Primary Implant Stability of a Bone Preserving Hip Prosthesis and the Effect of a Collar

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Introduction

- A new short fit-and-fill stem with a broached-only cavity should lead to endosteal stability with preservation of bone and soft tissues.
- A collar might provide stability in case of a compromised press-fit.
- Initial stability is critical to prevent aseptic loosening of the femoral component.
- The aim of this study was to compare the stability of the new implant system with a clinically established stem with a similar endosteal design. The influence of implant sizing was studied.

Methods

- Three implants: Two new short stem designs (one collared and one collarless), one clinically established (Figure 1).
- Stems implanted in n=5 paired cadaveric femora, with one side correctly sized and the other prepared and implanted 1 size too small.
- Loaded with up to 2100N (one-legged stance phase of gait) for 15,000 cycles at 2Hz (Figure 2).
- Relative translation and rotation measured between implant and bone (optical cameras).
- Implant migration, cyclic motion amplitude and fracture force output.

Results

- Migration (mean and variation) were lowest for the short collared stem and greatest for the long stem (Figure 3).
- The mean cyclic amplitude was lowest for the short stem without collar (Figure 3).
- Mean force to failure was greatest for the short collared stem; least for the long stem (Figure 4).
- For the short collarless prosthesis, the force to failure was always less for an undersized implant than for a correct fit (Figure 5).
- No clear effect of undersizing on displacements between short stem with a collar and short stem without collar. Less effect of undersizing for long stem than short stems (Figure 5).
- Note that differences were not statistically significant. None of the output magnitudes was significantly related to bone density.

Figure 1

Figure 2 – Displacement measured between Stem and Bone using optical markers. Output in Head Coordinate system (CS)
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Discussion
- The short stem with and without collar could be expected to perform at least as well as the clinically successful long stemmed implant in terms of primary stability.
- A medial collar may result in a more consistent and reproducible initial post-operative stability (relative translation and rotation magnitudes) for short fit-and-fill implant.
- Short fit-and-fill stems, intended to enable muscle-sparing surgical approaches may, with correct implantation, achieve or exceed stability metrics of a longer stem design currently in clinical use.