DOES THE HALLUX VALGUS SURGERY AFFECT SPATIOTEMPORAL PARAMETERS AND LOWER EXTREMITY KINEMATICS DURING GAIT?

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INTRODUCTION

The hallux valgus (HV) deformity affects 23% of adults aged 18-65 years and 35.7% of elderly people aged over 65 years [1]. The patients usually complain of pain, difficulties during walking and problems with selection of the shoes. In severe stages of this deformity a surgery is required; however the difficulties during walking often persist after the surgery. A frequent postsurgical complication is a lateral deviation of the lesser toes [2]. There is lack of the evidence of the influence of HV surgery on spatiotemporal parameters and lower extremity and pelvic kinematics during walking. The aim of this study was to investigate if kinematic parameters of the gait cycle are affected after a HV surgery.

METHODS

Based on PICO format (P: patients with HV, over 40 years, I: first metatarsal osteotomy, C: control group, O: spatiotemporal parameters, lower extremity kinematics during gait) we formulated a clinical question: “Does the first metatarsal osteotomy affect spatiotemporal parameters and lower extremity kinematics during gait in patients with HV?

The experimental group consisted of 17 women with HV deformity (average age = 51.5±11.9 years, weight = 69.2±10.9 kg, height = 1.7±0.1 m) that underwent the first metatarsal osteotomy. We included only persons without an anamnesis of metabolic and neurological diseases and an ischemic disease of lower extremity. We also utilized a control group of 13 women (average age = 46.2±7.1 years, weight = 70.5±11.2 kg, height = 1.7±0.0 m) without HV. We used the optoelectronic system for the gait examination by Vicon MX (Vicon Motion System Ltd., Oxford, United Kingdom) with seven infrared cameras (200 Hz). Patients were instructed to walk at a self-selected pace. Five measured trials were evaluated. We focused on spatiotemporal parameters of the gait cycle and maximal and minimal peaks of the ankle, knee, hip and pelvic movement in sagittal, frontal and transversal plane during walking. These parameters were compared with those acquired from our control group.

After the Shapiro-Wilk normality test we decided to use a parametrical TWO-WAY ANOVA for repeated measurement and consequently Fisher’s LSD post hoc test (Statistica 10.0, Stat-Soft).

RESULTS AND DISCUSSION

Results showed that patients after HV surgery walked slower and with decreased cadence (p<0.05) as compared to their gait before surgery and to that of the control group. We also found that the operated leg exhibited longer step length and step time, as well as a shorter duration of single support and stance phase, compared to the non-operated leg (p<0.05) indicating the presence of asymmetry (Table 1). This image corresponds to the antalgic type of walking, in which the patient relieves the operated leg. The cause of the described asymmetry is probably the pain in the operated segment or substitute motion pattern used preoperatively, which HV surgery accentuates.

Furthermore, the operated leg exhibited greater dorsal flexion during mid-stance, as compared to the non-operated leg and the control group (p<0.05) (Fig. 1). Plantar flexion at the end of the stance phase was significantly reduced on operated leg (p<0.01) (Fig. 1).
Increased dorsal flexion during the midstance according Kirtley [3] compensates limited dorsal flexion of operated segment due to the pain. Consequently the toe-off at the end of stance phase could not be performed in the whole range.

Hallux valgus surgery did not significantly change angle parameters of pelvic movement (Fig. 2). Before HV surgery we found decreased pelvic elevation (p<0.01) at the beginning of the stance phase and greater pelvic depression (p<0.01) at the end of the stance phase on the side of operated leg.

This asymmetrical pelvic movement in the frontal plane persisted for four months after HV surgery. This follows that the pelvis was sloping during the whole gait cycle. The sloping pelvis is in most cases caused by asymmetric leg length, blocking or shift in sacroiliac joint, muscle imbalances between abductors and adductors in the hip [4].

CONCLUSIONS

HV surgery in the short term most markedly altered the preswing phase on the operated leg. After HV surgery is very important to recover the dorsal flexion of the hallux and re-educate heel-off and toe-off.

REFERENCES


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**Table 1:** Description of spatiotemporal parameters of the gait in the HV group and the control group.

<table>
<thead>
<tr>
<th>Group</th>
<th>Parameter</th>
<th>HV group before S</th>
<th>HV group after S</th>
<th>Control group before S</th>
<th>Control group after S</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cadence [step/min]</td>
<td>112.65 ± 9.2</td>
<td>111.76 ± 10.3</td>
<td>104.32 ± 22.1</td>
<td>104.29 ± 22.2</td>
</tr>
<tr>
<td></td>
<td>Walking speed [m/s]</td>
<td>1.15 ± 0.1</td>
<td>1.14 ± 0.1</td>
<td>1.25 ± 0.2</td>
<td>1.25 ± 0.2</td>
</tr>
<tr>
<td></td>
<td>Step length [m]</td>
<td>0.61 ± 0.0</td>
<td>0.61 ± 0.1</td>
<td>0.65 ± 0.1</td>
<td>0.66 ± 0.1</td>
</tr>
<tr>
<td></td>
<td>Step time [s]</td>
<td>0.54 ± 0.0</td>
<td>0.54 ± 0.0</td>
<td>0.50 ± 0.1</td>
<td>0.50 ± 0.1</td>
</tr>
<tr>
<td></td>
<td>Single Support [%]</td>
<td>0.42 ± 0.0</td>
<td>0.42 ± 0.0</td>
<td>0.44 ± 0.1</td>
<td>0.44 ± 0.1</td>
</tr>
</tbody>
</table>


* Differences before and after hallux valgus surgery (ANOVA for repeated measurement, LSD Fisher’s post hoc test): significance at p<0.05.

# Differences between operated and nonoperated leg (ANOVA for repeated measurement, LSD Fisher’s post hoc test): significance at p<0.05.

* Differences between hallux valgus group and control group (ANOVA for repeated measurement, LSD Fisher’s post hoc test): significance at p<0.05.