

# Integral Suture-Handling Techniques for Arthroscopic Sliding Knots

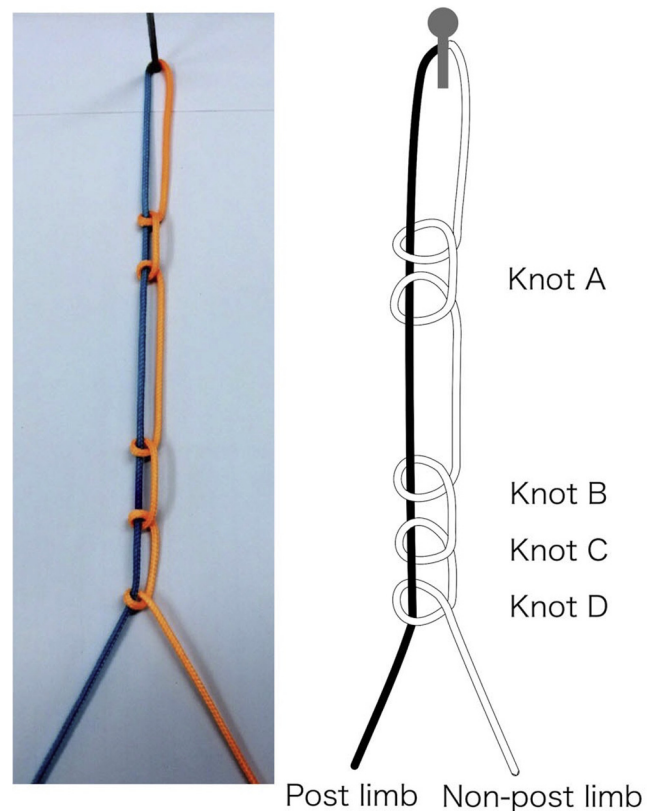


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**Abstract:** In arthroscopic tissue repair, the final step is achieving adequate tissue approximation with a secure knot. The sliding knot is widely preferred over the nonsliding knot, with numerous publications describing knot configurations. However, in the literature there are few published descriptions of suture-handling techniques, even though they are fundamental to arthroscopic knot tying. We describe integral suture-handling techniques for arthroscopic sliding knots to improve the surgeon's performance in knot tying.

Although a simple procedure, arthroscopic knot tying is significantly more complex than open knot tying because it involves securing the suture in a limited space in which suture manipulation may be difficult.<sup>1</sup> It is critical for the surgeon to understand the various types of knots, the path of the sutures within the tissues being approximated, and the tension effect on the suture limbs while securing the knot. Many techniques for arthroscopic sliding knots have been described, with each technique having its unique advantages and disadvantages.<sup>2,3</sup> An ideal knot should have a small profile, be easily tied, and provide adequate loop security.<sup>1</sup> The most commonly used technique is the use of any sliding knot (described as "knot A") followed by 3 or more alternating half-hitches (described as "knot B," "knot C," "knot D," and so on). There are many articles in the literature that predominantly focus on the various configurations of sliding knots (knot A) but very few articles addressing the issue of suture handling.<sup>2,4</sup> With the growing popularity and recent advances in arthroscopic

surgery, the understanding of integral suture-handling techniques for arthroscopic sliding knots is of utmost importance.



**Fig 1.** Diagram of knots used in Video 1. Knot A is a sliding knot, consisting of 2 alternating half-hitches (overhand followed by underhand). Knot B, knot C, and knot D are 3 alternating half-hitches: overhand, underhand, and overhand, respectively.

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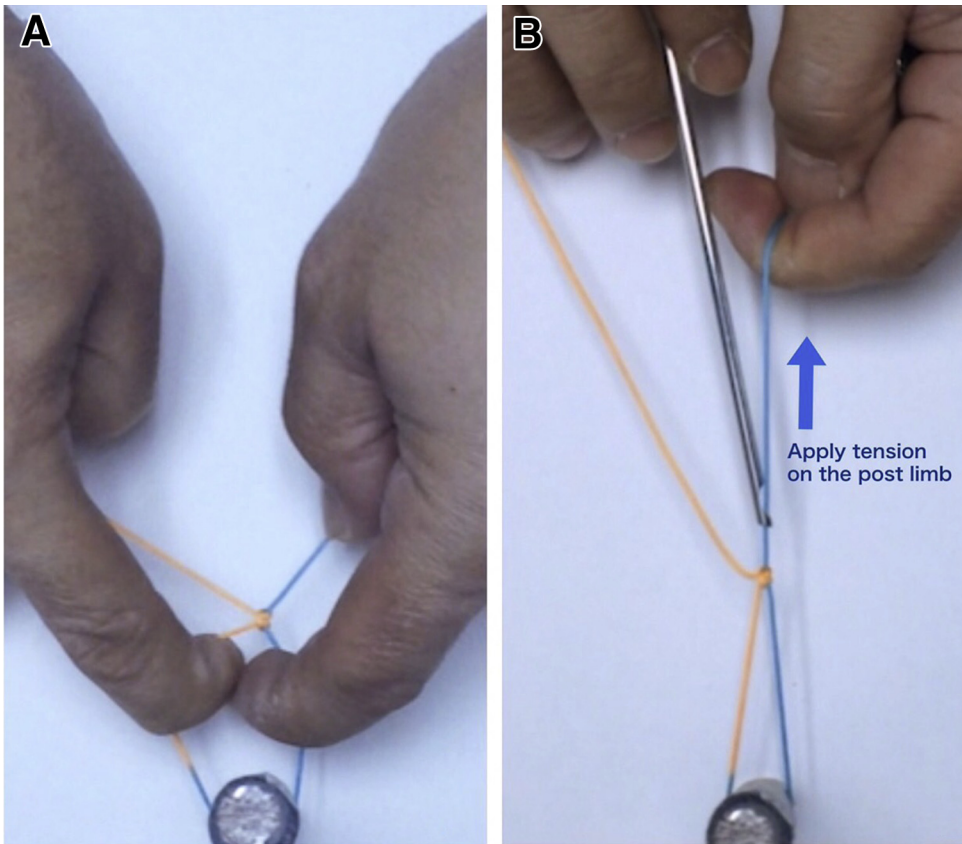
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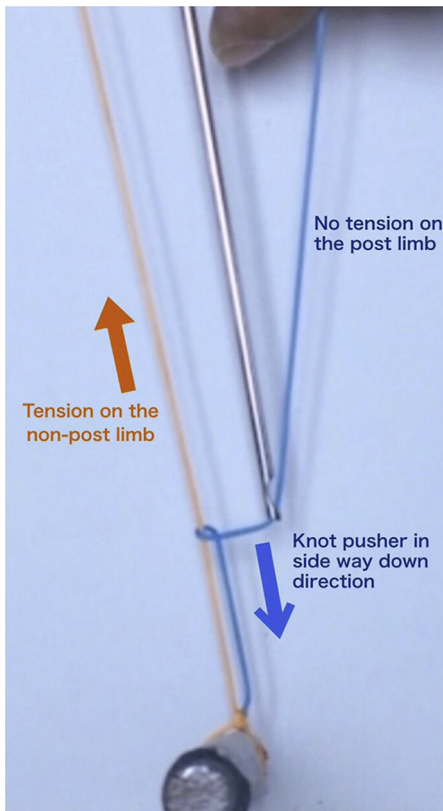
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**Fig 2.** In case of premature locking of the sliding knot (A), simple tension applied on the post limb will easily return the sliding property to the knot (B).



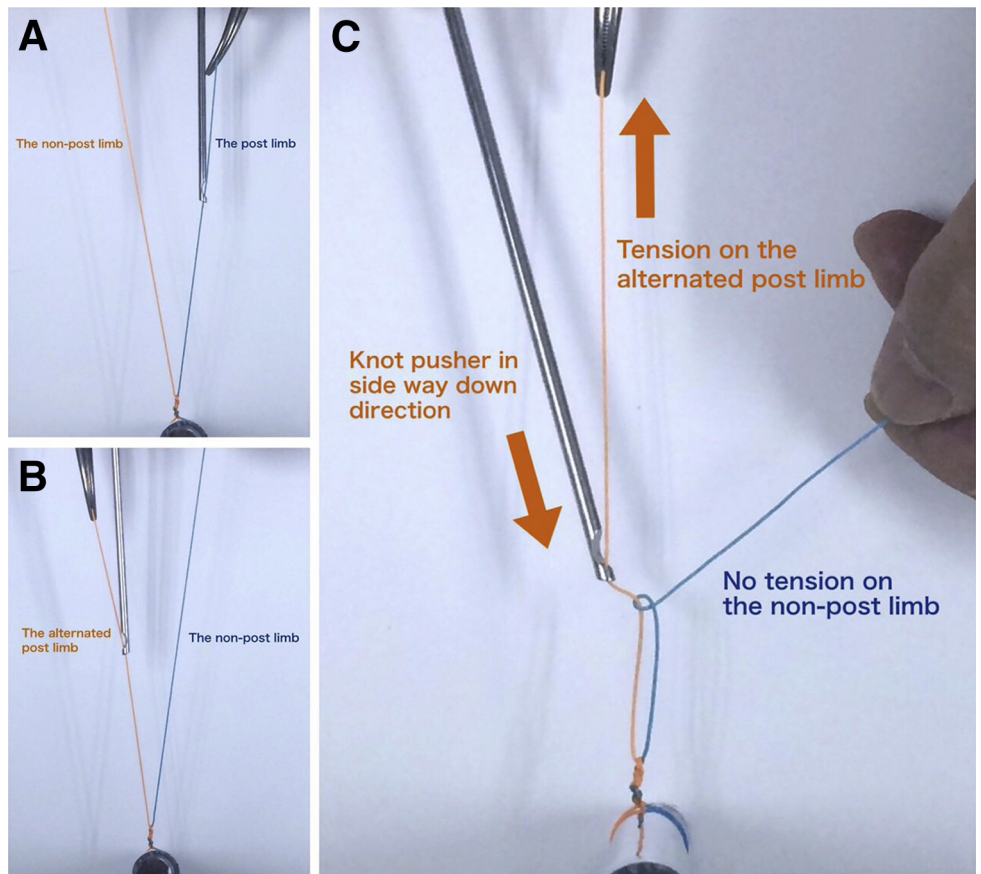
**Fig 3.** The alternating half-hitch knot should be delivered without any tension on the post limb. A knot pusher pushes in a sideways down direction (tension on non-post limb).

## Technique

The knot terms are defined as follows:

- The “post limb” is the suture limb around which the loops are made using the loop limb. A knot pusher pushes the knot down this limb.
- The “loop limb” (non-post limb) is the suture limb used to make loops over the post limb to create the knot.
- “Alternating half-hitch knots” (overhand loop followed by underhand loop) are used to provide loop security to the knot after placement of the sliding knot.
- In “alternating post half-hitches,” the post limb is alternated followed by alternating half-hitch knots.
- “Past pointing” is an action used to orient the limbs at 180° from each other by pushing the tip of the knot pusher beyond the knot being tied.

A common pitfall in arthroscopic knot tying occurs after the sliding knot (knot A) has been placed and secured by past pointing,<sup>2</sup> when the surgeon is placing the alternating half-hitch knot (knot B, knot C, knot D, and so on). If he or she is not careful, unnecessary tension on the post limb will easily result in loosening of the primary sliding knot (knot A). This will then lead to failure of tissue approximation. Further integral suture-handling techniques for arthroscopic sliding knots are reviewed in the following subsections.



**Fig 4.** (A, B) Delivering the alternating half-hitches by also alternating the post limb. (C) Tension is kept only on a newly established post or previous non-post limb.

**Tip 1**

The sliding knot (knot A) consists of several steps of loop reconstruction using the loop limb over the post limb. The post limb is always kept under tension and in a straight line. Therefore, any configuration of the sliding knot will retain its sliding property. In [Video 1](#), the sliding knot is reconstructed using 2 alternating half-hitches that are equivalent to a square knot<sup>5</sup> (Fig 1). In case of premature locking of the sliding knot (knot A) that can commonly occur if unnecessary tension is applied to the non-post limb, simple tension on the post limb will easily restore the sliding property as the post limb is being kept under tension and is in a straight line again (Fig 2).

**Tip 2**

After the sliding knot (knot A) is placed in the desired position and secured by past pointing, 3 or more alternating half-hitches (knot B, knot C, knot D, and so on)<sup>6</sup> will be reconstructed to provide loop security. While performing this step, the surgeon must realize that any tension applied to the post limb will cause the post limb to realign in a straight line, resulting in loosening of the primary sliding knot (knot A). To avoid this pitfall, the alternating

half-hitches can be delivered by the following 2 techniques:

1. Alternating half-hitches (knot B, knot C, knot D, and so on) should be delivered with care, without any tension on the post limb. In [Video 1](#), the half-hitch knot was delivered in a sideways down direction,

**Table 1.** Tips and Tricks for Suture Limb Tension During Arthroscopic Sliding Knot Placement

Tips

- Sliding knot delivery: tension on post limb without tension on non-post limb to prevent premature locking
- Alternating half-hitch knot delivery: tension on non-post limb without tension on post limb to prevent obstruction of knot delivery and loosening of primary sliding knots

Tricks

- To avoid premature locking of sliding knots, applying tension on the post limb will return the sliding property. The surgeon should be careful to ensure that no tension is applied to the non-post limb.
- For alternating half-hitch knot delivery, the surgeon has 2 options: The first is to apply tension on the non-post limb to deliver knots in a sideways down direction without tension on the post limb. The second is to alternate the post and apply tension on a newly established post limb to deliver knots in a sideways down direction.

**Table 2.** Advantages and Risks of Suture Limb Tension During Arthroscopic Sliding Knot Placement

Advantages	
	The technique can be applied to any configuration of arthroscopic sliding knot.
	The technique can prevent or correct premature locking of arthroscopic sliding knots.
	The technique allows the surgeon to secure and be able to tie the knots as tightly as possible.
Risks	
	Too much tension will result in pullout of the anchor from bone or damage to the tissue being approximated.

with tension on the loop limb (non-post limb) (Fig 3).

- Delivering the alternating half-hitches (knot B, knot C, knot D, and so on) can also be performed by alternating the post limb<sup>1,2</sup> (Fig 4). Tension is kept only on a newly established post or previous loop limb (non-post limb).

A summary of tips and tricks for suture limb tension during arthroscopic sliding knot placement is presented in Table 1, and advantages and risks are shown in Table 2.

### Discussion

In arthroscopic surgery, achieving adequate tissue approximation is critical for soft-tissue healing.

Arthroscopic knot tying requires practice and an understanding of knot-handling characteristics. It is important that the surgeon be comfortable with the knot of his or her choice, covering both sliding and nonsliding knots and their locking mechanisms. Having a greater understanding regarding integral suture-handling techniques for arthroscopic sliding knots will enable the surgeon to perform successful repairs.

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