# HEALING OF BONE, AND ENHANCED JOINT FIXATION, WITH A NOVEL ADHESIVE, PHOSPHOSERINE CALCIUM PHOSPHATE, IN-VIVO & EX-VIVO.

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Introduction: We have developed/tested biomimetic adhesives, OsStic, composed of solely an amino acid (phosphoserine), and calcium phosphate/silicate, in models of: fixation of bone fragments; screw augmentation; and joint fixation (arthrodesis). The purpose of this study was to evaluate safety, resorption, and whether OsStic improved primary fixation of bone-to-bone and bone-to-biomaterial.

Methods: Multiple formulations of adhesive were evaluated, containing from 0.5-73.5% calcium silicate; 0-75% alpha-tricalcium phosphate, and 25-50% phosphoserine (wt%), mixed with water (L/P 0.25 mL/g). A 0.5-1cc volume adhesive was applied; mechanical tests were conducted on a Shimadzu AGS-X, with a 50N or 5kN load cell, at 1mm/min, with comparisons made to control group(s) via ANOVA and Tukey post-hoc analysis. Rodent: 0.2x0.2cm bone fragment size. Human: 0.9x1.2cm fragment size. Canine: 1x1cm bone surface. Porcine: cancellous titanium bone screw (HB6.5) inserted into 1.5cm deep defect, over-drilled 1mm, filled with 1cc OsStic; 3.3x8mm dental implant in 5.3x9mm oversized osteotomy.

Results: In ex-vivo rodent bone-to-bone fixation, OsStic adhesive strength was 8N after 1 hour; and in live tissues 6N compared to 0.21N for Tisseel, after 4 hours. A similar model in human femora produced 90N after 1 hour. In canine tarsal arthodesis, OsStic bonded arthodeses withstood 92N shear force after 24 hour. In porcine lumbar vertebra, OsStic increased screw augmentation strength to 300% of controls, reaching 60% of the strength of PMMA after 3 hours (500N unaugmented, 1700N OsStic, 2500N PMMA). Finally, Hematoxylin and Eosin staining confirmed, in in-vivo porcine mandibles (dental implant augmentation) and rodents femora (bone-to-bone fixation) that, as OsStic is resorbed and replaced, up to 90% with new woven bone, it produces pull-out/torque strengths comparable to maturing woven bone.

Discussion: These results confirm strong and consistent performance, in multiple species/injury models, in-vivo and ex-vivo, of a bone- and biomaterial- adhesive, OsStic, which remodels into bone without sequelae.

**Keywords** : TISSUE ADHESIVE, PHOSPHOSERINE, CALCIUM PHOSPHATE