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

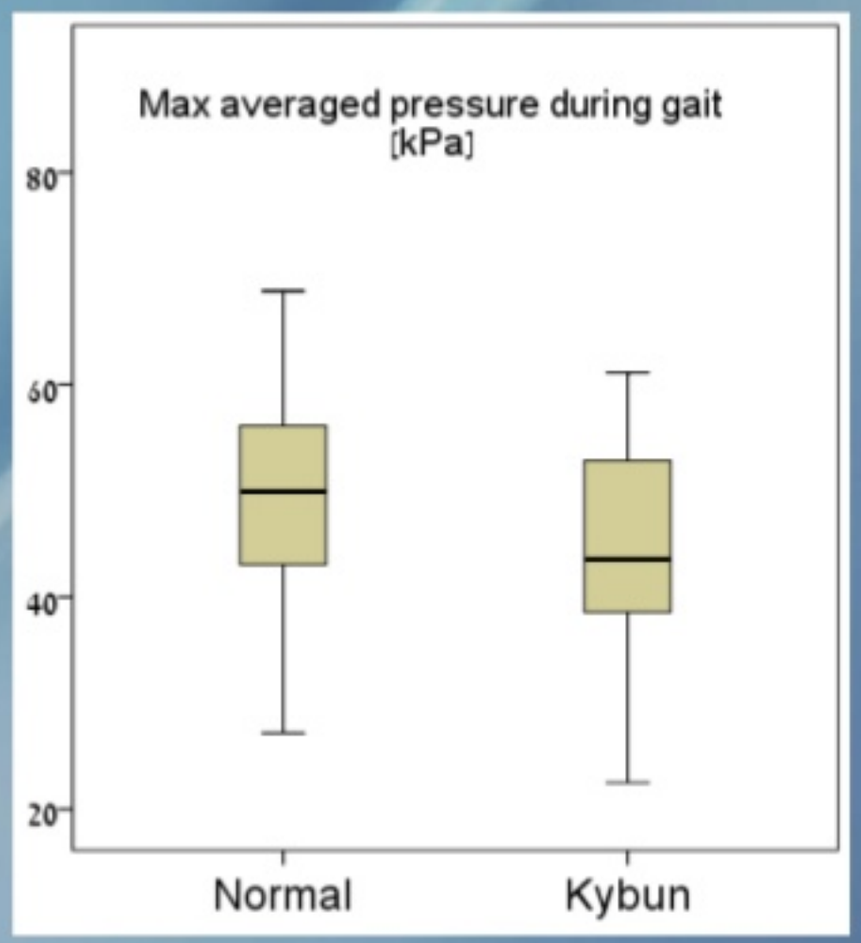
Exclusion criteria for group 2 (diabetic subjects):

- 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

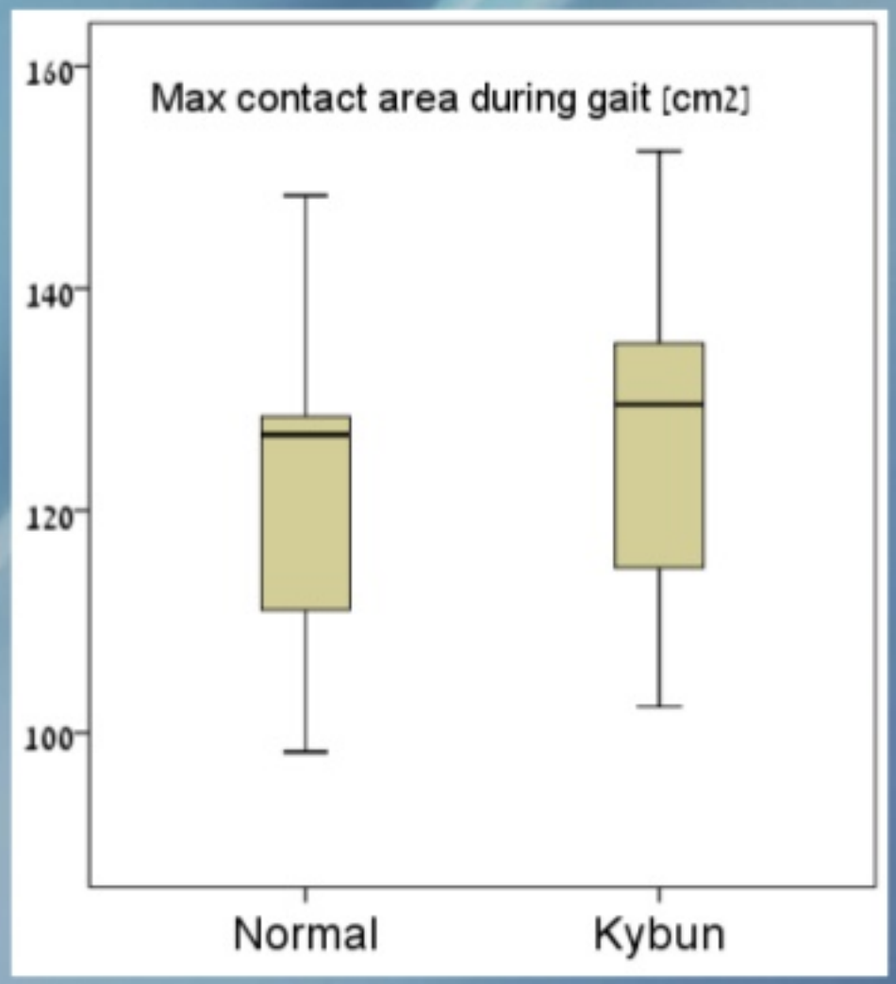
- In-sole Pressure Sensors (Tactilus Human Interface Stretch System) recorded the pressure distribution and changes in center of pressure inside the shoes.
- With the help of the GaitRite System we determined walking speed, length of stride and step and several other gait parameters
- We took measurements 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

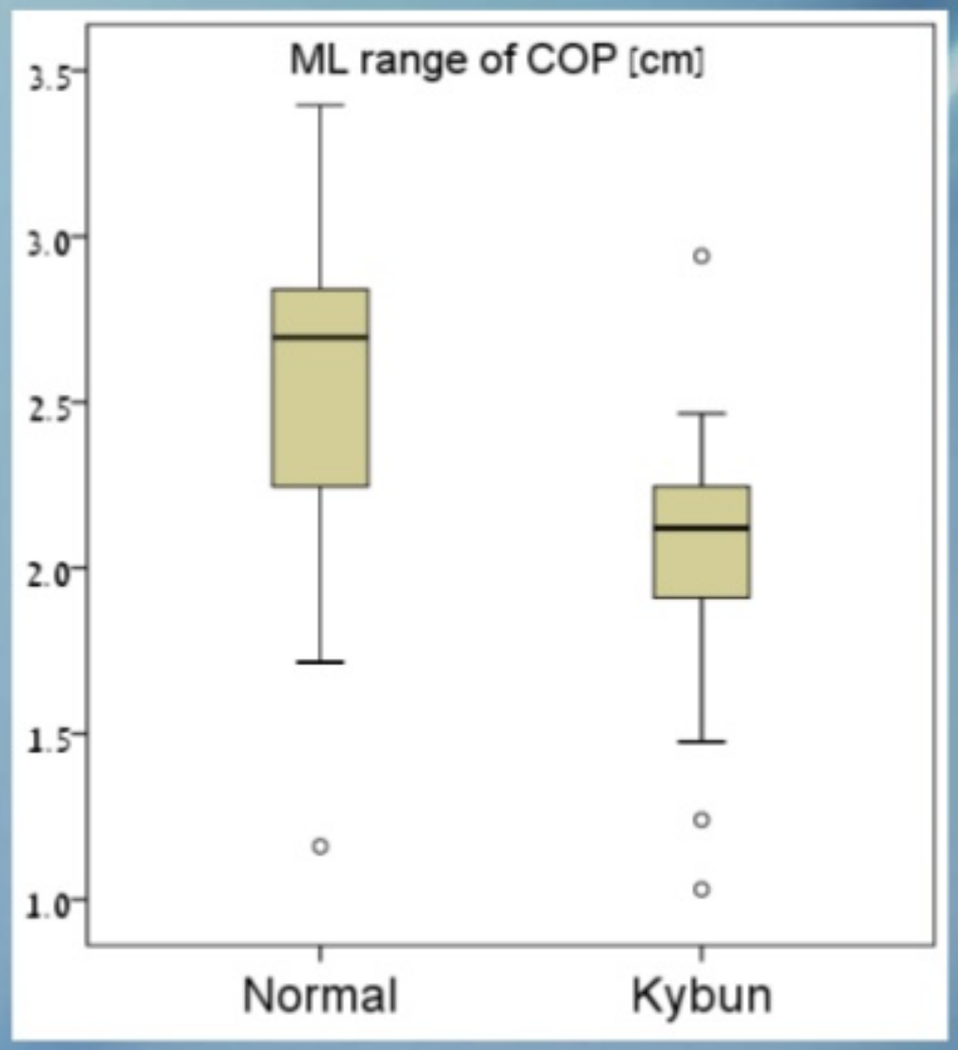
Results

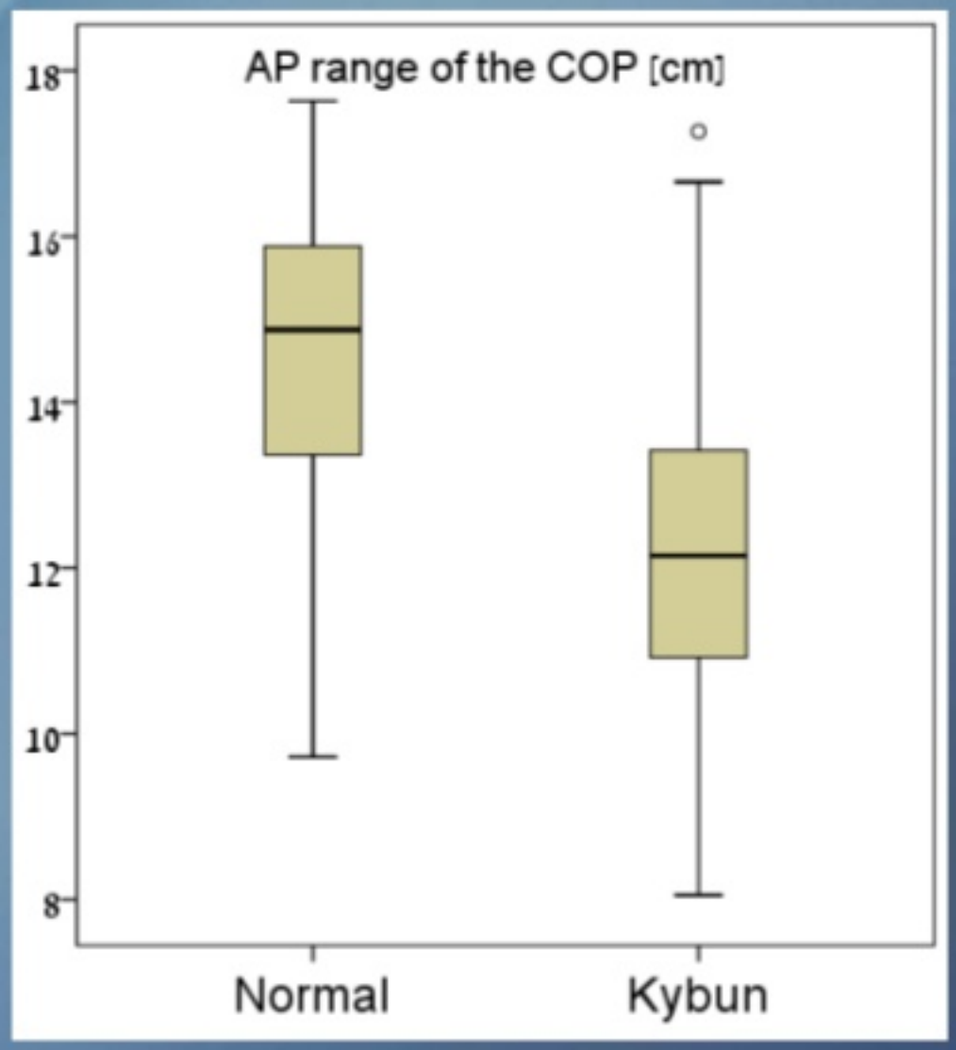


The maximal contact area is significantly increased with KyBoot shoes

Results

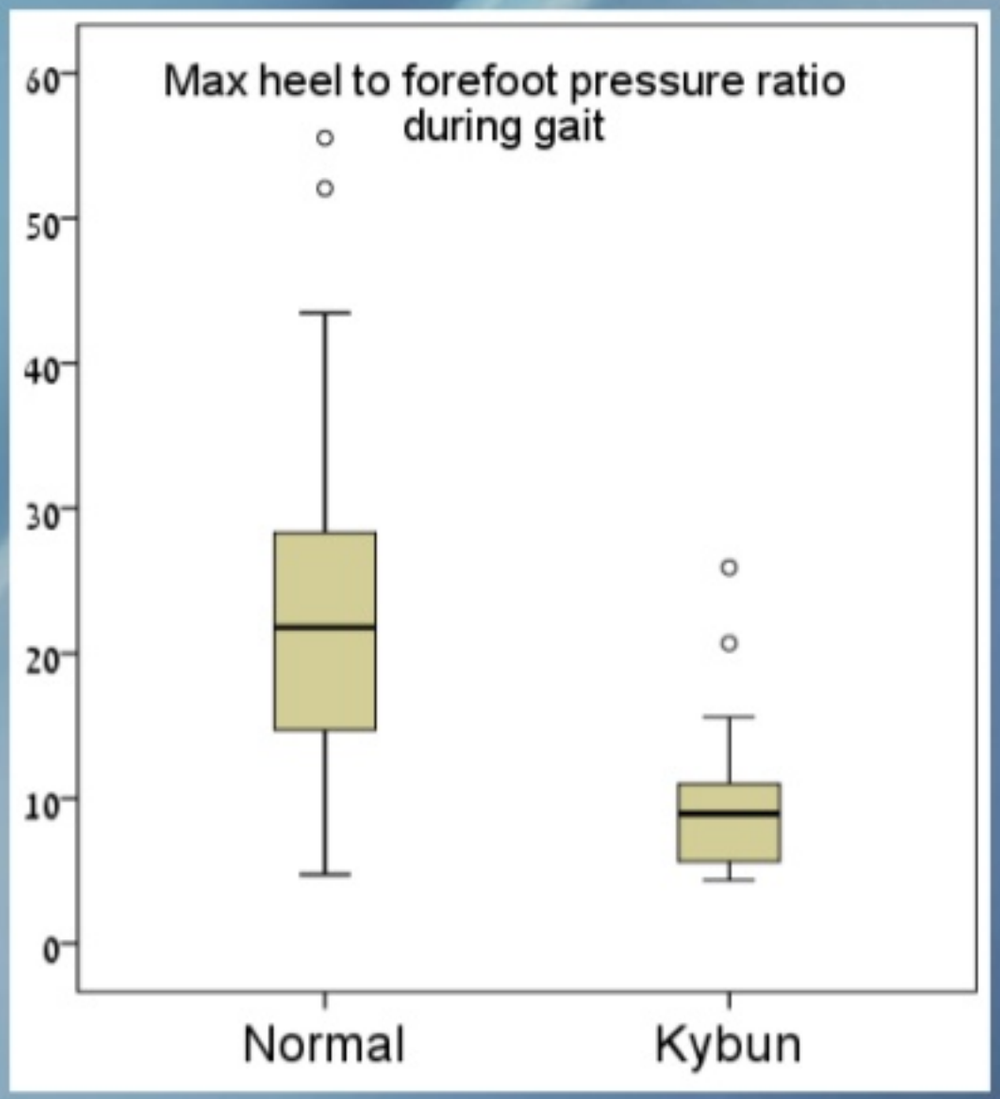
- Movement of the Center of Pressure





The center of pressure moved significantly less in the medio-lateral axis (22% less) and in the anterio-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:

Kpa	Color
207	
188	
169	
150	
132	
113	
94	
75	
56	
38	
19	
0	

0	0	0	0	12	10	35	19	8	2	2	1	12	28	71	50	0
0	0	0	1	6	44	84	46	19	11	3	19	70	147	195	76	0
0	0	0	7	18	66	74	39	11	5	2	22	75	200	207	156	0
0	0	4	9	36	72	61	13	2	4	2	5	55	135	207	97	0
0	0	8	1	45	62	48	7	0	1	0	0	8	26	11	12	0
0	0	7	1	30	47	43	10	1	0	0	0	0	0	1	0	0
0	2	4	3	18	56	16	2	0	0	0	0	0	0	0	0	0
0	0	5	4	4	8	6	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
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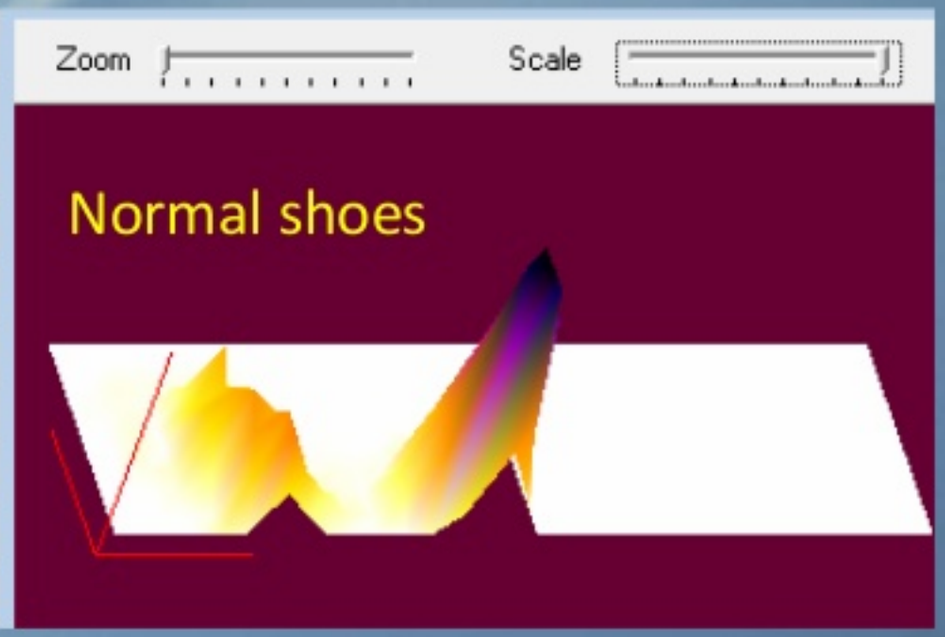
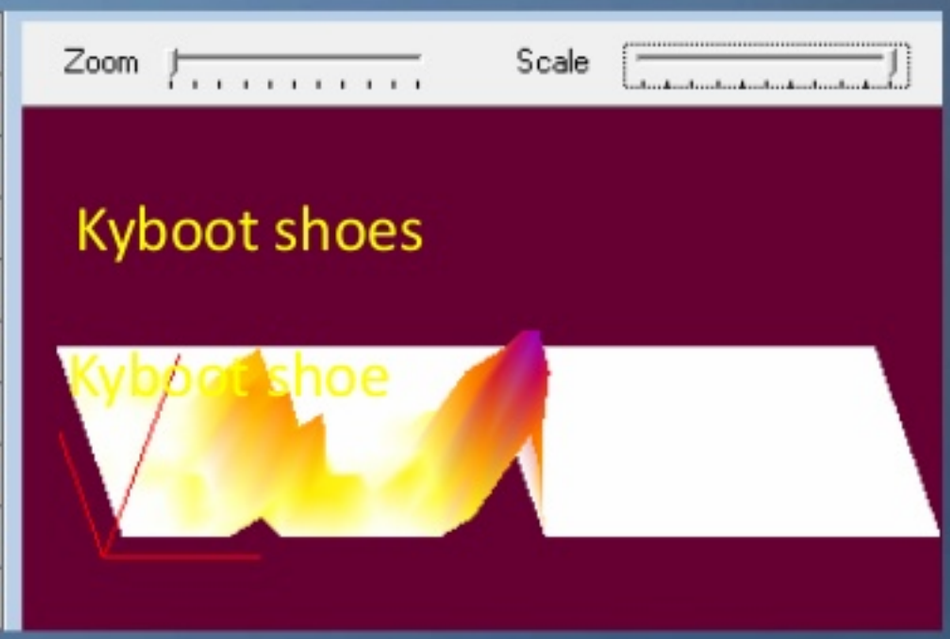
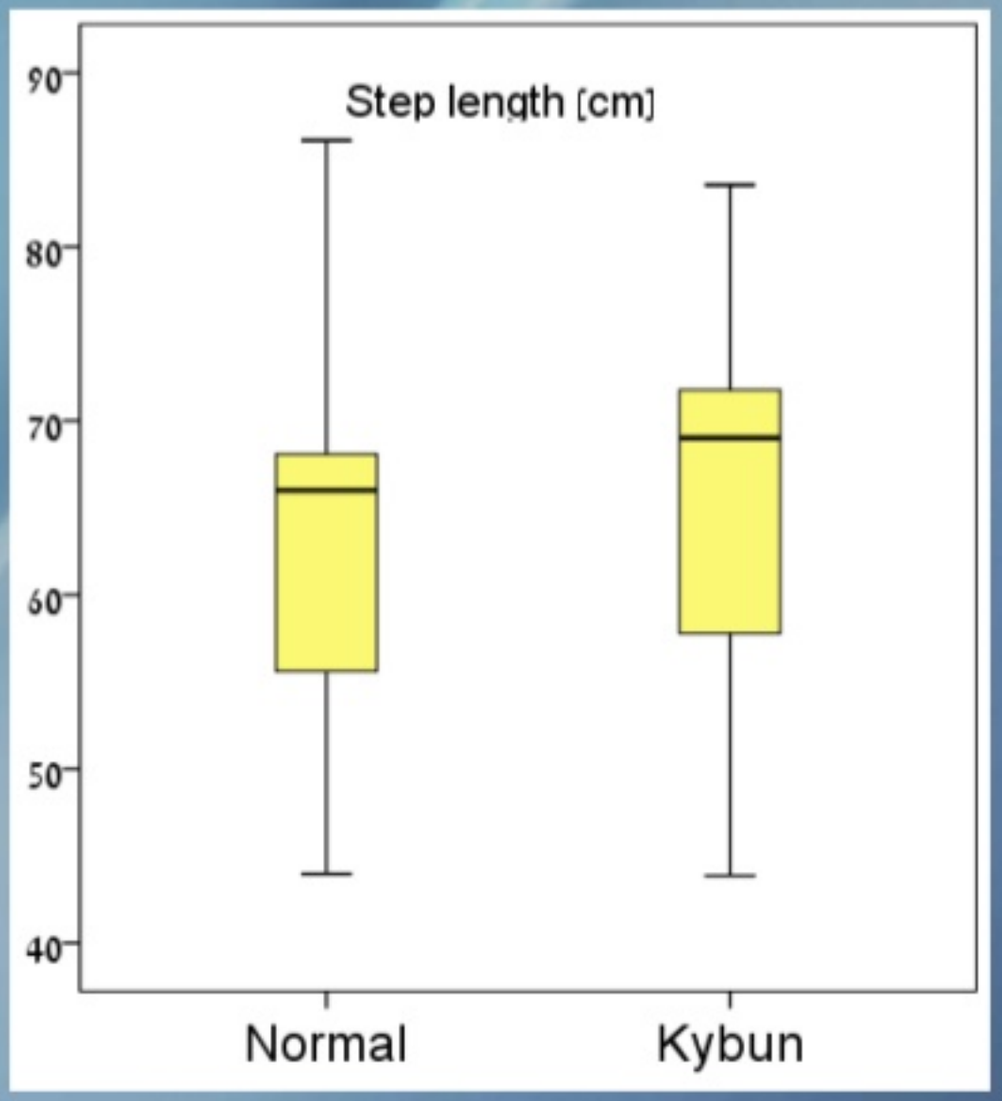


Kpa	Color
207	
188	
169	
150	
132	
113	
94	
75	
56	
38	
19	
0	

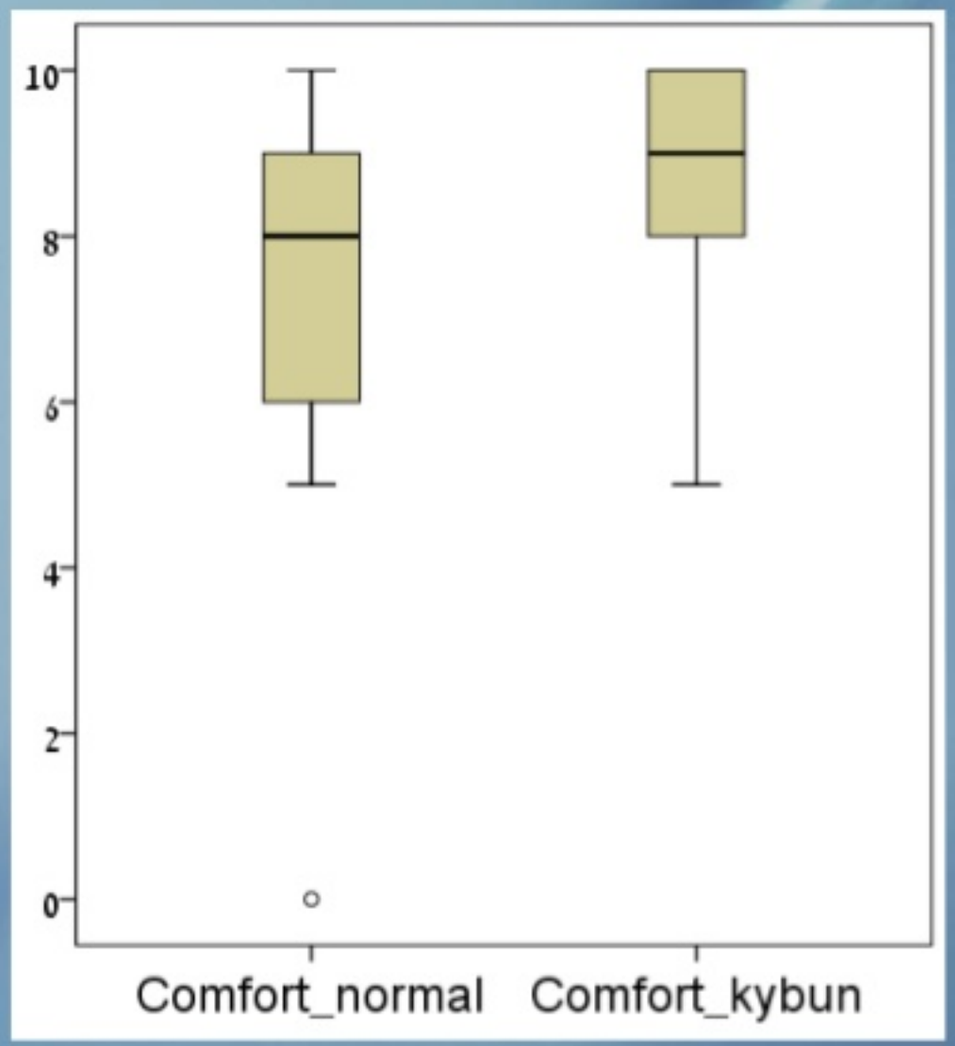
0	0	0	0	10	24	3	7	8	3	0	1	8	28	90	69	0
0	0	2	15	8	12	21	32	30	16	6	10	24	68	126	80	0
0	0	1	20	7	15	61	75	31	28	12	28	18	115	148	114	0
5	1	12	12	3	56	79	52	21	4	6	9	20	82	131	113	0
1	0	3	1	13	67	62	20	2	1	0	1	7	76	99	104	0
0	0	1	1	10	44	56	26	0	0	0	0	8	20	39	10	0
6	1	1	4	6	35	57	15	0	0	0	0	0	0	0	0	0
0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

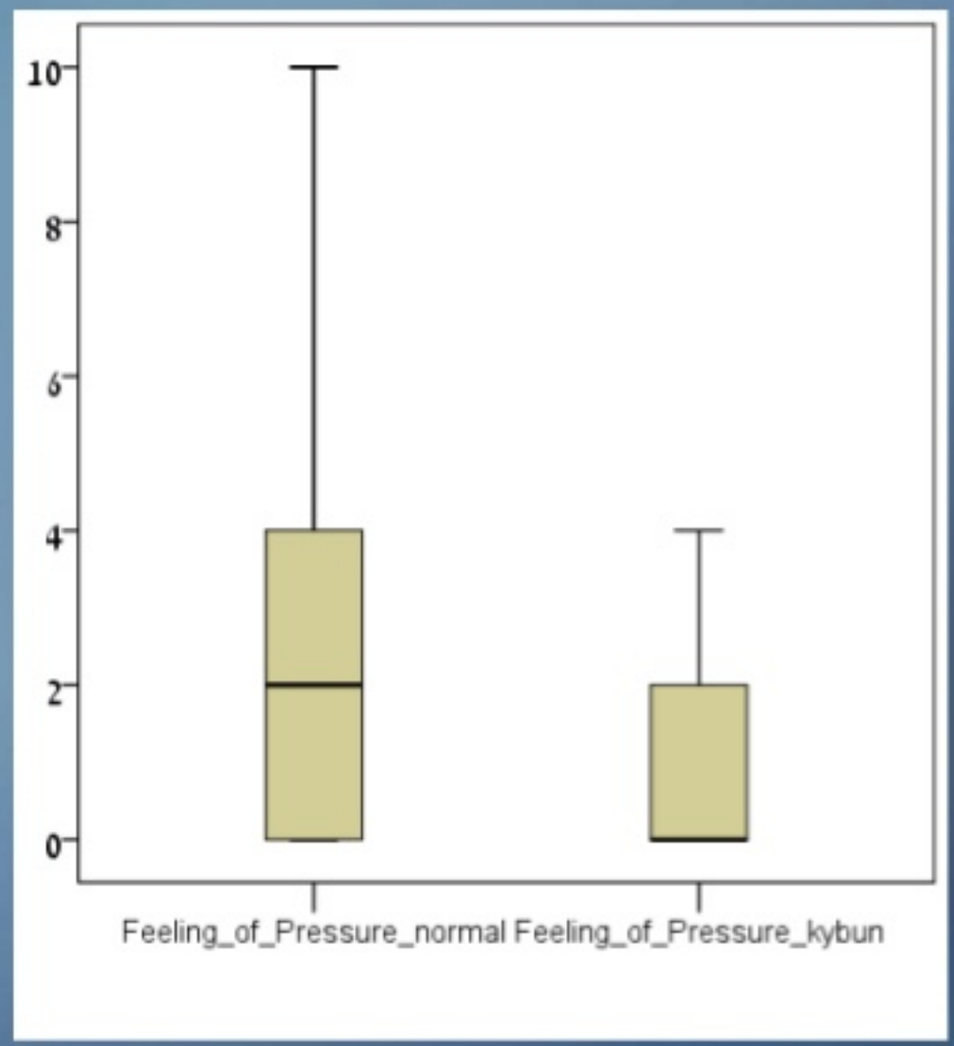




The step length increased significantly (3 cm) with Kyboot shoes

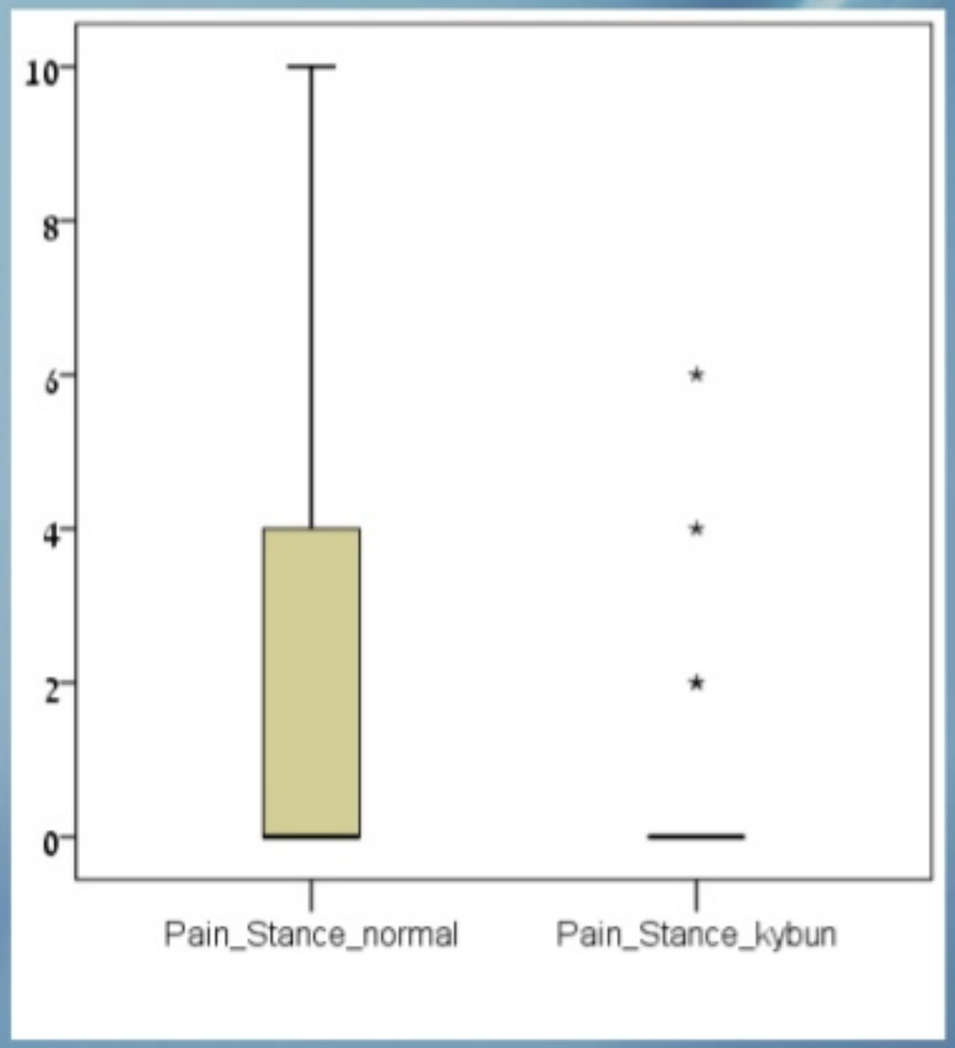
Subjective Questionnaire Results:

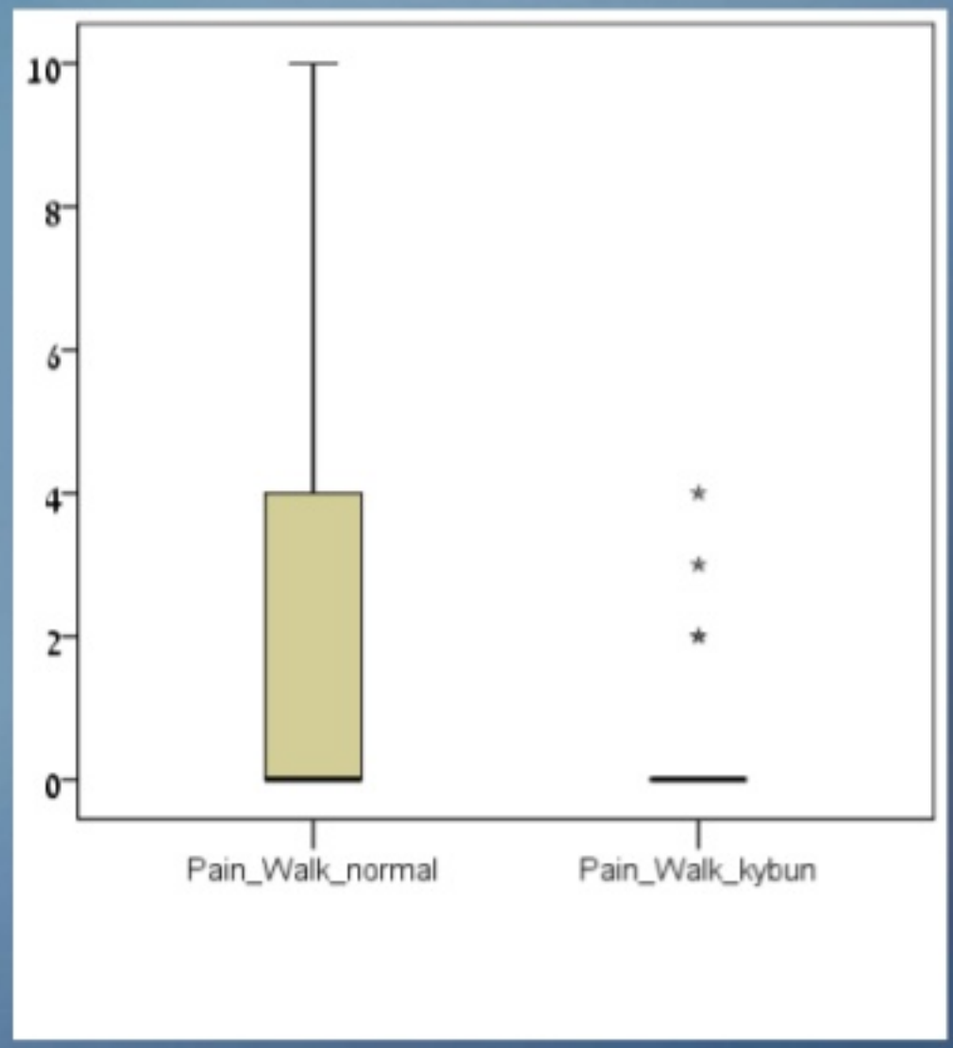




Results

Subjective Questionnaire Results:





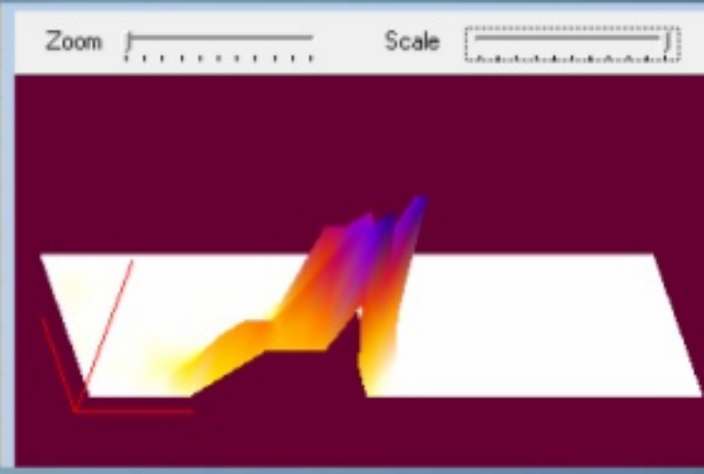
Discussion

- 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

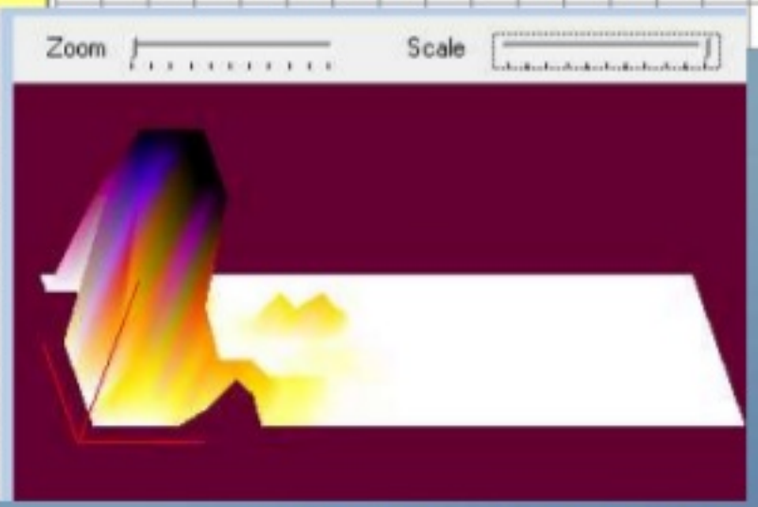
Kpa	Color
207	
188	
169	
150	
132	
113	
94	
75	
56	
38	
19	

0	0	0	0	3	10	35	48	58	54	56	59	109	50	16	0	0	
0	0	0	6	7	35	61	75	87	58	71	86	153	101	57	8	0	
0	0	3	1	11	16	19	34	48	59	97	126	159	183	118	75	0	
3	0	0	1	6	5	5	2	7	20	60	107	156	145	153	180	0	
1	1	0	0	1	0	0	0	1	1	18	128	138	140	104	158	0	
0	1	0	0	0	0	0	0	0	1	2	22	102	96	85	0	0	
0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
0	7	2	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
207	
188	
169	
150	
132	
113	
94	
75	
56	
38	
19	
0	

0	0	0	0	16	20	54	36	16	15	12	5	0	0	0	0	0	
0	31	24	15	28	67	65	55	44	18	16	9	3	1	2	0	0	
0	4	46	31	106	76	50	35	16	24	24	18	3	0	0	0	0	
12	69	72	145	207	84	21	6	4	7	9	8	6	7	6	0	0	
3	115	45	207	207	46	4	1	4	2	2	8	10	11	4	0	0	
16	159	79	207	207	75	5	3	2	4	2	2	9	4	2	0	0	
143	186	170	207	207	165	10	2	4	10	36	34	48	34	0	0	0	
131	207	207	207	207	61	3	21	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	0	0	0	0	0	0	0	0	



Kyboot shoes

Kpa	Color
207	
188	
169	
150	
132	
113	
94	
75	
56	
38	
19	
0	

0	0	0	0	7	20	48	22	35	44	34	28	26	35	38	31	0	
0	0	4	3	25	49	72	53	65	40	46	51	74	59	55	12	0	
0	0	7	13	34	50	45	47	51	54	76	77	65	60	39	29	0	
1	8	4	28	47	45	33	34	25		68	69	51	45	54	57	0	
1	3	1	34	45	35	29	24	55	60	64	111	61	59	41	59	0	
1	18	10	34	49	38	34	28	37	44	67	68	55	49	50	31	0	
9	18	17	26	50	48	16	2	5	6	0	0	0	0	0	0	0	
0	11	5	8	37	6	3	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	
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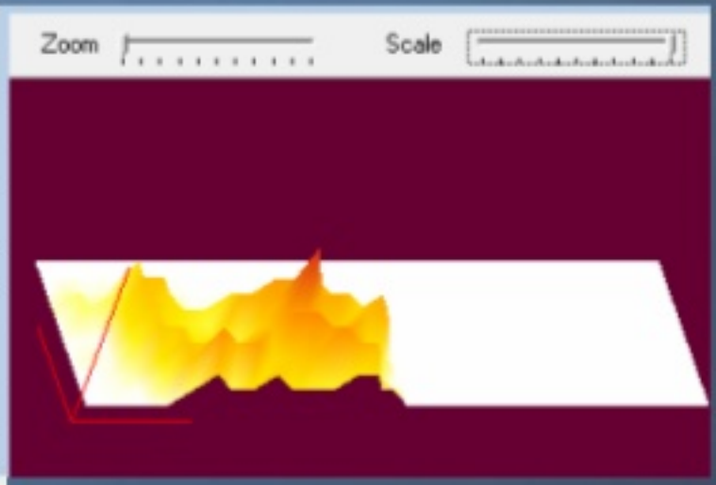

Kpa	Color
207	
188	
169	
150	
132	
113	
94	
75	
56	
38	
19	
0	

0	0	0	0	12	24	45	14	10	10	9	7	0	2	1	0	0
0	28	22	9	38	60	60	26	19	13	7	3	5	1	1	0	0
0	15	56	43	83	92	44	23	13	13	11	9	3	2	1	1	0
9	119	58	128	188	101	31	8	3	4	9	7	2	1	2	2	0
4	103	36	142	159	76	27	9	10	6	3	4	2	1	1	2	0
25	161	115	153	183	131	60	13	7	12	7	6	4	1	1	0	0
138	159	125	141	200	160	23	4	3	17	36	41	31	28	0	0	0
76	124	74	78	207	49	7	10	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	0	0	0	0	0	0	0	0