

# POSTURAL ASYMMETRIES IN PERSONS WITH A UNILATERAL TRANSHUMERAL UPPER LIMB AMPUTATION: BIOMECHANICAL EFFECTS OF WEARING A PROSTHESIS

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## BACKGROUND

In persons with a unilateral upper limb amputation, postural asymmetries such as trunk rotation or scoliosis are observed. Although wearing upper limb prosthesis may be considered to mitigate the effects of limb loss on posture, few studies have been conducted regarding the influence of prosthesis during walking.

## PURPOSE

The present study investigated the biomechanical influences of prostheses on the walking posture of patients with a unilateral transhumeral upper limb amputation. Kinematic analysis was used to quantify the impact of wearing different types of upper limb prostheses during ambulation, compared with not wearing an upper limb prosthesis.

## METHOD

Five male patients with a unilateral transhumeral upper limb amputation (average age:  $44.8 \pm 16.3$ , average period since amputation:  $2.6 \pm 1.6$  years) were investigated. The patients walked on a treadmill (ADAL3D-S, Medical Development) for 3 minutes (walking speed: 4.0 km/h). Patient posture was analyzed in the following five situations: 1) without a prosthesis, 2) with a socket (average weight:  $200 \pm 15$  g), 3) with a cosmetic prosthesis (average weight:  $634 \pm 23$  g), 4) with a body-powered prosthesis (average weight:  $1220 \pm 107$  g), and 5) with a myoelectric prosthesis (average weight:  $1600 \pm 119$  g). The kinematic parameters of their postures were biomechanically analyzed using 10 optoelectronic cameras (VICON, Oxford Metrix, UK).

## RESULTS

The kinematics revealed that the patient's trunk rotated toward the intact side when the prosthesis was not used, and all patients swung the intact arm; the trunk slightly leaning to the intact side. When patients wore the prosthesis, the rotation and lean of the trunk decreased. The axis of the trunk rotation moved to the center of the patient's body from the intact side. The heavier the prosthesis was, the more symmetric the

posture became. When wearing the prosthesis, the improved symmetry enabled increased prosthetic arm swing and decreased the trunk rotation

## CONCLUSION

From the biomechanical point of view, this study showed that the patient's body posture was significantly improved when a prosthesis was used. Compensatory movements, such as abnormal swinging of the contralateral arm, were reduced. Arm swing has been suggested as a useful motion in counteracting trunk rotation in gait. The reestablishment of upper limb mass may have improved the patient's overall balance, thus, improving confidence while ambulating.