The Migration Pattern of a Cementless, Tapered, Plasma Sprayed Femoral Stem using EBRA-FCA

1White, C A; 1Carsen, S; 1Rasuli, K; 1Doucette, S; +1Beaule, P
+University of Ottawa, Ottawa, ON
pbeaule@ottawahospital.on.ca

Modern cementless press fit stems rely on early fixation and stability for osteointegration and longterm success with early migration increasing the risk of failure. The Ein Bild Roentegen Analyse Femoral Component Analysis (EBRA-FCA) methods allow accurate measurement of femoral stem subsidence without the need for Tantalaum markers [1]. The degree of subsidence of femoral stems in the first two years has been shown to be highly predictive of failure when using the cut off value of 1.5 mm. We aimed to measure the early migration pattern of a titanium alloy, tapered, plasma and Hydroxyapatite coated femoral stem and any factors associated with subsidence.

MATERIALS AND METHODS

Between January 2005-June 2007, 387 Accolade cementless femoral stems (Stryker, Allendale NJ) were implanted at our institution by six surgeons. Seventy-seven had a minimum of two years post operative follow up and a complete set of pre and postoperative radiographs for analysis. Other patients were excluded because of an insufficient number AP radiographs to perform EBRA-FCA migration analysis, which requires a minimum of 4 as well as being implanted prior to digitization of our radiology department. Our group: 45 females with a mean age of 71.4 years and 32 males with a mean age of 68.5 years. The primary diagnosis was degenerative osteoarthritis in 71 patients, avascular necrosis in 2, and post fracture in four patients. There were 38 right hips and 39 left. The average BMI was 27.1. There were no complications requiring significant intervention or revision.

The pre operative radiographs were assessed by a single investigator using a digitised x-ray archiving system (Horizon Rad 11, McKessen Technologies) and the inbuilt measuring tools. The pre operative films were measured to quantify the canal index to assess bone quality and the canal calcar index to assess the proximal femoral morphology. We used the method described by Dorr et al [2] which measures endosteal size at a point 10 cm below the lesser trochanter and at the mid trochanteric line.

Immediate postoperative radiographs were used to assess the canal fill of the prosthesis and implantation varus/valgus angles. The EBRA-FCA software was then used to obtain migration curves for each stem and calculate migration for each at two years and beyond.

Best fit curve of subsidence over time was calculated and the data was also analysed using a Kaplan Myer survivalship analysis using 1.5 mm of subsidence as an endpoint. We then carried out a multivariate and univariate regression analysis to look for predictors of subsidence within the group.

RESULTS

The mean follow up was 29.3 months (24-48). The mean canal index was 0.55 (0.36-0.68) with a mean canal calcar index of 0.54 (0.39-0.79). 43 femora were classified as champagne flute (canal index 0.5-0.55), 31 were classified as normal (0.56-0.75) and 3 were classified as stove pipe (>0.76). The average angle of implantation was 0.4° of varus (-4 - 4). The average canal fill index at the midpoint of the stem was <0.8 in 37 stems and >80 in 40 stems.

A total of 414 radiographs were analysed for the EBRA measurements. Of these 21(5%) were discarded by the software as they did not meet the criteria for compatibility. This lead to the exclusion of 7 patients, leaving the final study group of 77. All remaining patients had a minimum of 4 radiographs with an average of 4.6 for analysis. The average subsidence at 24 months was 2 mm and this had risen to 2.4 mm by 36 months postoperatively. When analysed using a Kaplan Meier curve using 1.5 mm as an end point we found a survivorship of 63.4% (52.3-74.5) at 24 months and this had worsened to 41.6% (26.6, 56.5) by 36 months.

Multivariate and univariate regression analysis of measured variables did not reveal any significant hazard for any factor other than stem size. The hazard ratio for age, sex, BMI, canal index, canal calcar index, canal fill and varus/varus angle were 1.04 (1-1.08), 1.11 (0.51-2.43), 1.07 (1-1.15), 0.96 (0.89-1.03), 1.01 (0.95-1.08), 1.63 (0.76-3.5) 0.84 (0.65-1.1), respectively. Stem size returned a hazard ratio of 0.37(0.13-1.09).

DISCUSSION

RSA remains the gold standard in assessing early implant fixation with an accuracy of 0.2 mm, however it has to be done in a prospective fashion whereas the EBRA-FCA method has been shown to provide an accurate and reproducible measurement and can be done in a retrospective fashion but it requires a minimum of 4 radiographs. Although several cementless tapered stem designs (i.e., TAPERLOC, TRILOCK & CLS) have had an excellent track, our migration analysis of the Accolade stem is somewhat concerning [3]. 33% of stems had reached the 1.5 mm subsidence point by two years and continued to subside beyond this with no evidence of secondary stabilisation. This is of concern as work has previously shown this to predict failure of stems with aseptic loosening at 10 years with an accuracy of 79% [4]. If these stems go on to fail at the predicted rate this would represent an unacceptably high level of failure. Our study group had just under half of the stems which could be deemed as under filled however this did not prove to be an influence on the subsidence rate. Several previous studies of anatomic femoral stems have been published with similar canal fill averages and shown no difference in outcome [5]. We were unable to find any other significant factors within our study group that might explain such a high rate. More importantly, because no survivorship data has been published on the Accolade stem, our data raises serious concerns about the overall clinical performance of this stem design due to poor initial stability and integration. We recognize the limitation of our study in terms of being a purely radiological study and the subsidence has not led to revision in any of the study group. We are continuing clinical follow up and evaluation to see how many of these stems will go on to revision.