Cement Reinforcement for the Stabilization of Osteoporotic Bone

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Background: Cement augmentation is an emerging surgical procedure to improve the strength osteoporotic vertebrae to reduce the incidence of osteoporotic vertebral fractures. Drug therapy for osteoporosis reduces long-term bone mineral loss, but cement augmentation provides immediate benefits. To this point, there is only a limited understanding of what physical properties an ideal bone cement should offer. Today mainly acrylic, but increasingly calcium-phosphate cements are used for augmentation. Much needs to be refined regarding the current surgical techniques. Potential complications such as cement leakage harming vascular or neural structures, heat necrosis or cement embolism must be avoided. Optimal instruments along with standardized surgical techniques and more vigilant monitoring of the cement infiltration process would lower the risk of complication while improving the mechanical result of a cement augmentation.

Research Objectives: Our research objectives are: **(1)** Establish objective guidelines for the cement choice comparing the rheological, static, thermal, and handling properties of different acrylic and ceramic cements; **(2)** Characterize of the flow permeability of osteopenic cancellous bone for different cements and different degrees of bone mineral loss; **(3)** Merge computational and experimental methods to characterize cement flow through osteoporotic vertebrae and predict optimal injection regimes (canula design, injection pressure, flow rate); and **(4)** Identify adverse subsequent biomechanical effects of cement augmentation (e.g., load shift) using computational methods.

Significance of Research: The aging Western population has an increased incidence of osteoporotic bone fractures. Adequate treatment is often difficult because conventional internal fracture fixation fails to be sufficiently anchored. No reasonable treatment exists for the progressive kyphotic deformity following repetitive osteoporotic spine fractures. Cement augmentation is the key to preventing osteoporotic fractures. The potential gain in quality of life for millions of elderly people, who today suffer from osteoporotic bone fractures resulting in physical immobility and loss of independence and self-esteem, would be very significant. Prevention of osteoporotic vertebral fractures could potentially save billions of health care dollars.