

Intensive Electrical Stimulation Attenuates Femoral Bone Loss in Acute Spinal Cord Injury

ABSTRACT

Objective: To determine whether intensive electrical stimulation (ES) can reduce femoral bone mineral density (BMD) loss in acute spinal cord injury (SCI).

Design: Randomized controlled trial.

Setting: Inpatient rehabilitation hospital.

Participants: Twenty-six subjects with C4 to T12 American Spinal Injury Association Impairment Scale A or B SCI less than 12 weeks post injury.

Methods: The control group received usual rehabilitative care and the intervention group received usual care plus 1 hour of ES over the quadriceps 5 days per week for 6 weeks.

Main Outcome Measurements: Outcome measurements were collected at baseline, post-intervention (interim), and 3 months post injury (follow-up), and included dual energy x-ray absorptiometry, serum osteocalcin (OC), and urinary N-telopeptide (NTx).

Results: In the control group, there was increasing BMD loss with distance from the spine (lumbar -1.88% , hip -12.25% , distal femur -15.15% , proximal tibia -17.40%). This trend was attenuated over the distal femur in the ES group (lumbar -1.29% , hip -14.45% , distal femur -7.40% , proximal tibia -12.31%). NTx increased over the 3 assessments in controls ([mean \pm standard deviation] 115.00 ± 34.10 , 154.86 ± 70.41 , and 171.33 ± 75.8 nmol/mmol creatinine) compared with the ES group (160.56 ± 140.06 , 216.71 ± 128.40 , and 154.67 ± 69.12 nmol/mmol creatinine)—all of which were elevated compared with the reference range, and the differences between the 2 groups were not significant. Osteocalcin levels markedly decreased in the control group (12.90 ± 7.30 , 24.00 ± 4.29 , and 6.40 ± 7.28 $\mu\text{g/L}$) to subnormal levels, and remained stable and in the normal range in the ES group (13.80 ± 7.64 , 11.86 ± 6.77 , and 14.80 ± 12.91 $\mu\text{g/L}$), although differences between the groups were not significant.

Conclusions; Lower extremity BMD loss increases with distance from the spine. An intensive lower extremity ES program may attenuate BMD loss locally after acute motor complete SCI, although it is unknown whether these benefits are maintained in the long term.