Biomechanical Analysis of Fixation Strength of a Novel Intramedullary Plate for Chevron Osteotomy of the First Metatarsal

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Mandatory Disclosure Statement

All disclosures are in the Final AOFAS Program Book.

The authors have a potential conflict with this presentation based on receiving something of value (>\$100.00) from a commercial company or institution related directly or indirectly to the subject of this presentation as noted below:

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Background

• The Chevron osteotomy is a widely used technique for correction of the hallux valgus deformity.¹

• Screw fixation is commonly used, however construct stability can be compromised through inadequate rotational stability and insufficient contact area due to increased correction.

• Biomechanics test to demonstrate that a novel intramedullary plate fixation device offers a stronger, more stable fixation option than single bicortical screw fixation when used with a standard Chevron osteotomy
Methods

• Comparison of a single screw and ISO™ Plate fixation techniques for Chevron osteotomies of 25% and 50% shifts.

• Twelve first metatarsal models were constructed using polyurethane foam (Sawbones®)
  • Ø25mm model - 15pcf core inside of a 30 pcf “cortical” layer (3.0mm thick).
  • 60° Chevron osteotomy
  • A 2mm resection on the medial aspect of the distal portion was performed prior to shifting
Methods

• Screw constructs were fixed with a bicortical solid screw (ø2.7mm) oriented dorsal-plantar and distal-proximal, perpendicular to the plantar face of the osteotomy cut.

• ISO™ Plates were inserted distal-proximal into the intramedullary canal and fixed using three 2.4mm screws.

• Constructs were fixed at a 15° plantar-flexed angle to simulate ground force loading at the distal metatarsal head²,³

• Loading was applied until catastrophic failure occurred.
Results

• Construct strength was assessed through peak load at initial failure while stability was assessed through a stiffness regression calculation.
  • A two-sample T-test (α=.05) was utilized to establish statistical significance

• The ISO™ Plate was significantly stronger than single screw fixation in constructs with 25% and 50% shifts (p=.001 and .0001, respectively).

• The ISO™ Plate construct strength of a 50% shift was significantly stronger than that of a 25% shift fixed with a screw (p=.004).
Results

• The ISO™ Plate was significantly stiffer than single screw fixation in constructs with 25% and 50% shifts (p = .0005 and .029, respectively).

• The ISO™ Plate construct stiffness of a 50% shift was significantly stronger than that of a 25% shift fixed with a screw (p = .0006).
Conclusion

• The ISO™ Plate demonstrates superior fixation strength and stiffness for Chevrons with 25% and 50% shifts

• For a 50% shift, the ISO™ Plate has the potential to increase stability compared to traditional fixation methods.

• Ongoing studies will include further mechanical analysis as well as prospective clinical studies examining the clinical outcomes seen with this implant.
References

