

Title: Radiostereometric Analysis of Femoral Head Penetration in Cross-Linked Polyethylene in THR Patients

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Background:

In the young total hip replacement (THR) population limiting polyethylene liner wear is crucial to preventing premature implant failure. Highly cross-linked ultra-high molecular weight polyethylene (HXLPE) liners were designed to improve wear resistance of polyethylene liners. Radiostereometric analysis (RSA) provides highly precise measurements of liner wear. This study utilized RSA to characterize wear of conventional versus HXLPE liners up to five years following THR.

Methods:

This IRB-approved, prospective, randomized, blinded study, involved 46 patients with a mean age of 58 and BMI of 30. Each patient was double randomized to receive a conventional or HXLPE liner with an uncemented titanium mesh or tantalum trabecular metal cup. Both liners were prepared from compression-molded GUR 1050 resin without calcium stearate, while HXLPE liners undergo further e-beam irradiation and annealing. At the time of surgery, 1mm tantalum RSA markers were implanted around the liner periphery, femur and periacetabular bone. RSA examinations, Harris Hip, UCLA, WOMAC, SF-36 scores were obtained pre-operatively, post-operatively, at six weeks, six months and annually through five years.

Results:

All patients had statistically significant improvement in Harris Hip, WOMAC and SF-36 PCS scores following THR with no difference between cohorts. On RSA examination, of titanium shells, HXLPE liners revealed significantly lower femoral head penetration at each follow up except six weeks and six months ($p < 0.003$, Figure 1), and a significantly lower polyethylene wear rate compared to conventional liners from one to five years follow up (0.002 mm/year vs. 0.04 mm/year). Penetration in the radiodense tantalum shells was calculated by a novel fictive head measurement technique and showed similar results.

Conclusion:

In this young THR population RSA shows significantly less femoral head penetration in the HXLPE liners compared to conventional liners. Novel RSA techniques have been developed to determine polyethylene wear in patients.