ROLE OF PERIOSTEUM AND BONE MARROW IN LENGTHENING: A QUANTITATIVE STUDY IN RABBITS USING DXA

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INTRODUCTION: This study values quantitatively the bone formation due to periosteum and/or bone marrow-endosteum in distraction osteogenesis.

MATERIALS AND METHODS: Sarcal procedure. One femur of 18 NZW 2.4-3.0 kg rabbits was fitted with a custom-made external fixator (contralateral one-control). Periosteum (P) and bone marrow (BM) were treated, according to their preservation (+) or destruction (-): P+ : P elevated; P- : P stripped from the bone; BM+ : corticotomy; BM- : marrow cavity filled with PMMA. 4 surgical groups were individualized: 1) P+BM+ (5 animals); 2) P+BM- (5); 3) P-BM+ (5); 4) P-BM- (3). From POD 5, femora were lengthened 0.25 mm/day until POD 25. At sacrifice on POD 30, femora were harvested with a 0.5-1 mm muscle layer. Dual energy x-ray absorptiometry study (QDR1000, Hologic). The area, bone mineral content (BMC) and density (BMD) were calculated. Femora were divided into 5 regions of interest (operated), or 4 (control), as shown below. Statistical study (JMP V2.0, SAS). Values (% obtained = [op. femur/area] - [non-op. femur/area] x 100) were transformed (arcsec). The P effect (P+ vs. P-), without considering the role of BM, was compared. BM effect on BMC and BMD was compared. ANOVA and MANOVA tests were used to analyze differences between groups.

RESULTS: X-ray evaluation: BM forms bone around the distraction area. P spreads new bone almost entirely along the diaphysis, PBM+: no bone deposition is seen around the distraction gap, nor in the muscle. Percentage increase in area, BMC & BMD with respect to the contralateral bone : Table I. Statistical analysis on the transformed data : Table II. The comparison of surgical groups showed a significant difference for area (p<0.0008), BMC (p<0.0004) & BMD (p<0.004) in the whole specimens. Tukey-Kramer test : significant differences between surgical groups 1 and 3, 2 and 4. For the 3 central regions, similar results, but greater significant difference (p<0.0001, area, BMC, not BMD).

CONCLUSION: A synergistic effect (spatial and qualitative) may result from the combination of periosteum and bone marrow-endosteum in bone healing.

ACKNOWLEDGMENTS: Johnson & Johnson Professional, Inc. RF.


DISCUSSION: Quantitatively, the P contributes more than the BM to new bone formation in distraction osteogenesis. The interaction between P and BM is significant. The spatial distribution of the bone formed is different for P and BM: BM deposits new bone around itself, at the fracture or distraction site, and P forms bone along the elevated P and covers a huge area. P spreads new bone almost entirely along the diaphysis, PBM- : no bone deposition is seen around the distraction gap, nor in the muscle.

CONCLUSION: This analysis demonstrates reverse screwhome rotation can occur, most commonly after PCR TKA. This may be related, in part, to abnormally anterior femoral translation during flexion that has been observed in previous in vivo kinematic studies. Reverse screwhome rotation is potentially detrimental, enhancing the risk of patellofemoral instability, and premature polyethylene wear.


ACKNOWLEDGMENTS: Johnson & Johnson Professional, Inc. VF.