THE EFFECTS OF A SINGLE INJECTION OF OP-1 ON STIMULATING OF NEW BONE FORMATION IN DISTRACTION OSTEONEOSIS IN THE RABBIT.

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INTRODUCTIONS: The objective of this work is to attempt to accelerate the consolidation of newly formed bone at the lengthened site with the use of a single injection of Osteogenic Protein-1 (OP-1) at the lengthened site at the end of the distraction phase.

MATERIALS AND METHODS: Thirty-three (33) white New Zealand rabbits, weighing 3 to 3.5 kilograms, 9 months old, were used in this study. Under general endotracheal anaesthesia and sterile techniques, an Orthofix M-100 unilateral fixator was applied to the right tibia by means of four screws. An osteotomy was performed at the middle of the tibia between the screws. Following a delay of seven days, distraction was started at 0.5 mm every twelve hours for three weeks. This was followed by another three weeks of consolidation time. [1] All rabbits were sacrificed at six weeks post-start of lengthening. The rabbits were divided into five groups: Group 1 (n=9) – control – simple lengthening; Group 2 (n=6) – placebo – only the acetate buffer injected; Group 3 (n=4) – OP-1 at a dose of 80 micrograms (µg) injected in acetate buffer; Group 4 (n=8) – OP-1 at a dose of 800 µg injected in acetate buffer; Group 5 (n=6) – OP-1 at a dose of 2000 µg injected in acetate buffer. All the injections, OP-1 and the placebo, were done three weeks after the start of distraction and under image intensifier. For the assessments of the consolidation, we used radiological examination, densitometry studies, biomechanical testing and histological studies. For the densitometry studies, DEXA was performed using a Hologic QDR 2000W device (Hologic, Inc., Waltham, MA) and bone mineral content (BMC) and bone mineral density (BMD) were determined in the lengthened zone. The mechanical testing was performed in uniaxial tension using MTS 858 machine (MTS System, Eden Prairie, MN). In the histological studies, samples were embedded undecalcified in methylmethacrylate, and stained with toluidine blue and Goldner Trichrome. Differences between treatment groups in densitometry and biomechanical results were tested for significance using analysis of variance (ANOVA). p<0.05 was considered significance.

RESULTS: Radiology. Three weeks after the elongation, the control and placebo groups had a wide radio-lucent area in the distraction site. Even the 80µg and 800µg groups still had a narrow radio-lucent line and the complete bone bridging has not been seen. However, in 2000µg group, the radio-lucent line has already been diminished, and the bone bridging was completed. (Fig. 1)

Mechanical testing. Only the highest dose of OP-1 at 2000 µg gave statistically significant results (p<0.05). There was a 45 percent increase in ultimate load to failure when tested in uniaxial tension in the group where 2000 µg OP-1 was injected. (Table 2, Fig.2)

DISCUSSION: This work showed that a single injection of OP-1 at 2000 µg significantly increases the biomechanical properties of lengthened bone compared to a control group without injection of OP-1. These results show the potential beneficial effect OP-1 could have in accelerating new bone formation in cases of distraction osteogenesis. [2] This could lead to a diminished length of time the fixator would be kept on and therefore minimize many of the complications associated with this procedure.

REFERENCES:

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