

COMMENTARY ON:

# Is Locking Screw Fixation in Carbon Fiber Composite Plates Mechanically Equivalent to Stainless Steel Plates?

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LEVEL OF EVIDENCE: Peer Reviewed, Pre-clinical, *In-vitro* Study<sup>1</sup>

## Overview

Carbon fiber reinforced PEEK is gaining popularity for fracture fixation due to its high fatigue strength, favorable modulus of elasticity, and radiolucency.

This study sought to compare the mechanical stability of locking screws in locking proximal humerus plates composed of PEEK-OPTIMA™ Ultra-Reinforced polymer versus stainless steel, finding that the screws inserted into PEEK-OPTIMA Ultra-Reinforced plates tolerated an equivalent or superior load to failure.



Figure 1 - Proximal humerus plate made with PEEK-OPTIMA Ultra-Reinforced polymer

Courtesy of CarboFix Orthopedics, Inc.

## Summary

This study compared proximal humerus locking plates manufactured from PEEK-OPTIMA Ultra-Reinforced polymer (CarboFix Orthopedics, Inc., ref. figure 1) and stainless steel (DePuy Synthes, Inc.). Screws were inserted in both the proximal and diaphyseal portions of the plate, and the stiffness and load to failure were measured under cantilever bending.

The load to failure of the diaphyseal locking screws was significantly greater in the PEEK-OPTIMA Ultra-Reinforced plate. The load to failure of the proximal screws was comparable for both materials. Stiffness was comparable between materials in both the proximal and diaphyseal sections of the plate (ref. figures 2,3).

The study further assessed the implication of inserting, removing, and reinserting a screw at the same angle, and found no difference after the second insertion. Stiffness and load to failure were greater when inserting a screw on-axis versus a 10° off-axis deviation.

## Key Findings

PEEK-OPTIMA Ultra-Reinforced locking plates provide comparable or superior locking screw fixation strength when compared to traditional stainless steel locking plates. Locking strength is not significantly compromised by reinserting a screw.

Inserting a screw on-axis increased the mechanical stability versus insertion at 10° off-axis. This finding is in line with

other systems, as reduction in strength of polyaxial locking screws inserted off-axis is also seen in metallic systems.<sup>2,3</sup>

## Load to Failure of Screws Locked in PEEK-OPTIMA™ Ultra-Reinforced Plates vs. Stainless Steel Plates

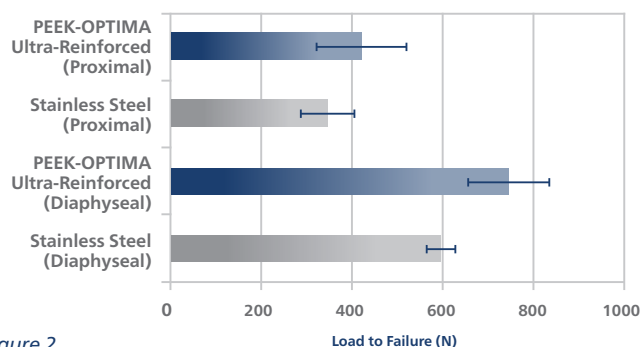


Figure 2

## Stiffness of Screws Locked in PEEK-OPTIMA™ Ultra-Reinforced Plates vs. Stainless Steel Plates

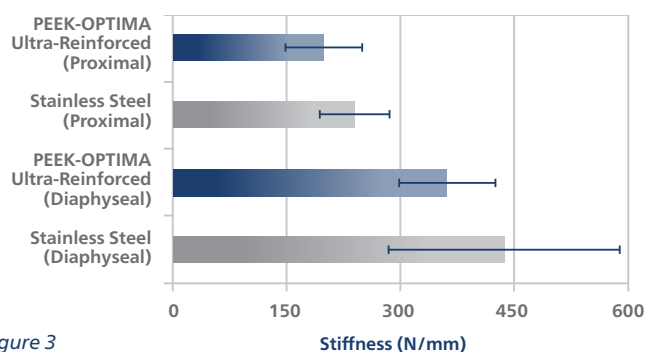


Figure 3

## Commentary

This study demonstrates comparable, and in some cases superior performance of currently marketed carbon fiber reinforced PEEK plates compared to stainless steel plates when assessing screw stability. While this study is a laboratory study and cannot completely simulate the *in vivo* environment, there are clinical studies demonstrating favorable outcomes of carbon fiber reinforced PEEK proximal humerus plates including: improved functional scores, fewer complications,

reduced surgical time, and improved lateral imaging compared to metallic plates.<sup>4-7</sup>

## Point of View

Carbon fiber based PEEK locking trauma plates afford excellent mechanical stability and improved intraoperative visualization compared to traditional stainless steel locking plates. Their use in the treatment of proximal humerus fractures may decrease the incidence of postoperative complications relative to traditional treatment methods. Additional studies are necessary to inform their optimal use *in vivo*. ▲

## ABOUT THE AUTHOR

### David J. Hak, MD, MBA, FACS

Dr David J. Hak is the Interim Director of the Department of Orthopedics at Denver Health/University of Colorado. Dr Hak is a member of the American Academy of Orthopaedic Surgeons, American Orthopaedic Association, Orthopaedic Research Society, and the Orthopaedic Trauma Association. He currently serves on the Editorial Board of the Journal of Orthopaedic Trauma, as Chair of the ORS/ISFR Committee, and recently served as Chief Financial Officer of the Orthopaedic Trauma Association.



Dr Hak is a graduate of the Ohio State University. He completed his internship and residency training at the University of California, Los Angeles and a Trauma Fellowship at the University of California, Davis. He has served on the faculty at the University of Michigan and at the University of California, Davis prior to assuming his current position. Dr Hak is actively involved in both clinical and basic science research relating to fracture healing biology, bone morphogenetic proteins, role of mesenchymal stem cells in fracture healing, and the effects of aging on fracture healing.<sup>8</sup>

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8. During 2013 - 2014, and since 2017 David J. Hak, MD MBA, FACS has provided ad hoc consultancy services to Invibio Ltd.

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