The Doubled-Suture Nice Knot

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Abstract: The authors describe a novel suture fixation technique that combines a doubled suture with a sliding knot. The knot can be tied in both open and arthroscopic surgery to fix torn tendons/ligaments and fractured/osteotomized bones. The advantages of the doubled-suture Nice knot include strength, adjustability, simplicity, and versatility. The technique, which has proven useful in the authors’ practice for the past 10 years, has replaced metallic wires and cables for bone fixation. The doubled-suture Nice knot can also be tied over a double-button and has been used for ankle syndesmosis, acromioclavicular joint separation repair, and coracoid bone block fixation. [Orthopedics. 2017; 40(2):e382-e386.]

Secure fixation is crucial for tissue healing, whether it is bone or soft tissue. A knot is considered to be of good quality if it is easy to learn and tie, has a low profile, has good loop and knot security, and allows accurate control of the tension applied. Traditionally, flat non-sliding knots, such as square knots, have been used in open surgery because they have been perceived to be more secure than sliding knots. With the development of arthroscopic and endoscopic surgery, the technical challenges of tying intracorporeal flat knots have contributed to the development of many effective sliding knots.

Besides the knot itself, the type of suture used and its configuration are also important biomechanical parameters that should be taken into account at the time of soft tissue and bone repair. It has been the authors’ experience that doubling the suture on itself provides a stronger means of fixation for both soft tissue and bone repair. However, the use of a doubled suture means that a specific knot must be done to provide both progressive tensioning and secure fixation. For the past 10 years, the authors have been using the doubled-suture Nice knot for the fixation of bone fragments and soft tissues alike, in various surgical contexts.

In this article, the authors describe a novel fixation technique that combines a doubled suture with a sliding knot that is self-stabilizing (nonslipping), adjustable, easy to perform, and solid. The doubled-suture Nice knot can be tied in both open and arthroscopic surgery to fix torn tendons/ligaments and fractured/osteotomized bones. Its use with a doubled high-strength suture also makes it applicable in a variety of contexts involving large displacement forces.

Technique

A high-caliber (at least No. 1), braided, absorbable or non-absorbable suture is used. The suture is doubled over itself to obtain 2 free limbs on one end and a loop on the other (Figure 1A). The suture is passed around the tissues to be fixed, using a suture shuttle or a removable needle mounted on the loop end. Alternatively, a commercially available “looped” suture with needle can be used (Figure 2). A simple square knot is thrown using the loop on 1 hand and the 2 free
limbs on the other (treated as a simple, undoubled suture) (Figure 1B). The loop is opened and both free limbs are passed through it (Figure 1C). The knot is then dressed by making the loop smaller (Figure 1D). When ready to secure the involved tissues, surgeons tighten down the sliding knot by either pulling the 2 free limbs apart (Figure 1E)—as done during open surgery—or pulling the free limbs (acting as the post) back toward them, which is most useful during arthroscopic surgery. As with other sliding knots, while the post is being pulled back, the knot can be helped down either manually or with an arthroscopic knot pusher to reduce the traction forces seen by the tissues around which the sutures are sliding. Another way to reduce such traction forces is to pull the 2 free limbs of the post separately in alternation (but still in the same axis). Finally, 3 alternating half-hitches or surgeon’s knots are performed using the 2 separated free limbs (Figure 1F). This precludes the possibility that the free limbs will slide back out of the loop, thus securing the knot definitively. As excellent as its loop security and holding capacity may be, the authors consider the knot provisional until secured definitively with the 3 alternating half-hitches.16,17

APPLICATIONS
The following are a few examples of the various contexts, open and arthroscopic, in which the doubled-suture Nice knot has proven useful.

Tuberosity Fixation During Fracture Treatment With Humeral Hemiarthroplasty or Reverse Shoulder Arthroplasty

The authors’ technique for tuberosity fixation using 4 horizontal cerclages and 2 vertical tension-band sutures has been published previously.18 The authors have modified their technique in that each cerclage and tension-band sutures are now made using the Nice knot with strong (eg, No. 5 Ethibond [Ethicon, Somerville, New Jersey] or No. 2 Orthocord [DePuy Mitek, Warsaw, Indiana]) nonabsorbable sutures. As explained above, the knots can be tightened in stages without slipping. This allows provisional fixation while the tuberosity positions are adjusted to achieve an anatomic reduction (Figures 3-4).

Fixation of an Isolated Greater Tuberosity After Acute Fracture, Nonunion, or Malunion

For fixation of an isolated greater tuberosity after acute fracture, nonunion, or malunion, the horizontal cerclage double sutures are passed through the hard bone of the bicipital groove (or through the lesser tuberosity) on one side and through the tendons of the infraspinatus and teres minor distally on the other side. This technique can also be used for the treatment of 3- or 4-part fractures, together with a lateral locking plate or intramedullary humeral nail.

Cerclage Sutures for Humerotomy or Femorotomy Fixation During Revision Arthroplasty

Multiple doubled sutures can be shuttled around the diaphysis and used for cerclage. This is
much easier than passing wires or cables and is less traumatic to the surrounding soft tissues, both during insertion and in case of an unexpected breakage. Two, 3, or 4 cerclages are set up and, again, partially and progressively tightened while the osteotomy fragment is reduced anatomically. Suture is less likely than wires or cables to irritate the surrounding tissues; yet, if for any reason the doubled-suture cerclage needs to be removed, it is much easier to cut with scissors and pull out (Figure 5).

**Fixation of Small Butterfly Fragments**

A butterfly (wedge) fracture fragment is often encountered when performing open reduction and internal fixation of fractures of, for instance, the clavicle or distal fibula. An attempt to fix such a butterfly fragment with a lag screw can result in its fragmentation or devitalization. However, it is a simple matter to pass 1 or 2 doubled sutures around it and secure it with the Nice knot.

**Arthroscopic Applications**

The authors systematically use the Nice knot when performing side-to-side rotator cuff repairs or anchorless, transosseous repairs (Figure 6). In some situations, they also pass a doubled suture through the eyelet of an anchor and use it with the Nice knot as they would any other sliding arthroscopic knot. The authors have also used this technique in the fixation of both posterior and anterior bone blocks for the treatment of shoulder instability. Finally, the doubled-suture Nice knot can also be tightened over a double-button for anterior cruciate ligament graft fixation, ankle syndesmosis, or all-arthroscopic reconstruction of acromioclavicular joint disruptions.

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**Figure 3:** Tuberosity fixation during hemiarthroplasty for proximal humerus fracture (left shoulder, anterosuperior “saber” incision). Note that 2 cerclages have already been placed to fix the greater tuberosity to the prosthesis (after bringing the arm into external rotation for anatomic tuberosity reduction). This figure illustrates the 2 final cerclages around both tuberosities, their doubled sutures having been shuttled around with a regular needle-loaded suture. With the lower blue cerclage, a Nice knot is prepared and left loose; on the upper green cerclage, a Nice knot is tightened provisionally (A). The tuberosity reduction is adjusted as required, then the lower blue cerclage Nice knot is tightened (B). The upper green cerclage can now be tightened definitively, then both knots are secured and cut (C). Final appearance with all 4 cerclages and 2 vertical tension bands in place (D).

**Figure 4:** Preoperative (A) and 6-month postoperative (B) radiographs of tuberosity fixation during hemiarthroplasty for a 4-part fracture-dislocation using 4 cerclages and 2 tension-band sutures with the doubled-suture Nice knot. Axial (C) and coronal (D) computed tomography scans 6 months postoperatively showing a preserved tuberosity reduction and good bone healing.
Other Possible Applications

The authors have also used the doubled-suture Nice knot for tension banding of olecranon fracture and for patellar fracture fixation. This novel fixation technique has proven useful in their practice for the past 10 years, replacing metallic wires and cable fixation.

DISCUSSION

Advantages

The doubled-suture Nice knot has several advantages. First, its use of a doubled-over suture theoretically doubles the suture’s strength. The tension in each strand is halved, as is the risk of breakage. The doubling of the suture also results in increased internal friction, which translates into excellent loop and knot security.¹

Second, tightening the knot by pulling the free limbs apart results in a feel similar to that of flattening a half-hitch or surgeon’s knot, allowing more accurate and adjustable tensioning of the suture.

Third, the tightening process can be stopped and resumed at any stage, as the loop security of the knot prevents it from slipping. Thus, when repairing a tissue under tension, 2 or more sutures can be placed an appropriate distance apart and the Nice knot can be prepared on each of them (Figure 4). Provisional tightening can then be performed and the reduction adjusted as required before the knots are finally tightened and secured. This is in stark contrast to tying a simple knot, which requires immediate and irreversible locking, constant tension on the limbs, or other extra (and sometimes unreliable) maneuvers by an assistant to prevent slippage.

Fourth, as long as it has not yet been secured, the knot can be completely undone by simply pulling the free limbs back out of it. Once that is done, the knot unravels automatically and the doubled suture can be reused immediately.

Fifth, despite the above advantages, the Nice knot remains a low-profile, simple knot compared with other existing sliding knots. By combining a relatively simple initial knot with equally simple security knots, the Nice knot provides knot security without excessive complexity and bulkiness. Bulkiness is especially undesirable when a knot made with nonabsorbable suture is left adjacent to articular cartilage or moving tendons.¹²

Needled double sutures are available and can be used with either an absorbable (Doubled PDS; Ethicon) or a nonabsorbable (NiceLoop; Tornier Inc, Bloomington, Minnesota) suture (Figure 2).

Comparison With Related Knots

The closest relative to the doubled-suture Nice knot is the “modified racking hitch” knot. Although derived from the same “cow hitch” predecessor, the modified racking hitch is less straightforward and symmetric.²¹ Thus, in addition to being more difficult to perform, the internal friction and interference is increased in the modified racking hitch knot, making it also relatively more difficult to slide. The simpler “racking hitch” knot, which the senior author (P.B.) used prior to the Nice knot, had too little internal interference and therefore not enough holding power.

An even more complex knot, the “giant knot,” is re-
ported to have enough internal interference after being “flipped” to not require securing with additional knots. Concern has previously been expressed regarding the effect of such post switching on knot tightness and tissue apposition. In addition, this knot is performed with a single, not a double, suture. Comparisons between these various knots have yet to be made with objective laboratory testing. The mentioned phenomena and the authors’ clinical experience with all of the above knots together support their conclusion that the Nice knot strikes the best balance among all of the attributes of the ideal sliding knot.

Limitations

The strength of this technique may be underestimated while the knot is tightened. This may lead to ischemia of the tissues being fixed. Furthermore, later on, the weakest link in the construct may be the bone or soft tissues themselves. Thus, the surgeon should not subject them to unreasonable biomechanical conditions (e.g., accelerated weight bearing or resisted range of motion) simply because a stronger fixation technique has been employed.

CONCLUSION

The doubled-suture Nice knot is helpful and remarkably easy to execute. The authors encourage other surgeons to employ it. Whether in trauma or elective surgery, in open surgery or arthroscopy, its applications are numerous. Its strength and effectiveness can provide the surgeon with confidence and efficiency in various critical surgical situations.

REFERENCES