Knot Strength and Loop Security

Recently Stephen S. Burkhart, M.D., San Antonio TX, and his team of investigators evaluated a series of arthroscopic knots to determine the optimal knot configuration which maximizes knot strength and loop security.

Among the series of arthroscopic knots tested (Duncan Loop, Nicky's Knot, Tennessee Slider, SMC, Roeder Knot, Weston Knot), each knot was tied and tested with and without a series of three reversing half-hitches on alternating posts (RHAP's). The sliding knots were then compared to a static Surgeon's Knot for strength and loop security.

The results demonstrate that for an arthroscopic knot to withstand *in vivo* forces placed on a rotator cuff repair, all sliding knots (locking or non-locking) should be followed up by a minimum of three reverse half-hitches on alternating posts. The subsequent strength and security of the knot will then exceed the predicted *in vivo* forces placed on a repaired rotator cuff. It is suggested in a standard 4 cm tear, the load per suture ranges from 37.7 to 60.4N depending on the number of suture anchors and sutures within each construct. With respect to loop security, a loop elongation greater than 3 mm will affect tissue healing. Preventing slippage of knots with half-hitches behind the knot is also preferable for loop security.

All knots were then tied over a 30 mm circumferential post to replicate the suture loop created during an arthroscopic rotator cuff repair. Each of the complex sliding knots (except Duncan's) was flipped by tensioning the wrapping limb to lock the knot in place and thus prevent the knot from slipping backwards. Therefore, the closer to 30 mm the resultant loop circumference is, the better the loop security.

As you can see from the chart below, significant differences in strength and loop security are noted in sliding knots tied with and without a series of three reversing half-hitches on alternating posts. Examples in the improvement of knot strength with #2 Arthrex FiberWire vs #2 Ethibond should equally be noted.

KNOT STRENGTH

	Knot Strength w/ RHAP's *(in Newtons)*		Knot Strength w/o RHAP's *(in Newtons)*	
Knot	**#2 FiberWire**	**#2 Ethibond**	**#2 FiberWire**	**#2 Ethibond**
Surgeon's (static)	197.8	102.8	197.8	102.8
Weston (sliding/locking)	192.4	100.2	74.1	68.5
Roeder (sliding/locking)	157.2	99.5	34.5	23.8
Nicky's (sliding)	130.9	70.8	11.5	14.7
Duncan Loop (sliding)	124.2	67.6	24.5	19.7
Tennessee Slider (sliding)	104.2	83.8	8.8	4.7
SMC (sliding/locking)	103.1	96.4	25.3	17.9

LOOP SECURITY

	Loop Circumference w/ RHAP's *(NL = 30 mm)*		Loop Circumference w/o RHAP's *(NL = 30 mm)*	
Knot	**#2 FiberWire**	**#2 Ethibond**	**#2 FiberWire**	**#2 Ethibond**
Surgeon's (static)	30.46	30.51	30.46	30.51
Roeder (sliding/locking)	30.70	30.66	33.10	32.52
Duncan Loop (sliding)	31.24	31.23	30.71	32.50
Nicky's (sliding)	31.30	31.63	34.19	37.29
Weston (sliding/locking)	31.95	31.99	32.31	32.60
Tennessee Slider (sliding)	32.35	32.20	34.09	34.12
SMC (sliding/locking)	34.10	35.58	35.51	38.19