A Substantial Reduction in Diameter of Autograft After Applying Circumferential Compression During ACL Reconstruction in Pediatric Population

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Purpose: Over 130,000 anterior cruciate ligament reconstructions (ACLR) are performed annually in the United States and are on the rise in both adult and pediatric populations. Previous studies have investigated the effect of tension and circumferential compression on the diameter of fresh-frozen allografts, but none have described its effect on ACL autografts harvested for implantation during the ACLR procedure. The purpose of this study was to elucidate how hamstring autograft diameter changes in response to tension and circumferential compression for ACLR in pediatric population.

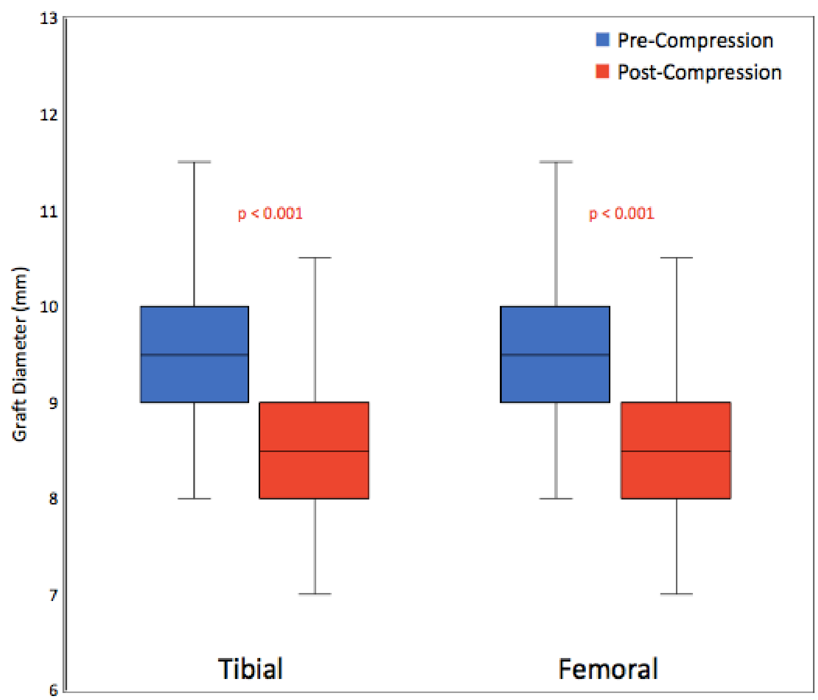

Figure 1

Methods: 135 ACLR surgeries (median age 15 [IQR 14-16] years; 50.4% male) were identified in two pediatric hospitals. Three orthopedic surgeons dictated hamstring autograft diameters at two time-points during graft preparation. Hamstring tendons were prepared in a standardized procedure. Autografts were tensioned to 15-20 pounds and their diameters were immediately measured using cylindrical sizing blocks (time-point 1). The graft was then compressed on both the tibial and femoral aspects using sizing blocks. After 10 minutes, diameters were measured again (time-point 2) before implantation. Comparisons were made between graft diameter at each time point. A random-effects regression model was performed to capture any unexplained variance on the linear predictor scale and to determine correlations between demographics and graft characteristics.

Results: The median initial diameter measurement of both femoral and tibial sides of the autograft during a longitudinal tension was 9.5 (IQR 9-10) mm. After

Variable	Coef. (B)	P value	Confidence Interval [CI]	
Application of compression	-0.785	<0.01	-0.82	-0.74
Height (mm)	3.18	<0.01	1.67	4.69
Strands number	0.17	0.01	0.041	0.3

Table 1. Random Effects Regression Model

adding circumferential pressure, the median final measurement of both sides was 8.5 (IQR 8-9) mm. The median graft diameter decreased by 1mm on both sides of the graft after applying an additional circumferential pressure to the longitudinal tension, which was a statistically significant change (P<0.001 for both). Only 3% of cases did not show any decrease in diameter between time points. There was no identified common feature that could explain this group of non-responsive cases. In the random-effects model, the application of compression, shorter patient height, and decreased graft strand number were each statistically significant predictors of greater change in graft diameter.

Conclusions: The pediatric and adolescent population necessitates a specific skill set to achieve the fine equilibrium between implanting a well-restored biomechanical construct while avoiding unnecessary bone loss or disruption of the physis. This study suggests that optimizing graft preparation with circumferential compression would allow for the drilling of tunnels, which are two (0.5mm) sizes smaller while providing a better fit between the graft structural content and a relatively small bony tunnel. This paradigm shift is particularly applicable to pediatric, revision, and double bundle ACL reconstruction techniques, where space for tunnel drilling is limited.

Median graft diameter pre-compression (red) and post-compression (blue). Graft diameter was significantly decreased after 10 minutes of tension and compression for both the tibial and femoral sides (p < 0.0001 for tibial and femoral).

The Mission of the AAP Section on Orthopedics is to foster the health of children through the AAP by mentorship, education, advocacy, and research. The AAP Section on Orthopedics has also collaborated with POSNA in joint leadership meetings creating shared strategic plans. Through these shared visions and collaborations our organizations have collectively partnered with the 50,000 pediatricians within the AAP to advocate for injured and ill children throughout the world.