IMPROVEMENT OF THE BONE PIN INTERFACE STRENGTH IN OSTEOPOROTIC BONE USING HYDROXYAPATITE-COATED TAPERED EXTERNAL FIXATION PINS. A PROSPECTIVE RANDOMIZED CLINICAL STUDY IN WRIST FRACTURES.

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Introduction: Progressive deterioration of the bone pin interface strength is the major drawback of external fixation and occurs even in absence of pin loosening and infection. This deterioration has been observed in all the biomechanically tested external fixation standard pin types and is caused by fibrous tissue interposition at the bone pin interface (1, 2, 3). A significant improvement in the bone pin interface strength and a lower incidence of pin loosening and infection has been recently demonstrated with tapered external fixation pins coated with hydroxyapatite (HA) in both animal and clinical studies (4,5). Morphological observations showed direct bone to pin contact without any fibrous tissue interposition (4,5). Given that a good bone purchase of external fixation pins is particularly difficult to achieve in the osteoporotic bone, in this study we address the question whether a similar improvement can be achieved in elderly osteoporotic patients.

Methods: Twenty female osteoporotic patients with wrist fractures were selected. Patients were divided into two paired groups and randomized to receive either standard (uncoated) tapered pins (Group A) or hydroxyapatite coated tapered pins of the same diameter (Group B). Hydroxyapatite coating thickness ranged from 30 to 60 µm and roughness was Ra=6.5±2 µm. Inclusion criteria were: female, age ≥ 65 years, AO type A2 or A3 wrist fractures, informed consent, and bone mineral density at the controlateral distal radius lower than -2.5 T score. A Pennig II wrist fixator with two pins in the distal radius and two in the second metacarpus was applied. All frames were removed six weeks after surgery. Pin insertion torque was measured during surgery and the pin extraction torque was measured at the end of the treatment. Pin track infection was graded according to Checketts and Otterburn’s classification (6). After removal, selected pins were examined microscopically and a few small bone particles were seen attached to the coating.

Results: Average patient age was 75±6 years in Group A and 74±7 years in Group B. Mean final pin insertion torque was 461±254 Nmm in Group A and 331±175 Nmm in Group B, (p=0.01). Mean pin extraction torque was 191±154 Nmm in Group A and 600±214 Nmm in Group B, (p=0.0005). In Group A, the pin extraction torque was lower than the corresponding insertion torque (p=0.0005), while in Group B it was higher than the corresponding insertion torque (p=0.0005). In Group A there were two Grade 1 pin track infections, while in Group B there were none. Pain during pin removal did not differ between groups. No exposure of the metallic substrate was observed microscopically and a few small bone particles were seen attached to the coating.

Discussion and Conclusions: As in previous studies on normal bone, pin insertion torque was lower in the hydroxyapatite coated pins than in the standard pins (5). This result is probably due to the hydroxyapatite coating’s better ability to cut and shape the bone during pin insertion. A lower insertion torque should correspond to a decrease in thermal damage to the bone during pin insertion. Pin extraction torque was three fold higher in the hydroxyapatite coated pins than in the standard pins, reflecting an enhancement of the strength of the bone pin interface. In the standard pin group, there was a severe deterioration of the bone pin interface strength. Extraction torque was two fold lower than the corresponding insertion torque. In the hydroxyapatite coated pin group there was an improvement of the bone pin interface strength. Extraction torque was two fold higher than the corresponding insertion torque. In conclusion, it was demonstrated that the hydroxyapatite coated tapered pins are also effective to improve the bone pin interface strength in the osteoporotic bone. Thus, by using hydroxyapatite coated pins, pin loosening can be avoided in osteoporotic bone. Osteoporosis should no longer be considered a contraindication for external fixation. Furthermore, the results of this study provide the first quantitative clinical proof of the effective osteoconductivity of hydroxyapatite coating in osteoporotic bone; these results can be extrapolated to other hydroxyapatite coated implants.

References:

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