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Title: Consequences Following Distal Femoral Growth Plate Violation with An Intramedullary Implant: A Pilot Study in a Ovine Model

Purpose

Retrograde femoral nailing is a useful technique in skeletally mature patients with applications towards acute osteotomy, lengthening over a nail, and internal lengthening nailing. These options are traditionally limited in skeletally immature patients due to concerns of violating the distal femoral physis. The resilience of the distal femoral femoral physis to a smooth metallic implant is poorly understood. This ovine study was designed to better understand the tolerance of the immature distal femoral physis to retrograde nailing.

Method

A total of 18 sheep underwent placement of a retrograde, intramedullary implant at 3-months of age through an open distal femoral growth plate. The cross-sectional area of the distal femoral physis was measured pre-operatively and implants were selected that violated 3% to 8% of the cross sectional area of the growth plate at 1% intervals (n=3 sheep at each interval). Growth across the distal femoral growth plate was examined radiographically at 4 weeks, 8 weeks and following euthanasia 10-weeks following surgery. Following euthanasia, both the operative and non-operative contralateral femurs were removed and dissected to compare differences in femoral maximal lengths using digital calipers.

Results

Radiographic measurements of growth across the distal femoral physis demonstrated that growth continued in all specimens at 4 weeks, 8 weeks and 10 weeks post-operatively. When compared to control specimens grossly, only operative specimens with 8% of cross-sectional physeal violation demonstrated significant growth arrest when compared to control limbs.

Conclusion

Distal femoral growth continues across the physis when 3% to 7% of the cross-sectional area of the physis is violated using a retrograde intramedullary implant. Specimens with 8% of growth violation demonstrated significant growth arrest. These findings suggest that retrograde femoral nailing may be a viable option in the treatment of pediatric distal femur shaft fractures in resource poor countries where other options are limited.