

# Knot Tying & Pushing

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## I. Suture Materials

### A. Absorbable

- i. PDS (Ethicone, Somerville, NJ)
- ii. ...

### B. Non-absorbable

- i. Ethibond (Ethicone, Somerville, NJ)
- ii. Fiberwire (Arthrex, Naples, FL)
- iii. Herculine (Linvatec, Largo, FL)
- iv. ...

Suture loads to failure<sup>1)</sup>

Fiberwire no.5>>>Ethibond no.5=Fiberwire no.2>>(Ethibond no.2=Panacryl no.2  
=Fiberwire no. 2-0)

## II. Knot Tying<sup>2-4, 7-9, 11-13)</sup>

### A. General concept

Knot configuration symbols

S- single sliding throw (Half-hitch) knots.

=- refers to identical throw, loop direction same around the same post.

x- refers to non-identical throw, loop reversed around the same post.

//- refers to alternating post between throw, throws are identical.

//x- refers to alternating post between throws, which are non-identical or reversed each time.

- i. For Good knot tying  
All of the following factors must be controlled
  - Suture material factor
  - Knot configuration factor
  - Surgeon's factor
- ii. Knot configuration → NO universally accepted classification NOR universally preferred knot<sup>9)</sup>
- iii. Use sliding knot whenever possible
- iv. How many additional half-hitch is optimal → 3 optimal, for Duncan may be more<sup>10)</sup>
- v. Soft tissue reattachment to bone with suture anchors has many factors to clinical success: Suture anchor strength, Soft tissue strength (Tissue quality), Suture passage manner, Adequate knot tying (Surgeon's factor), Post-op rehabilitation
- vi. Potential failure can occur at the anchor, the tendon, or the suture, **however the weakest point is the suture-tendon interface**
- vii. Suture anchors may provide better strength and more consistent results than bone tunnels
- viii. Higher load-to-failure strengths may be of questionable importance → Since the limiting factor is still suture strength, also this force is unlikely to occur in the clinical setting
- ix. Current trend of biodegradable anchors: polyglycolic acid → poly L-lactic acids. Polyglycolic acid known to cause inflammatory reactions in shoulder and other bones
- x. For mode of failure: in diaphyseal cortex mainly wire breakage (44%), in cancellous pullout (50%), and in metaphysis pullout and wire breakage were the main factors
- xi. Bone defect are related to drill hole size for nonscrew anchor and minor diameter size for screw anchors

## B. Principle

- i. Only one pair of sutures at any time is inside an operative cannula for knot tying
- ii. The cannula tip should be placed as close as possible to the area being tied which can minimize soft tissue interposition and suture limb tangling. Soft tissue entrapment occurs commonly as water is pumped up to the operative cannula.
- iii. Prevent knot twisting outside the cannula. This is done by tagging the

- post limb with a hemostat while tying the knot sequence.
- iv. Maintain tension in the first loop. As many authors emphasized the importance of loop security as well as knot security, it is crucial to maintain tension in the first loop to prevent reverse slippage.
  - v. Knot pusher should always be passed down one “post” of the suture through the cannula to make sure the posts (or limbs) of the suture are not tangled and are free of tissue. This is done before placing your first knot
  - vi. Never tie all loops of your knot around the same post. The best is alternating post with reversing throws with more than 3 additional half-hitches. This is true regardless of the type of suture material.<sup>10)</sup>
  - vii. Use a sliding knot whenever possible since they can be used in knots under tension. To improve sliding capability, proper suture anchor with good sliding capability must be used.
  - viii. As for anchor placement for proper knot: the anchor eyelet orientation must be properly place before knot tying, the screw hole made for anchor should be funnel shaped, and the anchor must be inserted not too deep and not too shallow.
  - ix. Learn and practice at least two sliding knots and one non-sliding knots.
  - x. Know the concept of “Chan method” of post switching without rethreading<sup>9)</sup>.
  - xi. Finally, don't hurry, be patient, and be prepared for the worst.

### C. Types

#### *Classical Knots*

Revo knot

Modified Duncan loop

Tennessee slider

#### *Recently published Knots*

SMC knot

Field knot<sup>6)</sup>

Giant knot

Nicky s knot<sup>9)</sup>

Double twisted knot

Whipknot (Smith & Nephew Endoscopy, Andover, MA)

Knotless (Thal, Mitek, Westwood, MA)

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