Patients with unilateral Charcot foot: affected versus unaffected foot comparison

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Background and aim

The incidence of those with diabetes who have Charcot arthropathy ranges from 7.5 to 13% [1,2,4]. Presentation is usually unilateral but bilateral involvement has been noted at 5.9 to 39.3% [2]. The tarsometatarsal (Lisfranc's joint) is the most common site for arthropathy, with initial involvement usually occurring on medial part of the foot [3].

The aim of this study was to estimate biomechanical changes in patients with unilateral chronic Charcot arthropathy (medial convexity, rocker-bottom).

Subjects and methods

24 patients (23 insulin dependent) with unilateral Charcot foot (medial convexity or/and rocker-bottom) without amputations were evaluated.

Table 1. Characteristic of patients (n=24)

	Age, years	Gender (m/f)	Diabetes type (1/2)	Duration of diabetes, years
Mean (SD)	51 (12)	12/12	23/1	20 (10)
Range	[21,69]			[1,41]

12 patients were available for repeated examination (6 patients - with rocker-bottom, 5 patients – with medial convexity, 1 patient – with medial convexity and rocker-bottom).

- Rocker-bottom deformity was revealed after 2 and 5.5 years on contralateral feet in 2 patients,
- Minor amputations resulted in exclusion of 1 patient,
- 9 patients colud not walk without assistance

Table 2. Characteristic of patients (n=12)

	Age, years	Gender (m/f)	Diabetes type (1/2)	Duration of diabetes, years
Mean (SD)	52 (10)	5/7	11/1	23 (10)
Range	[33,69]			[7,41]

Follow up period was equal to (26±21) months with range [4,66].

Pressure distribution measurement protocol and data analysis

Five dynamic records of each foot were made with first step procedure using emed-at 25 system (novel, Munich)

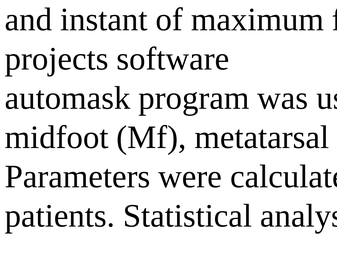
- Peak pressure (PP, kPa) and mean pressures (MP, kPa), maximum force (MF, %BW), pressure-time (PTI, kPa*s) and force-time integrals (FTI, %BW*s), contact time (CT, ms), instant of peak pressure (IPP, %ROP) and instant of maximum force (IMF, %ROP) were calculated with novel-projects software
- automask program was used for foot areas detection: hindfoot (Hf), midfoot (Mf), metatarsal heads (MH1-5), toes (T1, T2, T345)
- Parameters were calculated for each subject and averaged across all patients. Statistical analysis was performed with ANOVA

Results

Table 3. Significantly (p<0.001) different parameters: affected vs. unaffected foot (24 patients)

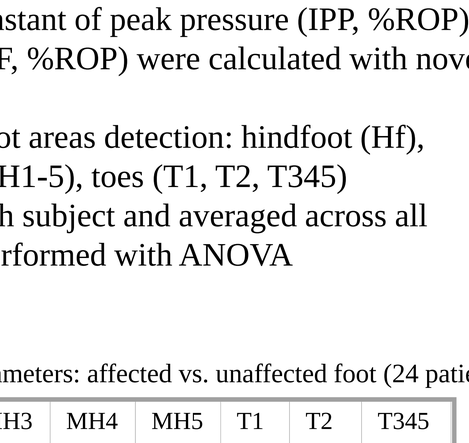
	Tf	Hf	Mf	MH1	MH2	MH3	MH4	MH5	T1	T2	T345
PP	NS	De	**In**	NS	De	De	De	De	De	De	NS
MP	**De**	De	**In**	De	De	De	NS	De	De	De	NS
MF	NS	De	**In**	De	De	De	De	De	De	NS	NS
PTI	NS	De	**In**	De	De	De	De	De	De	De	NS
FTI	De	De	**In**	De	De	De	De	De	De	De	De
CT	NS	De	**In**	De	De	De	De	De	De	De	De
IPP	De	NS	**In**	De	NS	NS	NS	NS	De	De	NS
IMF	NS	NS	NS	De	De	De	De	De	De	De	

(De – less, In – greater in affected foot).



Affected feet Unaffected feet

Fig.1. Averaged maximum pressure pictures for 24 patients with unilateral Charcot foot (rocker-bottom or/and medial convexity)



Unaffected feet

baseline follow up baseline follow up

Fig. 2. Average MPP: affected vs. unaffected feet

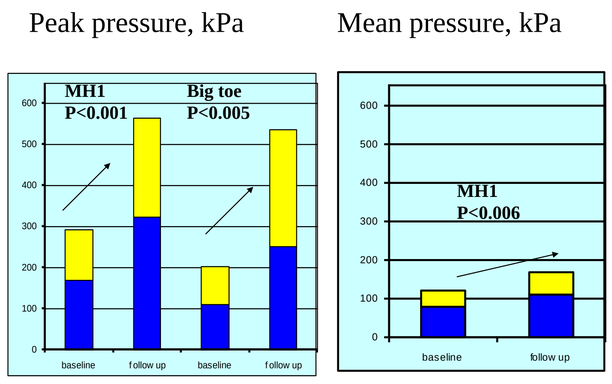


Fig. 3. Significantly different parameters in patients (6) with rocker-bottom (affected feet).

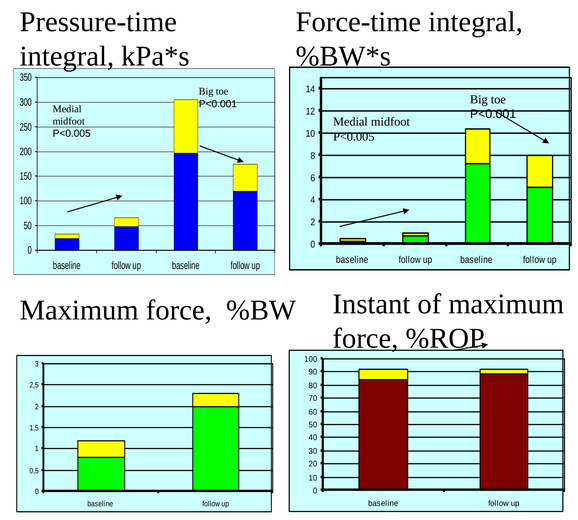


Fig. 4. Significantly different parameters in patients (6) with rocker-bottom (unaffected foot)

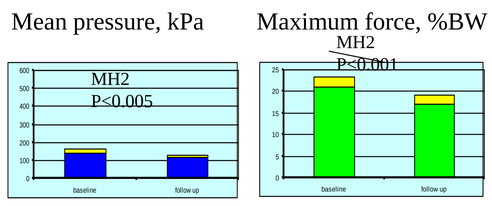


Fig. 5. Significantly different parameters in patients (5) with medial convexity (affected feet)

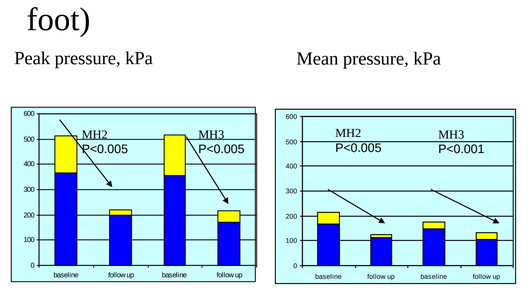


Fig. 6. Significantly different parameters in patients (5) with medial convexity (unaffected feet).

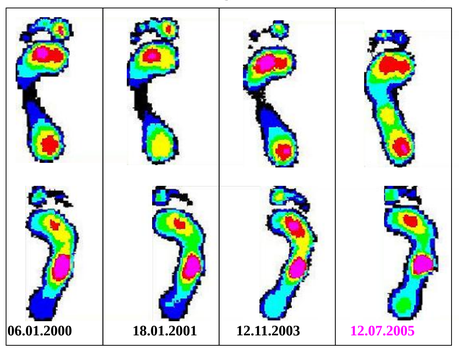


Fig. 7. Case history 1: rocker-bottom on contralateral foot in 66 months (female, 43 years, IDDM 34 years, pressure distribution measurements were carried out in 12, 34, and 20 months after first measurement).

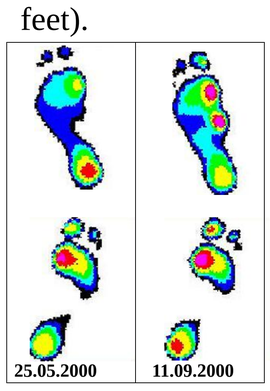


Fig. 8. Case history 2: medial convexity in 4 months (male, 39 years, IDDM 27 years).

Conclusion

The biomechanical changes during follow up period are different in affected vs. unaffected foot.

Affected foot:

· Elevated loading of midfoot is due to the fixed bony midfoot deformities. The Charcot foot is characterized by tarsal collapse of the medial or lateral longitudinal and transverse arches [5]

· Medial shift of loading of rocker-bottom foot could be due to several reasons. The first ray is the most prominent anatomic structure to bear the weight. A higher load may give an additional stability

· Decrease of second metatarsal head loading in medial convexity foot is caused with increasing of medial forefoot loading

Unaffected foot:

- Loading of medial midfoot is elevated and loading of big toe is decreased. Maximum force occurred later under the big toe
- Unaffected foot is playing a greater role in weight bearing resulting in significant increasing of hindfoot loading. At the same time loading of second and third metatarsal heads is significantly decreased.

References

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