Effect of Strontium Citrate on Bone Consolidation During Mandibular Distraction Osteogenesis

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Introduction

• Distraction osteogenesis is a surgical procedure used in craniofacial surgery to alleviate upper airway obstruction.
• Performed by making an osteotomy and gradually distracting the bone, allowing new bone formation
• Prolonged healing phase increases risk of complications
• Strontium Citrate has been shown to improve bone formation in osteoporotic patients
• Objective: Assess the effect of Strontium Citrate on bone consolidation in a rabbit model

Methods

• 20 New Zealand White Rabbits

  • Each rabbit randomized to control (normal diet) and study (normal diet + strontium citrate)
  • Surgery performed

  • 7-day latency period
  • 5-day distraction period (mm total)
  • 4 week consolidation period

  • Microscopic analysis
  • Histological analysis
  • Mechanical joint testing

Procedure

• Performed under general anesthesia
• Double exposure, osteotomy created
• External distraction device secure with self tapping screws
• Wound closed in 2 layers around distraction device

Results

Macroscopic Evaluation

• 18/20 appeared well healed
• Consolidated distraction gap was more similar to native adjacent bone in the study group

Mechanical 3 point bend test

• Statistically significant increase in maximum load in study group

Radiographic Analysis

• 3D Microradiographic tomography/ bone mineral density
• Statistically significant increase in mean density of bony regenerate in study group (expressed as % similar to normal bone)
• Evidence of more mature bone formation on 3D CT in study group

Histologic Analysis:

• Control: new bone was immature, with sparse trabeculae separated by callous tissue (left panel)
• Study: new bone histologically indistinguishable from native bone (right panel)
• Similar findings on H&E and Masson’s trichrome staining

Conclusion

• Strontium citrate effectively accelerated new bone formation in a rabbit model of mandibular distraction osteogenesis
• Oral intake of strontium citrate may be a possible strategy to enhance bone regeneration in distraction osteogenesis
• Prior to human use, further testing using different doses of strontium citrate, with varied distraction and consolidation periods are needed to determine the most favorable regimen for maximal bone regeneration

References