Göteborg, 2026

Fixation and Migration in Total Hip Arthroplasty

Akademisk avhandling

Som för avläggande av medicine doktorsexamen vid Sahlgrenska akademin, Göteborgs universitet kommer att offentligen försvaras i R-aulan, Sahlgrenska Universitetssjukhuset, Mölndal den fredag 13 februari 2026, klockan 13:00

av Vasileios Angelomenos, leg läkare

Fakultetsopponent:
Professor Stephan Maximilian Herbert Röhrl
Universitetet i Oslo, Oslo, Norge

Avhandlingen baseras på följande delarbeten

I. Angelomenos V, Mohaddes M, Itayem R, Shareghi B. Precision of low-dose CT-based micromotion analysis technique for the assessment of early acetabular cup migration compared with gold standard RSA: a prospective study of 30 patients up to 1 year. *Acta Orthopaedica*. 2022 Apr 22;93:459-465.

II. Angelomenos V, Mohaddes M, Kärrholm J, Malchau H, Shareghi B, Itayem R. A prospective randomized study of Refobacin Bone Cement R versus Palacos R + G. *The Bone & Joint Journal.* 2024;106-B(5):435-441.

III. Angelomenos V, Shareghi B, Itayem R, Mohaddes M. Comparison of the CT-based micromotion analysis method versus marker-based RSA in measuring femoral head translation and evaluation of its intra- and interobserver reliability: a prospective agreement diagnostic study on 27 patients up to 1 year. *Acta Orthopaedica.* 2025 Jan 9;96:38–44.

IV. Angelomenos V, Shareghi B, Mohaddes M, Malchau H, Kärrholm J, Itayem R. Evaluating Precision, Accuracy, and Observer Reliability of CT-RSA in Measuring Implant Migration in Total Hip Arthroplasty: An In Vitro Study. *Submitted.*

SAHLGRENSKA AKADEMIN
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Fixation and Migration in Total Hip Arthroplasty

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Abstract

Early implant migration in cemented total hip arthroplasty (THA) is a strong surrogate for later aseptic loosening; thus, precise, repeatable micromotion measurements are central to safe, stepwise evaluation of new cements and emerging imaging methods. This thesis addresses two linked needs: (i) clinical and experimental validation of low-dose CT–based radiostereometric analysis (CT-RSA) compared to marker-based RSA (MBRSA), and (ii) RSA-based, randomized comparison of a reformulated gentamicin-loaded cement (Refobacin® Bone Cement R, 2016) versus the widely used Palacos® R+G.

Study I was a prospective sub-study that showed that CT-RSA matched MBRSA for assessing acetabular cup migration, with precision and method agreement within clinically relevant bounds at 1 year.

Study II was a single-centre randomized comparison of Refobacin® (2016) and Palacos® R+G, also examining two vacuum mixing systems. 2-year femoral stem subsidence, cement mantle quality, alignment, and patient-reported outcomes (PROMs) were similar across groups, no revisions occurred, and mixing system choice had no measurable effect.

Study III was a second prospective sub-study that found CT-RSA comparable to MBRSA for measuring femoral stem subsidence at 1 year, meeting a predefined minimal important difference. Moreover, CT-RSA demonstrated excellent intra- and inter-observer reliability.

Study IV was an experimental phantom study with controlled translations that confirmed near sub-tenth-millimetre precision and accuracy for CT-RSA and excellent observer reliability; performance was maintained even after coordinate-system transformation.

In conclusion, across clinical and experimental settings, CT-RSA provided cup and stem migration measurements comparable to MBRSA, with good clinically relevant precision and excellent intra-/interobserver reliability, while enabling a marker-free workflow. The reformulated Refobacin® Bone Cement R (2016 formula) performed equivalently to Palacos® R+G at 2 years with a force-closed stem and cement and mixing system choice did not influence migration or PROMs. Taken together, these studies support CT-RSA as a validated alternative for early migration surveillance in cemented THA and reaffirm the value of RSA-based, stepwise introduction when assessing new cements and measurement methods.

Keywords: Total hip Arthroplasty, Migration, Radiostereometric Analysis, CT-based, RSA, CT-RSA, Cement, Precision, Accuracy, Reliability, Agreement.

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