Is There a Future for Femoroplasty in Hip Fracture Prevention? Introducing Anisotropy Restoring Femoroplasty

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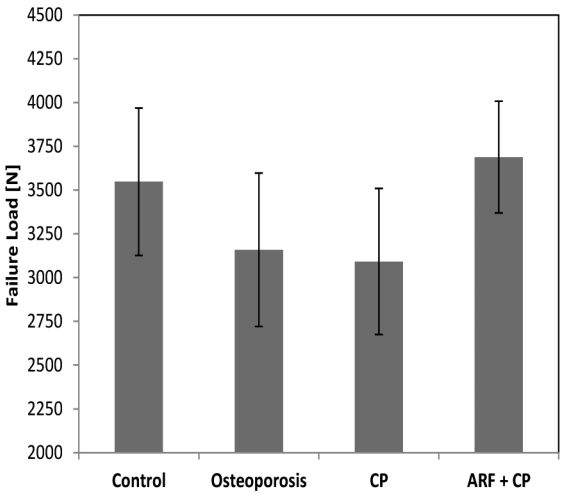
Background/Purpose: There are presently no standard of care interventional procedures aimed at preventing hip fracture occurrence in geriatric patients. Prior work on femoroplasty has focused on attempts to increase fracture resistance of the osteoporotic proximal femur by insertion of polymethylmethacrylate (PMMA), or other polymeric isotropic fillers. Results thus far have been inconsistent and no method has been adopted clinically. We introduce Anisotropy Restoring Femoroplasty (ARF), a technique that aims to mimic proximal femur anisotropy as defined by trabecular architecture. ARF combines linear structural elements with calcium phosphate (CP) filler to result in increased overall fracture resistance and improved stiffness matching.

Methods: A proof of concept pilot study was performed in which a minimally invasive intraosseous ARF device prototype was designed and tested in a cadaveric porcine proximal femur model to test whether ARF is a viable option for hip fracture prevention. Four groups of 6 porcine proximal femurs each—(1) normal control, (2) detrabeculated and partially decalcified (simulated osteoporotic), (3) simulated osteoporotic with CP isotropic femoroplasty, and (4) simulated osteoporotic with ARF device plus CP—were instrumented and tested to failure to quantify maximum load tolerance and construct stiffness.

Results: Insertion of the ARF device plus CP restores load to failure and stiffness of the proximal simulated osteoportic pig femur model to nearly normal values when tested to failure. The simulated osteoporotic group and the CP femoroplasty reinforced group (without ARF) exhibited similar failure load and stiffness, both significantly below the control group and the simulated osteoporotic group reinforced with the ARF device plus CP ($P < 0.05$ for both cases).

Conclusion: In this proof of concept pilot study, Anisotropy Restoring Femoroplasty results in increased fracture prevention potential when compared with traditional isotropic femoroplasty. A future minimally invasive procedure that effectively improves fracture resistance in osteoporotic proximal femur could result in a significant reduction of mortality, morbidity, and cost associated with geriatric hip fracture care.



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