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Gait analysis of a novel design of ankle replacement

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Introduction

A new three-part total ankle prosthesis was designed [1] to achieve maximal compatibility between component relative motion and ligament natural role. This results in ankle natural mobility while maintaining full conformity, achieved by a backward and forward motion of the meniscus within the flexion arc. In this study the expected early functional recovery was evaluated by a clinical scoring system and by gait analysis.

Methods

Ten patients operated with the BOX Ankle (Finsbury Orthopaedics, UK), with mean age 57.4 years (range 45–72), BMI 25.8 (range 20.4–34.1), 8 males and 2 females, 9 post traumatic ostheo- and 1 psoriasic arthritis were gait analysed preoperatively and at 6 and 12 month follow-up. The examination consisted in a clinical score (AOFAS) and in gait analysis (Vicon 612 System – Oxford UK, Kistler forceplates) adopting a recently validated protocol [2]. Results were compared with a 'control group' of 20 subjects, with mean age 27.9 years (range 23–36), BMI 21.9 (range 18.5–25), 11 male and 9 females. Figure 1.

Results

AOFAS score rose from 44.3 in pre-op to 80.0 at 12 months, with an important reduction of pain (score from 17.0 to 31.0, max 40) and of ankle alignment (from 4.5 to 9.3, max 10). Spatio-temporal parameters obtained with gait analysis showed a progressive recovery to normality in the first 6 months and a successive settlement on the operated site: i.e. mean stride length normalised (%high) was 64.1 pre-op and exactly 69.7 both at 6 and 12 months; speed rose from 86.6 cm/s to 98.7 cm/s at 6 months and 100.1 cm/s at 12 months, both with statistical significance. Ankle flexion range improved in all three anatomical planes, in particular in the sagittal, where there was an increase of max dorsi-flexion in the stance phase (3.2 deg pre-op, 5.2 and 6.3 at 6 and 12 months, the

Figure 1
A BOX Ankle patient instrumented with the marker-set of the protocol utilised.

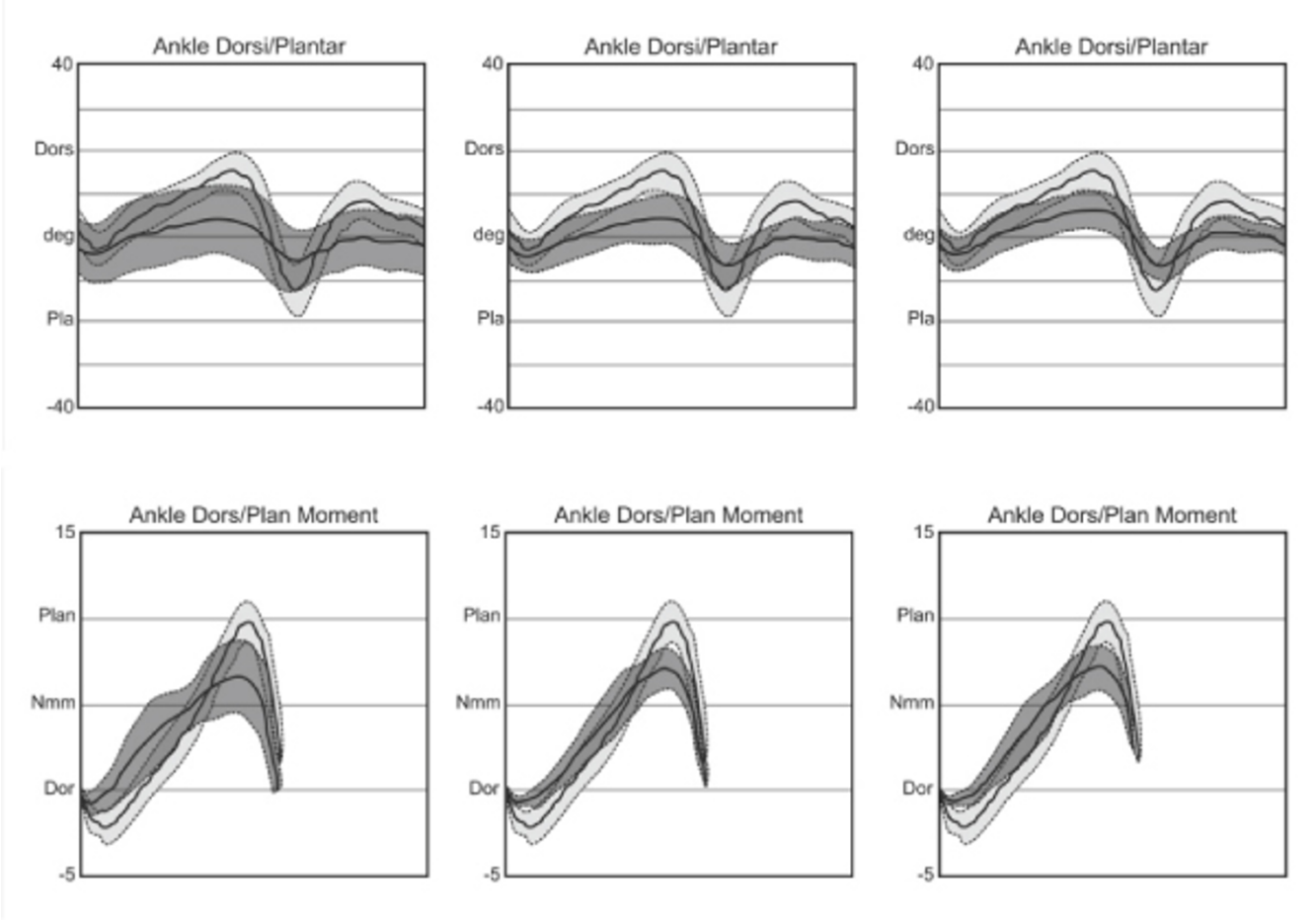

Figure 2
Ankle rotation (top row) and moment (bottom) in the sagittal plane (dark-grey), at pre-op (on the left), at 6 (in the centre) and 12 (on the right) months, superimposed to equivalents in the control group (light-grey).

latter significant), though a persistent little plantar-flexion at initial contact and a moderate reduction of plantar-flexion during swing were observed. Plantar-flexion moment showed a smoother pattern after surgery in the stance phase. Figure 2.

Conclusion

The novel ankle prosthesis seems to contribute to an early functional recovery at 6 months maintained at one year. Preliminary assessments at 24 months confirmed the improvements achieved at 12 months. With reduction of pain and recovery of joint control, gait variables of high clinical interest, such as stance balance and ability in propulsion, improve considerably.

References

1. Leardini A, *et al.*: *Clin Orth Rel Res* 2004, **424:**39-46.
2. Leardini A, *et al.*: *Gait & Posture* 2007, **26(4):**560-571.