Comparison of the Fixation Strength of PEEK and Composite Knotless Instability Anchors

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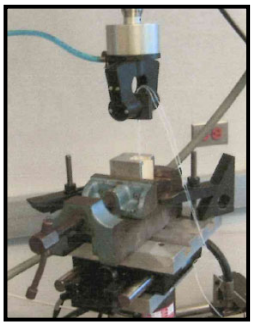
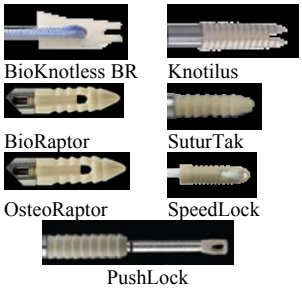
Statement of Purpose: Instability injuries in the glenohumeral joint are common with an expected 149,000 procedures in the US in 2012.[1] Surgical repairs include SLAP (Superior Labrum from Anterior to Posterior) and Bankart procedures which involve reattachment and tightening of the torn labrum and ligaments to the socket of the shoulder joint using sutures and small bone anchors to prevent further dislocations.

In recent years, suture anchors have evolved into knotless systems which are designed to facilitate arthroscopic repair through enhanced suture management and the ability to achieve fixation without the need to tie knots. Smaller knotless anchors are required for glenohumeral joint procedures. The objective of this study was to compare the initial fixation strength of a variety of knotless instability suture anchors.

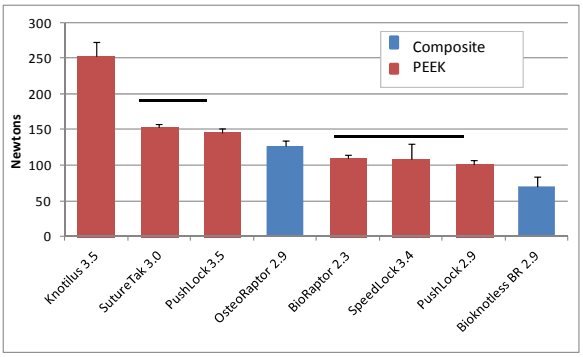
Methods: Six PEEK and two composite suture anchors were tested. The PEEK anchors were:
Knotilus 3.5mm (Stryker n=8), SutureTak 3.0 (Arthrex n=8), PushLock 3.5mm (Arthrex n=8), PushLock 2.9mm (Arthrex n=8), SpeedLock 3.4mm (ArthroCare n=5), and BioRaptor 2.3mm (Smith & Nephew n=8). The composite anchors were: BioKnotless BR 2.9mm (Mitek n=6) and OsteoRaptor 2.9mm (Smith & Nephew n=8). The BioKnotless and OsteoRaptro materials were PLGA/TCP and PLLA/HA respectively. Anchors were inserted into 20 pcf solid rigid foam with each manufacturer's high strength suture and according to manufacturer's instructions.

Foam blocks were held in an aluminum frame which was secured to the testing system (MTS 858 Bionix) by a vise. Sutures were held by pneumatic grips with a gage length of 5 cm from the top of the foam block to the grips. Anchors were loaded parallel to their long axis at an actuator speed of 30mm/min until failure. The ultimate load at and mode of failure were recorded.





Results: There was a slight positive correlation between anchor diameter and pull out strength (r^2=0.28), no significant difference as a function of material, and many significant differences as a function of design. The ultimate pull out strength of the Knotilus anchor was significantly greater than all other anchors. The only anchors for which there were no significant differences were the SutureTak 3.0 and Pushlock 3.5; and the BioRaptor 2.3, SpeedLock 3.4, and Pushlock 2.9. All other pairwise comparisons were significantly different.



Lines indicate groups that are not significantly different. p≤ 0.05

Ultimate Failure Mode	
Knotilus	Suture broke (8)
SutureTak	Eyelet broke (8)
PushLock 3.5	Anchor pullout (5) Suture slippage (3)
OsteoRaptor	Anchor pull-out (8)
BioRaptor	Anchor pull-out (8)
SpeedLock	Suture slippage (5)
PushLock 2.9	Anchor pullout (1) Suture slippage (7)
Bioknotless BR	Anchor pullout (6)

Considering only ultimate failure mode, the mean pull out strength for anchors which failed by suture breakage (253±19N) was significantly greater than all other failure modes: eyelet breakage(153±5N), anchor pullout (112±27N), suture slippage (113±21N) and failure by eyelet breakage resulted in significantly higher pullout strength than failure by anchor pullout or suture slippage.

Conclusions: The goal of this study was to compare the fixation strength of the latest generation of commercially available knotless suture anchors designed for labral repair in the shoulder. The results indicate that, in general, anchor design has more impact on pull out strength of these anchors than material and when the ultimate failure mode of the anchor reaches the strength of the high strength suture itself, a maximum pullout strength is achieved.

References:

1) Millenium Research Group 2011