Expert Scientific Meeting on Load Distribution Measurement | 2016 ESM | July 27 - 30, 2016 University of Lisbon, Portugal

REDUCING THE METATARSAL PAIN TO PROMOTE DAILY PHYSICAL ACTIVITY IN OBESE PEOPLE: A SUSTAINABLE PROPOSAL

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BACKGROUND

World Health Organization (WHO) launched a warning in 2015, indicating **overweight and obesity** as the next epidemic for the world! In 2030, 1 of 2 women and 7 of 10 men might be overweight; 1 of 5 men might be obese. Burden of obesity care is becoming hardly sustainable by healthcare systems.

KEY POINTS

WHO recommends physical activity for at least 150min/week (http://www.who.int)

High forefoot peak pressure are often found in obese population (Pedruzzi De Castro et al, 2014)

Muscle force inadequately counteract gravity during walking/running

Metatarsal pain very often limits/ prevents obese from reaching the WHO activity goal (Tanamas et al, 2012).

People with less education and lower socio-economic status are more likely to be obese (OECD Report, 2014) ➔ proposed solutions shall be sustainable!

AIM:

TO PROPOSE AND TEST EFFECTIVE, LOW-COST AND LONG-LASTING IN-SHOE MATERIAL TO:

- ✓ cope with heavy load
- ✓ reduce metatarsal pain
- ✓ improve foot-ground compliance during gait (without «interfering» with overall gait biomechanics)
- ✓ incentivate physical activity

METHODS

✓ 9 obese patients, metatarsal pain, high metatarsal peak pressure (PP) → 4F/5M, age 35±16years, BMI 34.5±2.7kg/m², cadence 92.3±11.2spm, PP 951±209kPa

✓ 3 preselected materials to test → Best performing materials among shore 25-70 & thickness 3-10mm:
- 6mm shore 25A expanded EVA
- 6mm shore 40A expanded EVA
- 6mm silicone gel-like+fabric

✓ foot loading during **barefoot** walking →  EMED-Q100 (novel$_{gmbh}$) 4 sensors/cm², 5 trials, controlled cadence

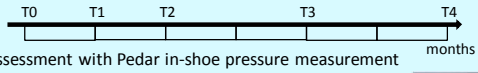
✓ identification of in-shoe offloading material → Hp: pain associated with Peak Pressure (PP) and/or Pressure-time Integral (PTI)
Material requirements: PP and PTI reduction up to negligible painful sensation in all patients

✓ in-shoe assessment and follow-up:

foot loading during in-shoe walking, 6 months follow-up

assessment of compliance, performance, adverse events

interpretation of results



Assessment with Pedar in-shoe pressure measurement system (≈1sensor/cm²) 

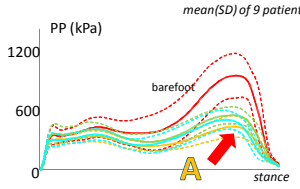
T0 ➔ Previously self-selected cadence

T1, T2, T3, T4 ➔ eventually updated cadence (plus cadence at T0 when different) 

Outcomes:
- biomechanical: % reduction of PP and PTI under the metatarsals
- clinical: lack of pain
- physical activity: spontaneous variation of cadence
- usability: compliance, satisfaction, reported adverse events

RESULTS

EVA Shore25, 6mm best performed as offloading material, with barefoot PP and PTI reduction >50% and 40% respectively, and +2% of force increase during propulsion. Pressure and Force curve patterns remained unchanged (gait biomechanics preservation)



%reduction

	PP	PTI	MF
A	-52 (6)	-43 (10)	+2 (5)
B	-39 (7)	-27 (10)	-1 (5)
S	-44 (6)	-33 (14)	+2 (6)

PP: peak pressure; PTI: pressure-time integral; MF: maximum force

Main outcomes of the in-shoe assessment and followup:

✓ biomechanical: significant PP and PTI reduction (paired t-test, P<0.05), maximal at T3 (PP:23.9±5.7%; PTI:19.8±2.4%), slightly reduced at T4

✓ clinical: no pain up to T4; calluses reduction; sensation of fatigue at T4

✓ physical activity: spontaneous cadence increased from 92.3±11.2spm at T0 to 105.5±8.3spm after 6 months

✓ usability: good compliance; no adverse events; daily use ranged 4-10 hours

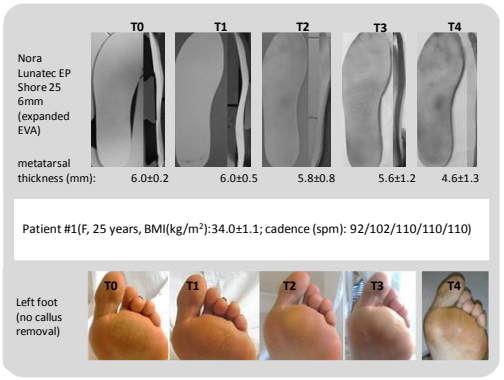
% reduction of PP and PTI

	T0	T1	T2	T3	months T4
PP	-14.7* (5.4)	-14.9* (5.0)	-20.8* (6.5)	-23.9* (5.7)	-17.7* aging? (4.5)
PTI	-7.3* (7.3)	-11.1* (7.9)	-12.5* (8.5)	-19.8* (2.4)	-13.3* (4.8)

*paired t-test (P<0.05) with/without insoles; **different (P<0.05) from T4

Clinical outcomes

	T0	T1	T2	T3	months T4
Cadence (spm)	92.3** (11.2)	93.8** (9.4)	98.2** (10.0)	102.3 (8.3)	105.5 (8.3)
BMI (kg/m²)	33.8 (2.0)	34.0 (1.4)	34.3 (0.5)	34.6 (0.9)	34.3 (1.3)
callus formation		no	no	no	no
pain	no	no	no	no	no
adverse events	no	no	no	no	no
other sensations	--	--	--	--	fatigue



DISCUSSION & CONCLUSIONS

Proposed insoles proved to be safe and effective at least for 4 months (T3), even in the presence of higher cadences. Longer duration with respect to previously tested PPT insoles may be associated with greater thickness and closed rather than open cells. Increase of spontaneous cadence was interpreted as a sign of positive changes in physical activity. At T3 the group showed higher and more homogeneous cadences, resulting in an offloading effect even higher than at T0. No adverse events and good compliance encourage to use the insoles with a wide population of obese patients. Cost might be estimated as 30€ every 4 months, which renders them sustainable. BMI slightly increased rather than decrease, remarking that its control is a complex multidisciplinary issue.

REFERENCES

OECD, Obesity Update Report 2014. (http://www.oecd.org/health/Obesity-Update-2014.pdf); Peduzzi de Castro et al., Applied Ergonomics 45 (2014) 1028-1034; Tanamas et al, Arthritis Care Res 2012, 64(2): 262–8