

Achilles Repair: Revised Modified Gift Box Reduces Gap Under Cyclic Loading

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INTRODUCTION: Various Achilles tendon repair techniques have been proposed and the strength of some of these have been evaluated.¹⁻⁴ This study introduces a modification to an existing repair technique which termed the revised modified Gift-box (LMGbx) repair.⁵ The goal of this study is evaluate the deformation of the new repair under cyclic loading and compared it to traditional Krackow repair techniques.

METHODS: Institutional approval was received for this study (Corid 1247). Twenty-four fresh frozen cadaveric Achilles tendons were harvested, checked for abnormalities, and randomly divided into three groups of repairs (n=8): Revised Modified Gift Box ((LMGbx), Krackow 2-strand, and Krackow 4-strand. A calcaneal block containing the tendon insertion was taken with approximately 12 cm of tendon and was potted in resin. The tendon was transected approximately 6 cm from the insertion and repaired using the assigned technique. The Krackow repairs are traditional⁵ the LMGbx technique⁶ is a revision of the Labib technique⁷. Markers were placed on the tendon at the left, right and center edges of the repair and 1 cm proximal and distal to the repair (figure 1). The resin block was fixed in an axial testing machine and the proximal gastrocnemius muscle tendon unit was clamped with a freeze clamp. The tensile loading consisted of 500 cycles of a 20-100 N load. A digital image correlation system (Correlated Solutions, Inc.) was used to video the sample during loading. The video and load data were used to measure to the left, middle and right gap at the repair at the last cycle (figure 1). Also, the distance between the proximal and distal markers with and without load was used to compute the overall construct elongation percentage.

Two ANOVAs of the gap distance, with the main factors of repair type and gap location, were performed to assess significant differences (p<0.05). Post hoc pairwise tests, with a Bonferroni correction, were performed to determine the significantly different data (p<0.0167). For the percent elongation an ANOVA with the factor of repair type was performed followed by post hoc pairwise tests with a Bonferroni correction.

RESULTS SECTION: The mean and standard deviation of the left, middle and right gaps at the last cycle for the different repairs is given in table 1. The gap location was not significant, and the repair type was significant (p<0.005). All three methods were significantly different from each other (p<0.005). The percent elongation of the construct (table 1) with the LMGbx repair was significantly different from the two Krackow repairs (p=0.01, p<0.005).

DISCUSSION: The revised modified gift box method has significantly lower gaps than the traditional Krackow repairs under cycling loading. This is also true for the percent elongation of the construct. The Giftbox has been previously found to have a reduced gap as compared to the Bunnell repair¹.

SIGNIFICANCE/CLINICAL RELEVANCE: The increased stiffness and gapping resistance of the revised modified giftbox technique gives rise to the potential of improved performance in Achilles tendon repair over traditional Krakow repairs.

REFERENCES: ¹Van Dyke, OJSM 2017; ²Lee, OJSM 2006; ³Jaakkola FAI 2000; ⁴Tian Injury 2019; ⁵Uban et al J Long Term Eff Med Implants 2016; ⁶Singhi Int J Res Ortho 2018; ⁷Labib et al FAI 2009

Table 1: Data (mean ± S.D) on the gaps and elongation at the last loading cycle.

Repair Method	Gap (mm)			Elongation [%]
	Left [mm]	Middle [mm]	Right [mm]	
Modified Giftbox	0.87 ± 1.77	0 ± 0	0 ± 0	22.5 ± 9.67
2-Strand Krackow	19.74± 7.43	19.46 ± 6.42	21.27 ± 6.65	107.3 ± 96.0
4-Strand Krackow	12.78 ± 5.06	10.70 ± 5.54	10.43 ± 4.38	57.5 ± 20.6

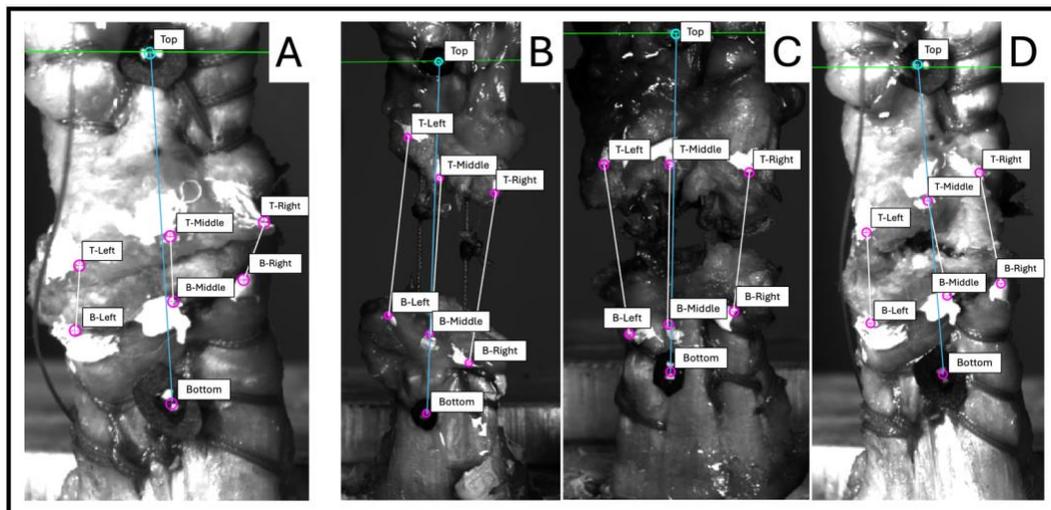


Figure 1: (A) Measurement of marker distance of left (L), middle (M) and right (R) gaps and overall construct elongation (bottom, top) in unloaded specimen. (B) Gaps during final loading cycle for 2-strand Krackow repair. (C) Gaps during final loading cycle for 4-strand Krackow repair. (D) Gaps during final loading cycle for modified Gift Box repair.