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# *Development of Senior shoes* *A new direction with Biomechanics*



*Picolet Victorien, Biomechanical Engineer, CTC , France*





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# Senior World Population

## A growing population

2008

2040

7%

14 %

506 Millions

1,3 Billions



- ☐ Special Requirements
- ☐ High purchasing power

**Interesting population for shoe manufacturers**



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## Shoe French Federation and CTC carried out a project : ADOCS

To improve shoe offer for senior.



## 15 Shoe manufacturing partners

Belloe, Boissy, Colonnier-Coiffard, Laubuge, Plastigom, Fargeot & Cie, GEP, Javerflex, Luxat, Manufacture de Chaussure Maurice, Mephisto, Pedi Girl, Produit A. Bioteau, Samson, Société Nouvelle Chaussures Marco





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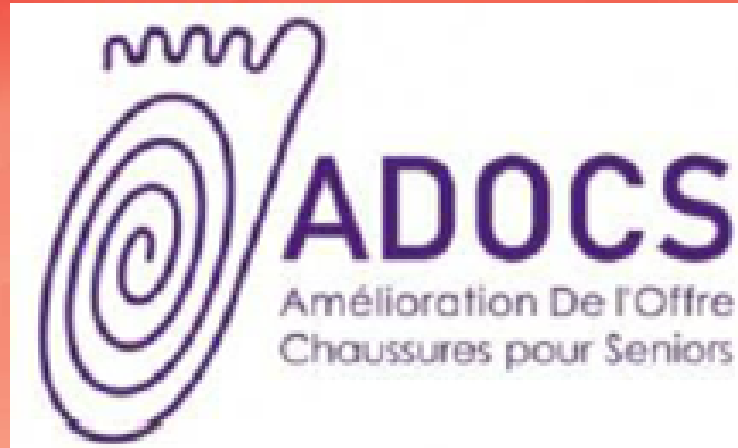


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## Objectives :

- I. To know the morphological changes to the senior foot*
- II. To analyze the shoe characteristics that influence the balance and walking of elderly.*
- III. To design a new generation of shoe, adapted to the senior*



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## Morphological modifications



**700 people**



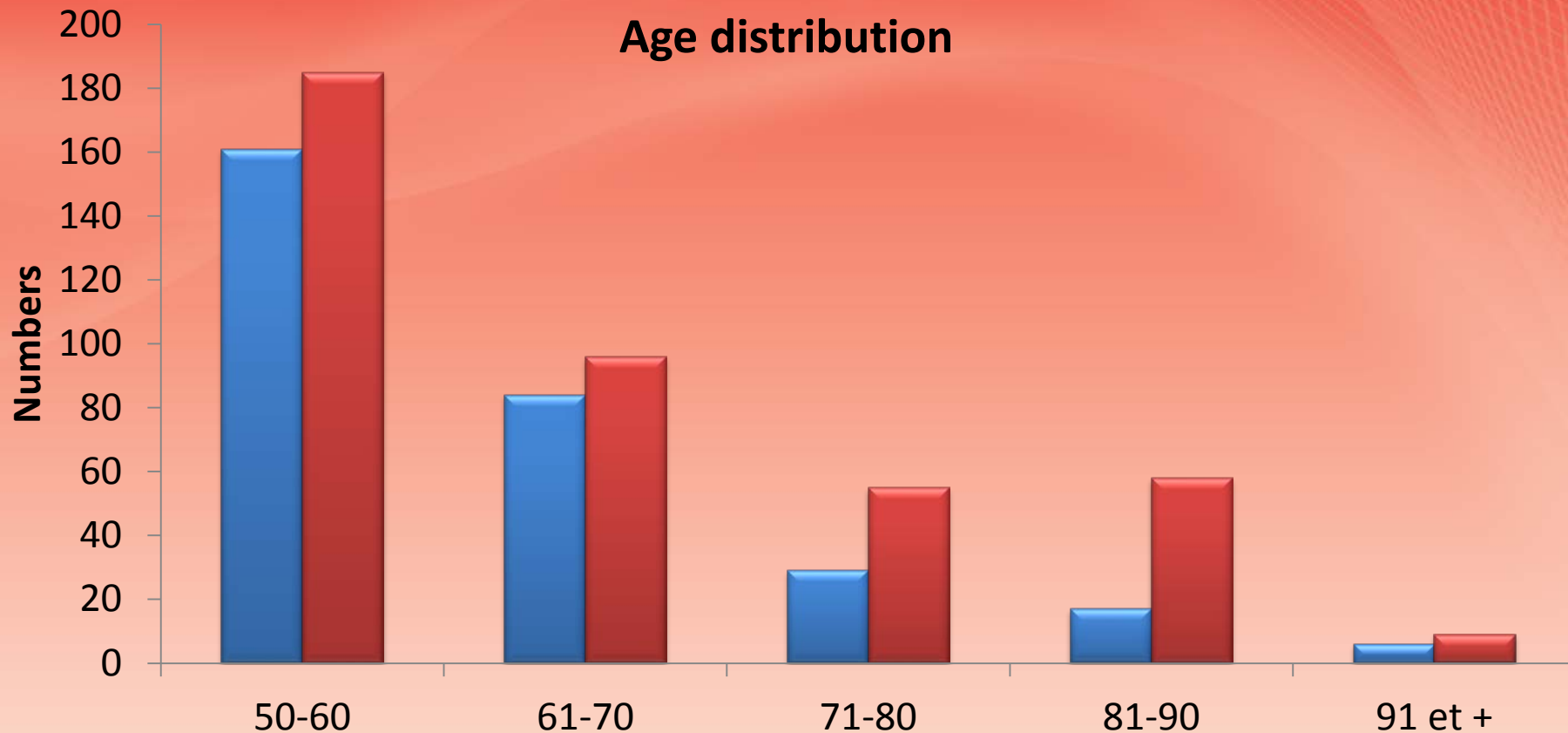
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## Morphological modifications



### *Differences between young and older feet :*

- ❖ *Increasing metatarso phalangeal joint perimeters*
- ❖ *Increasing metatarso phalangeal joint width*
- ❖ *Increasing heel width*





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## Physiological modifications

- ❖ Loss of strength
- ❖ Loss of power
- ❖ Loss of sensory properties
  - ❖ *Visual qualities*
  - ❖ *Vestibular qualities*
  - ❖ *Proprioceptive qualities*
  - ❖ *Tactile qualities*
- ❖ ...

M. Filimonov  
29 years



**173 kg**

M. Deni  
80 years

**59 kg**

## Different consequences :

- ☐ Decrease of Performance
- ☐ Decrease of balance
- ☐ **Increase of falls risk**



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Denis Kimetto  
2H 02' 57"



Mavis Lindgren,  
8H 53' 08"  
90 years

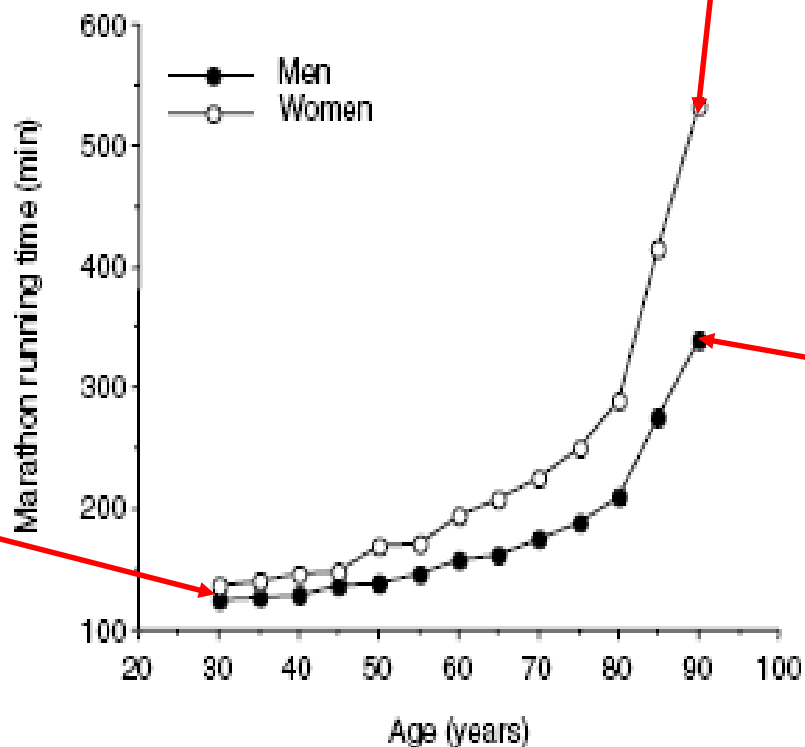


Figure 1  
Changes in men's and women's marathon running times with advancing age (from USA Track & Field and World Masters Athletics).



Fauja Singh,  
5H 40' 01"  
92 years





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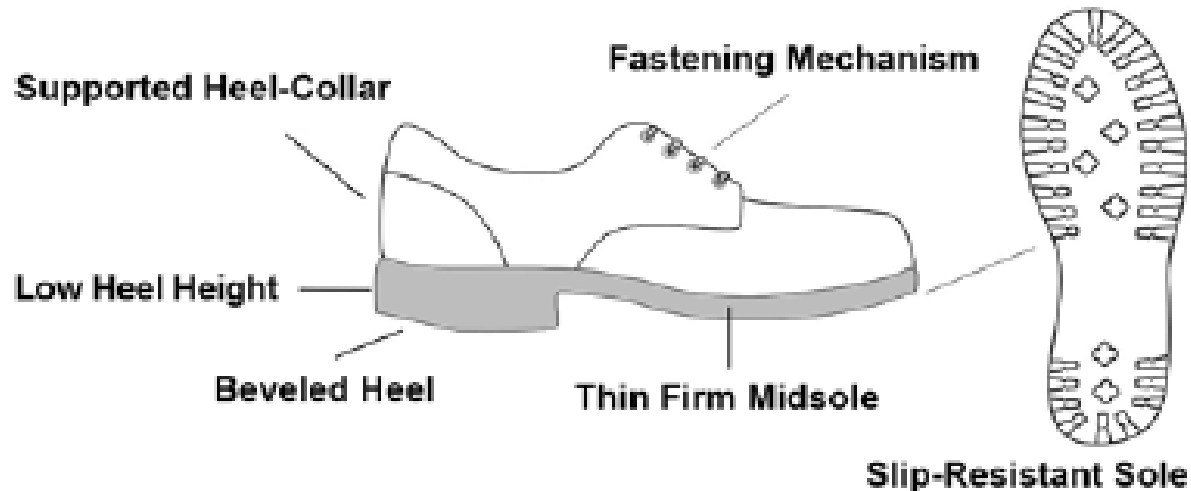
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**Extrinsic factors also explain the increase risk of falls for elderly people.**

- Presence of obstacles at home
- Slippery surfaces...
- **UNSUITABLE FOOTWEAR**

## Shoe impact on the risk of falls



*Maki et al., 2003*



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## Observations / Questionnaire

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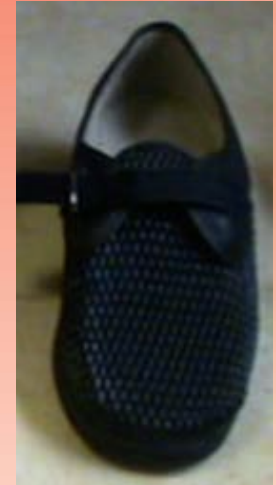


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50 seniors (Women, Men, people in retirement home)

**Observations on daily life activities** : Walking, Climbing stairs, Driving...

**Questionnaire** : Feelings (aesthetic, comfort, safety...)





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## Two most important parameters



**HEEL**



**INSOLE**



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## Second Objective

**To analyze the shoe characteristics that influence the balance and walking of elderly.**

*Using Biomechanical tools.*

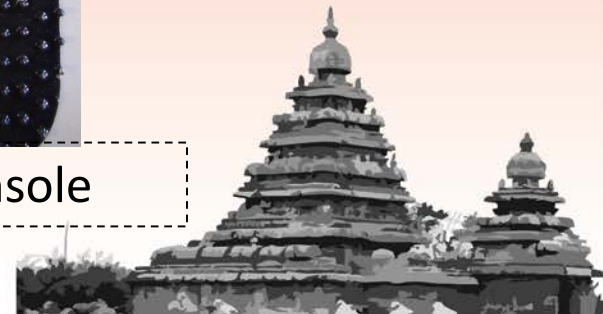
**Two parameters of shoe were analyzed :**



High Heel (3cm)



Textured Insole





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## PROTOCOL

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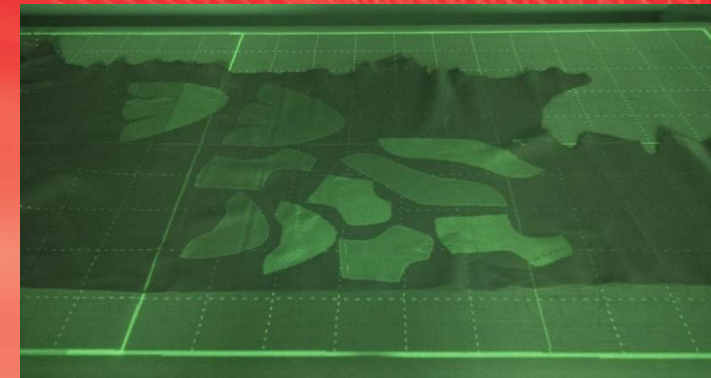
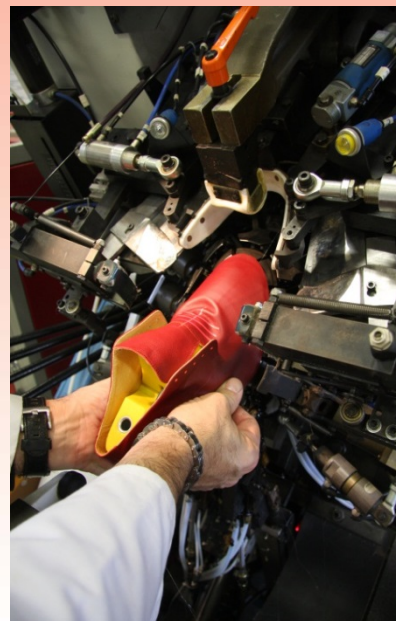


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## PROTOCOL



Close nubs : 4 mm center to center



Spaced nubs : 8 mm center to center



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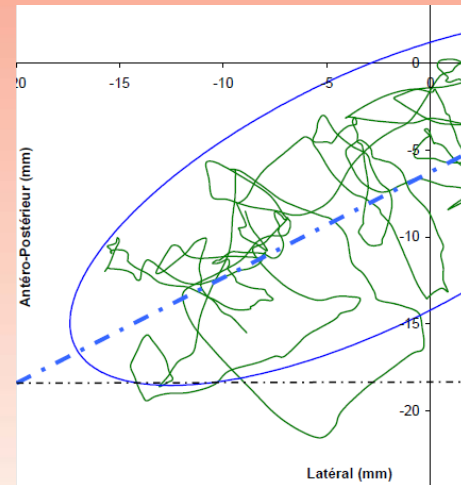


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## PROTOCOL Static Test





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## PROTOCOL Dynamic Test

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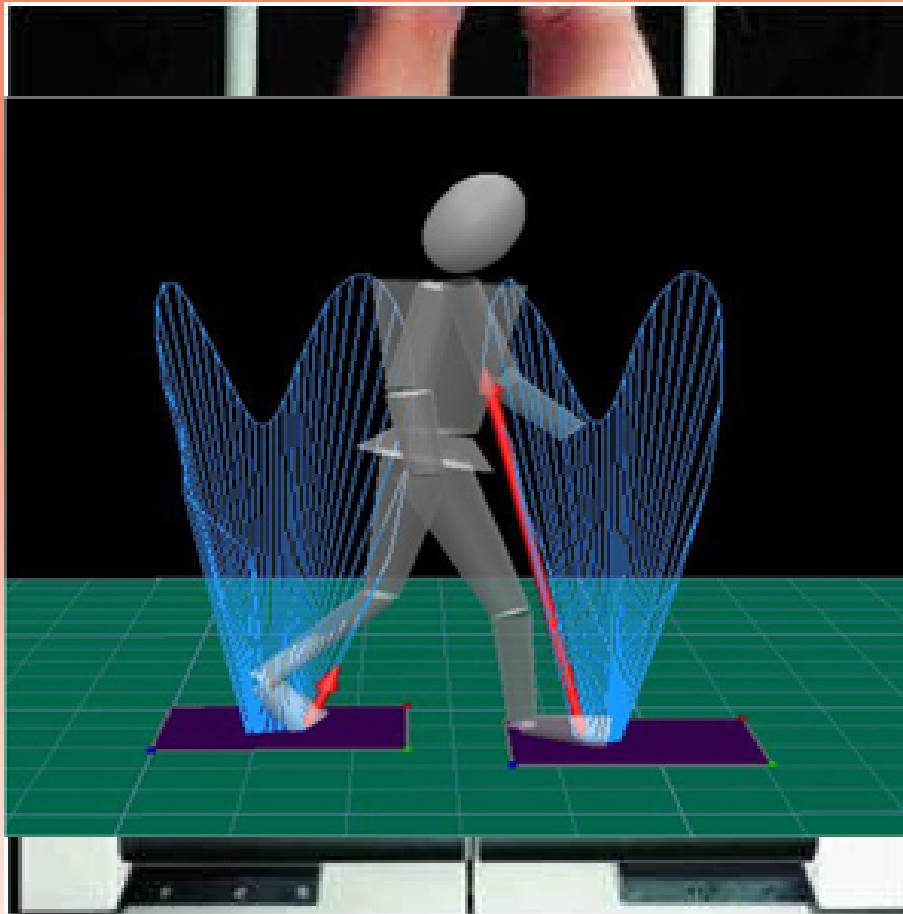


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Ground Reaction Forces





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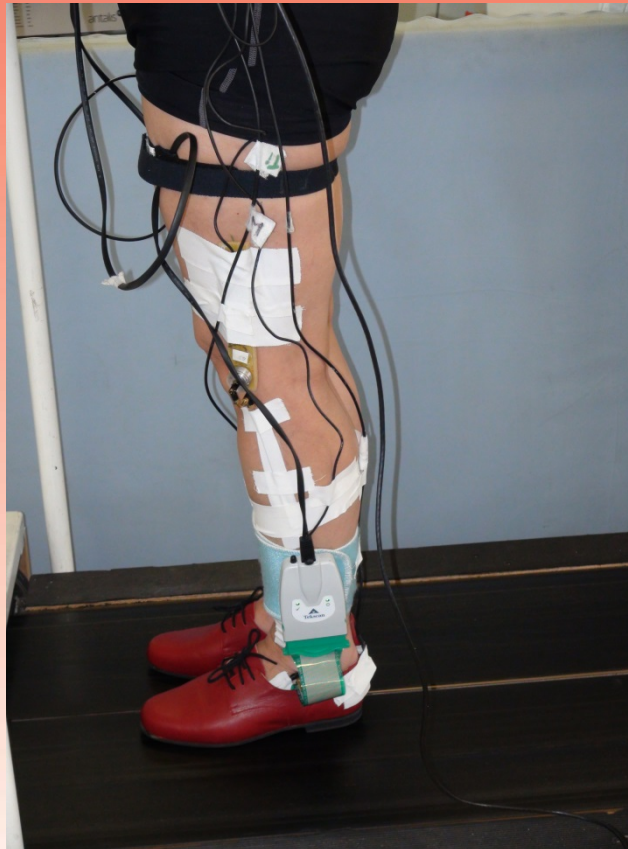
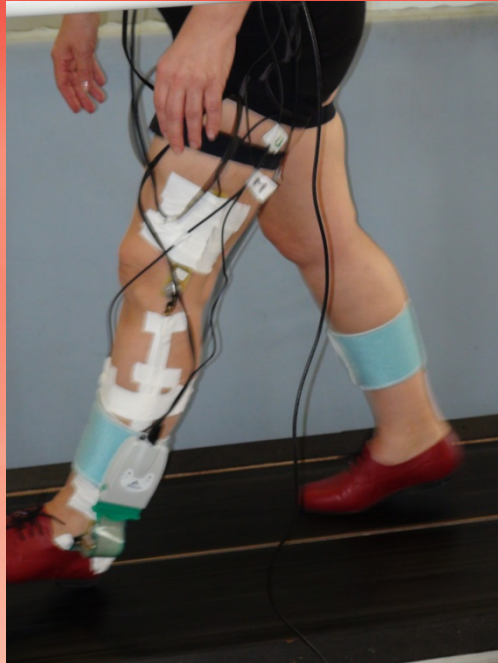


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## Results



## REFERENCE SHOE



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## Results REF / High Heel

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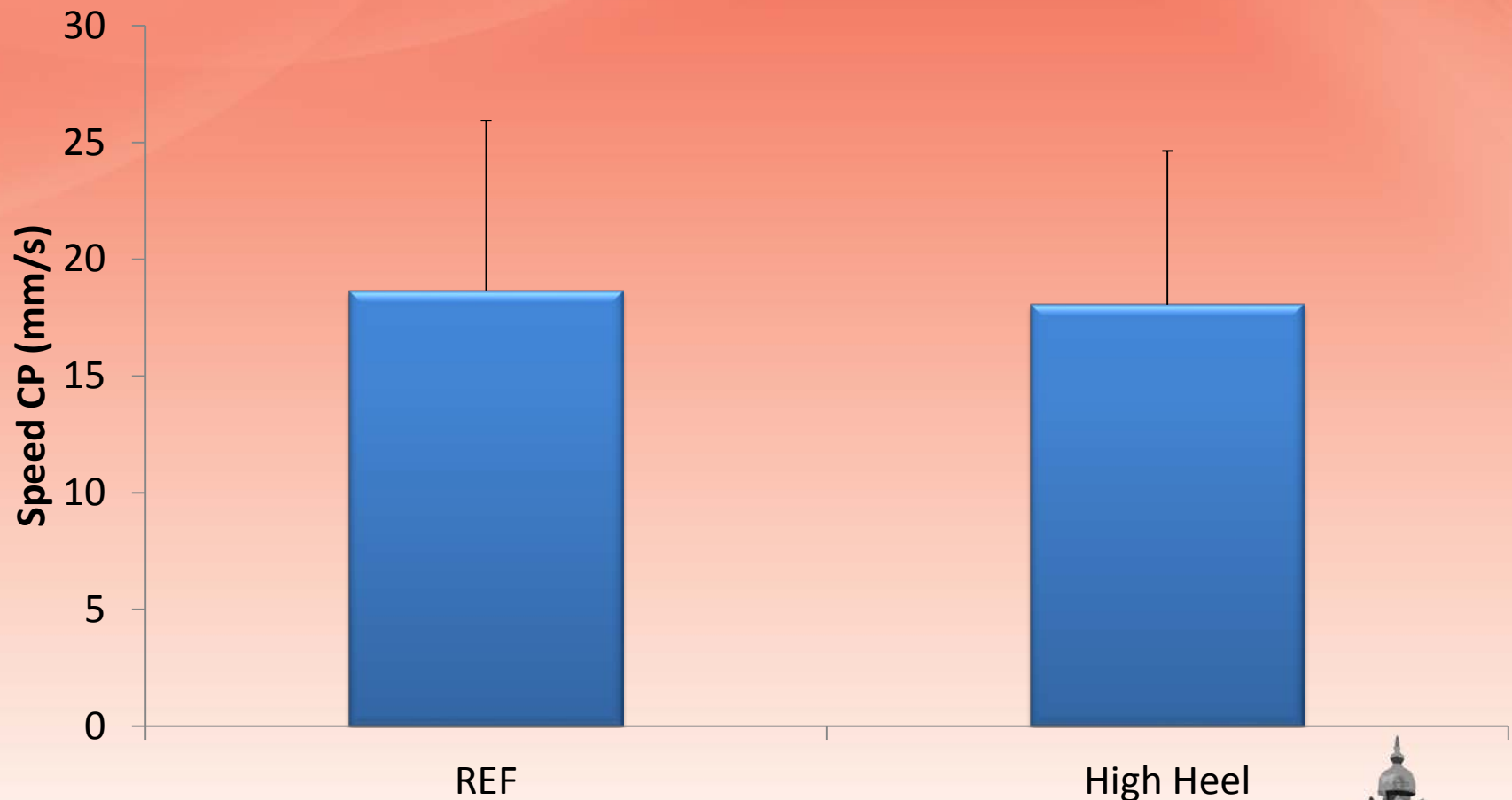


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### Postural Stability





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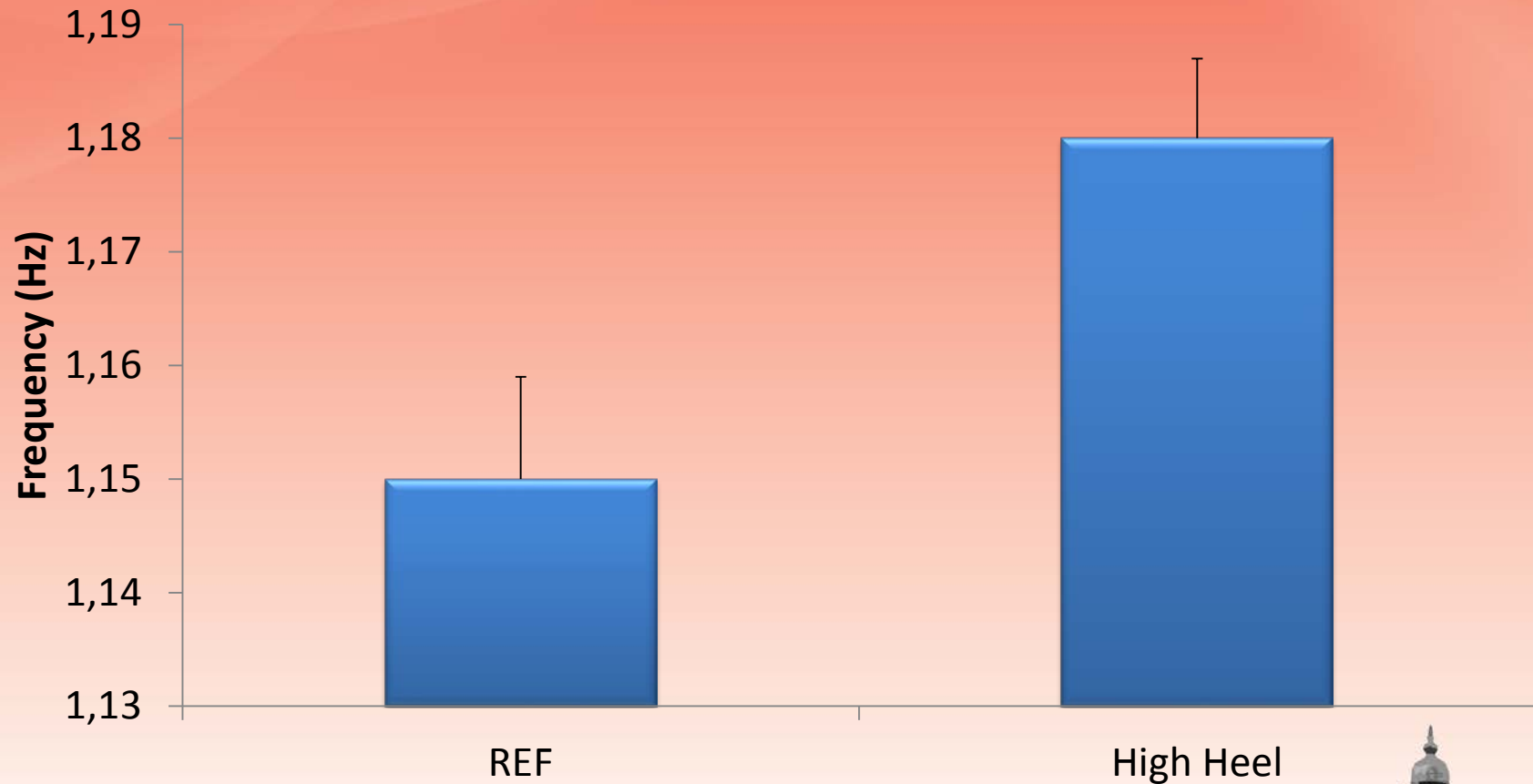
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## Results REF / High Heel

### Stiffness ankle



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### Conclusion



- No significant change when wearing a heel of 3 cm
- Static, increase ankle stiffness



**Fatigue most important only in the long-term**



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## Study on textured insoles

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REF



Close Nubs



Spaced Nubs



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## Study on textured insoles Objective

**To analyze the shoe characteristics that influence the balance and walking of elderly.**

### Hypothesis :

- ❖ Textured insoles increase the foot stimulation
- ❖ Postural control will be improved





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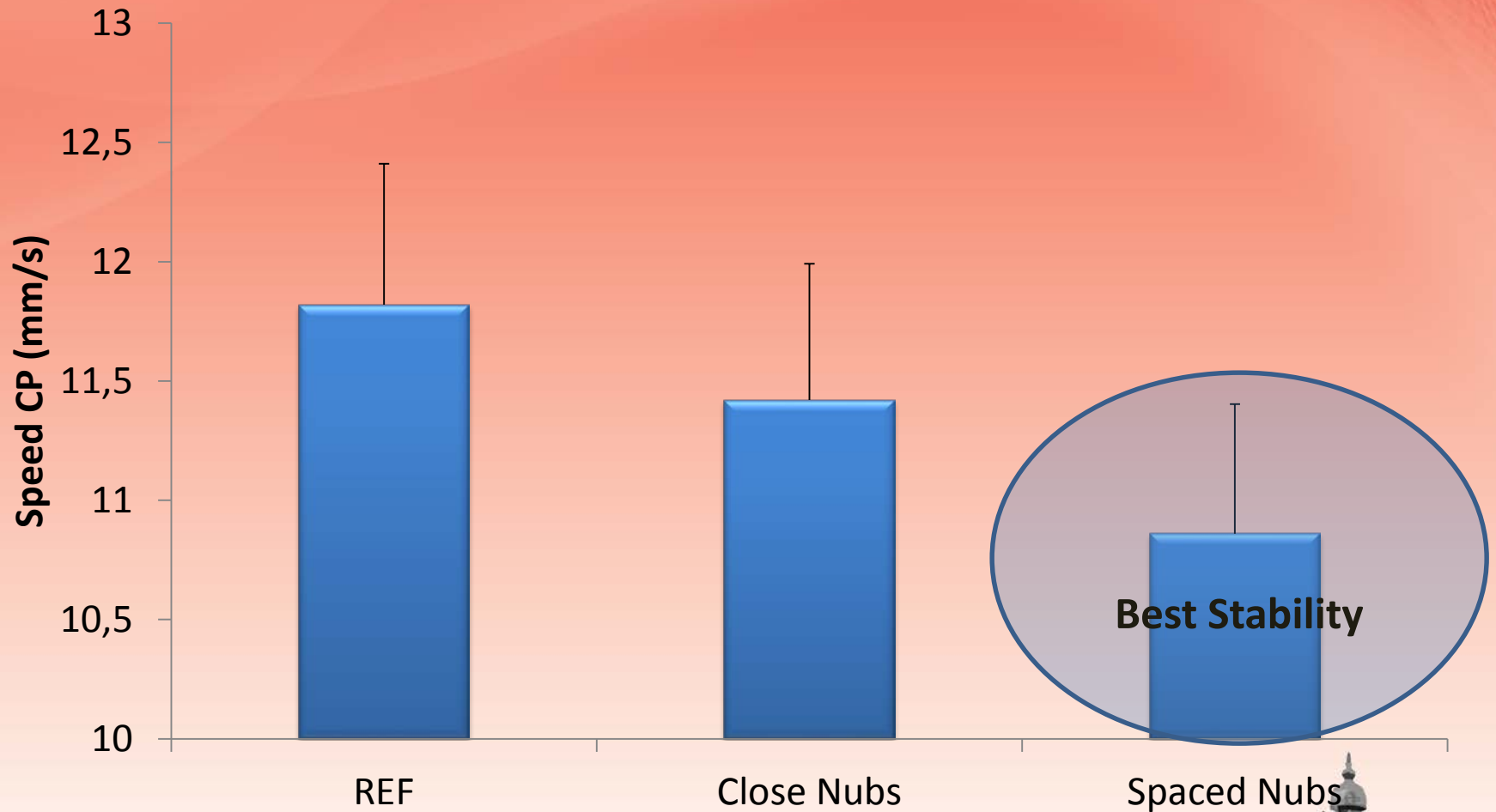
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## Results

### Postural Stability



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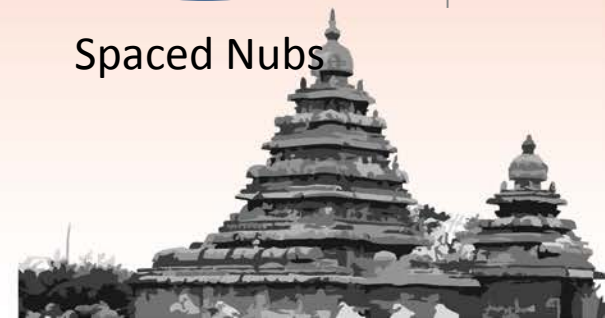


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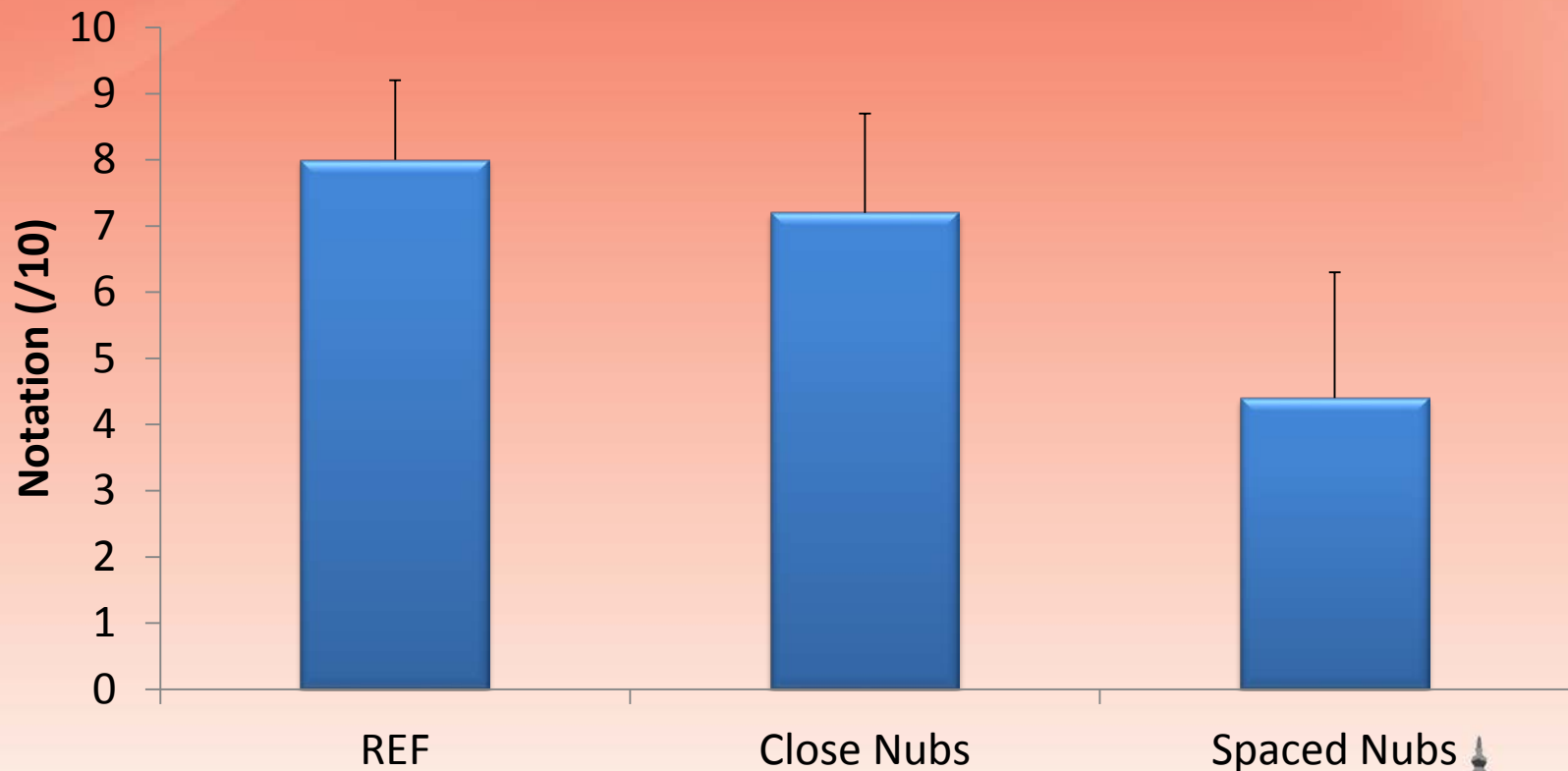
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## Results

No degradation of the walking pattern

### Visual Analogue Scale (Comfort)



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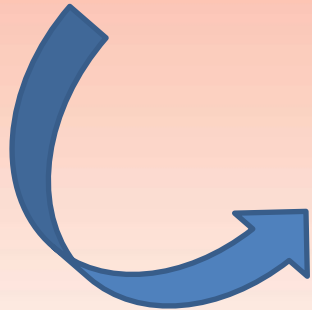
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## Conclusion



- ❖ Improvement of postural stability when increasing the plantar stimulation
- ❖ There would be an optimum spacing



**Textured insoles can be a simple way to reduce the risk of falls for elderly people**



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## Conclusion / Perspective

- ❖ 3 cm heel and textured insoles are parameters for senior footwear that limit the risk of falls.

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