In Vivo Kinematics of Three-Component Mobile-Bearing Total Ankle Arthroplasty.
A 3D-Evaluation Using Fluoroscopic Imaging

INTRODUCTION
High complication rates and low survivorship are still problematic in total ankle arthroplasties (TAA), as compared to total knee and hip arthroplasties. This could primarily be due to implant loosening and subsidence induced by excessive articular contact stress during ankle motion, especially in gait cycles. The purpose of this study was to investigate in vivo kinematics of a three-component mobile-bearing TAA by 3D-evaluation of fluoroscopic imaging of ankle motion.

METHODS
Five ankles (5 patients) implanted with a three-component mobile-bearing TAA (FINE Total Ankle System, Nakashima Medical, Japan; Fig. 1) were studied. Fluoroscopic images were obtained while each patient moving the implanted ankle without weight-bearing, maximal dorsiflexion and plantarflexion, as well as while walking with full weight-bearing on the implanted ankle. Thereafter tibio-talar motion was analyzed by 2D/3D registration technique, a reproduction method of the spatial position of each component in TAA from single-view fluoroscopic images by use of computer-assisted design (CAD) models. (Fig. 2,3).

We evaluated the dorsi-plantarflexion angle, internal/external rotation angle, inversion/eversion angle and anteroposterior translation between the components.

RESULTS
Average tibio-talar motion without weight-bearing on the implanted ankle was 14.9 ±11.6° of plantarflexion and 5.4±8.7° of dorsiflexion, with average internal/external rotation arc and average inversion/eversion arc were 2.2±0.6° and 4.5±4.1°, respectively (Fig.4). On the other hand, average tibio-talar motion in gait cycles with full weight-bearing on the implanted ankle was 5.9±15.7° of plantarflexion and 4.9±9.8° of dorsiflexion, while average internal/external rotation arc and average inversion/eversion arc were 4.4±1.5° and 2.9±0.8°, respectively (Fig.4).

In addition, the amount of AP translation was 4.5 ±1.7mm in non-weight bearing condition, and 3.3 ±1.8mm in walking condition (Fig.5).

Discussion and conclusion
Increased internal/external rotation was observed in gait cycles with full weight-bearing on the implanted ankle, suggesting that three-component mobile-bearing TAA could allow high demand of mobility, which could be thought similar to the kinematic pattern of the natural ankle.

References
4) Conti S. Foot Ankle Int. 2006;27:980–984.