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During arthroscopic knot tying, one of the suture limbs may break before completion of the knot. With a single suture limb left, it may not be possible to secure the knot against slipping, and the surgeon may be forced to use an additional anchor to obtain a secure repair. We present a tool and method that allow completion of the knot on a single suture limb. Alternatively, the method can be used to perform all-inside endoscopic or arthroscopic knot tying without removal of the instrument from the body.
Arthroscopic Knot Tying on a Single Suture Limb in Case of a Torn Suture

Running title: “Knot Saving”

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We declare that there has been no financial support from a third party and there is no conflict of interest for any of the authors.

Acknowledgments:
The authors thank TAG Inc for producing the documented prototype.

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During arthroscopic knot tying, one of the suture limbs may break before completion of the knot. With a single suture limb left, it may not be possible to secure the knot against slipping and the surgeon may be forced to use an additional anchor to obtain a secure repair. Here we present a tool and method, which allow completing the knot on a single suture limb. Alternatively, the method can be used to perform all-inside endoscopic or arthroscopic knot tying without removal of the instrument from the body.

Key words: Suture, Arthroscopy, Knot tying, all-inside, suture limb
Introduction

Arthroscopic knot tying techniques generally rely on the ability of the surgeon to handle both suture ends outside the patient’s body. There are usually two possibilities to tie the knot: If the suture has the ability to glide such as in a suture anchor, then knot is usually pushed down as a sliding knot by simultaneous pulling on the post (suture limb along which the knot is pushed down) and by pushing on the knot with a knot-pusher. If the suture cannot slide, then usually single slacks are pushed down along the fixed post with the knot-pusher.

A severe problem arises however, if not both suture ends reach outside the body, i.e. only one end is there to handle. The technique presented here allows to perform arthroscopic knot tying even if one suture end is torn and very short or to perform all-inside knot tying.

Technique

A faster and more elegant method is to use the here presented specifically designed suture grasper, here called “Knot Saver”. The Knot Saver consists of an arthroscopic suture grasping device, equipped with a forward oriented hook located behind the clamp at the tip of the instrument.

Use of the Knot Saver:
While the long suture limb is held with one hand it is wound around the tip of the knot saver, while the tip is oriented towards the hand which holds the suture. This corresponds to the movement when a knot is tied in open surgery using a needle holder. The suture loop can now be brought into the joint with the hook near the instrument’s tip, by advancing the Knot saver into the joint. The loop will slide along the long suture limb, pushed by the hook. Inside the joint, the short suture limb is grasped with the tip of the knot saver, then the knot saver pulled back a little. Thereby the loop is released. Now the slack for the knot is in place and the knot can be secured. As described above, the tension should be varied between short and long limb to ensure locking of the knot. For a secure knot, with a braided suture like Ethibond, at least 4 single slacks should be used and with Fiber Wire 6 single slacks.
Discussion
If a suture tears for example at the tip of an arthroscopic cannula during tying of a knot to a suture anchor, the entire repair may be jeopardized. In practice it has been necessary to remove the suture and to overdrrill the anchor and place a new anchor at the same site with a new suture or even to reload the anchor (1). With the above described technique, such a knot can be saved and completed. There may also be other situations in arthroscopic or endoscopic procedures where a long suture limb is to be tied to a short limb.

This problem has been addressed previously in the literature, where it is proposed that the torn, short suture is substituted with a suture grasper instrument, along which the single half-hitches are pushed down (2). This method has the advantage that there is no need for an additional instrument. However, to bring the suture loop down along the suture grasper, the knot pusher, suture and suture grasper must be held at the same time, which is technically a little demanding, but possible. Further it has been described that changing of the post to obtain an asymmetrical knot is difficult with said technique.

The here presented Knot Saver allows to place the half-hitches in one single step and to secure the suture with it. In return, the short suture limb must be grasped for each new half-hitch, which however is considerably well feasible with the forceps tip. A general advantage of the here described technique is, that knots are made with exactly the same movement as when using a needle holder in open surgery. With good exposure and experience, it is possible to wind the suture loop around the knot saver intra-articularly without removing the instrument from the joint and to tie knots all-inside like when using a needle holder.

Therefore this method appears well suitable to also perform all-inside knot tying endoscopically in the abdominal cavity without removing the instruments for each new half-hitch. All aspects of conventional knot tying apply to the described technique, such as alternating the direction of the half-hitches and of the pull on the suture limbs for secure knot tightening and the method has proven to be easily reproducible.
References

2. Tauro, JC. Completing arthroscopic knots with a broken suture limb, Arthroscopy 1997;13:268-270
Legends to Figures:

Fig. 1: The “Knot Saver”: It is composed of an arthroscopic suture grasper equipped with a forward-looking hook at the end of the instrument. The hook is shaped such that soft tissue is not caught when advancing the instrument through the portal into the body. The mouth can be opened with the handles (“A” vs. “B”).
Fig. 2a: The long suture limb is wound around the tip of the Knot Saver outside of the body, equal to knotting with a conventional needle holder. In endoscopic surgery, this may be performed intraabdominally.
Fig. 2b: The Knot Saver advances the suture loop towards the knot, thereby the loop slides along the long suture limb, which is held under soft tension.
Fig. 2c: The short suture limb is grasped with the Knot Saver’s tip.
Fig 2d: The Knot Saver pulled back a little to release the suture loop, while the long end is slack.
Fig. 2e: The knot is tightened. Alternating the main pull on the Knot Saver or on the long suture limb with each additional half-hitch will result in a knot equally stable as when the posts are alternated with each half-hitch.