INTRODUCTION

Proximal femoral varus osteotomies (VROs) are commonly performed for neuromuscular hip dysplasia in children with cerebral palsy. Several options exist for internal fixation of these osteotomies, and pediatric blade plates are commonly used1-3. There is a greater emphasis being placed on early postoperative mobilization that places greater biomechanical loads and stresses on these implants4,5. Implant-related complications such as varus collapse or blade pullout are rare but serious, and often require re-operation. There have been no studies to our knowledge comparing the biomechanical profiles of two commonly used pediatric blade plate implants for VROs.

OBJECTIVES

The primary objective of this study was to compare the load to failure of two common blade plate implants under axial compression. Additional aims of this study were to determine whether the addition of a proximal screw strengthens the bone-implant construct when subjected to axial stresses and whether it affects pullout strength.

METHODS

Two commercially available blade plates were compared in this study. Both plates were stainless steel, 3.5mm, 90° cannulated implants with a 35mm blade, and a hole immediately distal to the blade. In plate A (Smith & Nephew, Memphis, TN; Figure A) this hole accepts a 3.5mm cortical screw; whereas in plate B (OrthoPediatrics, Warsaw, IN; Figure B) this same hole is designed for a 3.5mm locking screw. Both implants were inserted into pediatric sawbone proximal femur model. Plate A with (n=9) and without (n=9) a proximal screw was compared to plate B with (n=10) and without a proximal screw (n=10). Axial load to failure was assessed using a servohydraulic load frame (Figure C). In addition, 10 samples using plate B, with (n=5) and without (n=5) a proximal locking screw, were tested in tension to quantify the effect of the proximal screw on pullout strength (Figure D).

RESULTS

Axial Load Testing
Plate B had a higher mean load to failure than plate A independent of the presence of the proximal screw (Table 1). The plate B group without a proximal locking screw reached significance in load to failure when compared to the Plate A group with and without a proximal screw (p=0.018 and <0.001, respectively). In these cases, an approximately 20% higher load was achieved. Adding the screw did not affect the load to failure for either plate B (p=0.682) or plate A (p=0.584).

Pullout Testing
Blade plates fixed with the proximal locking screw failed at a significantly higher load (856.3 +/-120.9 N) compared to those blade plates without proximal fixation (68.1 +/-9.3 N, p<0.001).

Table 1. Comparison of the two blade plates in load to failure in Newtons (N) in axial load testing.

<table>
<thead>
<tr>
<th>Group</th>
<th>Average load to Failure (N)</th>
<th>Standard Deviation (N)</th>
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<tbody>
<tr>
<td>Plate B no screw</td>
<td>102.3</td>
<td>7.9</td>
</tr>
<tr>
<td>Plate B with screw</td>
<td>97.0</td>
<td>4.2</td>
</tr>
<tr>
<td>Plate A no screw</td>
<td>84.6</td>
<td>10.3</td>
</tr>
<tr>
<td>Plate A with screw</td>
<td>89.8</td>
<td>9.0</td>
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CONCLUSIONS

• Blade plate fixation is commonly used for proximal femur VROs in patients with cerebral palsy
• Early mobilization and weight bearing after surgery is important, but increases the stress placed upon the plate construct
• Plate B withstands 20% greater axial load compared to plate A
• Addition of a proximal screw has no effect on inherent strength of the construct to axial compression, but it increases pullout strength by a factor of 12
• Differences in the blade plate design and thickness are likely associated with the difference in axial load to failure
• Additional studies are needed to compare other types of internal fixation, as well as look at other modes of failure including flexion, extension, and torsion

SIGNIFICANCE

There are significant differences in axial load to failure between commonly used blade plates, and these differences may have implications to early weight-bearing. Placing a proximal screw provides additional stability to pullout and it should be placed in all cases.

REFERENCES


For additional information please contact David Scher, MD at scherd@hss.edu