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FOOT LOADING CHARACTERISTICS OF UGANDAN CLUBFOOT CHILDREN AFTER PONSETI TREATMENT

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SUMMARY

An interdisciplinary team of the Uganda Sustainable Clubfoot Care Project (USCCP) performed pedobarographic and clinical foot function measurements in 101 Ugandan children after Ponseti treatment. A sub-sample of 25 children showed a unilateral clubfoot. Their pedo-barographic foot loading data was compared to their contralateral, unaffected foot and to those of Ugandan healthy feet.

The foot loading parameters showed significant differences between healthy controls and clubfoot children after Ponseti treatment. Furthermore, significant differences especially for the medio-lateral loading between the unilateral clubfoot and their contralateral, unaffected foot were identified. Furthermore, significant differences could be observed between the unaffected feet and the feet of healthy controls.

INTRODUCTION

Pedobarographic measurements are used to identify foot loading characteristics in physiological and pathological feet. The clubfoot is a foot deformity with pathological characteristics and therefore shows functional limitations that also influence gait.

In Uganda, an estimated 1400 children are born with clubfeet each year. The Uganda Sustainable Clubfoot Care Project trained orthopedic paramedics in diagnosing clubfeet and in the Ponseti treatment as an efficient and cost-effective option to improve foot function in Ugandan clubfoot children. [1].

The objective of the present investigation was to evaluate whether foot loading profiles of unilateral clubfeet treated by paramedics in Uganda are comparable to their contra–lateral, unaffected foot and to those of healthy Ugandan controls.

METHODS

25 Ugandan children (3.6±0.6 years; 16 boys; 9 girls) with unilateral clubfoot after 3 to 4 years of Ponseti treatment and 8 healthy Ugandan controls (3.4±0.5 years 4 boys; 4 girls) walked barefoot at self-selected pace over a pressure distribution platform (emed ST4; 4 sensors/cm^2; 50 Hz; Novel Munich). The platform was embedded flush in a 9 m long walkway.

Five valid trials of each foot were collected during full gait.

As dynamic foot loading parameters peak pressure (kPa), maximum force (MF%; in % of body weight), force time integral (FTI%) and contact area (CA%) were calculated for the whole foot and 10 regions of interest: medial (MH) and lateral heel (LH), medial (MM) and lateral midfoot (LM), metatarsal head 1 (MTH1), metatarsal head 2 (MTH2), metatarsal head 3-5 (MTH3-5), big toe (BT), second toe (T2) and toes 3-5 (T3-5).

Data was normally distributed (Kolmogorow Smirnow). T-test were conducted for paired (affected vs. unaffected clubfoot) and unpaired (unaffected foot vs. healthy controls) comparisons ($p<0.05$).

RESULTS AND DISCUSSION

Significant differences between foot loading of the affected foot in the clubfoot population and healthy controls were found for each parameter and almost every foot region. Differences in plantar foot loading between clubfeet and healthy controls could previously be demonstrated in a European sample [2].

Furthermore, foot loading parameters showed significant differences between the clubfoot and the contralateral foot in almost every foot region. Especially the lateral fore- and midfoot region showed significantly higher MF%, CA%, FTI% and PP values for the affected feet, whereas the medial foot and the toe region showed a significantly lower load distribution (Fig. 1).

Significantly lower PP values were found under the heel and big toe in unilateral clubfoot in comparison to the contra-lateral, unaffected foot. These results are in accordance to published findings in surgically treated clubfeet children [3]. The lower PP values under these foot regions in clubfeet can be attributed to a less dynamic roll-over process with a potentially less efficient activation of the calf muscles [4, 5].

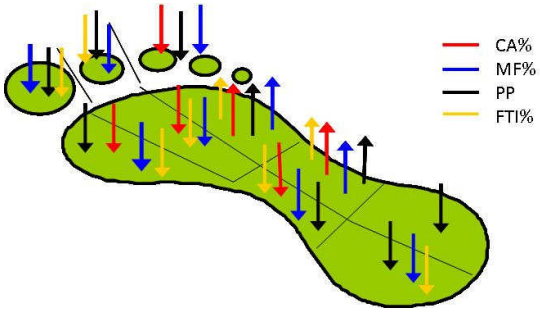

Figure 1: Significant differences in clubfoot (affected) vs. contralateral (unaffected) foot.

Considering the comparison between healthy Ugandan feet and the unaffected contralateral feet in clubfoot children, significantly lower CA% and PP values for the lateral heel could be observed for the unaffected contralateral feet (Fig. 2). These PP findings are in accordance with Favre et al. [2] who compared surgically treated clubfeet and the contra-lateral, unaffected foot and explained the differences by adaptations of the central nervous system (CNS) to retain gait symmetry.
Furthermore, normalized maximum forces (MF%) of the lateral midfoot were significantly higher for the contralateral feet than in healthy controls. Peak pressures for the whole foot were significantly higher in healthy controls. These differences for the presumably healthy foot in unilateral clubfoot children could be attributed to potential adaptations of the CNS to preserve symmetry [5].

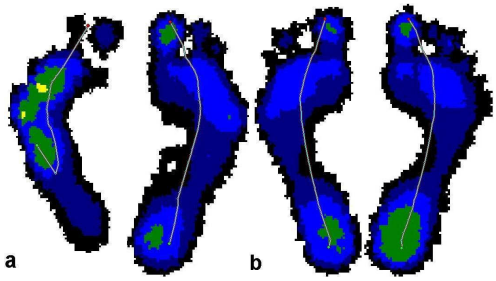

Figure 2: Mean foot loading picture of J29 with unilateral clubfoot (a) and J04 healthy control (b).

CONCLUSIONS

After 3 to 4 years of Ponseti treatment the foot loading characteristics of the affected foot in unilateral clubfoot children still showed a more pronounced lateral load distribution in comparison to the contralateral side and to healthy Ugandan controls.
Furthermore, the present results show that the contralateral, presumably healthy foot in Ugandan clubfoot children cannot be considered as a normal healthy foot.

ACKNOWLEDGEMENTS

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