

A novel continuous compression staple fixation technique for ankle arthrodesis

Kadosa Bodo, Mike Karski

Wrightington Hospital, Wrightington, Wigan and Leigh NHS Foundation Trust, United Kingdom

Introduction

- The incidence of ankle osteoarthritis exceeds 29 thousand per year in the UK.
- The prevalence of symptomatic, radiographic ankle OA is 3.4%
- The demand is growing for surgical intervention: total ankle replacement or ankle fusion
- TARVA study, to compare ankle replacement and fusion outcomes, is currently under data collection phase
- Surgery is increasingly successful owing to improved implant design and surgical technique
- Arthroplasty limitations are deformities, age, and technical demands
- Ankle fusion surgery is still gold standard

Aim and Method

- The aim of this study is to audit the first 10 operated cases prior to proceed to further interventions. Clinical and radiological outcomes were measured at 6 months after surgery.

Milestones

- The first ankle fusion by Eduard Albert in 1882 at Vienna
- Transfibular ankle arthrodesis, in 1948 by John Crawford Adams
- Fusion with extrafocal compression device by Sir John Charnley in 1951
- blade plate (Sowa, 1989)
- lateral T-plate (Wang, 1993)
- cannulated 6.5 screws fixation (Mann, 1991)
- Combination of screw fixation with staple (Verhelst, 1976)
- Sliding bone graft arthrodesis (Blair, 1943; Patterson, 1997)
- Chevron ankle fusion (Marcus, 1983)
- Arthroscopic ankle fusion (Schneider, 1983)
- Dowel graft with screw fixation (Stranks, 1994)
- According to our best knowledge solely anterior compression staple fixation for ankle arthrodesis has never been published before

Surgery

- Pre-operative planning: weight bearing radiographs +/- CT scans
- Coronal plane varus or valgus deformity
- Sagittal plane flexion or extension deformity or talus anterior translation
- Supine position, manual axial compression during the fixation phase
- Standard anterior approach in the intertendinous plane of extensor hallucis longus and tibialis anterior
- Resection plane: 90 degrees to mechanical axis and parallel to the ground
- Good quality subchondral cancellous bone surface
- Talus reduced under tibia and kept longitudinally compressed
- Fixation: two or three bridging nitinol staples (DePuy, BME staples) in vertical-sagittal plane



Results

- The first 10 operations between September and December 2019
- average age was 53.7 years (range 29 to 74) gender ratio was 3:7 to men
- Average total operation time (1 h 22 min) in contrast with other fixation methods (1 h 50 min)
- Radiologically 9 ankles fully consolidated, 1 non-union (known heavy smoker)
- Clinically 7 returned to normal mobility and activities
- 3 have ongoing symptoms: 1 non-union and 2 adjacent joint OA
- No complications of wound healing, infection or nerve/vessel damage
- Neither breakage nor loosening of the staples were seen in any of the cases.

Discussion

- The reported incidence of non-union of open ankle arthrodesis is 7 to 15%
- Sharp learning curve and less demand on using x-ray
- Excellent compression on anterior half of fusion site
- Less than 50% remaining gap, later all consolidated
- Gap-healing brought no clinical significance, similar to opening wedge osteotomy cases
- Nitinol (Nickel Titanium Naval Ordinance Laboratory) is a half nickel half titanium alloy
- Tissue friendly and stable and more durable comparing to stainless steel
- Continuous compression effect on bone healing with low failure rate
- Low-profile nitinol staples allow optimal environment for tension free closure
- Single incision ankle fusion has advantage to older patients, with suboptimal vascular or skin status or diabetes

Conclusion

- Our early experience with the use of continuous compression nitinol staples in single incision anterior approach ankle arthrodesis is encouraging.
- The staple fixation does not require additional violation of periarticular soft tissues
- This novel method is simpler, safer, reliable, reproducible,
- However further prospective study with PROMs is necessary with longer-term follow-up.

References:

- Smith, R., & Wood, P. L. R. (2007). Arthrodesis of the ankle in the presence of a large deformity in the coronal plane. *The Journal of bone and joint surgery. British volume*, 89(5), 615-619.
- Aiyer, Amiethab, et al. "The impact of nitinol staples on the compressive forces, contact area, and mechanical properties in comparison to a claw plate and crossed screws for the first tarsometatarsal arthrodesis." *Foot & ankle specialist* 9.3 (2016): 232-240.