Rappel Backup Efficacy: Techniques for Friction Hitches

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Abstract

This paper explores various common practices for backing up a rappel and tests the efficacy of each. The results indicate the continued viability of consensus best practices for rappelling. Additionally, results of particular note are: the insufficiency of using the leg loop to rig a friction hitch backup in the case of loss of consciousness, the inability of a friction hitch backup to protect against mis-rigging the rappel device, and the potential for "panic grab" failure if the friction hitch is tended with the entire hand.

Introduction

Rappelling is a commonly utilized descent tool for recreational climbing. Variations abound, such that there are entire texts dedicated to the craft of technical descent via rope (Kirkpatrick 2020). However, as a singular category, errors during technical descent comprise approximately 31% of reported climbing accidents in North America (Caroom 2020). Consequently, various methods have been devised to increase security while rappelling. These often take the form of a backup, a mechanism that will prevent catastrophic failure of the system should the rappeller lose control of the descent.

Many options exist for rappel backups, and might include:

1) A belay from above.
2) A belay from below.
3) An integrated backup.
4) A friction hitch.

When rigged properly, the belay from above with a separate strand of rope is the most effective form of rappel backup and can address not only loss of control of the descent but also stuck material in the rappel device (clothing, hair, etc.). Consequently, a belay from above is an exceptionally appropriate choice when instructing novices with little or no rappel experience. However, a belay from above is often not practical for multipitch descents for a number of reasons, not least of which is the difficulty in belaying the last person to rappel.

A belay from below, often referred to as a "firefighter's belay," utilizes a second person loosely holding the rope, ready to provide downward tension should the rappeller lose control of the descent. This technique only addresses loss of control, but does not address extrication of stuck material from the rappel device. Further, the effectiveness of a belay from below can be compromised over long distances or when the rope contacts the terrain with a significant change in angle (Kovach 2004). The technique is also obviously inapplicable for the first person to descend.

Integrated backups are features of assisted braking devices (ABD), belay/rappel devices that include a braking mechanism should the operator lose control of the rope. While assisted braking devices can prevent catastrophic failure if the rappeller loses control, many of the options on the recreational climbing market (ex. Edelrid Mega Jul) use the geometry of the device to passively generate braking power, thereby relying on specific configurations of device, rope, and carabiner to ensure complete braking. Consequently, users must test the specific equipment combinations they anticipate utilizing. Other options, such as the Petzl GriGri, use active mechanisms to achieve braking much more reliably, such as if the operator loses consciousness (MacDonald, in press). However, these options can be limiting for rappelling for many reasons, such as the inability to accommodate two ropes or poor function with wet ropes.

A friction hitch backup provides the most general solution as it can be used with both single and double rope systems and across a variety of conditions. The most significant consideration when using a friction hitch backup to rappel is whether the friction hitch should be placed on the rappel rope(s) above or below the rappel device. Various tests over several decades have demonstrated that a friction hitch above the rappel device is subject to "panic grab," an instinctual forceful gripping of the rope and friction hitch, which renders the backup ineffective in the event the rappeller loses control of the descent (Penberthy 1970, Storrick 1997). Over the last 20 years or more, rappelling with a friction hitch backup below the device has become much more commonplace among climbers (Robinson 1999). Use of a friction hitch below the device avoids, but does not eliminate (MacDonald 2020), many of the pitfalls among other options above. Use of a friction hitch does complicate rescue if the rappeller loses consciousness compared to a belay from above or below.

Methods and Results

This paper seeks to address various rappelling methods using a friction hitch as a backup placed below the rappel device. Test cases herein are not exhaustive but illustrative, in many cases demonstrating via counterexample the insufficiency of common rappelling practices. The author employed a 9.8mm rope, a Black Diamond ATC-Guide, and a 6mm nylon prussik loop rigged as an autoblock (all in used condition) to personally test the below cases three times each during a double strand rappel, secured against catastrophic failure by a Trublue auto belay mounted above the test site. Each test case is individually explored below. Results and recommendations are integrated with each test case to better link practice to the potential antecedent errors or hazards.

Friction Hitch on Leg Loop Behind Buckle

An early practice to employ a friction hitch below the rappel device was to affix the friction hitch to the harness leg loop and place the rappel device on the belay loop. This required careful configuration of the rappel device and friction hitch to ensure the friction hitch could not interact with the rappel device, thereby tending the friction hitch and preventing it from gripping the rope(s). One concern with this technique is the potential for a friction hitch placed behind a “speed adjust buckle” on the leg loop to open the leg loop (Figure 1). Nearly all modern harnesses employ speed buckles (as opposed to older double-back buckles), highlighting this concern (see Martin 2010). The author tested a friction hitch behind the leg loop buckle with the rappel device on the belay loop.

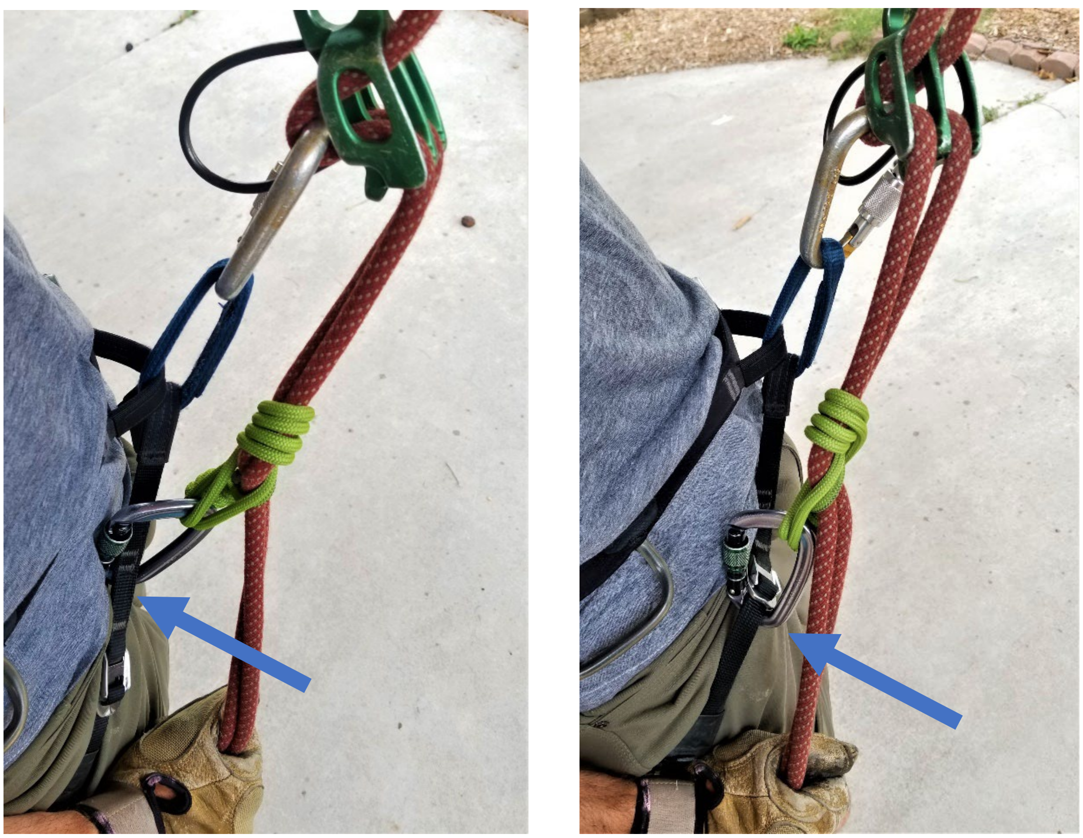

Figure 1. Note the carabiner affixed medially to (inside) the leg loop buckle in the photo on the left, and in the right photo, the carabiner affixed laterally to (outside) the buckle, pulling the buckle into the open position.

Across three test cases with 40 feet of rappelling in each, the author was able to cause the leg loop webbing to creep though the buckle on only one test case, the webbing slipping about 2cm. This certainly demonstrates the plausibility of this occurrence, though its likelihood depends on the specific configuration of the rappel rigging: the carabiners used, the spacing between components, and the buckle and webbing employed on the harness.

Recommendation: Rappelling with the friction hitch backup on the leg loop is not recommended (see next section). However, if it must be employed, ensure the friction hitch cannot compromise the leg loop buckle by affixing the friction hitch medially of the buckle (see Figure 1).

Friction Hitch on Leg Loop with Inversion

A rappeller may invert during a rappel due to loss of consciousness (ex. after being struck by falling rock or ice) or potentially due to loss of control of the descent. If the rappeller employs a friction hitch on the leg loop and inverts during the rappel, the friction hitch may contact the rappel device, thereby tending the friction hitch and rendering it ineffective (Figure 2). Indeed, in all three test cases wherein the author inverted with a friction hitch on the leg loop and rappel device on the belay loop, the friction hitch failed to hold the load, resulting in catastrophic descent.

Recommendation: When employing a friction hitch backup, place the friction hitch on the belay loop and extend the rappel device using a sling, locking quickdraw, personal anchor system, or other means (see Figure 2). The extended rappel creates adequate distance to prevent the friction hitch from contacting the rappel device in case of inversion. Given the potential for panic grab, the most reliable backup a friction hitch affords is protection against rappeller loss of consciousness (since panic grab is impossible); this requires extending the rappel device. Consequently, there is limited value in employing a friction hitch backup without extending the device. The extended rappel can reduce (but not eliminate) the likelihood of inversion due to the raised pivot point relative to the rappeller's center of gravity when compared to a rappel with the device clipped directly to the belay loop.

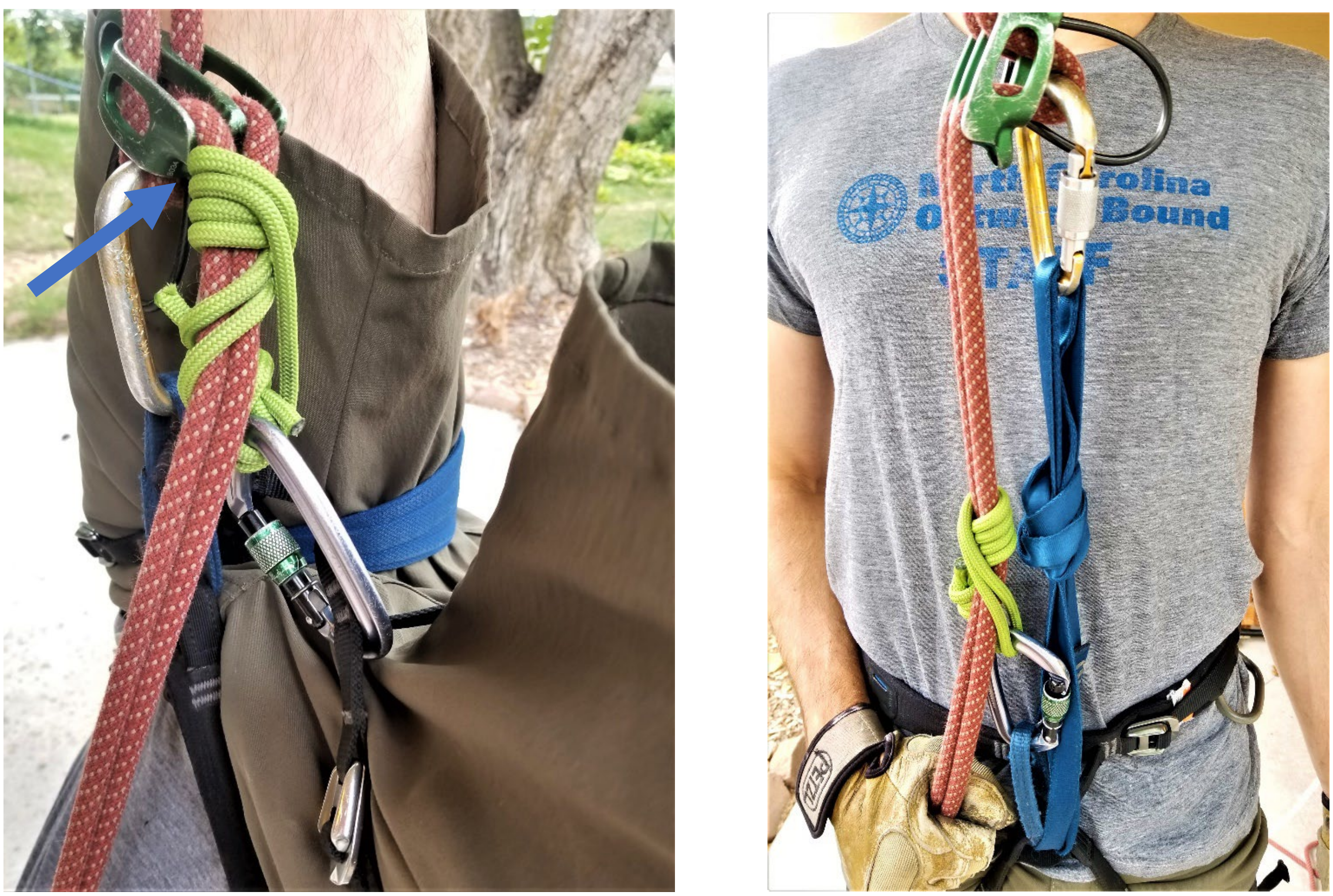

Figure 2. On the left, the friction hitch can be seen contacting the belay device upon inversion of the rappeller. To the right is an extended rappel, preventing the friction hitch from contacting the belay device even if inverted.

Loose Friction Hitch

While properly dressing and setting knots and hitches is a fundamental skill for a recreational climber, a cursory inspection of friction hitches both in candid photos and videos online as well as at the local crag reveal examples of friction hitches that are quite loose. As might be expected, such friction hitches are not effective. The author employed an extended rappel device with a friction hitch clipped to the belay loop. The hitch was intentionally kept quite loose and not checked for appropriate function (Figure 3). In all three test cases, the hitch did not grab the rope at all when the author released the ropes from his grip.

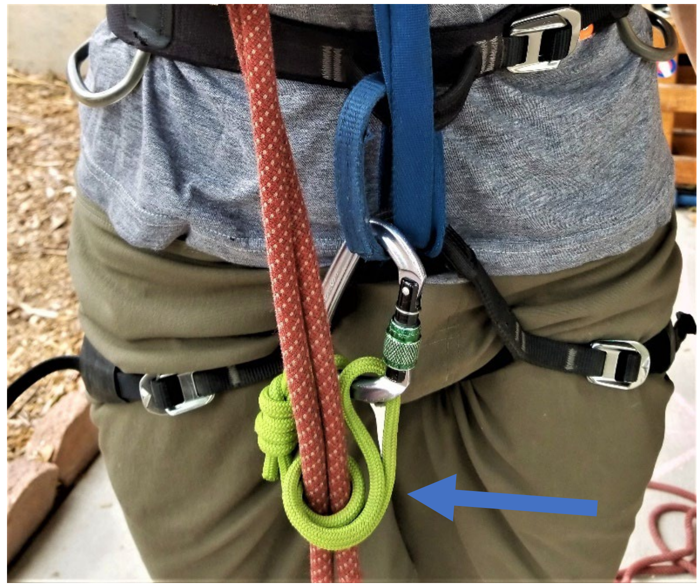

Figure 3. A loose friction hitch.

Recommendation: Rappellers should dress and set the friction hitch backup and test it to ensure it grabs. Otherwise, there is no point in employing the backup. A simple way to guarantee the friction hitch is checked that also makes the rappel itself easier to rig is to build the friction hitch backup first. This is relatively easy to do as the weight of the rope typically provides enough tension to make it easier to build a friction hitch. Then the rappeller can pull some rope up through the friction hitch to provide slack for rigging the rappel device. If the friction hitch fails to hold the slack in place, the backup is inadequate. If the slack is secured, then the friction hitch is adequate, making it easier to rig the rappel device since the rappeller does not have to work against the tension created by rope weight.

Mis-Clipped Rappel Device on One Strand

An oft touted benefit of a friction hitch backup is that the friction hitch serves as a catastrophic backup if the rappeller has mis-threaded the rope(s) through their rappel device. The author tested this by attaching a friction hitch to the belay loop, capturing both strands of rope. The rappel device was extended, with one strand of rope clipped properly to the rappel device, while the other strand was placed inside its slot of the ATC but not secured to the carabiner (Figure 4). In each test, the author gripped the rope below the friction hitch and weighted the rappel system. In all three cases, the friction hitch failed to grab, causing the autobelay to engage.

Recommendation: Rappel rigging, including device, ropes, and friction hitch, should be checked prior to the rappeller untethering from a secure anchor point and committing to a rappel. This requires a sufficiently long tether such that the tether can remain slack while the rappeller transfers their weight to the rappel system. Once the rappel system has been weighted, the tether can be unclipped.

Mis-Clipped Rappel Device on Two Strands

Similar to the preceding test, the rappel device could be mis-threaded on both strands; that is, both strands of rope are in the appropriate slot but neither is clipped to the carabiner. This effectively creates a situation where the rappeller would fall directly onto the friction hitch backup. The author rigged this with the friction hitch on the belay loop and an extended rappel, as in Figure 4. When weighting the mis-threaded rappel, the friction hitch slipped and caught in the first test, slipped and failed to grab effectively in the second test, and caught effectively and immediately in the third test.

Recommendation: A friction hitch backup does not appear to afford protection if one rope is mis-threaded, and *may* afford protection if both ropes are mis-threaded. Consequently, the above recommendation to weight test any rappel system prior to the rappeller unclipping from a secure anchor point remains the most reliable course of action.

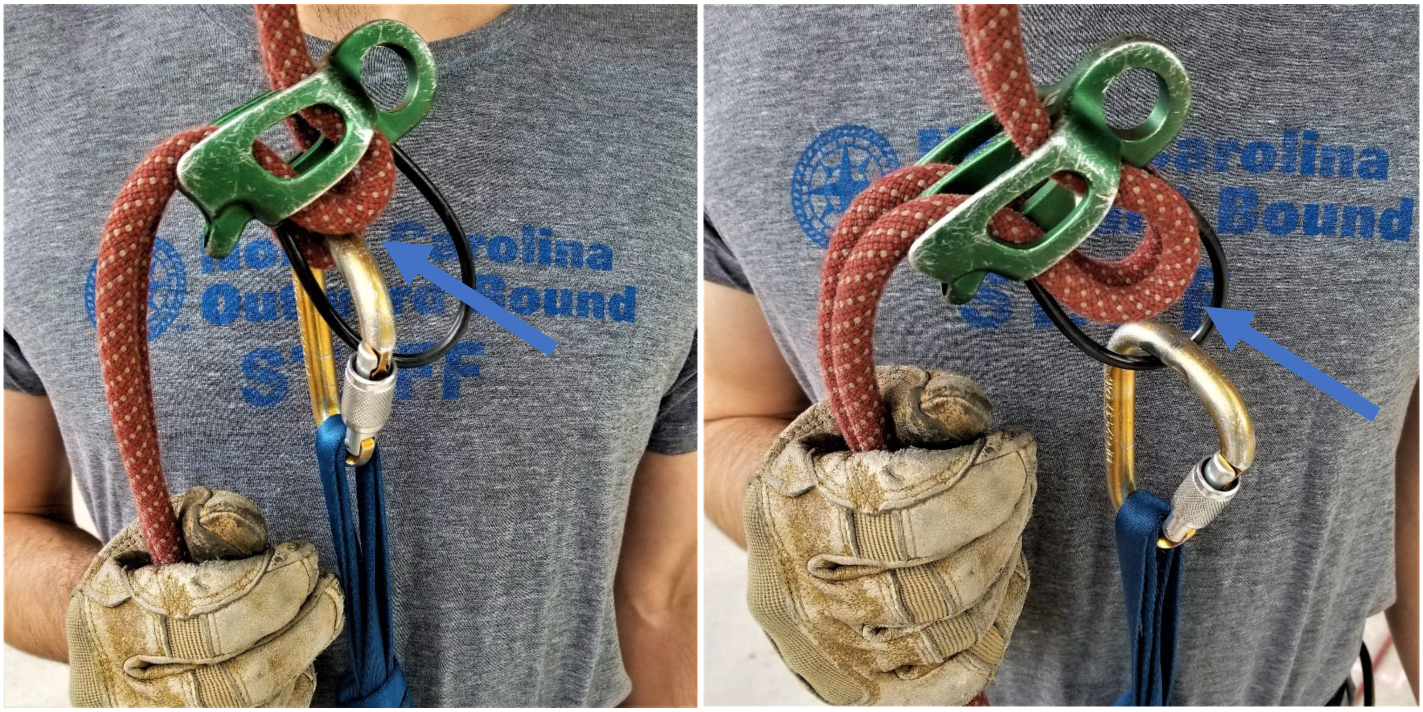

Figure 4. Mis-clipped rappel devices, with a single strand missed on the left, and both strands missed on the right.

Tending Friction Hitch with Hand on Hitch vs. Hand above Hitch

Even if a rappel is properly rigged with an effective friction hitch backup an appropriate distance from the rappel device, the rappel could still fail catastrophically due to the panic grab noted in the introduction above. Many climbers who employ a friction hitch backup choose to rappel with one hand gripping the hitch directly to tend the hitch (see Figure 5). This is unlikely to be problematic in most cases as the rappeller can use their second hand to grip the ropes. Consequently, in the case of panic grab, one hand will still grasp the ropes firmly, retaining control of the descent.

However, complete loss of control could result if rappelling with only one hand. A frequent occasion for most climbers to rappel with one hand occurs during the course of normal rappelling, when one hand is used to brace against the terrain as the other maintains control of the descent. These moments are also times when loss of control may be more likely, as a challenge in the terrain (ex. clearing a roof) necessitated removing one hand from the rope in the first place. Rappelling one-handed also happens frequently when tandem rappelling with a less experienced or injured partner.

To simulate this scenario, the author rigged an extended rappel device with a friction hitch backup on the belay loop. In three tests, one hand firmly gripped the friction hitch backup, which resulted in uncontrolled descent each time.

An alternative strategy when controlling the descent with one hand is to grip the rope while using the bottom of the hand to tend the friction hitch, as in Figure 5. This scenario was also tested three times, resulting in controlled descent each time due to hand braking, despite the friction hitch being tended.

Recommendation: A friction hitch backup is easily defeated by panic grab. Consequently, it is best to tend the friction hitch with the hand gripping the rope and the bottom of the hand tending the hitch. However, for this to work effectively, the rappel device and rope combination must provide adequate friction to control the descent irrespective of the application of a friction hitch (check manufacturer's technical notices for compatibility). If the friction hitch is providing friction in an otherwise inadequate system, loss of control of the descent is still likely.

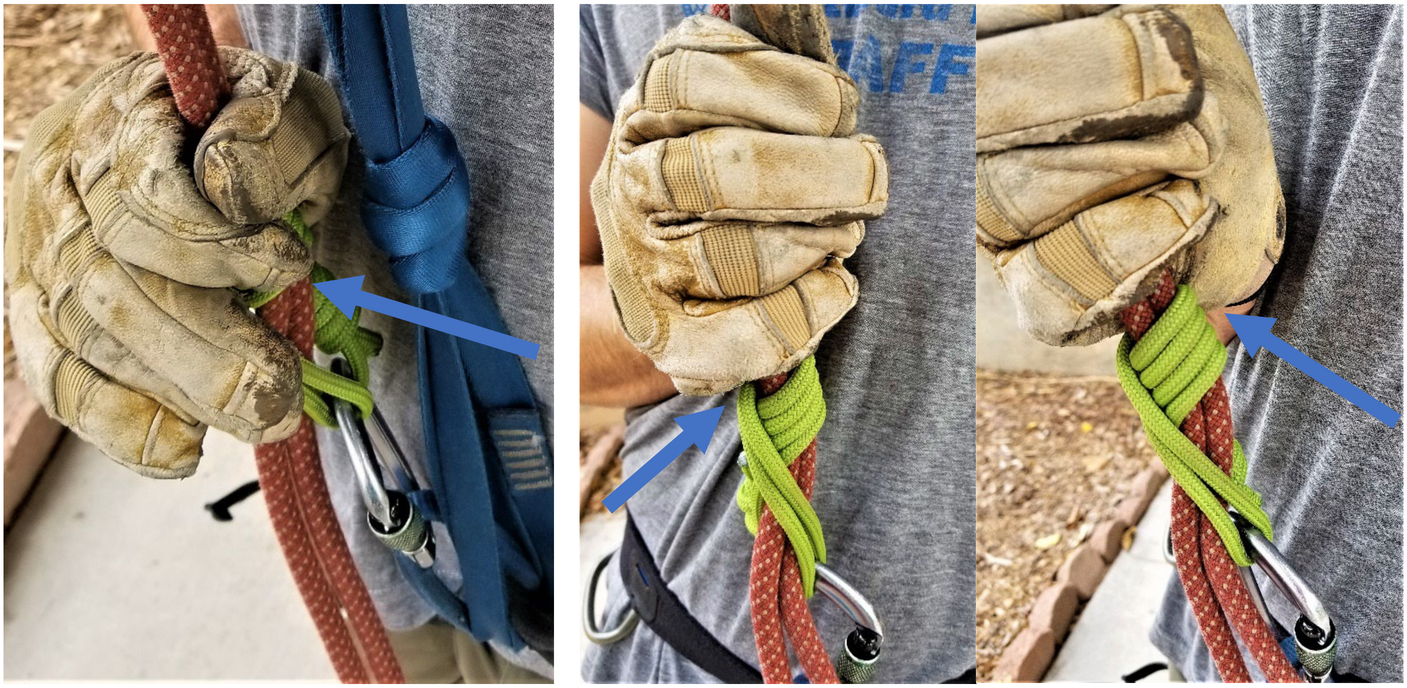

Figure 5. In the left photo, the rappeller's hand tends the friction hitch using the entire hand, with the ring made by the thumb and index finger tending the hitch. This technique is susceptible to panic grab. On the right are examples of tending the friction hitch that curtails panic grab, with the hand on the rope and the little finger of the hand tending the friction hitch.

Untended Friction Hitch

During complete loss of control of the descent (such as with any loss of consciousness), a friction hitch backup is intended to grab the rappel rope(s) to arrest the descent. However, even this primary purpose for the backup may be compromised if loss of control generates sufficient velocity to melt the friction hitch or overcome the available friction.

To test this, the author explored two use cases. The first featured a relatively short friction hitch that was tended with a minimum of slack between the hitch and the rope, minimizing the distance between the hitch and the rappel device. This arrested the descent immediately in all of three tests. The second case used a longer friction hitch that was tended with maximum slack between the hitch and the rappel device (Figure 6). While this still arrested all three descents, during the final test the friction hitch slipped prior to catching, resulting in glazing of the cord sheath and short travel down the rope.

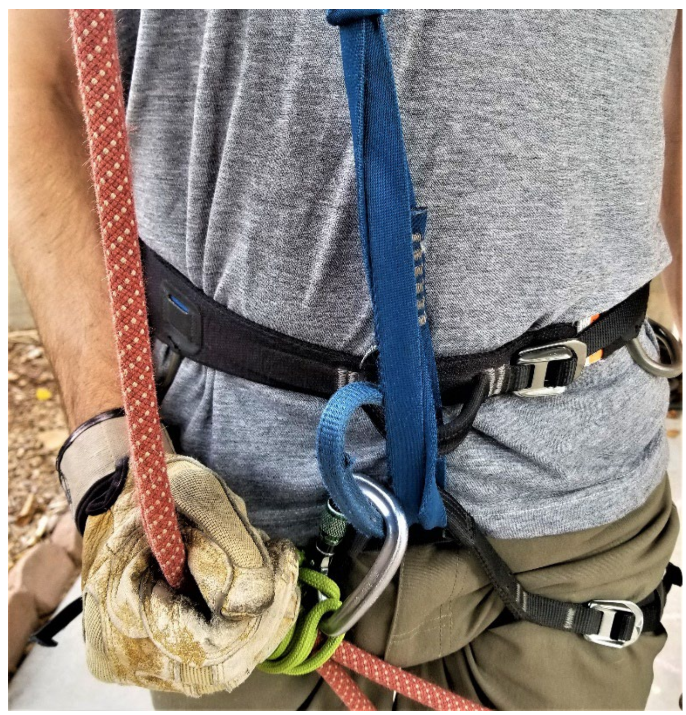

Figure 6. Friction hitch held low, maximizing distance between the hitch and rappel device.

Recommendation: Given the potential for a friction hitch backup to fail under sufficiently high velocity, rappellers should be conscious of tending the friction hitch in such a way that slack between the hitch and belay device is minimized.

Discussion

Summary recommendations based on these results are not significantly different from most widely recommended best practices for rappelling. They are:

1) Employ a rappel backup in the form of a friction hitch.
    a. This friction hitch should be positioned below the rappel device and of sufficient distance from the rappel device that it cannot be inadvertently tended by the device if the rappeller loses control of the descent. This is often best achieved by extending the rappel device away from the harness.
    b. The friction hitch must be well-dressed and function checked prior to use. A convenient way to achieve this is to rig the friction hitch prior to rigging the rappel device. This permits the use of the rope weight to check the security of the hitch (described above).
    c. During descent, the rappeller should grip the rope (NOT the hitch), tending the hitch using only the bottom of the hand, with the minimum pressure on the friction hitch necessary to permit controlled descent.
2) Double check rappel rigging prior to committing to rappelling.
    a. Perform a visual and/or function check of all components: rope position, rope-end knots, rappel device and carabiner rigging, friction hitch backup. Complete this check before unclipping from the anchor.
    b. When possible, utilize a partner check as part of the rappel check.

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