

# Foot Orthotics Reduce The Navicular Drop - A Novel Method Allowing For In-Shoe Measurement

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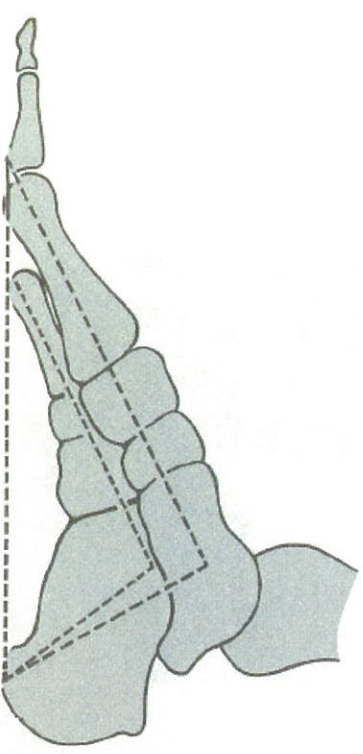
The longitudinal medial arch is essential for energy absorption (Willems et al 2006).

A lowering of the arch is associated with pronation.

The amount of pronation can be quantified by measuring the

Navicular Drop (ND) (Brody 1982; Magee 2008)

- Requires the subject to be in bare feet

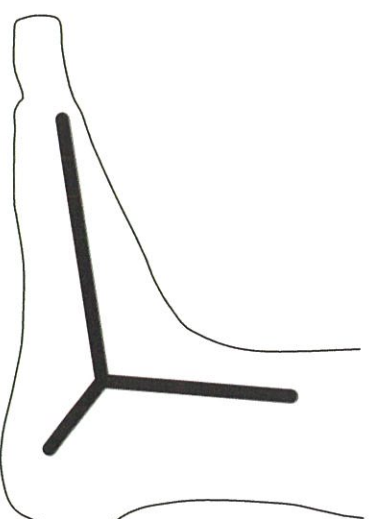


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An increased amount of pronation increases the risk of overuse injuries in shin and knee (Willems et al 2006; Boling et al. 2009)



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It has been hypothesized that foot orthotics can limit the amount of pronation (Baxter et al 2011)

Orthotics has been found to prevent overuse injuries, however the mechanisms of effect are unknown (Franklyn-Miller 2010)

To date it has not been possible to measure ND when subjects are wearing shoes

Therefore in this study a novel method, a strain-sensor, to measure in-shoe ND was used, and the aim was to investigate

- 1) The validity and reliability of the strain-sensor and
- 2) If foot orthotics reduced the ND during walking measured with the strain-sensor.

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### The strain sensor:

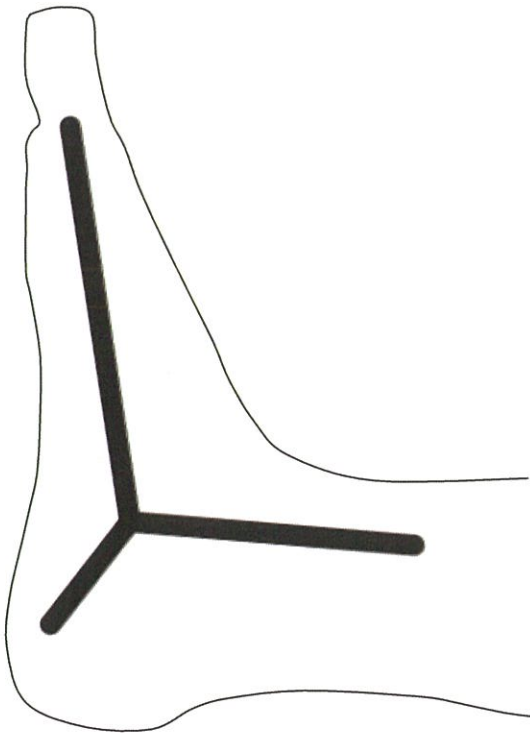
- Thin, flexible and robust capacitative sensor
- Measures electrical capacitance
- Recordings in custom-made software program Datalogger (Kappel 2012)

### Placed between two points

- 20 mm posterior to malleolis medialis
- 20 mm posterior and 20 mm distal to tuberositas naviculare

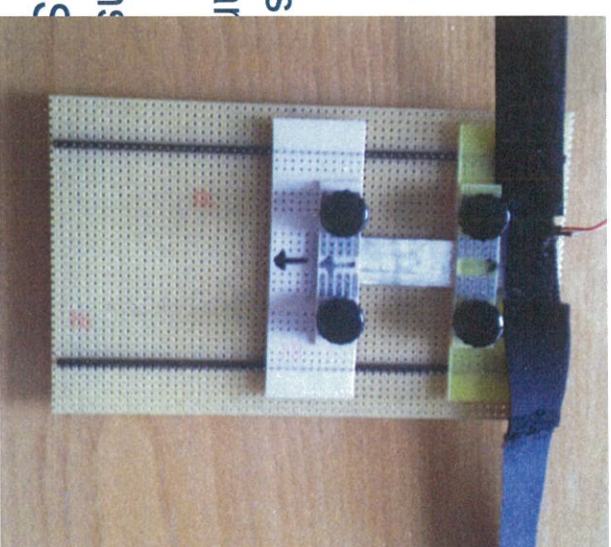


# Navicular height



Validity was measured in two ways

1. Technical validation comparing the degree of stretch from a calibration slade with the stretch measured from the strain sensor (electrical capacitance).
  - Results calculated with a linear fitting and coefficient of determination
  - $R^2 = 0,999$  (Kappel 2012)
2. Comparing ND measured with the measured ad modum Brody (static)
  - $n = 24$
  - Difference between the height of tuberositas neutral position and when subjects were star position (Brody 1982)
  - The difference measured with the strain sensor
  - Linear Regression Model performed in SPSS



ND  
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## Reliability

- $n = 27$
- Subjects walked two times on a treadmill with one day between
- Intra- and interraterreliability was investigated
- Subjects walked 6 minutes on the treadmill followed by 1.5 minutes of recording (Matsas et al 2000)
- Results based on 10 consecutive steps identified after 30 seconds of recording in a custom-made program (DataAnalyzer)
- Intraclass Correlation Coefficient in SPSS 20.0



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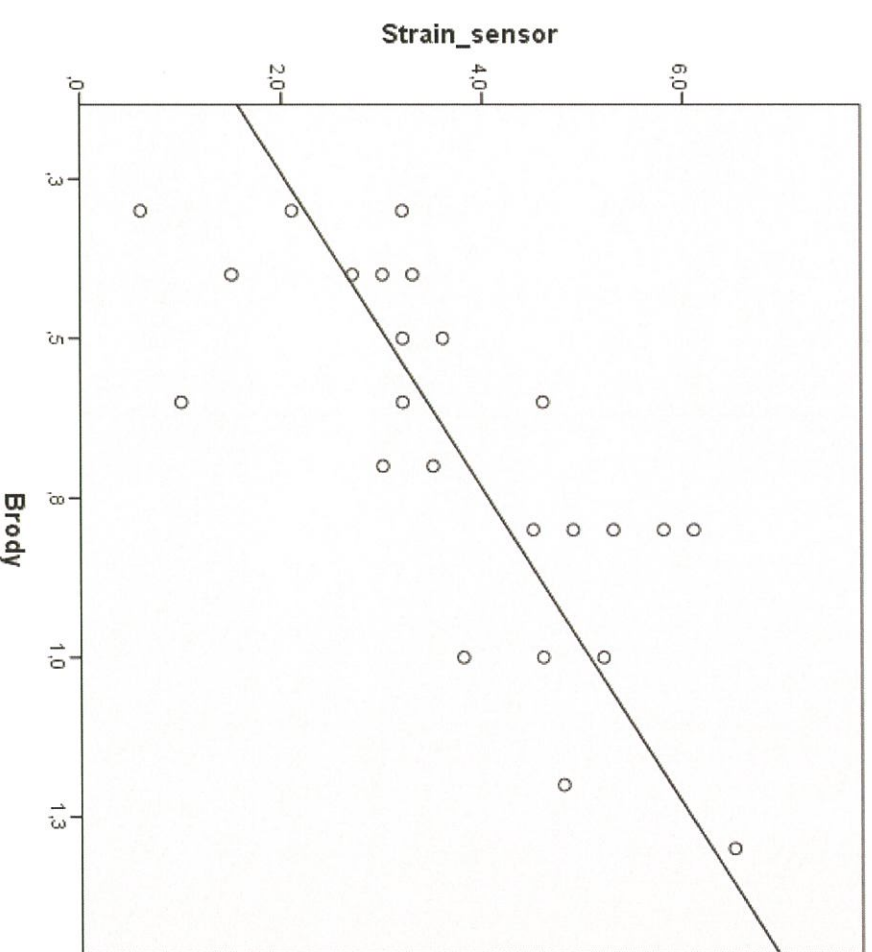
Foot orthotics (Formthotics)

- Full length, dual-density prefabricated Formthotic™
- $n = 24$
- Subjects walked 6 minutes on a treadmill with and without foot orthotics in a randomized order followed by 1.5 minutes of recording
- Results based on 10 consecutive steps identified after 30 seconds of recording in a custom-made software program (DataAnalyzer)
- Paired t-test in SPSS 20.0



## Validity

- Linear correlation between ND measured with the strain sensor and ND ad modum Brody ( $p < 0,001$ )
- $R = 0,745$  ( $p < 0,001$ )



## Reliability

	ICC
Intrarater, rater 1	0,77
Intrarater, rater 2	0,78
Interrater, day 1	0,84
Interrater, day 2	0,76
Interrater	0,80

## Foot orthotics

- A reduction in ND when wearing orthotics (p=0.015)
- On average, orthotics reduced the ND by 0.4mm (95%CI: 0.1-0.7 mm, p=0,02) corresponding to 19.0% of the average ND without orthotics

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The strain sensor is

- Valid compared with ND measured ad modum Brody
- Reliable
- Capable of measuring a reduction in ND when subjects were wearing shoes

The potential of the strain sensor

- Measure movements of the midfoot when subjects are wearing shoes
- Simple and not time consuming which makes it applicable in clinical settings

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