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Flexible growing rods: polymer rods provide stability to skeletally immature spines

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ABSTRACT

Introduction: Surgical treatments for early onset scoliosis typically require multiple operations and many complications. A more flexible growing rod construct might result in a more flexible spine with fewer complications. Polymer rods (polyetheretherketone, PEEK) are relatively flexible in bending, and therefore might allow for greater range of motion (ROM) during treatment. The purpose of this study was to determine changes in spine ROM after implantation of simulated growing rod constructs with a range of clinically relevant structural properties.

Methods: Biomechanical tests were conducted on six skeletally immature porcine thoracic spines (domestic pigs, age 2–4 months, 35–40 kg, T1–T13). Paired pedicle screws were inserted into T3 and T4 proximally, and T10 and T11 distally. Specimens were tested under the following conditions: (i) control, then dual rods of (ii) PEEK (6.25 mm, $n = 6$), (3) titanium (4 mm, $n = 6$), and (4) CoCr alloy (5 mm, $n = 4$). Lateral bending (LB) and flexion-extension (FE) moments of ±5 Nm were applied. Vertebral rotations were measured using video analysis. ROM for the treated region was determined by averaging all maximum side-to-side rotations at each instrumented level. Differences were determined by *t*-tests and Bonferroni posthoc.

Results: In LB, ROM of specimens with PEEK rods was lower than control at each instrumented level. ROM was greater for PEEK rods than both Ti and CoCr at every instrumented level. Mean ROM at proximal and distal uninstrumented levels was lower for PEEK than for Ti and CoCr. In FE, mean ROM at proximal and distal uninstrumented levels was lower for PEEK than for Ti and CoCr. Combining treated levels, in LB ROM for PEEK rods was 35% of control ($p < 0.0001$) and 270% of CoCr rods ($p < 0.05$). In FE, ROM for PEEK rods was 27% of control ($p < 0.005$) and 180% of CoCr rods ($p < 0.05$).

Conclusions: PEEK rods provided increased flexibility versus metal rods, but also significantly greater stiffness than controls. Smaller increases in ROM at proximal and distal adjacent motion segments occurred with PEEK compared with the metal rods, which may decrease probability of junctional kyphosis. This biomechanical feasibility study of flexible polymer rod constructs showed that PEEK rods provided increased flexibility compared with CoCr and Ti rods, but also significantly greater stiffness than uninstrumented controls.

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