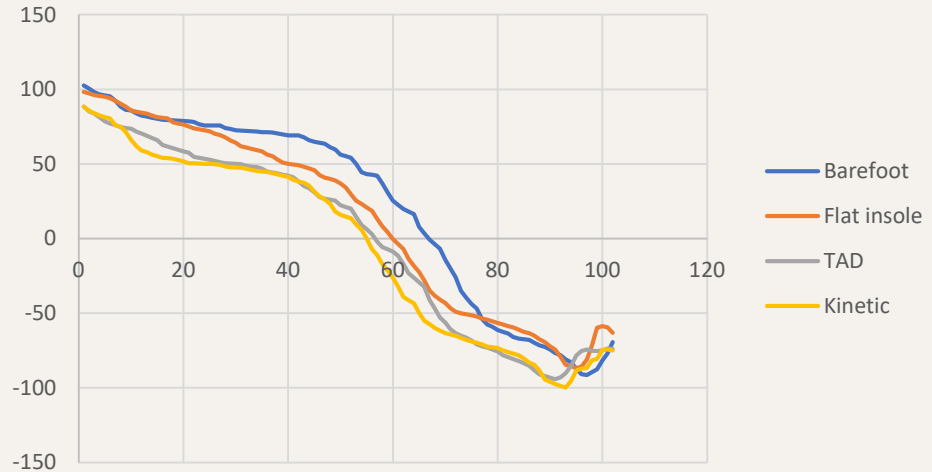
PLANTAR PRESSURE DATA

- 1-D DATA

M-L 4 condition



A-P 4 condition



Biomechanical data / results.



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