METHODS:

Twenty subjects were analyzed in vivo using video fluoroscopy. Ten subjects had a metal-on-metal (MOM) THA and ten subjects had a metal-on-polyethylene (MOP) THA. All THA subjects were implanted by the same surgeon and judged clinically successful (Harris hip scores >94.0). Each subject performed normal gait while under frontal fluoroscopic surveillance. The two-dimensional (2D) fluoroscopic videos were converted into 3D using a computer automated model-fitting technique (Figure 1) (Sarojak, 1998). Five distinct femoral head positions were defined in the femoral head reference frame and transformed in the acetabular cup reference frame. At various flexion angles, these five loci positions were located, tracked and plotted with respect to flexion angle and time (Figure 2).
RESULTS:

During stance phase of gait, subjects having a MOM THA did not experience tortuous vector pathways with points of self intersection, but in swing phase all subjects had at least one loci position that crossed the vector pathway it was producing (Figure 3). Similar to the MOM subjects, all MOP subjects did not experience a tortuous vector pathway during stance phase, but produced multiple vector crossings with points of self-intersection during swing phase. It also appeared that the subjects having a MOM THA produced larger vector pathways, thus were using more of the acetabular cup area (Figure 4).

DISCUSSION:

This is the first study to determine femoral head loci pathways under in vivo conditions. The results from this study, depicting non-uniform loci pathways, are significantly different than those previously reported under in vitro condition using hip joint simulators which reported less multidirectional wear vectors. Previous retrieval studies have reported that multi-directional wear vectors are present, which supports the findings of this study (Ramamurti, et al., 1996). Since polyethylene does not respond well to multi-directional wear vectors, the results from this study lead to a better understanding to polyethylene wear failure in THA. Therefore, wear may be enhanced due to creation of these multidirectional wear vectors or excessive loads due to eccentric femoral head pivoting. This data may be of value in hip simulation studies to better duplicate wear patterns observed in retrieval analyses along with an accurate load profile.
References:


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