CoxaTrain®

IMPACT OF FLEXIBLE HIP ORTHOSES ON BIOMECHANICS AFFECTED BY OSTEOARTHRITIS OF THE HIP

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INTRODUCTION

Osteoarthritis of the hip (HOA) is a degenerative condition which often leads to pain, movement limitations, and restrictions in quality of life.

In addition to reduced hip extension, previous biomechanical analyses of HOA patients' hip function also show restrictions in the frontal and transverse planes when walking in a straight line. This even occurs in early stages of the condition but often remains undetected. Earlier publications by Steingrebe et al. confirm that HOA influences the affected hip joint as well as changing the kinematics of adjacent joints: both knees are affected. The sagittal range of motion (ROM) in particular is often reduced. Even though no definitive meta data is currently available, there is a tendency to compensate by tilting the pelvis, which has an impact on the kinematics of the sacroiliac joints.[3]

Study results indicate that 90° rotational movements and taking the stairs are more effective than walking in a straight line for detecting restrictions during early-onset HOA, particularly in the frontal and transverse planes.[4]

Thanks to scientific insights, conservative treatment approaches are gaining significance, to prevent or delay surgery as well. Hip orthoses represent potential, non-invasive intervention. In a study conducted at KIT's BioMotion Center, the effect of a flexible hip orthosis was examined during taking the stairs and 90° rotational movements.[1, 2] Both represent complex everyday activities with high demands made on joint stability and mobility.

METHODOLOGY

Patients suffering from one-sided, mild to moderate HOA were included in the study. An examination concerning the effect of using an orthosis (Bauerfeind's CoxaTrain) for one week compared the biomechanics when performing 90 degree turns (step turn and spin turn) as well as when taking the stairs (ascending and descending) in HOA patients and healthy test subjects. Additionally, the correlation between changes in perceived pain as well as biomechanical parameters in the hip, pelvis, and torso was analyzed.

Participants

- 21 participants with one-sided, radiologically confirmed and symptomatic mild to moderate HOA [Harris Hip Score (HHS): 65 – 95] and
- 21 healthy test subjects with a similar age, gender, height, and weight structure

Experimental setup

A Predefined 90° turns were carried out: step turns as well as spin turns (turning via the supporting leg).
B Test subjects went up and down stairs.

Measurements took place on three days for the HOA group:
1. Without an orthosis (baseline)
2. Immediately after donning of the orthosis (short-term effect)
3. After seven days of wearing the orthosis for at least 4h/day (medium-term effect)

Measurement techniques

- 3D movement analysis with a 16-camera system (Vicon) and two force measurement plates.
- Calculation of joint angles and ranges of motion (ROM), joint torque, and movement speed of the center of mass (COM).
- Statistical analyses: t tests, ANOVAs with post-hoc tests, correlations with HHS within the HOA group, correlations with perceived pain based on visual analog scale (VAS).

RESULTS

Compared to healthy test subjects, HOA patients had significantly reduced hip extension both during the step turn and the spin turn (MD = -4.82°, p = 0.01) as well as a restricted range of motion in the sagittal (-6.27°) and transverse planes (-9.96°). The orthosis resulted in an increase in movement speed (COM speed, e.g. step turn: +0.13 m/s) and in a reduction in transverse hip movement, without increasing strain on the hip joint (Fig. 1 and 2). At the same time, increased adduction and rotation torque was observed in the knee joint on the affected side.

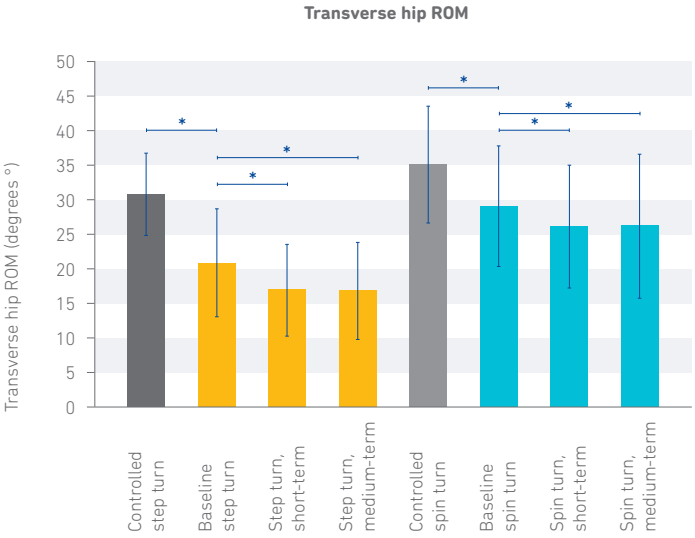

Fig. 1: Transverse hip ROM with and without an orthosis compared to the control group when carrying out step turns and spin turns

Baseline: measurement without an orthosis; short-term: measurement with the orthosis immediately after handover; medium-term: measurement with the orthosis after seven days of wearing it; control group: healthy test subjects

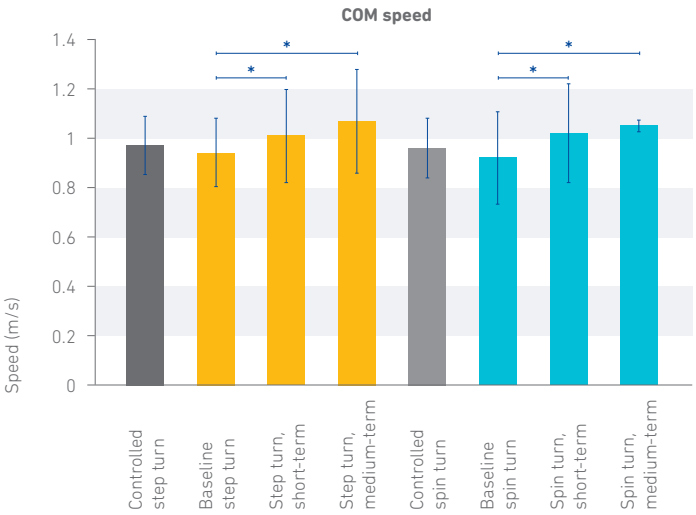

Fig. 2: COM speed with and without an orthosis compared to the control group when carrying out step turns and spin turns

Baseline: measurement without an orthosis; short-term: measurement with the orthosis immediately after handover; medium-term: measurement with the orthosis after seven days of wearing it; control group: healthy test subjects

When taking the stairs, the orthosis reduced pain from an average of 24.9 points to 17.9 points (-28%, p = 0.008) (Fig. 3) and increased movement speed. There was more hip extension (+3.27° when ascending, +2.6° when descending) as well as reduced flexion and internal rotation (Fig. 4). The pelvis posture became more upright, thanks to a reduction in anterior tilting (Fig. 4).

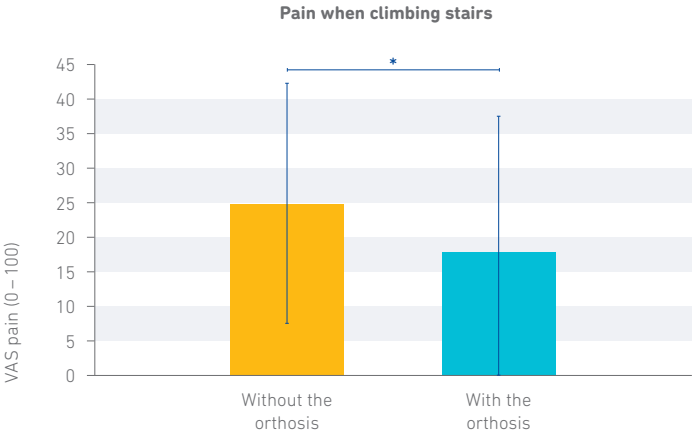

Fig. 3: Pain when climbing stairs with and without an orthosis, VAS values: 0 = no pain, 100 = maximum pain

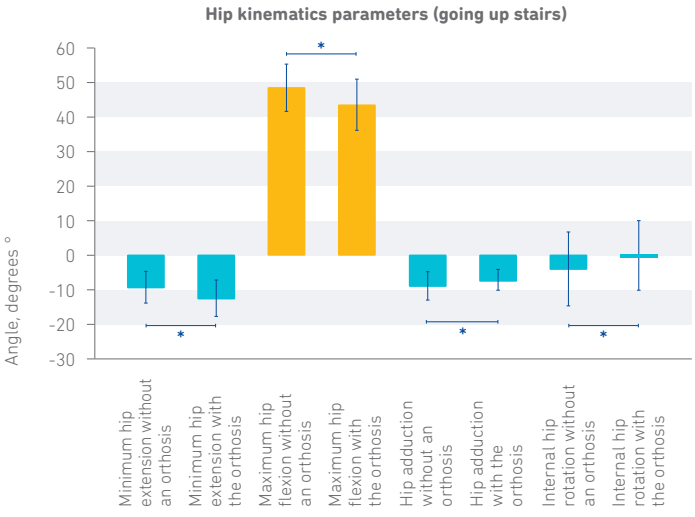

Fig. 4: Hip kinematics parameters when going up stairs, joint angle in degrees

DISCUSSION

The study results show clearly that restrictions in movement affected by HOA can become visible in particular during rotational movements and taking the stairs. The flexible hip orthosis had positive effects on movement performance and perceived pain. The reduction in internal hip rotation may have a protective function where painful limits in movement are concerned. At the same time, movement speed increased, which partly explains the increase in strain on adjacent structures, such as the knee joint. The upright pelvis posture and increased hip extension can have a favorable biomechanical effect on joint strain and must be considered in the context of muscle activation.

These results justify the use of orthoses during conservative HOA management, especially during early stages of osteoarthritis of the hip. Future studies should focus on long-term effects and individual adjustment to movement strategies.

CONCLUSIONS

- → CoxaTrain has a positive influence on HOA patients' gait during key everyday movements.
- → CoxaTrain reduces hip pain during movement.

Sources:

[1] Steingrebe H, Sell S, Stein T; Mild-to-moderate hip osteoarthritis and hip bracing influence hip and knee biomechanics during 90° turns while walking. Clinical Biomechanics, 122, 106420, 2025. https://doi.org/10.1016/j.clinbiomech.2024.106420

[2] Steingrebe H, Ehmann H, Sell S, Stein T; Effect of hip bracing on stair walking biomechanics and pain in patients with mild-to-moderate hip osteoarthritis: an intervention study. Data are submitted for publication

[3] Steingrebe H, Spancken S, Sell S and Stein T: Effects of hip osteoarthritis on lower body joint kinematics during locomotion tasks: a systematic review and meta-analysis. Front. Sports Act. Living 5:1197883, 2023. doi:10.3389/fspor.2023.1197883

[4] Steingrebe, H.; Sell, S.; Stein, T. Mobility Requirements and Joint Loading during Straight Walking and 90° Turns in Healthy Older People and Those with Hip Osteoarthritis. J. Clin. Med., 13, 5021, 2024. https://doi.org/10.3390/jcm13175021