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Is rapid bone loss captured by bone shape in spinal cord injury patients?

Introduction: Spinal Cord Injury (SCI) can trigger bone loss below the level of injury. Bone loss and fractures most commonly occur at the distal femur and proximal tibia and are associated with significantly increased morbidity. Bone loss following SCI has been shown to vary between 0 and 40% in the first year, with no current biomarkers to predict who will suffer severe bone loss. Standard osteoporosis treatments are risky for SCI patients and most effective in the early stages, therefore early identification of those at greatest risk is desirable.

Active Shape Modelling (ASM) is a statistical technique for modelling bone morphology that predicts postmenopausal hip fractures. SCI can be considered an accelerated model of osteoporosis progression, and biomarkers for bone loss in SCI may be applicable to those at high risk of developing osteoporosis in the general population.

This study investigated whether ASM predicts SCI-associated bone loss.

Material and Methods: 25 patients with motor complete SCI (aged 16-76 years, 21 male and 4 female, 10 paraplegic and 15 tetraplegic) were scanned at the distal femur and proximal tibia using peripheral quantitative CT (Stratec Medizintechnik GmbH) at <5weeks, 4, 8 and 12 months post-injury. An ASM was made for each site. Links between 7 shape-modes (defined as standard deviations from the mean shape) and 12 month BMD loss were analysed using multiple linear regression (SPSS V21).

Discussion: One mode from each ASM significantly predicted bone loss after adjustment for age ($P < 0.05$). High mode 4 femur scores showed a taller and narrower intercondylar notch. A +1 score was associated with an additional 6% BMD loss at 12 months. High tibia mode 1 scores represented a flatter tibial tuberosity. A +1score at baseline was associated with an additional 7% loss of BMD at 12 months.

Conclusion: This is the first study to use ASM to predict bone loss. Baseline bone shape predicts 12-month bone loss in SCI patients. This imaging biomarker may help in early identification, treatment and prevention of SCI osteoporosis, with wider implications for postmenopausal osteoporosis.