Dynamic Foot Pressure in Patients with Hallux Valgus During Stair Climbing

拇指外翻患者於爬樓梯時之動態足底壓力

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摘要

拇趾外翻是女性最常困擾的足部問題。由於拇趾外翻會改變足部骨骼對位、甚至影響下肢關節生物力學，因此評估拇趾外翻患者的動態生物力學對於拇趾外翻之治療決策是非常重要的。雖然過去已有研究以足底壓力分析探討拇趾外翻於走路時之影響，但未曾探討過於上下樓梯時之拇趾外翻的生物力學影響。因此本計劃旨在利用動態足底壓力分析評估上下樓梯時拇趾外翻的足壓變化。12 位診斷爲拇趾外翻的女性參與本研究，並以 RSscan 平板系統量測各受試者於上、下樓梯時的足底壓力與站立時間，而足底壓力分析則將足部分爲十區。結果顯示，在上樓梯時，拇趾外翻患者的前足外側有較大的受力，而下樓梯時，足跟外側則有有較大的受力。由本研究結果可知，拇趾外翻患者在上下樓梯時確實會出現不同的足底壓力分布的改變，因此利用上下樓梯時的足底壓力分析可以有效確認拇趾外翻患者的足部變異。

關鍵字：拇趾外翻、足底壓力分析、上下樓梯

1、Introduction

Hallux valgus (HV) is a relatively common condition in forefoot deformity and has a marked female preponderance of about 9:1. HV not only affects the structure of the foot, but also results in biomechanical changes. An increased medio-lateral load transfer and a rise of plantar pressure of the lateral forefoot was found correlating to the aggravation of the HV deformity [2, 3]. Using plantar pressure measurement technology to study the changes of foot function over time is useful for diagnosis and evaluation in clinics. Although there is some studies of HV using plantar pressure analysis during gait [4, 5], there is no study on these patients during stair climbing. The aim of this study was to investigate the dynamical plantar pressure distribution of the patients with HV during stair ascending and stair descending.

2、Materials and Methods

Twelve females (age: 39.6±6.62 year [30-50 years], body weight (BW): 56.2±9.2 kg, body height: 159.2±3.12 cm) with diagnosis of HV were participated in the study. Each participant was instructed to ascend the stairs for 5 times and descend the stairs for 5 times at a self-selected pace with their right leg and left leg, respectively. The plantar pressure was measured by RS Foot Scan platform system (RSscan International, Belgium) and was analyzed using Matlab programming (MathWorks). The foot of each subject was divided into 10 regions for analysis, namely the big toe (T1), 2nd-5th toes (T2), 1ST -5th metatarsal bones (M1-M5), mid foot (MF), medial and lateral part of the heel (MH & LH) (Figure 1).

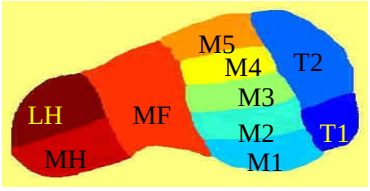

Figure 1: 10 regions of the left foot

Peak force, the instance when the peak force occurred (% of stance phase), and time-force integral for the various regions of the foot during stair ascending and descending were then

analyzed statistically using SPSS 14 (SPSS Inc., USA).

3、Results

The averages of stance period during stair ascending and descending were 0.96±0.18 second and 0.87±0.17 second. The peak forces, the instance when the peak force occurred, and time-force integral in each foot regions were shown in Figure 2, 3 and 4(the order from left to right and from top to down was T1-T2, M1-M5, MF, MH and LH). The peak forces under later heel during stair ascending were different from these during stair descending. The time when the peak forces occurred was also different between these two activities.

4、Discussion

As the pattern shown in Figure 3, all patients loaded their fore foot, especially for the 2^{nd}-5^{th} toes, less during up-stair and more during down-stair ambulation, while loaded their lateral heel more during stair ascending and less during stair descending. These results indicate that there was a tendency for an increase of pressure under the toes during down-stair and under the heel during up-stair walking.

5、Conclusions

We conclude that the additional stress by walking upwards and downwards causes some changes of pressure distribution under the foot, especially for the foot with HV.

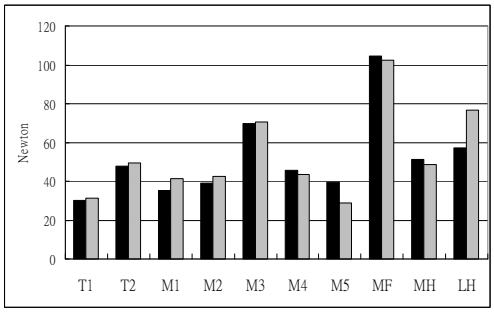

Figure 2: The peak pressure (unit: % of BW/cm^2) during stair ascending (gray bar) and stair descending (black bar).

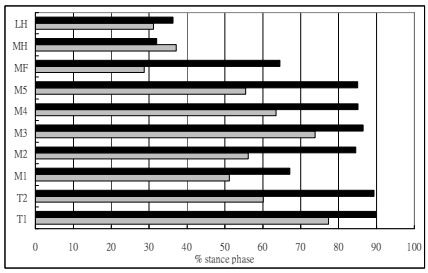

Figure 3: The time (unit: % of stance phase) when it occurred during stair ascending (gray bar) and stair descending (black bar).

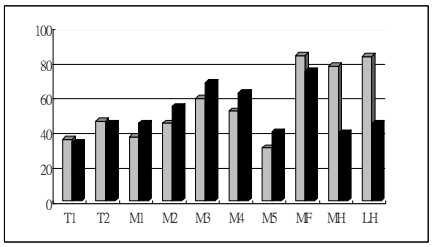

Figure 4: The time-force integral (% of BW*Second) during stair ascending (gray bar) and stair descending (black bar).

6、References

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