Introduction

Trochanteric fractures are common in the elderly osteoporotic patient population. There is a significant morbidity and mortality rate of 18% in the first year following operative treatment (1). Although fracture stability is crucial for rapid bone repair, poor bone quality remains a surgical concern that must be given priority when choosing the type of implant. Screw loosening is a common cause of fracture malunion and nonunion, particularly in osteoporotic bone. Because of this, fixation augmentation techniques such as the use of hydroxyapatite (HA)-coated screws have been recommended for treatment of fragility fractures. Another innovative approach to enhance implant fixation is bisphosphonate therapy. Animal studies have shown that alendronate (ALN) inhibits bone resorption at the bone-screw interface thereby enhancing fixation (2). However, no clinical data is yet available. We thought that fixation with HA-coated screws might be further improved by postoperative alendronate therapy in osteoporotic pertrochanteric fracture patients.

Methods

Sixteen consecutive patients with AO/OTA A1 pertrochanteric fractures were selected. Inclusion criteria were: female over the age of 65, BMD T-score less than -2.5 SD. Fractures were fixed with a pertrochanteric fixator and 4 hydroxyapatite (HA)-coated screws. Two screws were implanted in the femoral head (screw positions 1 and 2) and two in the femoral diaphysis (screw positions 3 and 4). Patients were randomized to either postoperative systemic administration of ALN, 70 mg per week for 3 months (Group A) or no ALN (Group B). Fixators were removed at 3 months post-op in all patients. In our study, for biomechanical evaluation of pin fixation, after the implantation of the four pins is complete, the fixator is temporarily removed in order to measure pin insertion torque and then remounted. The instrumentation used to measure pin insertion torque is identical to the instrumentation used in our previous studies (3). At fixator removal, the same instrumentation is used to measure pin extraction torque.

Results

All the fractures healed. No differences in screw insertion torque between the two groups were found. No pin loosening or infection occurred. The combined mean insertion torque of the pins implanted at positions 1 and 2 was 1736 ± 581 N/mm in Group A and 1382 ± 626 N/mm in Group B (ns). The combined mean extraction torque of the screws implanted at position 1 and 2 (cancellous bone) was 3181 ± 1385 N/mm in Group A and 1890 ± 813 N/mm in Group B (p < 0.001). The combined mean extraction torque of the screws implanted at positions 3 and 4 (cortical bone) was 4327 ± 1720 N/mm in Group A and 3785 ± 1181 N/mm in Group B (ns). [Figure 1]

Implant loosening is one of the major problems in both trauma and reconstructive surgical procedures. Upon bone implantation of screws and joint prostheses, bone matrix and cells are damaged and an inflammatory response occurs. Around a recently inserted implant there is osteocyte apoptosis and osteoclast activation with a risk for rapid bone resorption, fibrous tissue formation and consequently deterioration of implant fixation (4).

Our results indicate a two-fold fixation increase in the screws implanted in the cancellous bone of the femoral head. Screw fixation in cancellous bone was also higher than previously observed in a similar study of Orthofix pertrochanteric fixator and HA-coated screws in which alendronate was not administered (3). With cortical bone, the difference in fixation between the treated patients and the control group was less marked. We believe that this is because of the very high fixation achieved by the HA-coated screws alone in cortical bone. In our study the longer period of alendronate administration (3 months) could also be another factor responsible for the absence of a significant increase of fixation for the screws implanted in cortical bone. We maintain that with osteoporotic bone, the need of improving cancellous bone fixation is certainly more significant than cortical bone because implant loosening in cancellous bone is by far more frequent than in cortical bone. Concerning the local delivery of bisphosphonates as a means to improve implant fixation, we believe that this is certainly a very attractive and effective solution however it does not address the special needs of the osteoporotic patient and in particular the restoration of the bone quality.

Conclusion

This is the first study to demonstrate in a clinical setting improved screw fixation following post-operative ALN treatment. We observed a two-fold fixation increase in the screws implanted in cancellous bone. With cortical bone, the difference in screw fixation was less marked. Besides its bone preserving ALN should be recommended as an effective solution to improve fixation in osteoporotic bone.

References

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Figure 1. PIN EXTRACTION TORQUE AT 3 MONTHS

Discussion