Distal Biceps Tendon Repair with Interlinked Knotless All-Suture Anchors Demonstrates Greater Footprint Optimization and Higher Fixation Strength over Intramedullary Cortical Button Repair: A Biomechanical Study

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INTRODUCTION:

Onlay distal biceps tendon repair (DBTR) can reduce iatrogenic posterior interosseous nerve injury risk, enhance bone preservation, and better recreate the tendon-bone interface anatomy. Although anatomic footprint restoration is important to post-repair biceps function, and tendon-cortex contact area is essential to onlay healing, to date DBTR biomechanical studies have primarily assessed fixation strengths, not repair footprints. Therefore, **little is known about potential interactions between DBTR construct configuration, footprint optimization, and fixation security.**

The purpose of this biomechanical study was to evaluate and compare the footprint parameters and fixation strengths of two onlay DBTR constructs: 1) a novel construct with two interlinked, knotless all-suture anchors, and 2) an established construct with an intramedullary cortical button. We hypothesized the new interlinked construct will achieve a larger repair footprint, greater anatomic footprint restoration, and higher fixation strength.

METHODS:

Twenty fresh-frozen cadaveric elbows in 10 matched pairs were thawed, dissected, and side-randomized into 2 matched groups. All distal biceps tendons were sharply detached, secured distally with a tape-reinforced looping suture, then in one group repaired with 1) **two unicortical, interlinked 2.6 mm knotless all-suture anchors** with repair sutures passed through the looping suture reinforcement (Fig 1A), and in the other group repaired with 2) **a 2.6 mm X 7.0 mm intramedullary cortical button** with repair sutures in standard tension-slide configuration (Fig 1B). Anatomic and repair footprint areas and locations were captured with a 3D coordinate measurement machine (CMM). The tendon repairs underwent cyclic stressing under progressive loads (50/75/100 N loads, 100 cycles of 0-90° flexion at each load), then were loaded to failure with elbows fixed at 90° flexion.

Data collected: **post-cycling tendon-bone gap, ultimate failure load, anatomic footprint, and repair footprint**. Anatomic/repair footprint overlap area as shown by 3D CMM data was used to calculate the **anatomic footprint restoration percentage** (overlap area divided by anatomic footprint area)(Fig 2).

Group means were compared with paired *t*-Test. A sample size calculation based on a pre-study 1- vs 2-anchor pilot test showed $n \geq 8$ per group would have sufficient power ($\alpha=0.05$, $1-\beta=0.80$).

RESULTS:

In footprint analysis and comparison, the interlinked knotless-anchor DBTR construct demonstrated a significantly **larger repair footprint area** (55.1 ± 14.9 mm^2 vs 35.2 ± 19.8 mm^2, p=0.032) with **greater anatomic footprint restoration percentage** (42.7 ± 12.9% vs 20.2 ± 9.4%, p=0.003)(Table 1), compared to the intramedullary cortical button construct.

For fixation security, the interlinked knotless-anchor DBTR construct demonstrated a **lower post-cycling tendon-bone gap** (3.2 ± 1.2 mm vs 12.4 ± 6.6 mm, p=0.003)(Fig 3) and **higher ultimate failure load** (468.4 ± 124.2 N vs 313.2 ± 103.4 N, p=0.001)(Fig 4), compared to the intramedullary cortical button construct.

The cortical button construct primarily failed at the fixation knot (6/10), while the knotless anchor construct mostly failed at the suture-tendon interface (5/10)(*p*=0.004).

DISCUSSION AND CONCLUSION:

In summary, the novel onlay DBTR construct with two interlinked knotless all-suture anchors excelled in footprint optimization and fixation security, achieving a significantly larger repair footprint with greater anatomic footprint restoration, lower post-cycling tendon-bone gap, and higher ultimate failure load, over the single intramedullary cortical button construct.

This study evaluated the first DBTR construct with suture interlinkage, a feature made possible by the novel use of knotless anchors, to directly compress tendon to bone over a broad area similar to the "suture bridge" effect in rotator cuff repair. Most importantly, our findings suggest that **an onlay, interlinked approach to distal biceps tendon repair can optimize repair footprint and also achieve high fixation security** that compares favorably to current inlay and onlay DBTR options.

In conclusion, our study presents favorable biomechanical evidence that suggest the novel interlinked onlay DBTR construct can **enhance repair healing, improve post-repair biceps function, and facilitate early rehabilitation**, to improve overall clinical outcome.

Fig 1

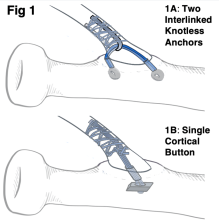
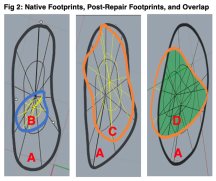


Fig 2: Native Footprints, Post-Repair Footprints, and Overlap



Footprints as captured via 3D CMM. A: Native footprints (black borders). B: Single-button footprint (blue border). C: Twin-anchor footprint (orange border). D: Native/post-repair overlap (green area).

Fig 3: Post-Cycling Tendon-Bone Gap

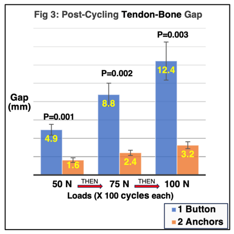


Fig 4: Ultimate Failure Load

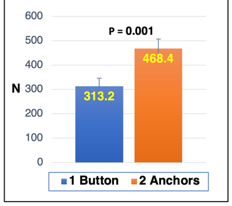


Table 1: Post-Repair Footprint Areas and Native Footprint Restoration Percentage

	Two Anchors	Single Button	P-Value
Post-Repair Footprint (mm^2)	55.1 ± 14.9	35.2 ± 19.8	0.032
Native Footprint Restored (%)	42.7 ± 12.9	20.2 ± 9.4	0.003