UNCEMENTED FEMORAL STEMS
STUDIES ON PERIPROSTHETIC BONE REMODELLING AND PREVENTION OF BONE LOSS IN TOTAL HIP ARTHROPLASTY

Akademisk avhandling
som för avläggande av medicine doktorsexamen vid Karolinska Institutet offentligen försvaras i aulan, Danderyds sjukhus,

Fredagen den 17 december, 2010, kl 13.00
av Olof Sköldenberg

HUVDHANDLEDARE:
Doc. Per Adolphson
Karolinska Institutet
Institutionen för kliniska vetenskaper,
Danderyds Sjukhus,
Enheten för ortopedi

BIHANDLEDARE:
Doc. Torbjörn Ahl
Karolinska Institutet
Institutionen för kliniska vetenskaper,
Danderyds Sjukhus,
Enheten för ortopedi

FAKULTETSSOPPONENT:
Prof. Johan Kärreholm
Göteborgs universitet, Sahlgrenska akademin,
Institutionen för kliniska vetenskaper,
Enheten för ortopedi

BETYGSNÄMND:
Prof. Sune Larsson
Uppsala universitet,
Institutionen för kirurgiska vetenskaper,
Sektionen för ortopedi

Doc. Jan Tidermark
Karolinska Institutet
Institutionen för klinisk forskning och utbildning,
Södersjukhuset,
Enheten för ortopedi

Doc. Per Wretenberg
Karolinska Institutet
Institutionen för molekyler medicin och kirurgi
Enheten för ortopedi

TREDJE OPPONENT:
Fil. kand. Mattias Konnebäck
Länsjukhuset i Kalmar
Introduction
Tapered uncemented femoral stems are popular implants in total hip arthroplasty (THA). They are easy to use and excellent long-term results have been reported for patients with primary osteoarthritis of the hip (OA).

The disadvantages of these devices include post-operative periprosthetic bone loss, the clinical importance of which is still uncertain, and an increased risk of early periprosthetic fractures. These stems rely on initial primary stability to achieve biological fixation to bone. Poor bone quality, such as in patients with previous surgery of the hip or osteoporosis, is therefore generally considered to be a contraindication.

Hypotheses
We hypothesized that (1) femoral periprosthetic bone loss occurs after implantation of these devices and is related to the stem size used as well as the pre-operative bone mineral density (BMD) of the hip, (2) that femoral hip revision surgery using these implants is a reliable procedure with predictable mid-term results despite compromised proximal femoral bone stock prior to revision, (3) that a bisphosphonate will reduce the femoral periprosthetic bone loss and finally (4) that a tapered, uncemented, hydroxyapatite-(HA) coated femoral stem can provide durable fixation and good clinical outcome in elderly patients with osteoporotic fractures of the femoral neck.

Materials and methods
Two similar tapered uncemented HA-coated femoral stems were used in the studies. Bone mineral density (BMD) was measured using Dual-energy X-ray Absorptiometry (DXA), migration was assessed using radiostereometry (RSA) and Einzel-Bild-Röntgen-Analyse (EBRA). Clinical outcome was evaluated using the Harris hip score (HHS) and health related quality of life (EQ-5D).

Results
STUDY I
In a retrospective study, a single cohort of 138 patients with a unilateral THA was examined 3 years after surgery with DXA. It was found that periprosthetic proximal bone loss was related to stem size. Patients with the larger stem sizes lost more bone than patients with smaller stems.

STUDY II
In a retrospective analysis of 60 patients, who were examined 6 years after uncemented femoral stem revision surgery due to aseptic loosening, we found a 95% survival rate of the stem and no cases of aseptic loosening. We also noted that all stems were stable according to radiological parameters and that the clinical outcome was acceptable.

STUDY III
In a randomized, double-blind, placebo-controlled trial of 73 patients with hip OA, risedronate was given once weekly for 6 months following THA surgery. Risedronate reduced the proximal femoral bone loss by 7% up to 12 months post-operatively. In both groups, patients with a low pre-operative BMD lost significantly more bone than patients whose initial BMD was high.

STUDY IV
In a prospective single-cohort study of 50 cognitively intact elderly patients operated with a new HA-coated stem due to a displaced FNF, we found stable stems after 3 months. We also found a continuous decrease in BMD around the stems up to 2 years after surgery. Patients with osteoporosis lost more bone than patients with a normal BMD.

Conclusions
Periprosthetic bone loss after THA can be reduced with bisphosphonate treatment. Future studies on prevention of bone loss after THA should focus on patients who have a low pre-operative BMD of the hip.

An uncemented, tapered HA-coated stem can be used successfully for elderly patients with osteoporotic fractures of the femoral neck. Further studies are needed to ascertain whether uncemented femoral stems are superior, equivalent or inferior to cemented stems in the treatment of FNFs in the elderly.

KEYWORDS
Total hip arthroplasty, Uncemented, Stem size, Bone remodelling, Stress-shielding, Hydroxyapatite, Osteoarthritis, Femoral neck fracture, Dual-energy X-ray Absorptiometry, Radiostereometry, Clinical outcome