



# **Evaluation Of Pressure Distribution Of Kyboot Shoes In Comparison To Other Foot Wear In Diabetic Patients And In Healthy Subjects**

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# Disclosure

- The Orthopedic Rehabilitation Department, Tel Hashomer Hospital received funding for this study by the Kybun company
- Our department initiated this study and we were solely responsible for the study design, choice of patients, conduct of the study and outcome without the influence of any third party.



# Introduction

- Every 30 seconds a limb is lost due to diabetes
- The amputations are preceded by a foot ulcer in 84% of cases
- Therefore a reduction of mechanical pressure is important
- Ideal footwear for a diabetic patient decreases weight-bearing pressure and shear forces



# Introduction

- In this study we wanted to compare:
  - The pressure distribution
  - changes in the movement of the center of pressure
  - Several gait parameters

of the KyBoot in comparison with normal shoes in healthy and diabetic subjects.

# Methods

- Location: Sheba Medical Center, Orthopedic Rehabilitation Department
- 2 study groups
  - Healthy volunteers (10)
  - Diabetic patients (11)



# Methods

Inclusion criteria for group 1 (healthy subjects):

- Signing of informed consent
- Intact cognitive function
- Healthy



# Methods

Inclusion criteria for group 2 (diabetic subjects):

- Signing of informed consent
- Diabetes mellitus Type 2
- Existence of sensory neuropathy
- Intact cognitive function



# Methods

## Exclusion criteria for group 2 (diabetic subjects):

- An orthopedic or rheumatic disease that negatively influences range of motion, strength, gait or balance
- Neurological diseases that influence proprioception , strength, balance, cognitive function / understanding, vision
- Injury or disease that can influence normal gait
- Need for assistive devices : crutches, cane, walker
- Dialysis Treatment
- Foot Ulcer
- Major foot deformations necessitating fitting of specially fitted foot wear



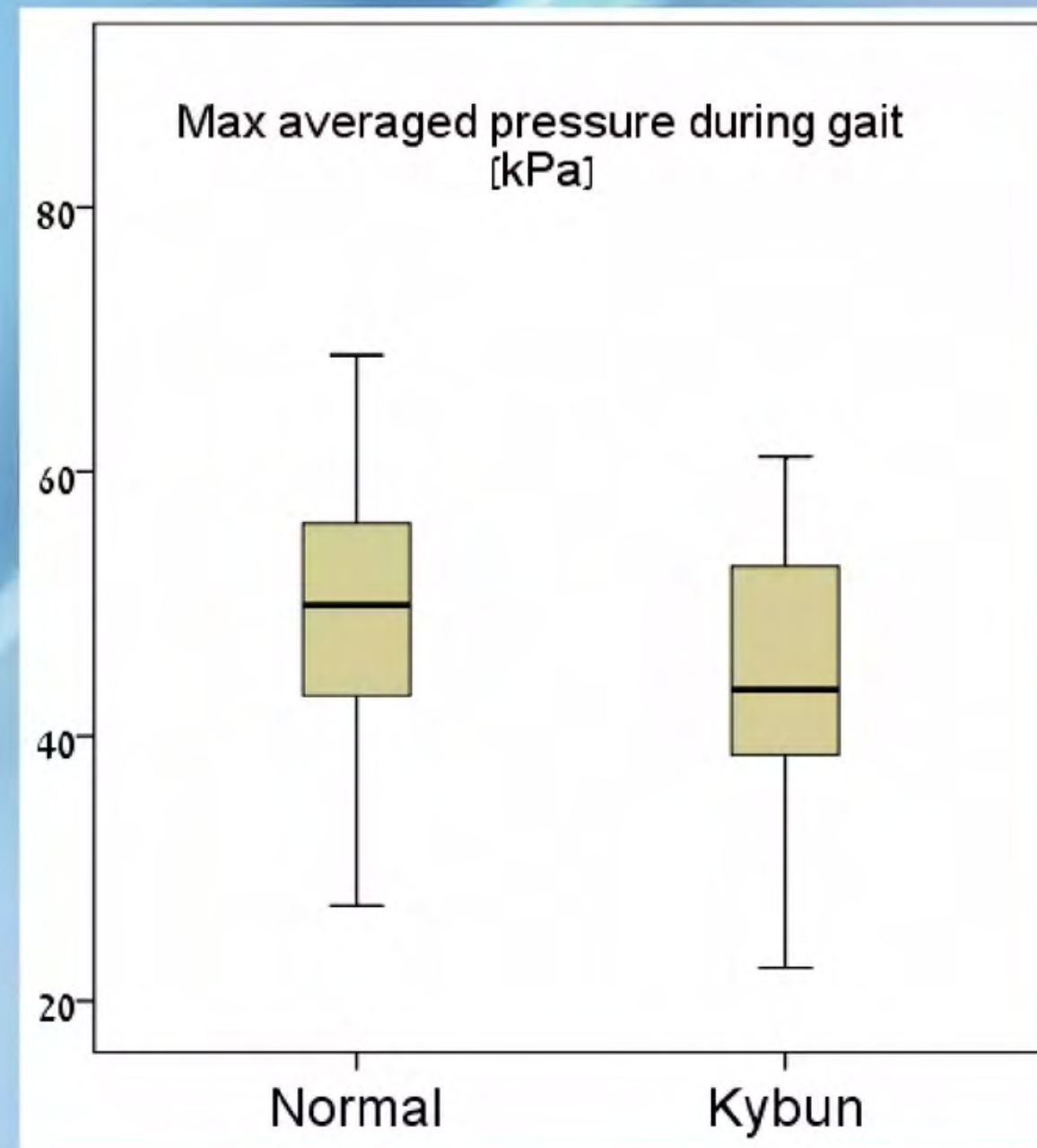
# Methods

- In-sole Pressure Sensors (Tactilus Human Interface Stretch System) recorded the pressure distribution and changes in center of pressure inside the shoes.
- With the help of the GaitRite System we determined walking speed, length of stride and step and several other gait parameters
- We took measurements in stance and walk
- The test subjects were asked to complete a questionnaire on comfort of wear, feeling of pressure and pain





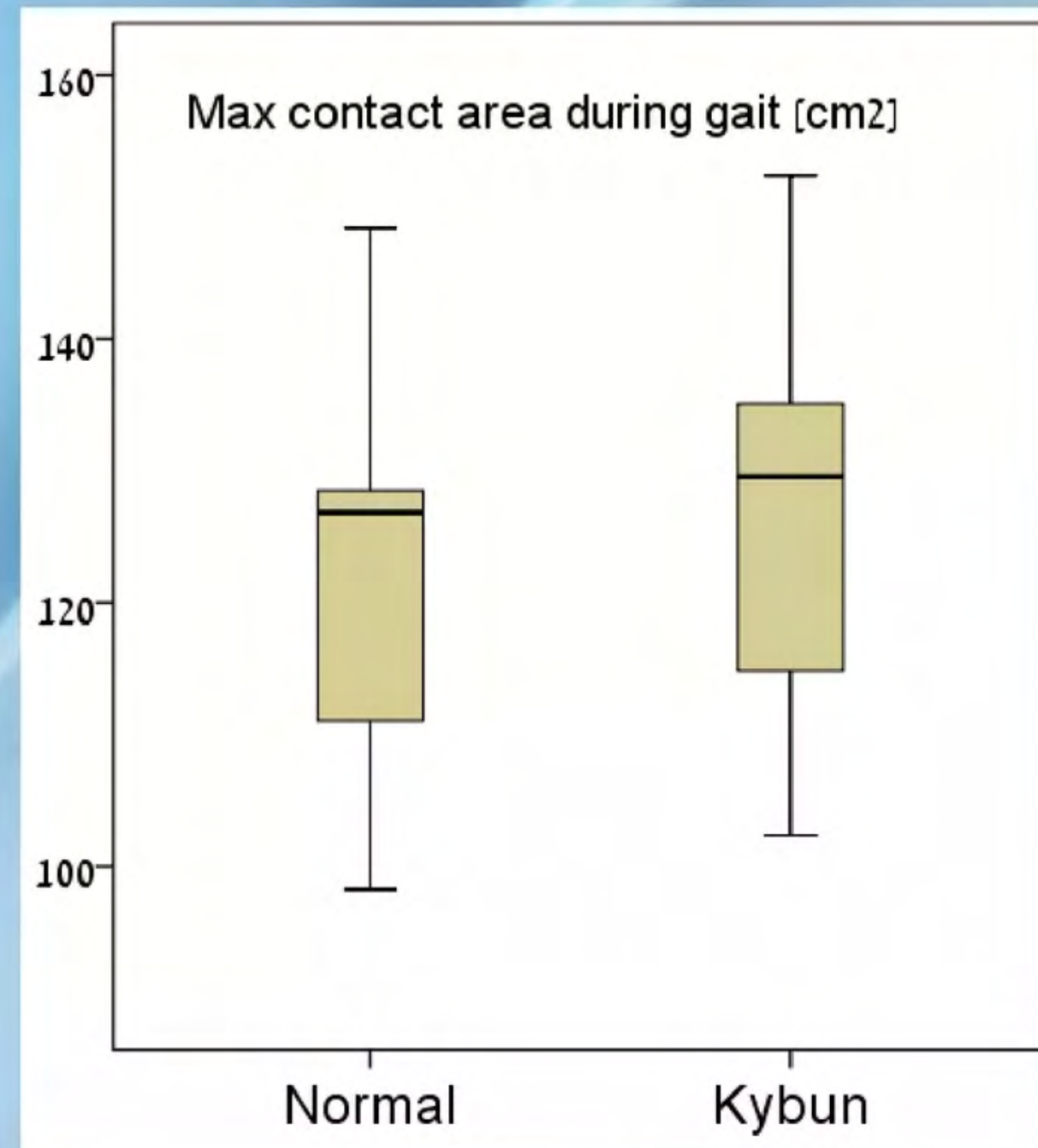
# Results



The maximal average pressure was significantly reduced by an averaged 12.8% in gait with Kyboot shoes



# Results

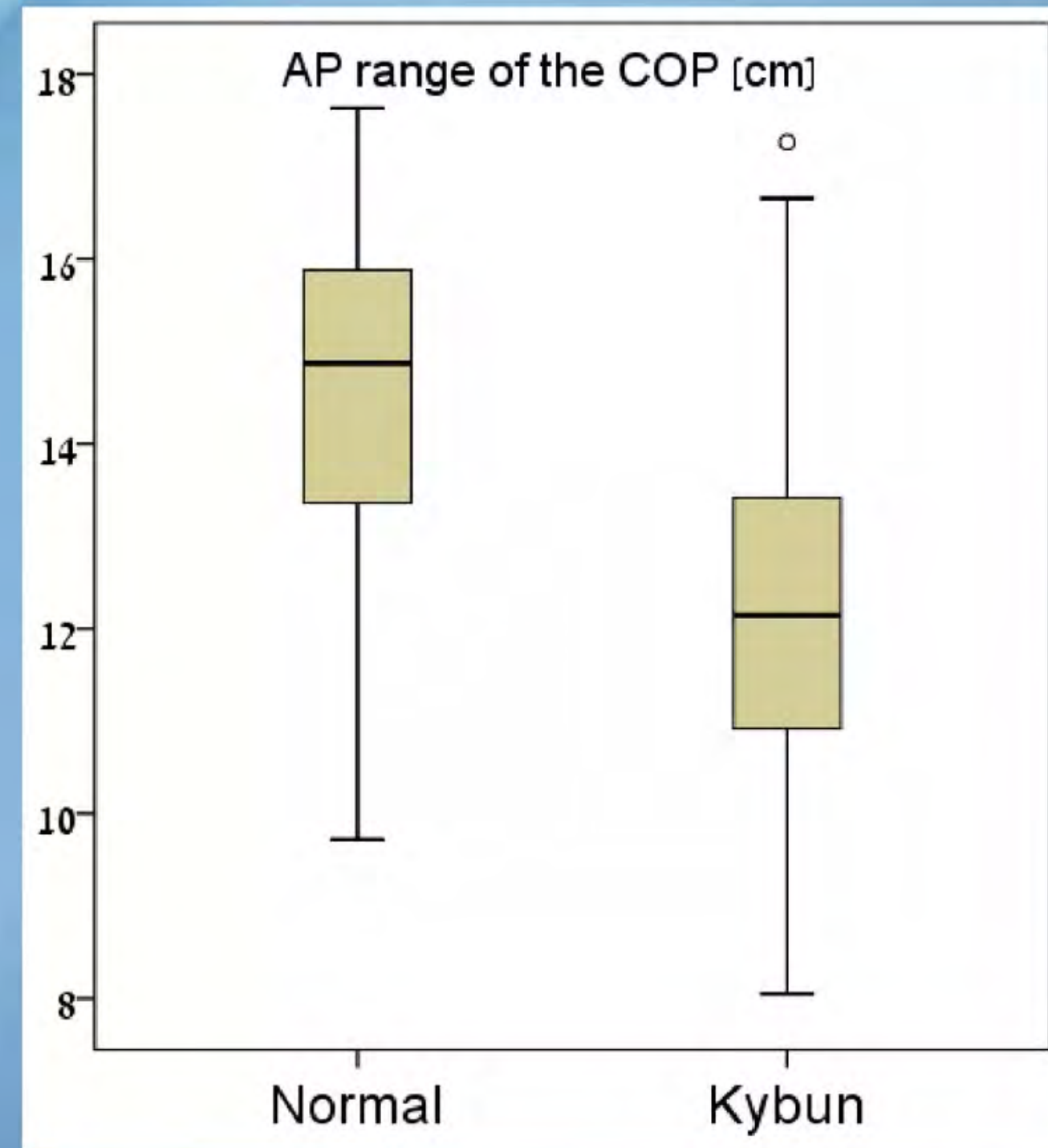
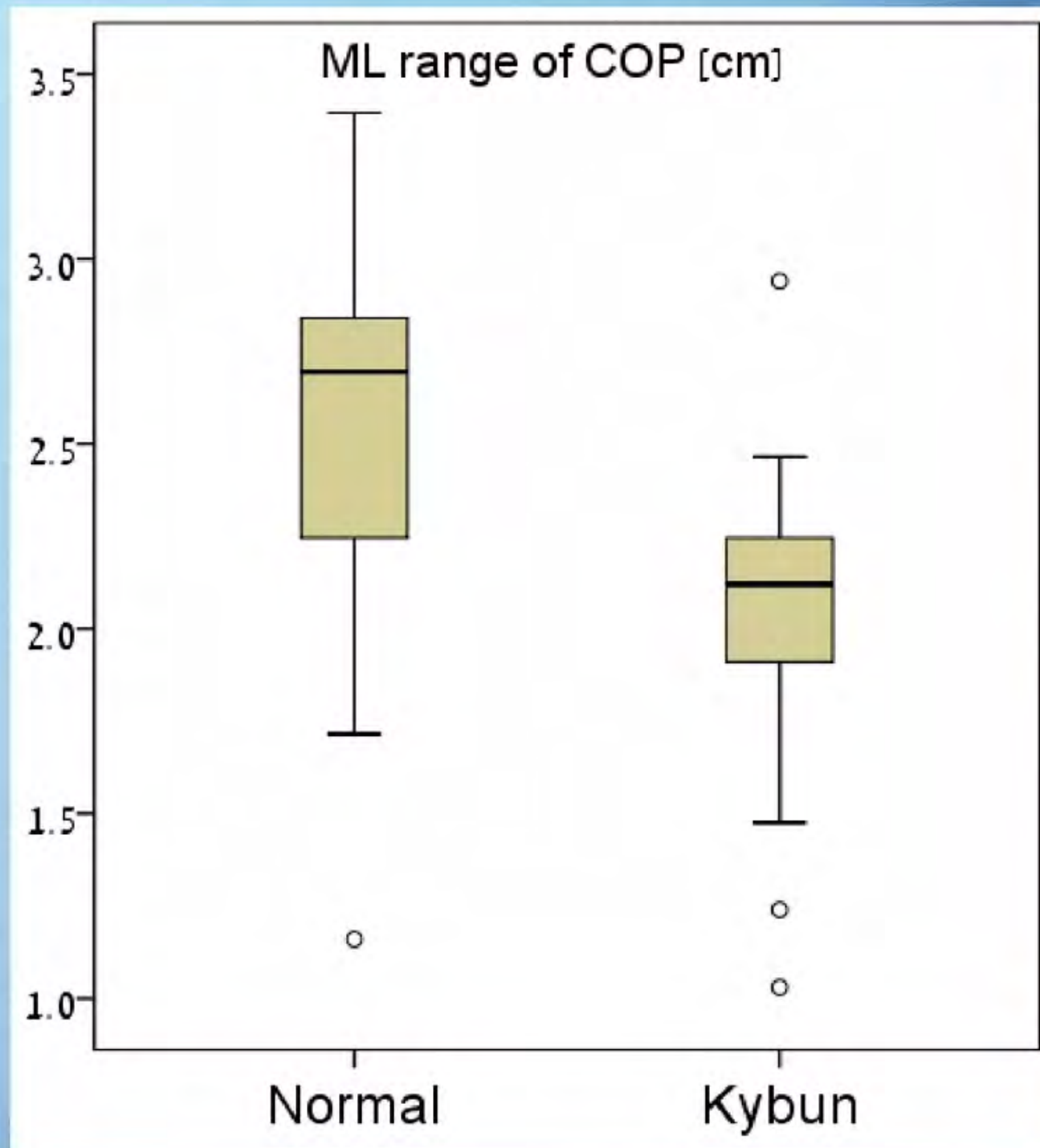


The maximal contact area is significantly increased with KyBoot shoes



# Results

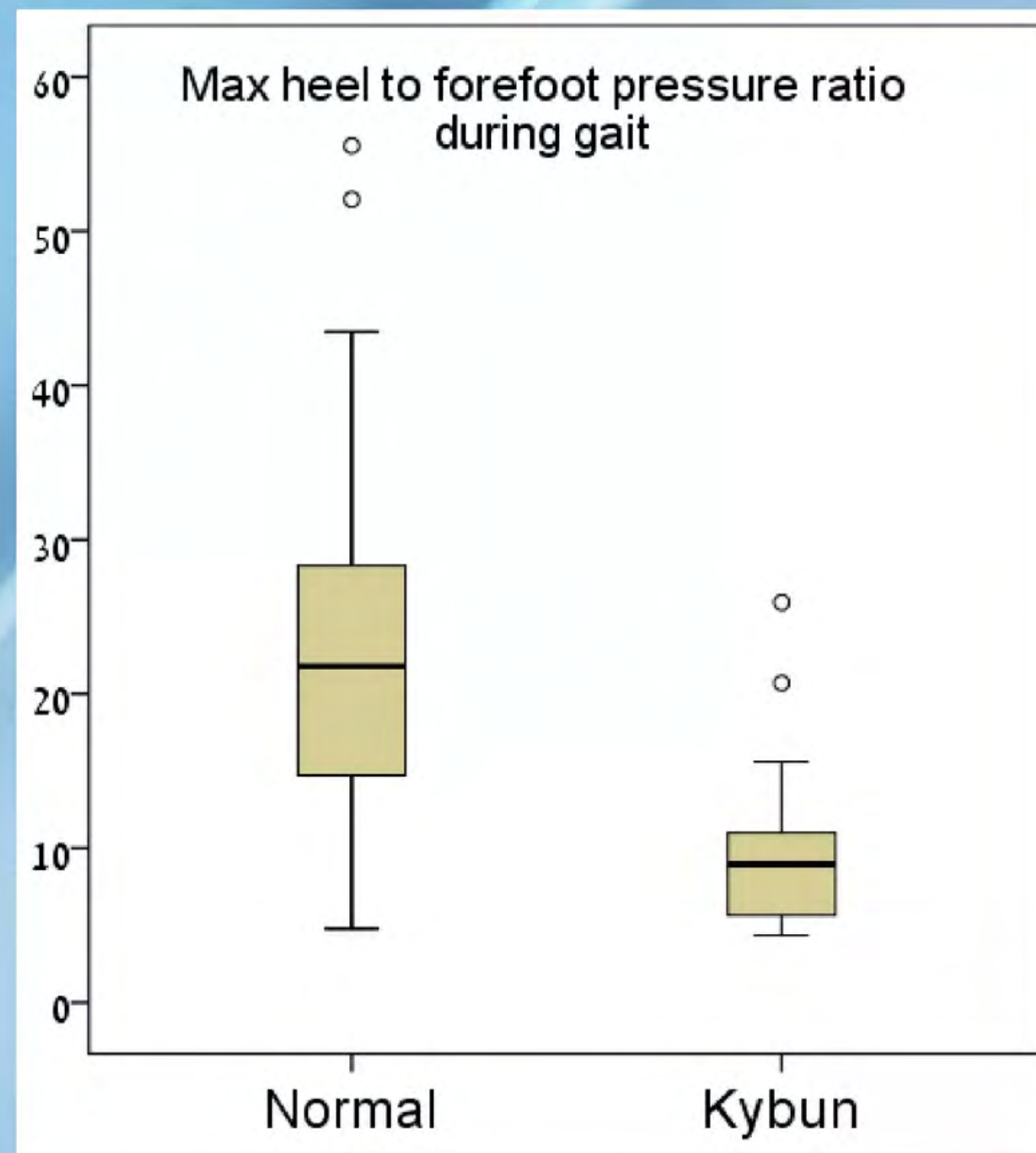
- Movement of the Center of Pressure



The center of pressure moved significantly less in the medio-lateral axis (22% less) and in the antero-posterior axis (19%) with Kyboot shoes



# Results

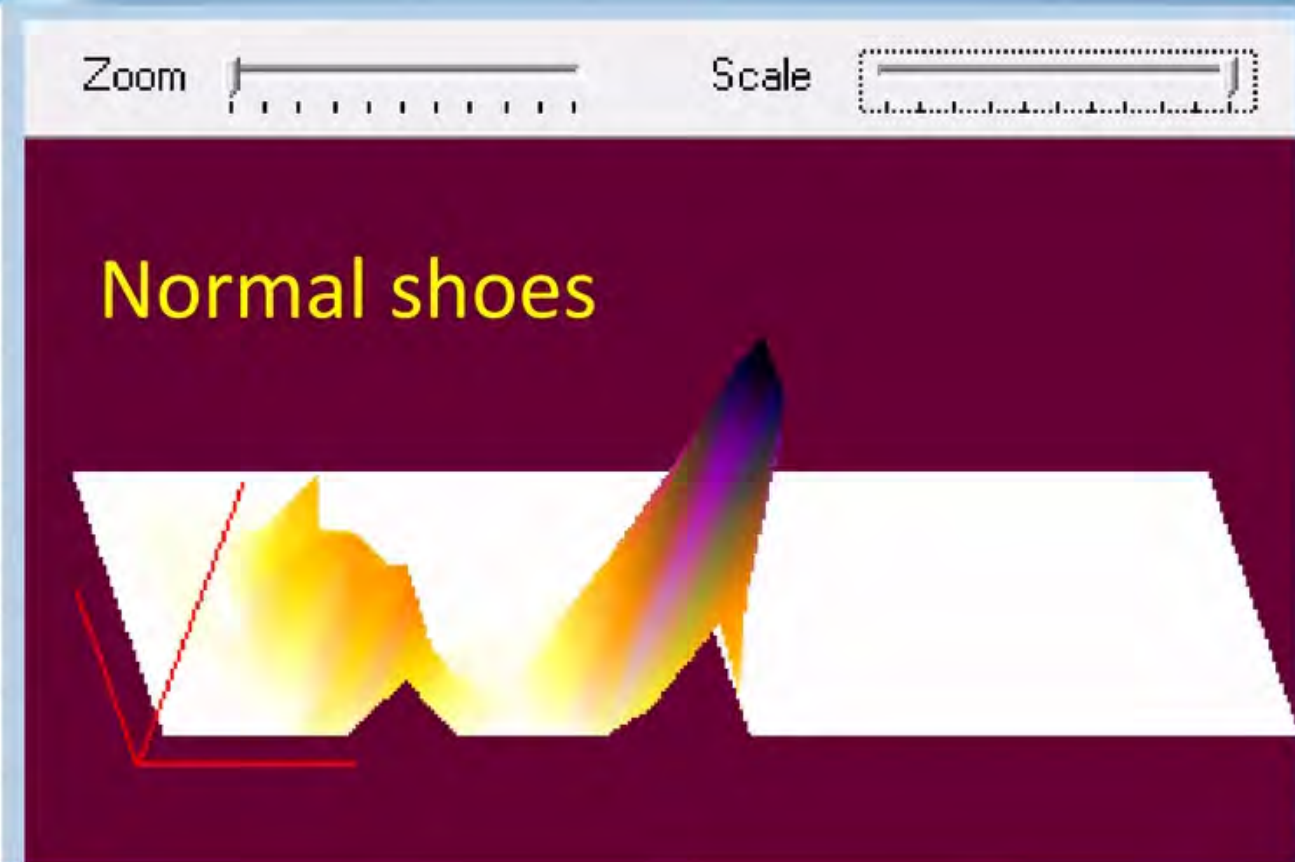


The maximal heel to forefoot pressure ratio decreased significantly by 58%  
Maximal heel pressure decreased by 26 kpa and max. forefoot pressure by 35 kpa

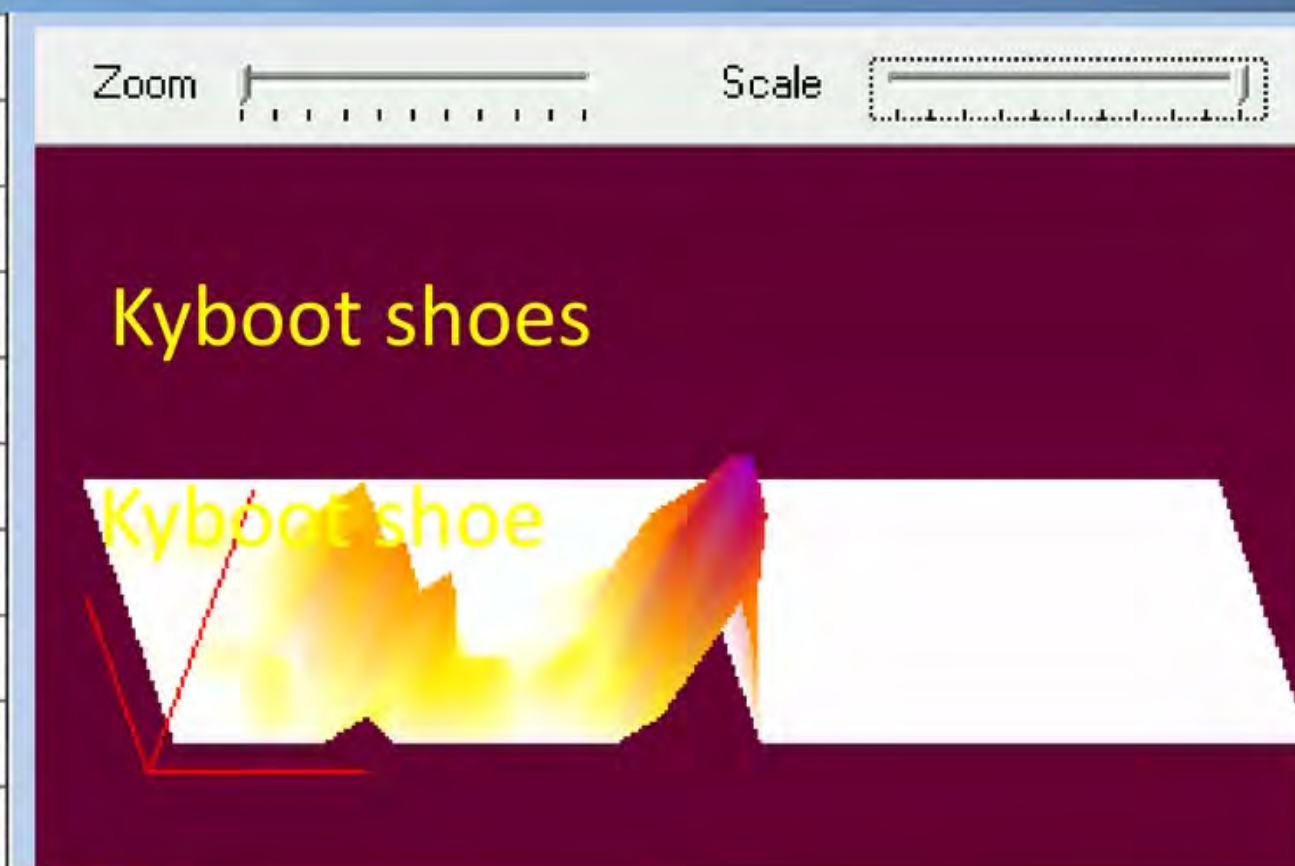


The same diabetic patient, during stance, same foot, each after 10 s of standing:

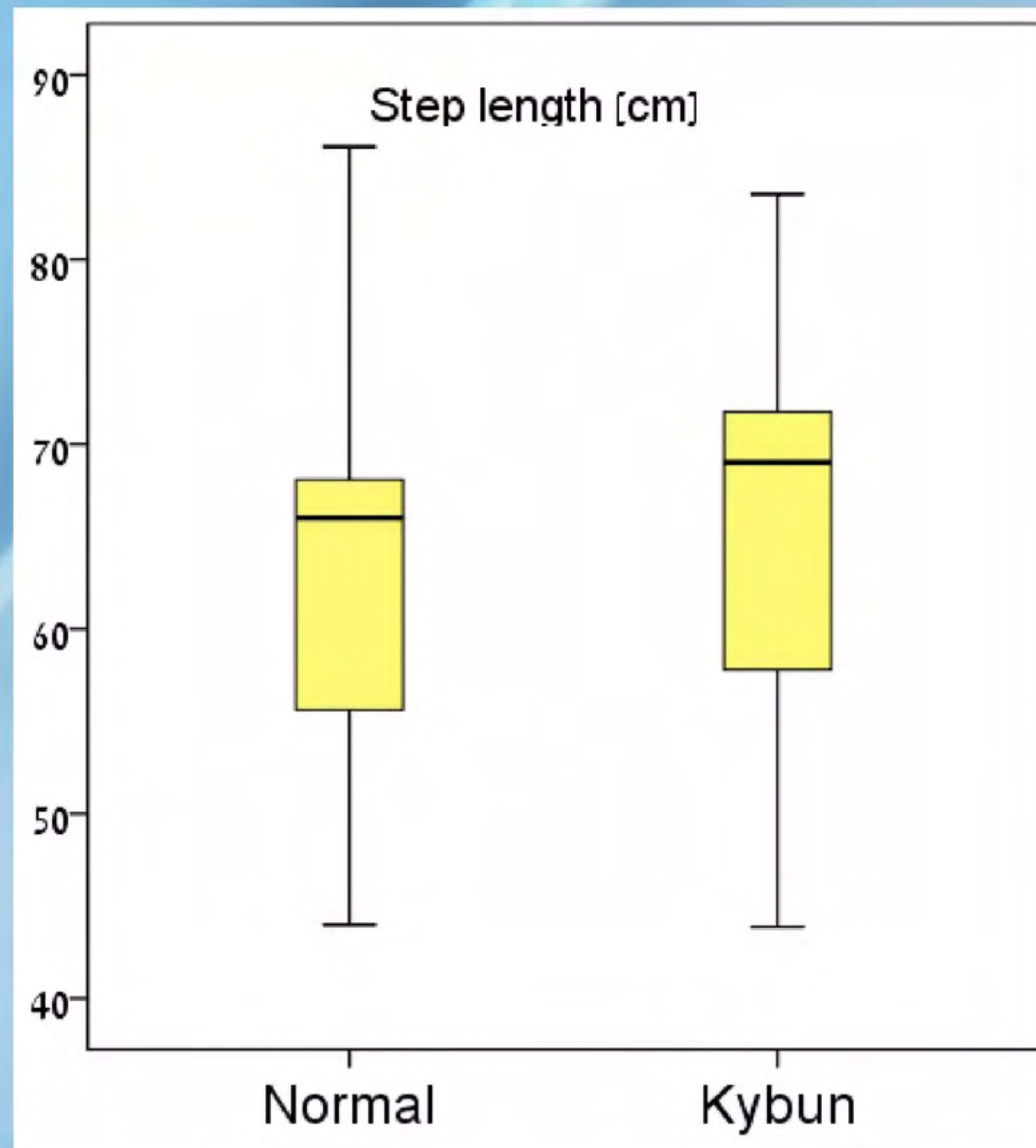
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207		0	0	0	1	6	44	84	46	19	11	3	19	70	147	195	76	0
188		0	0	0	7	18	66	74	39	11	5	2	22	75	200	207	156	0
169		0	0	4	9	36	72	61	13	2	4	2	5	55	135	207	97	0
150		0	0	8	1	45	62	48	7	0	1	0	0	8	26	11	12	0
132		0	0	7	1	30	47	43	10	1	0	0	0	0	0	1	0	0
113		0	2	4	3	18	56	16	2	0	0	0	0	0	0	0	0	0
94		0	0	5	4	4	8	6	0	0	0	0	0	0	0	0	0	0
75		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



Kpa	Color	0	0	0	0	10	24	3	7	8	3	0	1	8	28	90	69	0
207		0	0	2	15	8	12	21	32	30	16	6	10	24	68	126	80	0
188		0	0	1	20	7	15	61	75	31	28	12	28	18	115	148	114	0
169		5	1	12	12	3	56	79	52	21	4	6	9	20	82	131	113	0
150		1	0	3	1	13	67	62	20	2	1	0	1	7	76	99	104	0
132		0	0	1	1	10	44	56	26	0	0	0	0	8	20	39	10	0
113		6	1	1	4	6	35	57	15	0	0	0	0	0	0	0	0	0
94		0	7	8	16	1	11	15	0	0	0	0	0	0	0	0	0	0
75		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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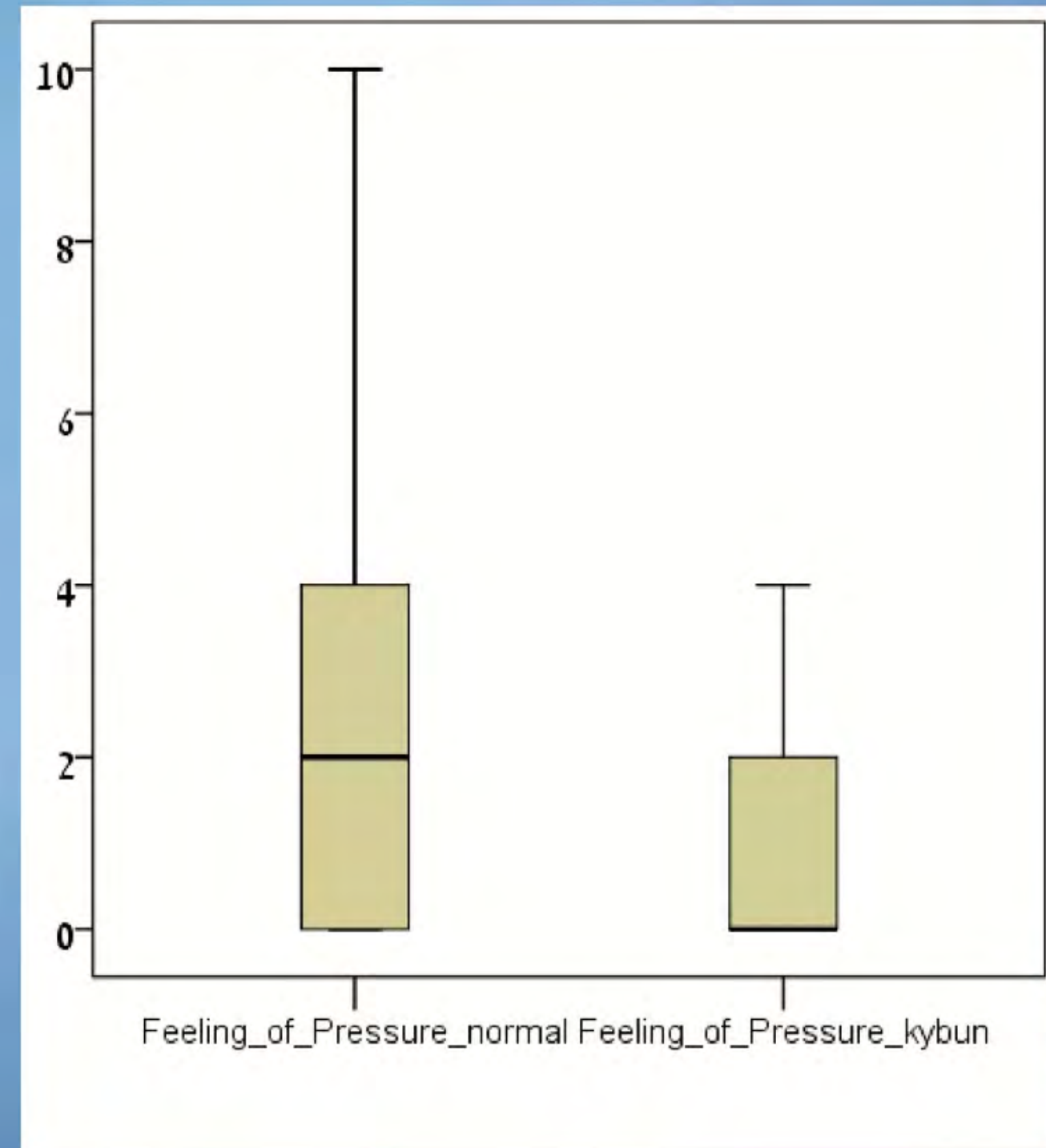
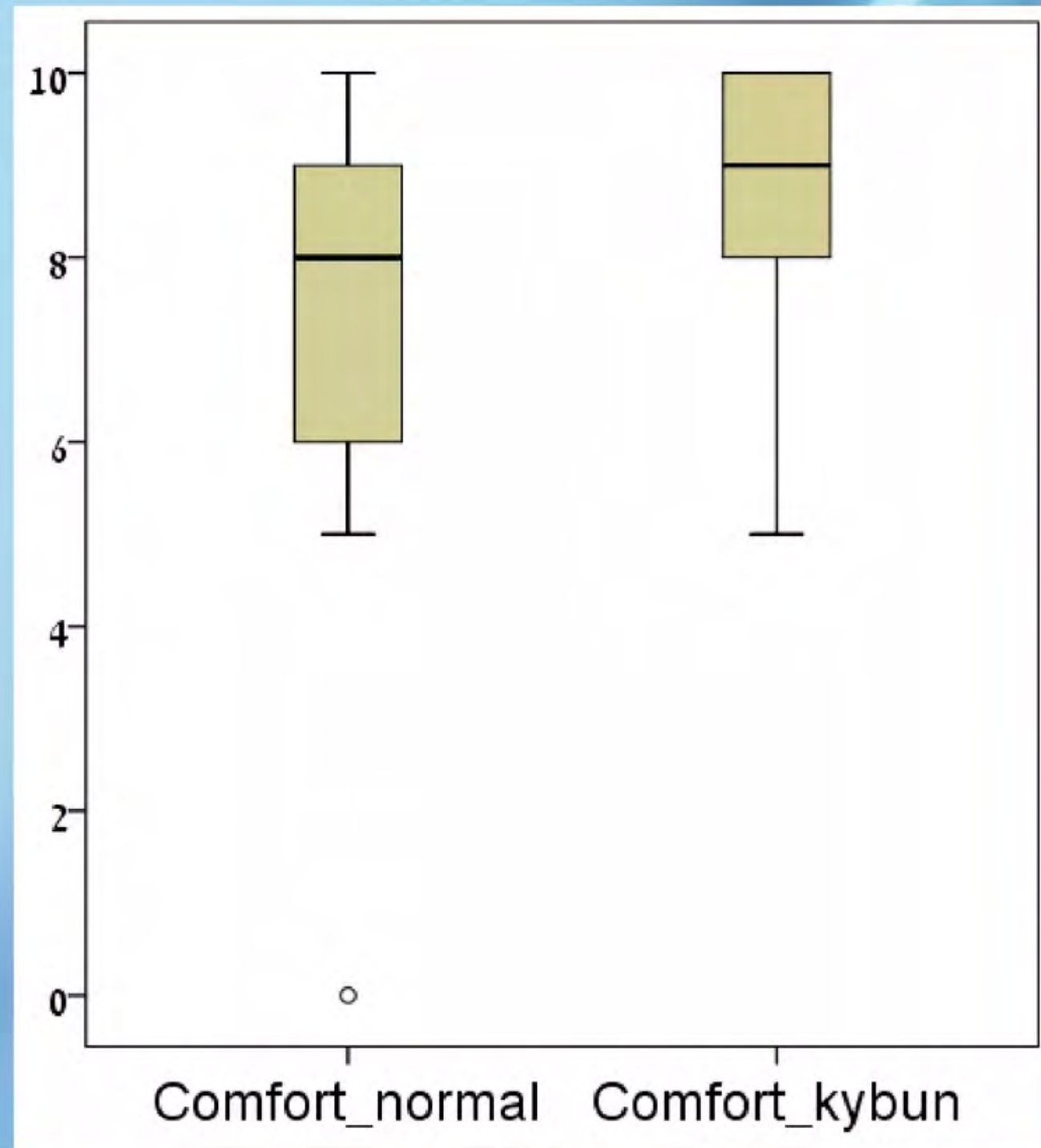




The step length increased significantly (3 cm) with Kyboot shoes



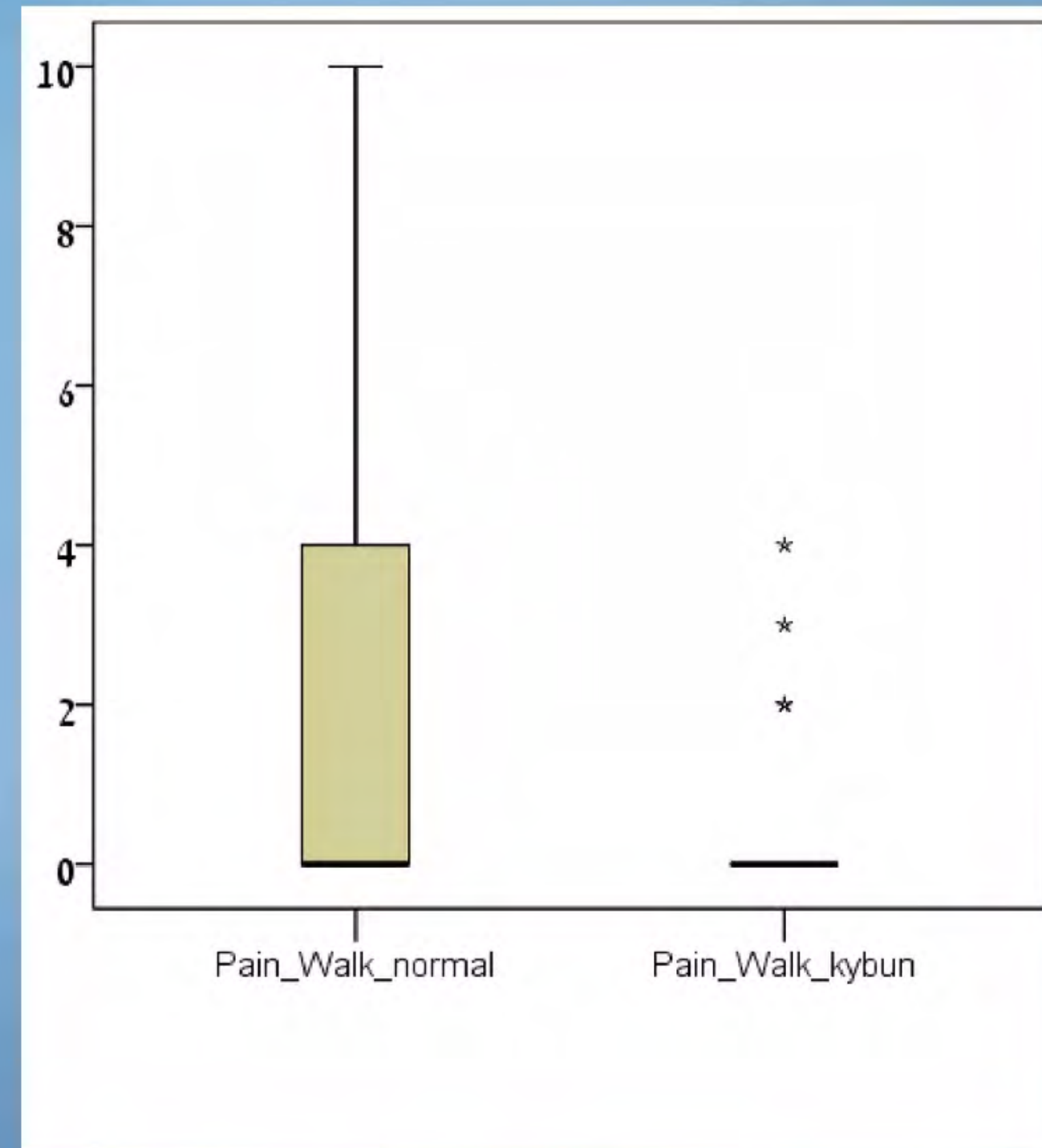
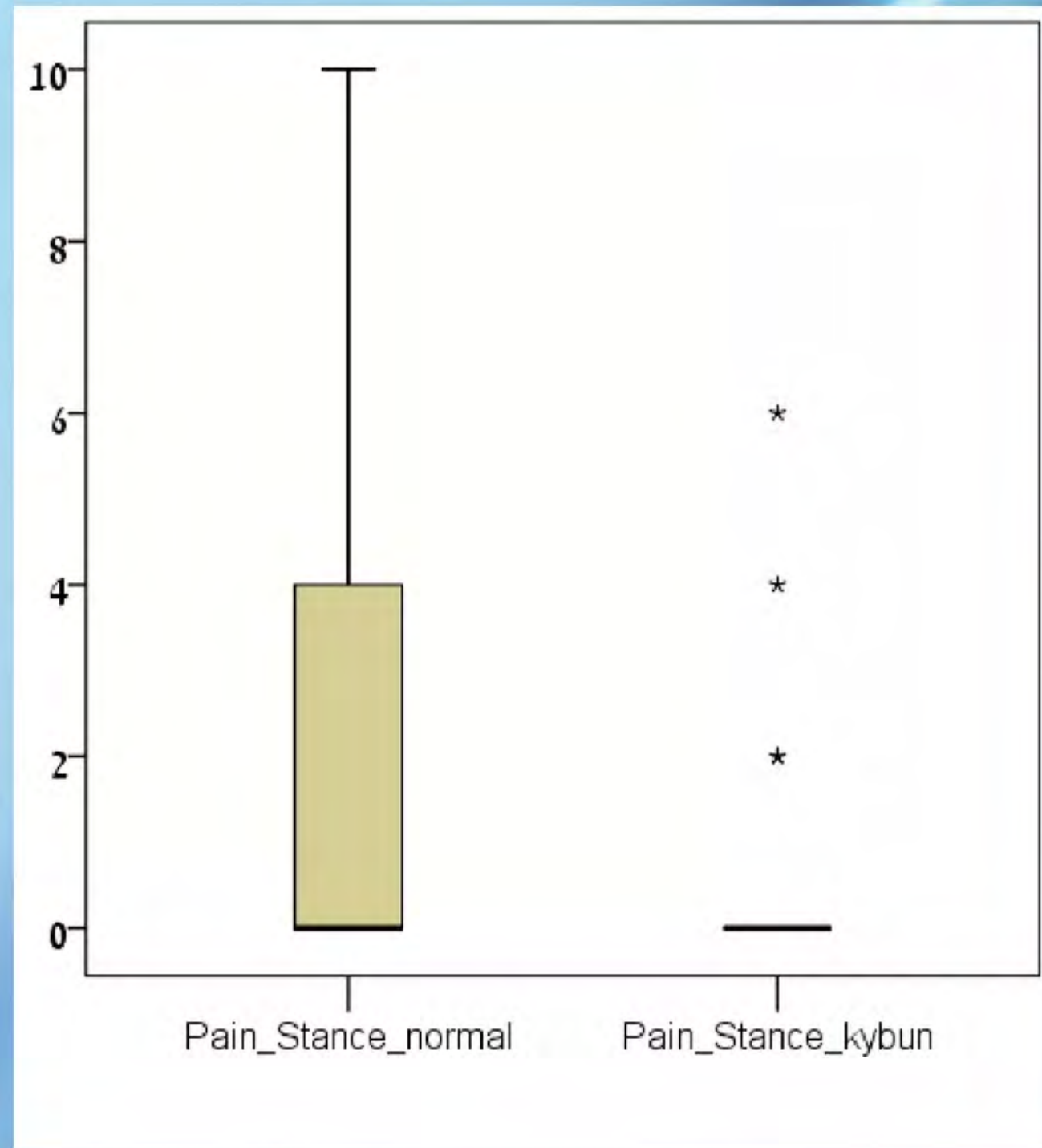
## Subjective Questionnaire Results:





# Results

Subjective Questionnaire Results:



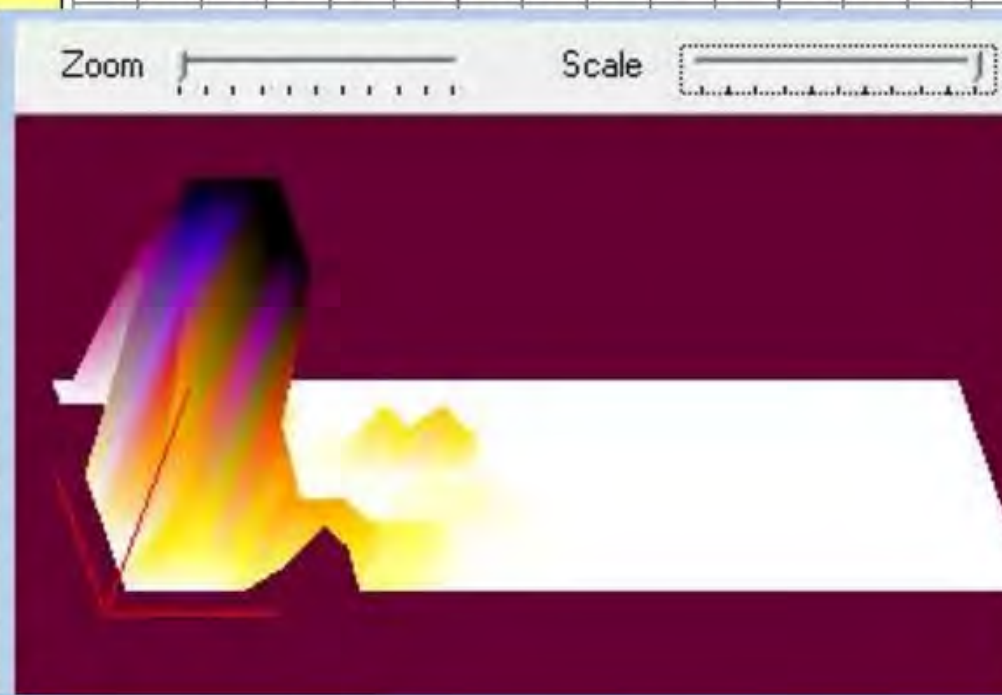
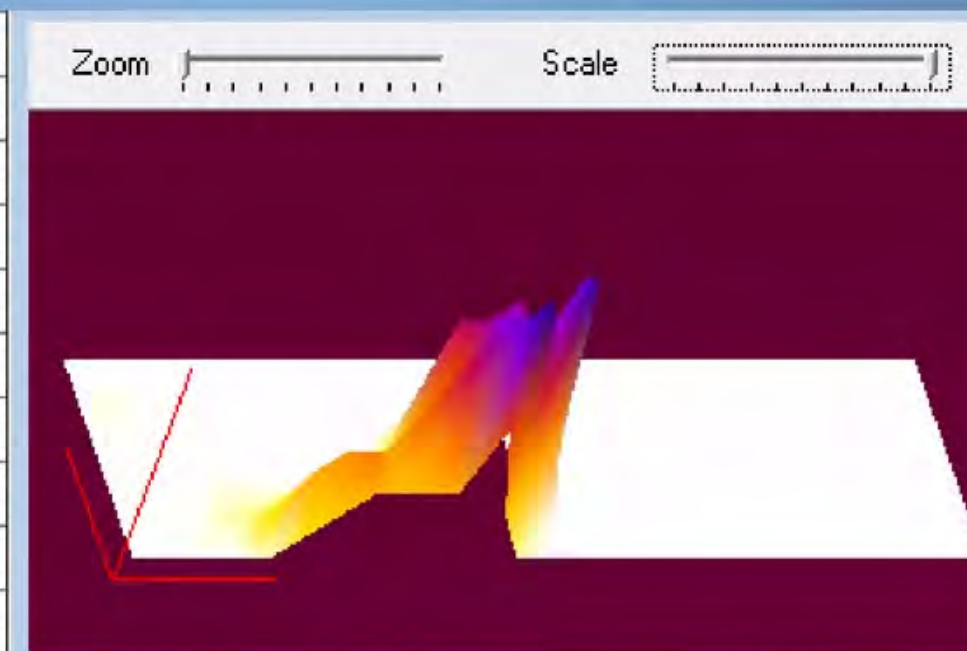
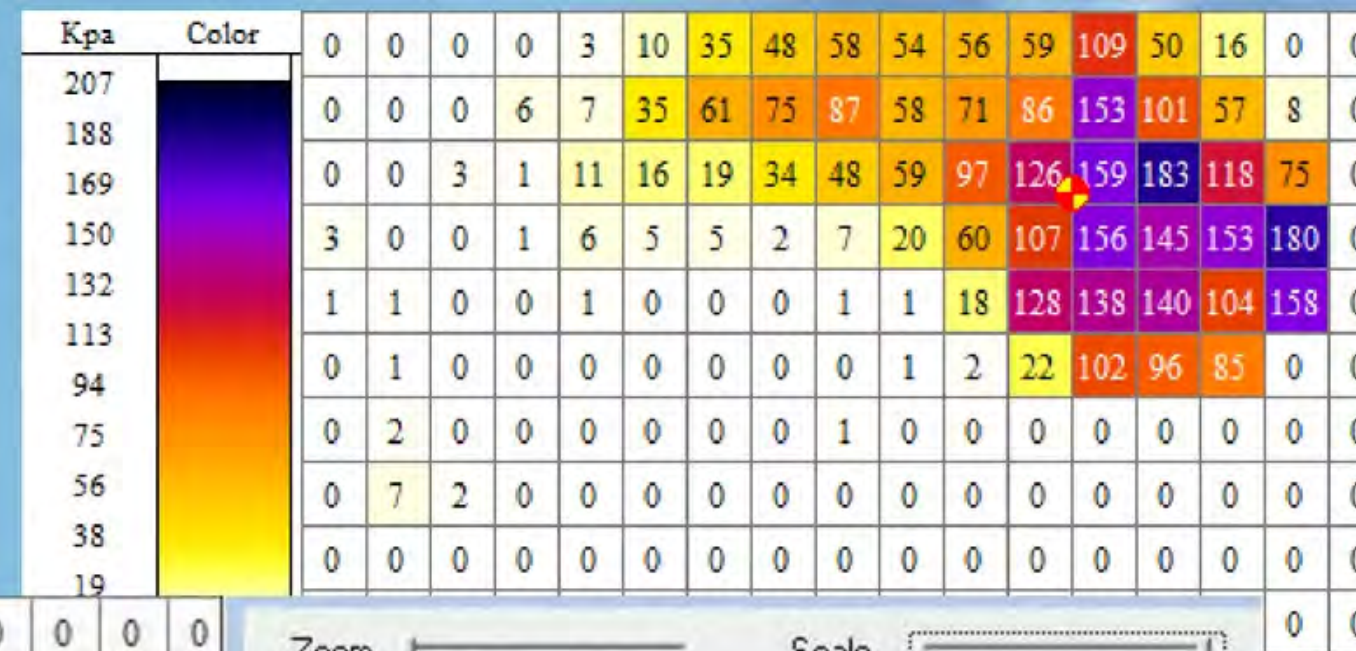


# Discussion

- KyBoot shoes reduce average pressure and distribute the pressure more effectively than other shoes in gait → reduced risk of ulceration
- The step length is significantly increased with KyBoot shoes (propulsion without increased pressure)
- KyBoot shoes could be beneficial for diabetic patients and in some cases could offer an alternative to shoes provided by the Ministry of Health (Louis Institute)
- We do not suggest Kyboot shoes for diabetic patients with significant deformities
- KyBoot shoes reduce pain and improve comfort during stance and gait



# Normal shoes



# Kyboot shoes

