CLIMBERS' CORNER

An Overview of Climbing Hitches

By Mark Adams

Arborists' climbing hitches have seen tremendous changes and improvements in the past ten years. Techniques have been adapted and borrowed from various high-angle disciplines, and now there are numerous knots, a variety of ways to tie them, and an assortment of accessory cords that alter how the knot responds when in use. Because of the wide range of resources available, some of the climbing hitches are well known and illustrated; some are known but have been published in only a few different sources; and some are known only by word of mouth. In many cases, the terminology is confused, and discrepancies exist about the names of and how to tie some of the climbing hitches.

One purpose of this article is to compile information and present standard terminology with the hope that we can achieve some uniformity in the nomenclature used for our various climbing hitches. This article also is intended to help people learn some of the similarities and differences between the various climbing hitches, but it is not intended to teach all of the details of how to use a knot. Descriptions of knots are to clarify the discussion, and photographs are for illustrative, not teaching, purposes. If you are not thoroughly familiar with any of these climbing hitches, then you should attend an industry seminar or training session before trying to climb with them. When you learn a particular climbing hitch, practice low and slow.

As with all knots, climbing hitches need to be properly tied, dressed, and set. "Tie" means to form the knot, "dress" means to align all of the parts of the knot, and "set" means to tighten or load the knot before actually using it.

For the purposes of this article, climbing hitches will be assessed by three main criteria:

- how well the climbing hitch *holds* the climber in place for work positioning
- how easily the climbing hitch *releases* to allow the climber to descend and then *grips* once the climber has reached the next (usually lower) work station
- how easily the hitch *breaks* and *advances* when pushed by a slack tender or the climber's hand and then *grips* once the climber has reached the next (usually higher) work station

How well the knot *holds* refers to how securely and reliably the hitch stays in place as the climber works in a particular location. Ideally, the hitch should not slide at all. *Release* refers to when the climber pulls down on the knot to descend to a new work station. The hitch should release with minimal effort yet should grip and hold consistently and securely when the climber lets go of the hitch on arrival at the next work station. *Break* and *advance* refer to when the climber slides or pushes the knot up the climbing line with his or her hand or with a slack tender. The hitch should break easily and advance with minimal effort yet should grip and hold consistently and securely whenever the climber pauses in the ascent or reaches the next work station. Note that, when ascending, the climber's hands are often above or below, and not necessarily on, the climbing hitch.

Open Hitches

Tautline

The version of the tautline that is most commonly known by tree climbers is "two under, two over" (Figure 1). Two counterclockwise turns are formed down the line below the bridge, then two counterclockwise turns are formed down the line above the bridge. (Note that the legs of the hitch exit the knot in opposite directions. It creates a good mnemonic because the legs look like a T for "tautline.")

The tautline holds the climber securely in place for working, but it tends to tighten under the load of the weight of the climber. The tautline can become difficult to release after some use and often requires a great deal of manipulation for the climber to descend. Advancing the tautline can be a struggle, and usually the knot has to be loosened or "cracked" to move it up the rope. The tautline grips fairly well, but if it has been loosened to advance it up the line, it must be set again when the climber needs to stop and work. The tautline also has a tendency to roll—the bridge gradually gets longer, the tail gets shorter, and the knot eventually works its way to the end of the tail and completely unties itself. To prevent rolling, it is necessary to put a stopper knot in the tail of the tautline.

Many people have also used a "two under, one over" version. Two counterclockwise turns are formed down the line below the bridge, then one counterclockwise turn is formed above the bridge. The two-under, one-over releases and advances a little more easily than the two-under, two-over, but it

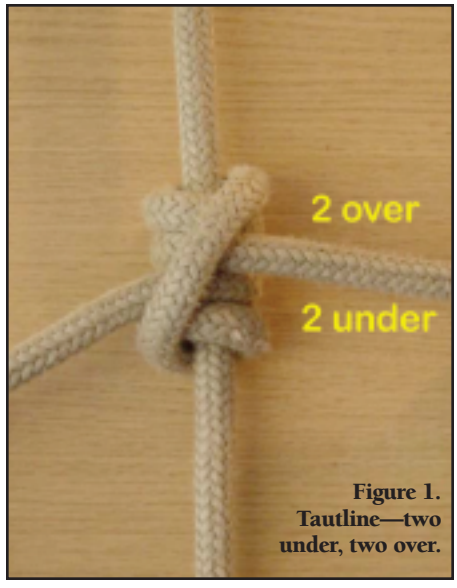


Figure 1. Tautline—two under, two over.

does not grip as reliably when the climber reaches a new work station and often needs to be set by tugging up on the tail of the hitch for it to hold securely. There are other variations in the number of turns, devised to accommodate climbers with different styles and body weights. When manila rope was used for climbing, both the number of turns and the direction of the turns relative to the lay of the climbing line were important.

Prusik

In the standard version of the Prusik, two counterclockwise turns are formed down the line below the bridge, then two clockwise turns are formed down the line above the bridge. Note that the tail changes direction when the turns are taken above the bridge. This change causes the legs of the knot to exit the hitch in the same direction (Figure 2), whereas the legs of the tautline exit the knot in opposite directions.

Figure 2.
Prusik.

The Prusik has many of the same characteristics as the tautline. It holds the climber firmly in place but often binds so that it may be difficult to release and difficult to advance. Although it is not considered a rolling hitch, it is recommended that a stopper knot be placed in the tail of the knot.

Many arborists are familiar with the Prusik as a friction hitch for use in the secured footlock. In this technique, the Prusik is tied with a loop of rope rather than with a length of rope. A bight of the loop is placed on the climbing line, and the other end of the loop is passed through the bight, creating a wrap, or turn, around the climbing line. Each time the loop makes a turn through the bight, it creates two coils (sometimes called "fingers") on the climbing line. If two turns are taken, then four coils are created, and the Prusik looks exactly like the first Prusik that was formed using a single length of rope (Figure 3). This hitch is called a two-wrap, four-coil Prusik.

Figure 3.
Prusik with a cord—four coils.

Prusik with a loop—four coils.

When used for the secured footlock, the Prusik is formed around both legs of the climbing line, and it is necessary to form a three-wrap, six-coil Prusik. The cord that is used for the Prusik should be smaller in diameter than the host line. Because the Prusik cord is doubled, both legs of the loop share the weight of the climber, and the breaking strength of the loop needs to be the same as that required for an arborist's climbing line (as stated in sections 3.23 and 8.7.4 of the Z133.1-2000 safety standards).

When used in this configuration, the Prusik should be used only for ascending. A climber should never attempt to descend with the Prusik that is used for the secured footlock. Although the single line and the loop Prusik look exactly the same, they perform differently. Some authorities even consider them to be entirely different knots.

When tied with a loop, the Prusik is also bi-directional—that is, it holds equally well when pulled in either direction and thus can be used for a two-in-one lanyard and in some rigging situations.

Blake's Hitch

Blake's hitch is tied by making four counterclockwise turns up the rope above the bridge. The tail is then dropped over/in front of the bridge, passed behind the climbing line, and then up through the bottom two of the four turns (Figure 4). It is critical that, after being dropped over the bridge, the tail is passed behind—not in front of—the climbing line.

Blake's hitch has several advantages over the traditional tautline and Prusik hitches. It is not a rolling hitch. Thus, it does not need a stopper knot on the tail, although it is still recommended that one be used. Blake's hitch holds securely, but it does not tighten and jam as much as the tautline and Prusik when the climber is working. It releases and advances more easily yet grips reliably when the climber arrives at a new work station.

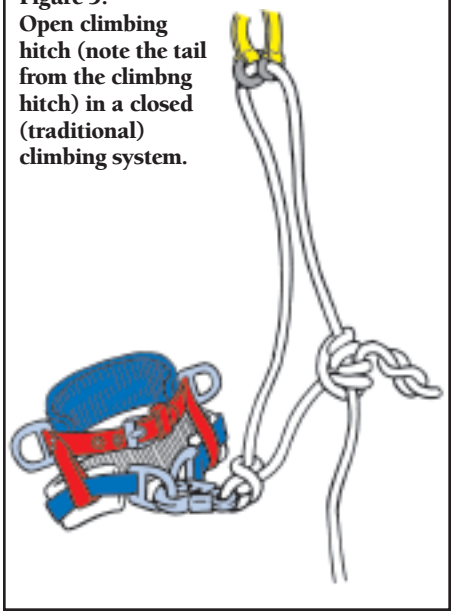
Figure 4.
Blake's hitch.

Although some frictional control is provided by all of the coils, one part of the hitch—called the "hot spot"—receives a disproportionate amount of friction and therefore burns more easily. The hot spot occurs on the part of the tail that is tucked under the bottom two coils. In a long, fast descent, this spot can be glazed to the point of rope failure, so it is important to descend slowly and always check the rope for excessive wear before and after climbing on it.

The tautline, the Prusik (when tied as a climbing hitch with a single length of cord), and Blake's hitch are all called "open" climbing hitches because the tail of each hitch is left free (Figure 5). Therefore, they may be used in a closed (traditional) or open (split-tail) climbing system and may be tied to either a locking snap or to a double-locking carabiner.

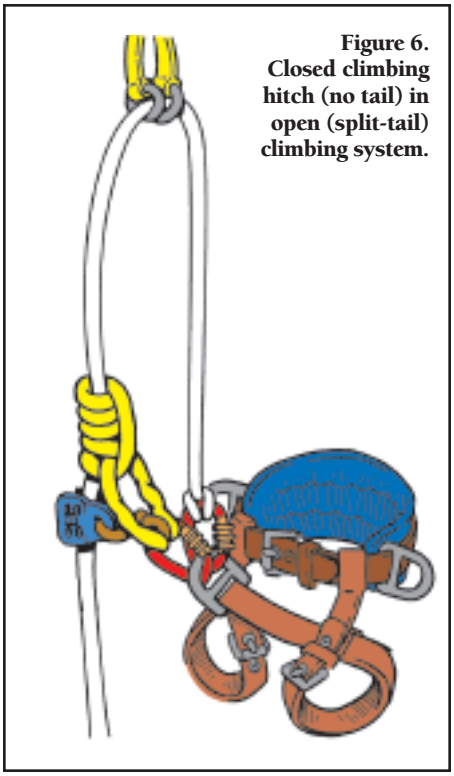
In a closed, or traditional, climbing system, the climbing line is tied to a connector

Figure 5. Open climbing hitch (note the tail from the climbng hitch) in a closed (traditional) climbing system.



(usually a locking snap), and a long tail is left in the knot. This tail is then used to tie the climbing hitch on the fall, or standing part, of the climbing line (Figure 5). In the open, or split-tail, system, the climbing line is attached to the connector using an appropriate endline knot or an eyesplice. The climbing hitch is tied using a short, separate piece of rope called a split-tail; the split-tail is attached to a second connector, which is then clipped to the saddle (Figure 6).

Figure 6. Closed climbing hitch (no tail) in open (split-tail) climbing system.



Closed Hitches

With closed hitches, the tail of the hitch is incorporated into the climbing hitch. Both ends of the cord are attached to the connector—usually a double-locking carabiner. There is no tail coming out of the climbing hitch.

However, closed hitches can form only an open (split-tail) climbing system because the hitch is always separate from the working end (the lead) of the climbing line (Figure 6). As with the Prusik loop, both legs of a closed climbing hitch share the weight of the climber and all of his or her equipment.

The hitches described in this section are often referred to as high-performance hitches. When properly adjusted, they hold securely, release with just a slight touch of the hand yet grip firmly after descent, break easily when advanced, and grip firmly and reliably when the climber weights them. Because these hitches require less manipulation, they allow the climber to move faster and more freely in the tree. Ascents, descents, limb walks, and swings all become more fluid and graceful.

The hitches described below are highly responsive, but they have more variables to consider than the open hitches. Where the tautline, the Prusik (when tied as a climbing hitch with a single length of cord), and Blake's hitch are all tied with a split-tail of the same construction as or very similar to the climbing line, the hitches described in this section use a split-tail different from the climbing line (note the wide variety of cords that are used for the split-tails in the high-performance knots).

The performance of each hitch is highly dependent on the length, type, diameter, and condition of the cord that is used for the split-tail and on the type, diameter, and condition of the climbing line. A particular split-tail may work very well with a particular climbing line yet be unpredictably loose or irritatingly tight on another climbing line. It is imperative that the climber be aware of this fact and always test the compatibility of the components of the system before leaving the ground. Some of the variables of the split-tail that affect the performance of the climbing hitch are discussed at the end of this article.

French Prusik

Like the traditional Prusik, described in the section on open hitches, the French Prusik can be tied with either a length of rope or a loop of rope, and it can be tied in several different configurations. Unlike the traditional Prusik, however, there are different names to describe different configurations of the French Prusik.

When tied with a loop of rope, the French Prusik is called a *Machard* or a *Machard tresse*, depending on how it is formed. When tied with a single length of rope or webbing, the French Prusik is called a *Valdôtain* or a *Valdôtain tresse*, again depending on how it is formed. The term "French Prusik" includes all of these variations and is not specific to any particular one.

The vast majority of tree climbers who use a French Prusik use a single piece of rope or cord to tie a climbing hitch, so only the *Valdôtain* and the *Valdôtain tresse* are discussed.

The *Valdôtain* is actually quite easy to tie. The split-tail makes seven turns around the climbing line (Figure 7). A carabiner is then attached to the eyes of the split-tail, and the carabiner is pulled down so that the legs of the split-tail cascade into place (Figure 8). This hitch holds the climber securely, releases with just a gentle tug on the hitch, and grips consistently and reliably when the climber lets go of the hitch. It breaks easily and with little effort. But, if the split-tail and the hitch are not properly adjusted, then the *Valdôtain* may not consistently and reliably grip the climbing line after it has been advanced with a hand or slack tender. It sometimes is necessary for the climber to hold the hitch against the climbing line so there is contact between the split-tail and the climbing line and so the hitch will then grip the line. Ways to compensate for this problem and to adjust, or "fine-tune," a climbing hitch are discussed at the end of this article.

The *Valdôtain tresse* (also called the *Vt*) is tied in a similar manner as the *Valdôtain* but with one significant difference: Four turns are made around the climbing line, then the

Figure 7. Forming the *Valdôtain*.

►

legs are braided down the line, below the wraps/turns. "Braided" means that, as the legs are passed around the climbing line, each leg alternates between being on top of, then under, the other leg. After the first four turns are taken around the climbing line, the top leg continues around the line but moves down (rather than up) the line and is first on top of, then under, then on top of the other leg. A carabiner is then attached to the eyes of the split-tail and the knot is set (Figure 9). When completed, the *Valdôtain tresse* looks much like the *Valdôtain* (compare Figures 9 and 8).

The *Valdôtain tresse* holds the climber in place, releases easily and grips reliably, and then advances easily and grips reliably as well. But, while the *Valdôtain* may become loose after being advanced up the climbing line, the *Valdôtain tresse* stays together and more consistently maintains contact with the climbing line, which means that it grips more reliably after it has been moved up the line.

When first formed, the *Valdôtain* is simply a series of turns around the climbing line. At this point, the hitch could be formed by attaching a carabiner and moving the legs either up or down the line—that is, the *Valdôtain* is bi-directional (Figure 10). This feature probably would not be used in any climbing system, but it may have some uses in certain rigging situations. Knowing that the *Valdôtain* is bi-directional also helps one understand how the knot functions. When the legs of the split-tail are pulled down to form the hitch, the leg that forms the top turn is the top leg all the way down the hitch. When the hitch is advanced and pushed up the line in quick succession (as when ascending to a new work station), one leg stays at the bottom of the hitch, and the other loosens all the way to the top of the hitch. The coils open, and there is no overlap to maintain some contact with the climbing line (Figure 11).

When the *Valdôtain tresse* is formed, it is a series of turns and braids. *"Tresse"* means "braid" in French, and the braids create a dramatic change in the way the knot functions. When the *Valdôtain tresse* is pushed up the line, the shape of the hitch is retained, and, if the hitch is properly adjusted, both legs are held close to the climbing line and have some contact with it (Figure 12). This arrangement allows the *Valdôtain tresse* to grip more quickly, reliably, and firmly than the *Valdôtain*. It must be emphasized, however, that the climber might have to experiment with different types, lengths, and diameters of the split-tail in order for the *Valdôtain tresse* to perform to this degree. If, for example, the split-tail is too long, then the hitch may become loose after a long ascent and not grip immediately when it is pulled down.

The *Machard* is tied exactly as the *Valdôtain* (a series of turns), but the turns are formed using a loop rather than a single length of line. The *Machard tresse* is formed exactly as the *Valdôtain tresse* (a series of turns and braids), but the turns and braids are formed using a loop rather than a single length of line.

The word "autoblock" has been used in some English-language knot books to refer specifically to the French Prusik, but this terminology is incorrect. "Autoblock" is a corruption of the French *"autobloquant,"* which means "self-jamming." It is used to refer to a group of slide-and-grip knots and is probably better translated into the English term "friction hitch."

Schwabisch

The Schwabisch is formed by making one counterclockwise turn below the bridge, then making three clockwise turns down the line above the bridge. This forms, in essence, an asymmetrical Prusik (Figure 13). Both legs

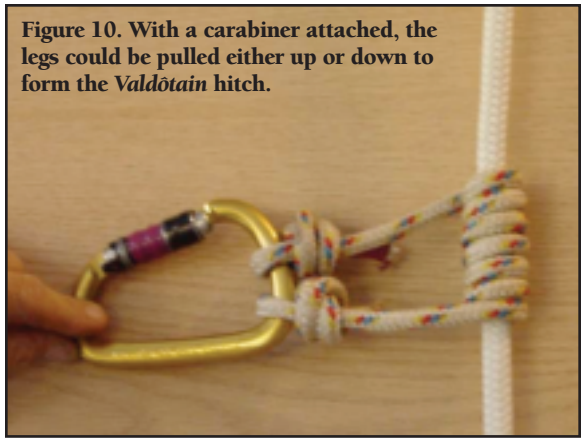


Figure 10. With a carabiner attached, the legs could be pulled either up or down to form the *Valdôtain* hitch.

Figure 11. When the *Valdôtain* is advanced quickly, one leg stays at the bottom of the hitch (arrow on the right), while the other leg loosens all the way to the top of the hitch (arrow on the left).

Figure 8. *Valdôtain.*

Figure 9. *Valdôtain tresse.*

Figure 12. When the *Valdôtain tresse* is advanced, the braid helps maintain the shape of the hitch and keep both legs in contact with the climbing line, as indicated by the arrows.

exit at the bottom of the knot, whereas, in the conventional Prusik, both legs exit from the middle of the knot (Figure 14). This one-down, three-up version was the one that was first shown in the United States for use in trees. Depending on the split-tail that is used, however, many climbers are now tying four turns above the bridge to create more friction so that the hitch will grip after it has been broken and advanced up the climbing line. If the legs of the hitch are too long, the hitch will become loose and not grip when the climber stops his or her ascent.

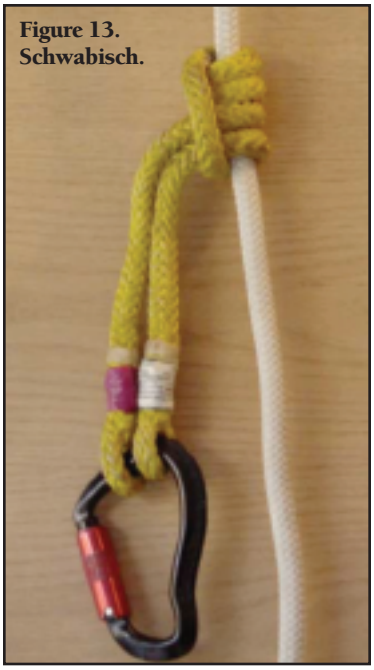


Figure 13. Schwabisch.

The Schwabisch holds securely. It releases much more easily than the tautline but not quite as smoothly as the French Prusik, and it grips reliably after descent. It can bind enough that it has to be hit more than once to break it, but, once loosened, it advances easily. Breaking and advancing are partly a matter of technique and proper placement of the slack tender. Because both legs exit the Schwabisch in the same direction and from the same place, the hitch is easily broken by pushing both legs back into the knot to loosen it. Generally speaking, the Schwabisch performs smoothly over a wide range of variables. Its best performance is probably not as fluid as the French Prusik, but it is not as temperamental and does not require as much fine-tuning.

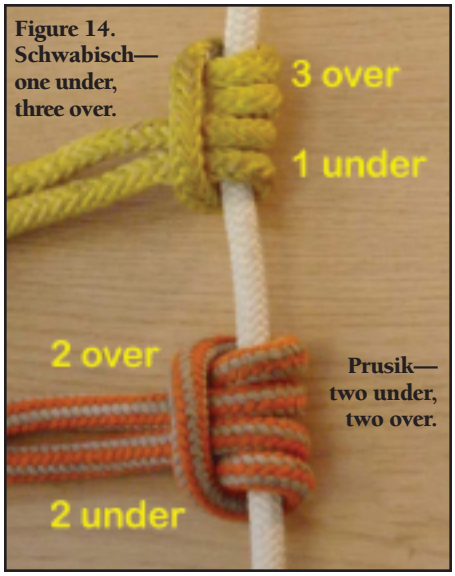


Figure 14. Schwabisch—one under, three over.

Distel

To form the Distel, one counterclockwise turn is made below the bridge, then four counterclockwise turns are made down the climbing line above the bridge (Figure 15). The difference between the Distel and the Schwabisch is that to form a Distel, the split-tail continues in the same direction when the turns are taken above the bridge; to form the Schwabisch, the split-tail changes direction when the turns are taken above the bridge. Note that this is the same difference that distinguishes the tautline from the Prusik.

Thus, the Distel is very similar to the tautline (Figure 16). For both hitches, a turn or turns are taken below the bridge; the tail moves above the bridge and continues to make turns in the same direction as the turn(s) below the bridge. The difference between the Distel and the tautline is that the Distel attaches both ends of the split-tail onto the carabiner, thus forming a closed climbing knot. The tautline leaves one end of the split-tail off of the connector and therefore is an open climbing knot.

The Distel holds the climber securely and reliably in place for working. It releases easily and grips reliably when the climber stops his or her descent. In some situations, it may become a little snug and not advance smoothly. The legs of the Distel exit the hitch in opposite directions, making it necessary to push them in opposite directions to loosen the hitch. Some split-tails may not do this without some manipulation.

In general, the Schwabisch and the Distel are easier to tie and untie than the French Prusik. Once tied, the Schwabisch and the Distel stay on the climbing line, which makes it easier to attach a carabiner and slack tender. The French Prusik has to be held on the line while the hardware is attached. The

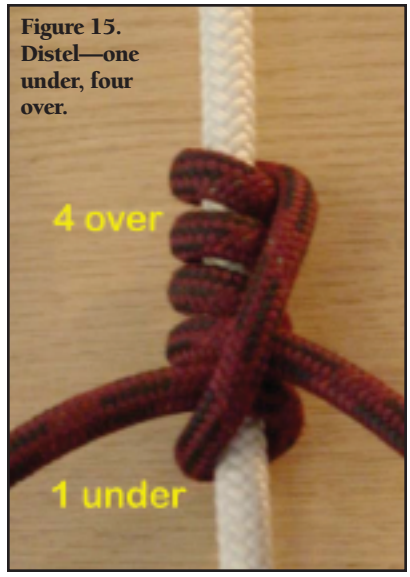


Figure 15. Distel—one under, four over.

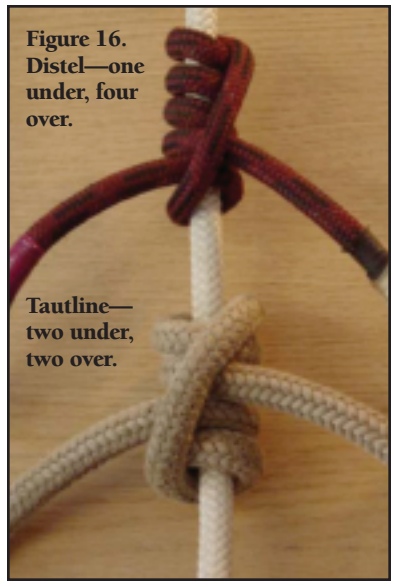


Figure 16. Distel—one under, four over.

Schwabisch and the Distel are not as finicky in their performance as the French Prusik, but neither are they as smooth and fluid.

Knut

The Knut hitch should not be confused with the Knute hitch, which attaches a lanyard or halyard to anything with a small eye. I learned the Knut from Knut Foppe in November 2001. I have never seen the Knut described in a publication, but I have seen at least three different people teach the Knut, each of whom showed a knot that was different from what the others showed and that was different from what Knut had shown to me.

The Knut is formed by making four counterclockwise turns up the climbing line. The top leg is dropped in front of the bottom leg. A bight of the bottom leg is held in place while the end of the leg forms

►

Figure 17. Knut—tied, ready to be dressed and set.

a clockwise turn down the climbing line, around the climbing line and the (now pendant) top leg. Finally, the bottom leg is passed through the bight (Figure 17). The split-tail that is used in this photograph is longer than normal so that it can easily show how to form the Knut. The split-tail in Figure 18 is a length that would typically be used for climbing.

The Knut holds securely when the climber is working, releases easily, and grips consistently after descending. It breaks easily, advances smoothly, and grips reliably when the climber pauses to work or rest. An added feature is that slack can be tended without a micropulley. The bottom turn through the bight acts as a slack tender and advances the hitch along the climbing line. It is not as smooth as a micropulley, but it can be useful if a micropulley is not available.

The Knut is somewhat more complicated to tie and untie than any of the previous knots. Like the Schwabisch and the Distel, it stays on the rope after it is tied and, in this respect, is a little easier to manage than the French Prusik.

Fine-Tuning: Variations and Considerations

There are many variations on these high-performance knots. A climber could add or subtract wraps, braids, or twists to fine-tune any of these hitches to fit his or her own particular style, body weight, climbing rope, or split-tail. Doing so may in fact be desirable because each climber can tailor a hitch to fit his or her own personal needs, but it can be dangerous if the climber is not aware of how subtle changes can drastically alter a knot's performance. The following are some of the variables to consider.

Generally speaking, for a given length of cord, a split-tail formed with a stiff cord advances more easily but, once loosened, retains its open form and does not readily grip the climbing line. A split-tail formed with a softer, looser cord may not advance as easily, but it tends to maintain some contact with the climbing line and thus grips more reliably after it is moved up the climbing line.

Using a slightly longer cord for the split-tail results in a hitch with longer legs. Longer legs prevent the hitch from breaking as quickly when hit with a slack tender or the climber's hand. Once the hitch does loosen and open, however, it may not have enough friction with the climbing line to instantly grip and tighten when the hitch is pulled down. Using a shorter length of cord for the split-tail results in a hitch with shorter legs, which helps keep the knot tight and compact. The hitch grips the line more readily after the hitch has been advanced. However, if the legs are too short, the hitch may bind and be difficult to release and difficult to break. Adding or subtracting wraps or braids has similar effects by increasing or decreasing friction and making the hitch tighter or looser on the climbing line. If wraps (or twists or braids) are added or subtracted, the knot's performance also may vary depending on whether the changes are made at the top or bottom of the knot (above or below the bridge).

The eyes of the split-tail for the closed climbing hitches may be formed by tying double fisherman's loops on each end of the split-tail, or the eyes may be spliced. If the eyes are tied, then the end knots may make it a little more difficult to tie the climbing hitch. If the eyes are spliced, however, the taper of the splice may affect the performance of the climbing hitch. If the splices of both eyes are tapered together in the middle of the split-tail, then the diameter of the entire tail will be slightly expanded, which may affect the performance of the hitch. Similarly, a knot's performance may be changed simply by changing the diameter of the cord that is used for the split-tail.

When properly adjusted, these hitches perform well and can be used for various other climbing and rigging applications. Lanyards, false crotches, and mechanical advantage systems can be improved and made more efficient through the proper use of a suitable climbing hitch.

These hitches can be seen on various Web sites; at trade shows and training seminars; and in videos, books, and magazines. Regardless of where the knots are seen or taught, it is up to the individual arborist to learn and use them safely.

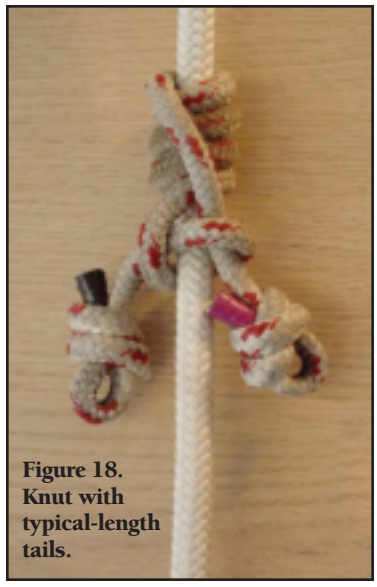


Figure 18. Knut with typical-length tails.

References

American National Standards Institute. 2000. *American National Standard for Tree Care Operations—Pruning, Repairing, Maintaining, and Removing Trees and Cutting Brush—Safety Requirements* (Z133.1). International Society of Arboriculture, Champaign, IL.

Ashley, Clifford W. 1944. *The Ashley Book of Knots.* Doubleday, New York, NY.

Bavaresco, Paolo. 2000. Practical arboriculture—Friction hitch fundamentals. *Landscaper Magazine*, March 3.

Blake, Jason. 1994. The slip—or knot (letter to the editor). *Arbor Age* 14(5):40–41.

Budworth, Geoffrey. 1999. *The Ultimate Encyclopedia of Knots and Ropework.* Hermes House, London, UK.

Budworth, Geoffrey. 2000. *The Complete Book of Sailing Knots.* Lyons Press, New York, NY.

Chisholm, Mark. Personal communication.

Confection du noeud machard tressé. www.ffme.fr/technique/corde/noeud/autobloquant/marchardt.htm (accessed 8/24/04).

Donzelli, Peter S., and Stanley Longstaff. 1999. The French Prusik revisited: More than just a climbing hitch. *Arborist News* 8(2):49–50.

Les noueds. membres.lycos.fr/climbrok/Sommaire%20noeuds.htm (accessed 8/25/04).

Palmer, Ken, Dwayne Neustaeter, Paul Sisson, Kay-Olaf Busemann, François Dussenne (with Frederic Mathias), and Mark J. Chisholm. 1998. The *Machard tresse*. *Arborist News* 7(2):41–45.

Prohaska, Heinz. 1990. Two jamming knots for thick cord and webbing. *Nylon Highway* 30:3.

Prusik, Karl. 1931. *Ein neuer knoten und seine anwendung. Osterreichische Alpenzeitung* 1116.

Raleigh, Duane. 1998. *Knots and Ropes for Climbers*. Stackpole Books, Mechanicsburg, PA.

Sherrill Arborist Supply. Product catalogs 2002, 2003, 2004.

Smith, Bruce, and Allen Padgett. 1996. *On Rope* (new revised edition). National Speleological Society, Huntsville, AL.

Thrun, Robert. 1973. *Prusiking.* National Speleological Society, Huntsville, AL.

Thrun, Robert. Personal communication.

Toss, Brion. 1990. *Knots: Chapman's Nautical Guides.* Hearst Marine Books, New York, NY.

Mark Adams is a Certified Arborist with Downey Trees, Inc., based in Atlanta, Georgia. *He would like to thank the reviewers for their many helpful comments.*

Photos by Dorothy Payne and Mark Adams. Illustrations by Bryan Kotwica.