



ORAL PRESENTATION

Open Access

How well can skin marker analysis detect the kinematics of a total ankle arthroplasty? - a comparison to videofluoroscopy

Renate List^{1*}, Hans Gerber¹, Mauro Foresti¹, Silvio Lorenzetti¹, Pascal Rippstein², Edgar Stüssi¹

From 3rd Congress of the International Foot and Ankle Biomechanics Community
 Sydney, Australia. 11-13 April 2012

Background

Previous *in vivo* studies on total ankle arthroplasty (TAA) kinematics were mainly performed using skin marker analysis, which has the drawback of skin movement artefacts [1]. A further limitation is the inaccessibility of the talus for attaching markers, thus the impossibility to distinguish tibiotalar from subtalar motion. So far it is not known how well skin marker analysis detects the kinematics of the TAA.

Materials and methods

The kinematics of 11 TAA participants were simultaneously analysed by skin marker and videofluoroscopic assessment during level gait (gt), walking up- (uph) and downhill (dnh). The fluoroscopic data analysis included

a 2D/3D registration (error < 0.2° in-plane, <1.3° out-of-plane) [2]. The markerset consisted of 4 rearfoot and 6 shank markers [3]. For both approaches joint rotations were described along the axes of the marker based joint coordinate system. As a descriptor of differentiation the maximal and the root mean square differences (max diff, RMS diff) between skin marker and fluoroscopic joint rotations were calculated over the whole stance phase. Besides, maximal ranges of motion (ROM) were compared using a paired t-test.

Results

Skin marker analysis significantly overestimated sagittal plane ROM of the TAA for 5(gt), 6(uph) and 6(dnh) and underestimated for 1(uph) and 2(dnh) subjects.

Table 1 RMS diff and max diff over the whole stance phase and ROM assessed by videofluoroscopy (fluoro) and skin marker analysis (skin). Mean and SD over all 11 subjects of sagittal (sag), frontal (front) and transverse (trans) plane rotations, * statistically significant difference between fluoro and skin (p<0.05).

		Level gait			Uphill			Downhill											
		Sag	Front	Trans	Sag	Front	Trans	Sag	Front	Trans									
RMS diff [°]	Mean	1.5	2.0	2.9	1.5	2.4	2.8	1.7	2.0	3.0									
	± SD	± 0.7	± 0.9	± 1.0	± 0.6	± 1.4	± 1.2	± 0.6	± 0.9	± 1.2									
Max diff [°]	Mean	3.9	4.9	6.8	3.6	5.1	5.7	4.3	4.5	5.7									
	± SD	± 1.7	± 2.5	± 2.7	± 1.8	± 2.8	± 2.2	± 1.7	± 1.9	± 1.9									
		Fluoro	Skin	Fluoro	Skin	Fluoro	Skin	Fluoro	Skin	Fluoro	Skin								
ROM [°]	Mean	10.0*	11.6*	2.9*	5.8*	8.1*	6.5*	9.6*	11.5*	2.5*	5.6*	6.6	6.8	13.1	14.7	3.0*	5.4*	7.7*	5.7*
	± SD	± 2.8	± 2.9	± 1.0	± 2.1	± 2.9	± 2.7	± 4.8	± 3.3	± 0.7	± 2.7	± 2.3	± 2.3	± 3.7	± 2.7	± 0.6	± 2.1	± 2.5	± 2.3

* Correspondence: rlist@ethz.ch

¹Institute for Biomechanics, ETH Zurich, 8093 Zurich, Switzerland
 Full list of author information is available at the end of the article

Frontal plane ROM was significantly overestimated for 7 (gt), 8(ugh) and 9(dnh) of the 11 subjects. Transverse plane ROM was for 2(ugh) and 2(dnh) subjects significantly overestimated, and for 3(gt), 1(ugh) and 7(dnh) subjects significantly underestimated by skin markers. For mean RMS diff, mean max diff and mean ROM see Table 1.

Conclusions

The differences between skin marker assessed rearfoot-shank and the fluoroscopic assessed isolated TAA motion were neither consistent between subjects, nor motion planes, nor conditions. For transverse and frontal plane rotations, the maximal differences were in the range of the maximal corresponding ROM. Discrepancies for the sagittal plane were smaller, but still for some subjects, ROM were significantly different.

Author details

¹Institute for Biomechanics, ETH Zurich, 8093 Zurich, Switzerland. ²Foot and Ankle Center, Schulthess Clinic, 8093 Zurich, Switzerland.

Published: 10 April 2012

References

1. Leardini A, Chiari L, Della Croce U, Cappozzo A: Human movement analysis using stereophoto-grammetry. Part 3. Soft tissue artifact assessment and compensation. *Gait Posture* 2005, **21**:212-225.
2. List R, Stacoff A, Foresti M, Gerber H, Stuessi E: An in vivo procedure to quantify 3D kinematics of ankle arthroplasties using videofluoroscopy. *J Biomech* 2008, **41**:S321.
3. List R, Unternährer S, Ukelo T, Wolf P, Stacoff A: Erfassen der Vor- und Rückfussbewegungen im Gehen und Laufen. *Sportmed Sporttraumatol* 2008, **56**:43-49.

doi:10.1186/1757-1146-5-S1-O35

Cite this article as: List *et al.*: How well can skin marker analysis detect the kinematics of a total ankle arthroplasty? - a comparison to videofluoroscopy. *Journal of Foot and Ankle Research* 2012 **5**(Suppl 1):O35.

Submit your next manuscript to BioMed Central
and take full advantage of:

- Convenient online submission
- Thorough peer review
- No space constraints or color figure charges
- Immediate publication on acceptance
- Inclusion in PubMed, CAS, Scopus and Google Scholar
- Research which is freely available for redistribution

Submit your manuscript at
www.biomedcentral.com/submit

