

DYNACORD™ Suture: Comparative Evaluation of Knot Security in a Mechanical Model

Samir Bhattacharyya, PhD, MS, MSc, Mike Mafilios, Dave Spenciner, PE, ScM, MBA. Joseph Algeri, BS ME

OBJECTIVE:

Soft tissue repair leads to good or excellent outcomes in most patients. However, structural failure of the repair occurs in a substantial number of cases and can lead to an unsatisfactory result. For example, a recent meta-analysis of 8,000 rotator cuff repairs showed a mean re-tear rate of 26.6%.¹ Additionally, the percentage of revision surgeries has been reported to be as high as 30% for isolated supraspinatus tendon tears.² This suggests that advances in repair techniques are needed to optimize the healing environment after surgery in order to facilitate restoration of function and minimize the risk of revision surgery.² Many studies have reported that the key features of an ideal rotator cuff repair are high initial fixation strength, greater contact area and contact pressure at the tendon- bone interface, minimal gap formation, and good knot holding security until the healing has been achieved.² The objective of this study is to compare the knot security of DYNACORD™ Suture (DePuy Synthes Mitek Sports Medicine, MA) and FiberWire® (Arthrex, Florida) suture after hydrating for 24 hours.

DYNACORD™ SUTURE TECHNOLOGY:

DYNACORD #2 Suture is a high strength orthopedic suture that is composed primarily of an outer Ultra High Molecular Weight Polyethylene (UHMWPE) sheath, inner polyester (PET) sheath, and a silicone/NaCl filled core. When DYNACORD Suture is placed in an aqueous environment, the salt particles within the silicone core elute out, leaving behind a micro-porous structure within the silicone core. These small voids are consequently filled with fluid as the core hydrates, resulting in a radial expansion of the suture braid. This radial expansion of the braid causes an axial shortening of the total suture length and a locking of the tied knots (Figure 1).

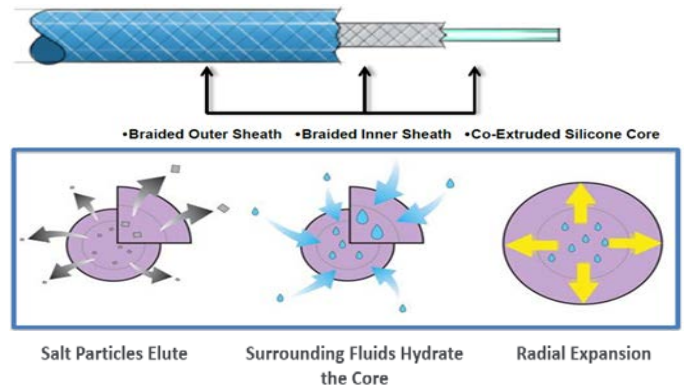


Figure 1: DYNACORD Suture Construct and Radial Expansion Mode of Action

METHODS:

A mechanical study was undertaken by DePuy Synthes to evaluate the knot security of tied DYNACORD Suture knots compared to tied FiberWire® knots.^{3,4} A sliding Duncan knot was chosen because it is a common sliding knot used during arthroscopic procedures and is known to most surgeons. Three study groups were evaluated: a DYNACORD Suture backed up with two alternating half hitches (n=10); a DYNACORD Suture backed up with three alternating half hitches (n=9), and a FiberWire® suture backed up with three alternating half hitches (n=10) (Table 1). Knots were tied around a steel mandrel with rubber tubing and placed in saline set to 37° C for 24 hours.^{3,4}

Knot Security Performance Study ⁴			
Description	DYNACORD Suture with 2 half hitches	DYNACORD Suture with 3 half hitches	FiberWire® Suture with 3 half hitches
# of samples	10	9	10
Knot Evaluated	Sliding Duncan backed up with alternating half hitches		
Time Point Evaluated	Knots tied and placed in saline set to 37C for 24 hours. Testing conducted using a mechanical test frame after allowing to hydrate for 24H.		
Maximum Load	50.06 lbs	75.97 lbs	51.61 lbs
St. Dev.	9.19 lbs	2.44 lbs	4.49 lbs
Failure Mode	Knot Unravel	Knot Break	Knot Unravel

Table 1: Knot Security Test Setup and Data Output

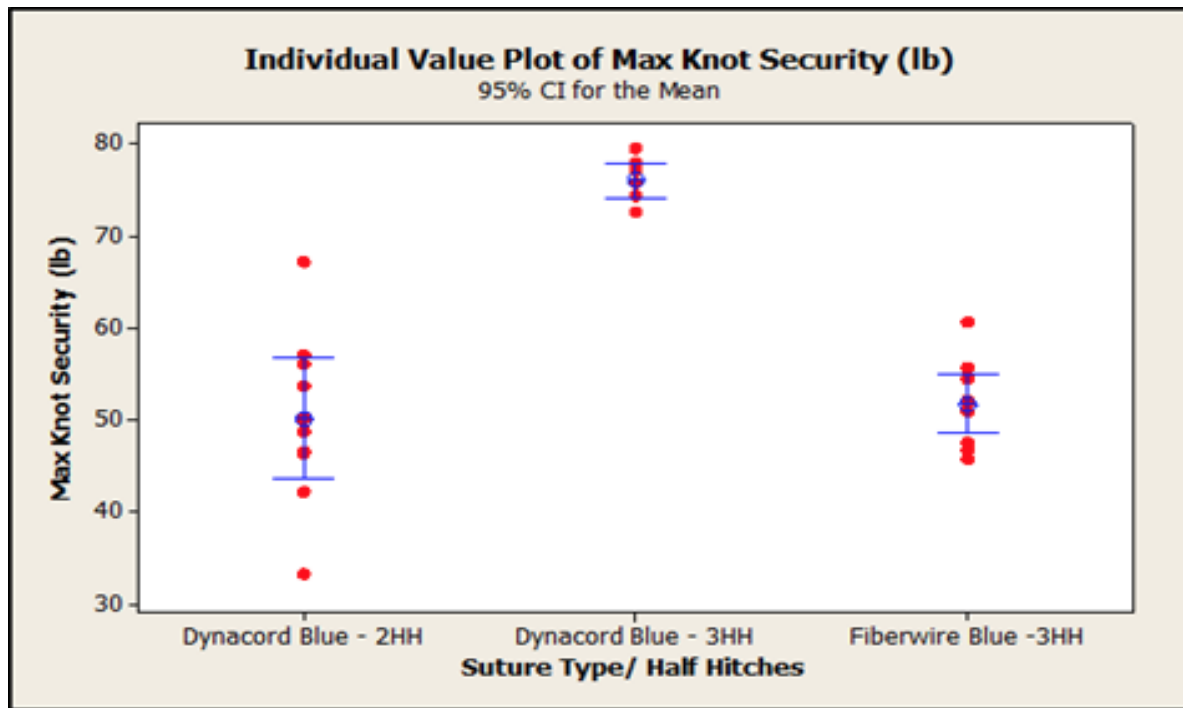


Figure 2: Individual Value Plot for Maximum Load

RESULTS:

The results of the study show that the maximum load before failure was 50.06 lbs for the DYNACORD Suture group with two half hitches, 75.97 lbs for the DYNACORD Suture group with three half hitches, and 51.61 lbs for the FiberWire® suture group with three half hitches (Table 1, Figure 2).³ These results show a statistical significant difference in favor of DYNACORD Suture with a confidence level of 95% (p -value < 0.05) between the DYNACORD Suture and Fiberwire suture groups when 3 alternating half hitches are tied.³

CONCLUSION:

The results of this mechanical study demonstrate that the DYNACORD Suture with two half hitches is comparable in knot security to the FiberWire® suture with three half hitches. Additionally, the results show that the DYNACORD Suture with three half hitches provides greater knot security than the FiberWire® suture with three half hitches. These results confirm the hypothesis that as the

silicone/NaCl core within DYNACORD Suture hydrates and expands, the knot tightens leading to greater knot security. Surgeons will also have the option to use one less half hitch thus reducing the overall size of the knot stack while still maintaining similar knot strength. Further research should aim to validate these findings in a clinical setting and the potential impact this improved knot security may have on the healing environment.

REFERENCES:

1. McElvany MD, McGoldrick E, Gee AO, Neradilek MB, Matsen FA. Rotator cuff repair: published evidence on factors associated with repair integrity and clinical outcome. *Am J Sports Med.* 2015 Feb;43(2):491-500
2. Yeh ML, Hong CK, Su WR, et al. Current Biomechanical Concepts of Suture Bridge Repair Technique for Rotator Cuff Tear. *International Journal of Orthopaedics* 2015;23(3):284-288.
3. DePuy Synthes. Test Method: Knot Migration and Security Testing. Study #:103033165. July 2014.
4. DePuy Synthes. Results of Knot Security Evidence Generation Study. Study Notebook 2017-14; page 20 -22.