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İple İniş mi, Alçalmak mı? İniş Emniyet Noktalarını Temizleme ve Tek İp Boyu Spor Tırmanışlarda İniş Tekniklerinin Karşılaştırmalı Kısa Bir Analizi

Rappel or Lower? A Brief Comparative Analysis of Techniques for Clearing Anchors and Descending from One-pitch Sport Climbs

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Öz

Serbest iniş ve iple inme, dağcıların tek ip boylu spor rotalarından inerken kullandikları başlıca tekniklerdir. Her iki stratejinin de yararları ve sakıncaları tartışma konusu olmuştur. Azalan yöntemlerin kısa bir karşılaştırmalı analizi, güvenlik, ekipman gereksinimleri ve bakımı, dönüştürme prosedürleri ve aksilik potansiyeline odaklanan on dört temel belirleyici kullanılarak sunulmaktadır. Her iki teknik de mükemmel değildir, ancak her ikisinin de bağlama bağlı olarak belirli avantajları vardır. Bu analize dayalı olarak öneriler sunulur. Sonuçlar, sınırlı veya çelişkili bilgi koşulları altında karar verme süreci için kritik olan dört değerlendirme sorusunu içermektedir.

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Abstract

Lowering and rappelling are the principal techniques employed by climbers when descending from one-pitch sport routes. The benefits and drawbacks of both strategies have been subjects of controversy. A brief comparative analysis of descending methods is presented using fourteen principal determinants which focus on safety, equipment requirements and care, conversion procedures, and mishap potential. Neither technique is perfect but both have specific advantages depending on context. Recommendations are offered based on this analysis. The conclusions include four evaluative questions critical to the decision-making process under conditions of limited or conflicting information.

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Geniş Özet

Güvenlik, ekipman ihtiyaçları ve bakımı, emniyet noktası dönüştürme prosedürleri ve aksilik potansiyeline odaklanan on dört temel belirleyici kullanılarak iniş yöntemlerinin kısa bir karşılaştırmalı analizi sunulmuştur. Her iki teknik de mükemmel değildir ancak her ikisinin de duruma göre belirli avantajları vardır. Tek ip boylu rotalarda hep alçalmayı seçmek ya da çok basamaklı rotalarda her zaman iple inmeyi seçmek, her durumun gerekliliklerini ve sınırlamalarını göz ardı eden ezberci bir kuraldır.

İniş emniyet noktalarını temizlemenin ve tek ip boylu spor rotalardan inmenin altı temel yöntemi vardır:

1) Serbest İniş
2) Açık Emniyet Noktası İnişi
3) Kapalı Emniyet Noktası İnişi: Döngü Besleme Yöntemi
4) Kapalı Emniyet Noktası: Arka Uç Besleme Yöntemi
5) Çift Hatlı İple İniş: Kişisel Prusik ve Uzatılmış Desteksiz Frenleme Cihazı
6) Tek Hatlı Halat-Kurtarma İpiyle İniş: Destekli Frenleme Cihazı

İlk iki teknik tartışılmayacaktır. Son dördü için dönüşüm sıraları makalenin tam metninde özetlenmiştir. Kapalı ankraj yöntemleri halatın açılamayan donanımlardan beslenmesini gerektirir. Döngü besleme yöntemi yalnızca ankraj donanımının bir miktar ipi barındıracak kadar büyük olması durumunda işe yarayacaktır. Ankraj dişlisi çok küçük olduğunda, misinayı boşaltmak için uçtan besleme yöntemi kullanılmalıdır.

Desteksiz bir frenleme cihazı kullanılarak yapılan halatla iniş, tırmanıcının güvenli bir şekilde alçalması için çiftlenen halatın her iki tarafının da bağlanmasını gerektirir. Hat, bağlantı noktasında ikiye bölünmeli ve her iki ucu da yere ulaşmalıdır. Tek hatlı halat çekme halatı, tırmanıcının destekli frenleme cihazı kullanarak halatın yarısına inmesine olanak tanır. Rappelling yöntemleri ayrıca halatın bir ucunun kapalı ankraj donanımından beslenmesini gerektirir.

İniş ile Halatlı İnişin Karşılaştırılması

1. İple iniş, inişe göre daha fazla teçhizat gerektirir.
2. İple iniş dönüşümleri daha fazla adım gerektirir ve halatın ankrajlardan geçirilmesi ekstra zaman alır.
3. İple iniş için gereken karmaşık dönüşümlerin sayısı arttıkça hata potansiyeli de artabilir.
4. İniş için gereken daha basit dönüşümlerde, daha yüksek rahavet kaynaklı hata potansiyeli olabilir.
5. İple inerken emniyet noktasının üzerindeki kuvvet daha yüksektir.
6. İniş ankrajın aşınmasını artırır.
7. Halat hasarı ve bozulması, inişlerde daha fazladır.
8. Halat dolanma potansiyeli ankraj konfigürasyonuna bağlıdır.
9. Açık ankraj sistemlerinde halattan ayrılma potansiyeli mevcuttur. Kapalı ankraj sistemlerinde bükülme ve halat dolaşması halatın sıkışmasına ancak kopmamasına neden olabilir.
10. İple inerken halat kollarındaki kuvvet daha azdır.
11. Tırmanıcının deneyimine bağlı olarak her iki dönüşüm türünde de sıkışma mümkündür.
12. Tırmanıcının deneyimine bağlı olarak her iki dönüşüm sırasında da halat atabilir.
13. Tecrübesine bağlı olarak tırmanıcının halattan çıkma ihtimali vardır.
14. Tırmanıcının halatı düşürmesi ve sıkışıp kalması durumlarında partnerin yardımıyla veya öz çabasıyla kendini kurtarması mümkündür.

Sonuçlar

- Ankraj donanımı keskin kenarlı çentiklere sahipse;

· Emniyet noktası bütünlüğü ve sağlamlığı şüpheliyse;
· Sabit teçhizat inişe uygun değilse;
· Ankraj donanımının dar çaplı bağlantı noktaları varsa;
· Yerel uygulamalar ve etik, iple inişi gerektiriyorsa;

Bu çok geniş koşullar altında inişlerden kaçınılması önerilir.

· Ankrajlar ve donanımlar uygun ve düzenek idealse;
· Hız ve verimlilik kritik öneme sahipse;
· Kişisel ekipmanlar sınırlıysa;
· Tırmanıcının deneyimi sınırlıysa;
· Yerel uygulamalar ve etik değerlerin düşürülmesini gerekiyorsa; İniş daha uygundur. Analiz edilen faktörlerin her birinin durumuna göre farklı uygulamalara öncelik verilmesi yararlı bir olacaktır. Aşağıdaki temel sorular karar aşamasında yardımcı olabilir:
· Hangi koşullar ani ve yıkıcı sistem arızasına yol açabilir?
· Hangi durumlar asılı kalmaya veya halat sıkışmalarına yol açabilir?
· Ekipmanın bütünlüğü ve uzun ömürlülüğü açısından hangi konular kritik olabilir?
· Hangi faktörler verimlilik ve rahatlığı sağlıyor?

Introduction

Mountaineers developed rappelling or abseiling techniques during the 1800s (Martin, 1987; Wilkinson, 2019). The practice of backing up a rappel with a Prusik Knot positioned above the rappel device occurred between the 1940s and 1980s (Blackshaw, 1965; Casewit & Pownall, 1968; Chisnall, 1985; Ferber, 1974; Loughman, 1981). Rappelling with an extended rappel device and a Prusik Knot below it became popular in the 1990s and 2000s, and lowering off routes commenced around the 1990s (Shepherd, 2002; UIAA - Petzl®, 2013). In the past few years, however, sport climbers have been lowering off one-pitch routes more frequently for speed and efficiency. Descending techniques have been a matter of regional practice and personal preference, as well as a topic of discussion and controversy in blogs, websites and internet forums (for example: Felix, 2014; JRZane, 217; Kennedy, 2020; Johnson, 2011; Gergich, 2017a, 2017b; Obsidian, 2017; Thomas, 2019). It is informative to follow the string of opinions that ensue when questions are posed. Several of the key issues raised in these on-line discussions will be summarized herein.

Is it better to rappel or lower? Binary thinking can be misleading. A balanced pro-con approach is recommended when assessing the merits and relative safety of specific techniques, procedures and systems (Chisnall, 1985). Every safety system can fail and the chosen technique should fit the context. Electing to lower only on single pitch routes and rappel only on multi-pitch routes is a rote rule that ignores the requirements and limitations of each situation. There are circumstances in which lowering may be necessary on a multi-pitch climb – during pendulums and tension traverses for example. There are situations when lowering on single-pitch sport routes may not be advantageous and might even be dangerous, as will be discussed.

There are six basic methods of clearing anchors and descending from one-pitch sport routes: 1) Walk Off; 2) Open-Anchor Lowering; 3) Closed-Anchor Lowering: Loop-Feed Method; 4) Closed-Anchor Lowering: End-Feed Method; 5) Double-Line Rappel: Personal Prusik and Extended Non-Assisted-Braking Device; 6) Single-Line Rope-Retrieval Rappel: Assisted-Braking Device. Each method has variations, so this discussion will be very general.

The walk-off method is more appropriate to trad routes but it is dangerous or even impossible to perform on most modern sport routes because the top anchors may be located well below easier terrain. This is particularly true when leading or top-roping the first pitch of a multi-pitch route. Even on one-pitch sport routes, the top may be inaccessible from the anchors, and the anchors may be inaccessible from the top. Lowering by using the open-anchor method is simple and quick, if the proper anchor hardware is in place. At the end of a climb, the leader clips rated station anchors, stainless-steel carabiners, mussy or anchor hooks, or similar hardware. The climber then lowers and pulls the rope. Similarly, the top-rope climber transfers to the fixed gear, removes the temporary anchor setup, lowers off and pulls the rope. (Climbers should not top-rope off fixed anchors to reduce wear.) No personal equipment is left behind. These two techniques will not be included in this comparison. However, a few relevant issues concerning open-anchor systems will be mentioned throughout this discussion.

Closed-anchor methods require the rope to be fed through solid rings such as quick links, chains, rappel rings, lap links, and so forth – hardware that cannot be opened. (See Figures 1 through 4 for examples of closed anchors.) This equipment should be appropriate for anchoring purposes, and ideally CEN rated (Godino, 2018; Marcus, 2023).

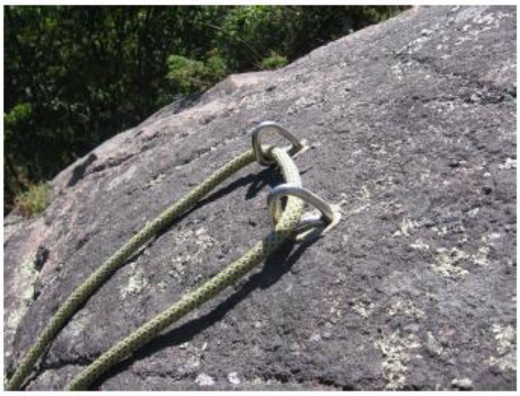

Figure 1. Glue-in bolts.

Figure 2. Expansion bolts with rappel hangers.

The loop-feed method will work only if the anchor hardware is large enough to accommodate a bight of rope. Large quick links and steel rappel rings are usually suitable for this method. When the anchor gear is too small – as with chains, rappel hangers or compact quick links, and hammer-shuts or lap links – the end-feed method must be employed to reeve the line.

Figure 3. Expansion bolts with paired quick links.

Figure 4. Expansion bolts with quick links and steel rappel rings.

Rappelling using a non-assisted-braking device with a backup – such as the Prusik, Klemheist or Autoblock – requires attachment to both sides of a doubled rope for the climber to descend safely. The line has to be halved at the anchor point and both ends must reach the ground. The single-line rope-retrieval rappel allows the climber to descend on one half of the rope using an assisted-braking device. (The multi-pitch technique known as Reepschnur – meaning cord in German – requires a length of accessory cord or a second rope to be joined to the rappel line, thus allowing the climber to rappel a full rope length during multi-pitch descents. Although similar to the rope-retrieval method, this multi-pitch single-line variation will not be examined). Rappelling methods also require an end of the rope to be fed through closed-anchor hardware.

Basic Closed-Anchor Strategies – Lowering and Rappelling

The following sequences apply to a one-pitch situation using paired bolt anchors. The goal is to descend safely after retrieving personal anchoring equipment, and then pull the rope down. Top-rope climbers usually call for tension to initiate the conversion process. In a lead situation, the climber clips the rope to the top anchor using a quickdraw, and then attaches their harness to the anchor using a leash or personal anchoring system (PAS), ideally maintaining two connections at all times. It will be assumed that the anchors are fully weighted during the entire conversion process. The fundamental steps for these methods are listed sequentially. Each technique has variations, depending on certain system details and the gear employed. Nevertheless, there are three overarching safety rules. The climber must communicate clearly with the belayer, the climber must stay attached to the system, and the rope should be secure at all times. It is important to remain organized in order to avoid carabiner congestion and possible entrapment. Having too many unsecured pieces of equipment in hand during transfers should be avoided to help prevent accidentally dropping needed items.

Lowering – Loop-Feed Method

1. Stay on belay and communicate.
2. Clip in to the anchor, check and hang. (One attachment point is usually sufficient because the climber remains on belay.)
3. Feed a bight of rope through the permanent anchor hardware. (Ask for slack as needed.)
4. Tie a Figure Eight Loop in that bight.
5. Clip the Figure Eight Loop to the harness and double check. (A proper partner check is not possible. Two locking carabiners are recommended.)
6. Untie and pull the end through the permanent anchor hardware.
7. Communicate to tension the belay, then move up slightly to unweight attachments.
8. Unclip and remove all temporary anchoring equipment.
9. Communicate to lower, lower, and retrieve the rope.

Lowering – End-Feed Method

1. Stay on belay and communicate.
2. Clip in to the anchor, check and hang. (One attachment point is usually sufficient because the climber remains on belay.)
3. Tie a Figure Eight Loop in the belay line between the harness and the temporary anchor hardware, leaving enough rope for steps 5 and 6. (Ask for slack as needed.)
4. Clip that loop to the harness and double check. (A proper partner check is not possible. Two locking carabiners are recommended.)
5. Untie and feed the end of the rope through the permanent anchor hardware.
6. Retie the end of the rope to the harness and double check. (Again, a proper partner check is not possible.)
7. Unclip from the Figure Eight Loop and untie it.
8. Communicate to tension the belay, then move up slightly to unweight attachments.
9. Unclip and remove all temporary anchoring equipment.

10. Communicate to lower, lower, and retrieve the rope.

Figure 5. Lowering – Loop-Feed Method: For simplicity, the personal anchoring system (PAS) is omitted in the photograph. The green sling to the right represents either a quick draw for leaders, or a top-rope setup. The loop is fed through the anchor, a Figure Eight Loop is tied and clipped to the harness, and the original harness tie-in is removed.

Figure 6. Lowering – End-Feed Method: For simplicity, the personal anchoring system (PAS) is omitted in the photograph. The green sling to the right represents either a quick draw for leaders, or a top-rope setup. A Figure Eight is tied and clipped to the harness. The original harness tie-in is removed, the end is fed through the anchor and it is then retied to the harness.

Rappelling – Double-Line Method (Prusik and Extended Non-Assisted-Braking Device)

1. Stay on belay and communicate.
2. Clip in to the anchor, double check and hang. (A proper partner check is not possible. Two attachment points are recommended because the climber will be off belay.)
3. Communicate to discontinue the belay.
4. Pull up the rope to find the middle.
5. Tie a Figure Eight Loop in the middle of the rope.
6. Clip that loop to the anchor. (Do not clip it to a harness gear loop, which could fail by way of a shock-load if one or both halves of the rope were dropped.)
7. Feed one end through the permanent anchor hardware.
8. Ensure than <u>both</u> ends touch the ground. (Tie stopper knots in the rope ends if there is any danger of rappelling off the ends.)
9. Tie a Prusik Knot/Hitch around <u>both</u> arms of the hanging rope.
10. Clip the Prusik Knot/Hitch directly to the harness rappel/belay loop.
11. Pull up some slack above the Prusik.
12. Attach the rappel device to <u>both</u> rope arms above the Prusik and clip it to a leash extension.

(A leash can be a Daisy Chain, Chain Reactor, Purcell Prusik or equivalent. Reeving both rope bights while the device is attached reduces the chances of dropping it.)

13. Take up slack and transfer weight to the rappel setup, then lock the Prusik.
14. Bounce check to ensure that the spacing and setup are correct. (Once again, a proper partner check is not possible.)
15. Unclip the harness attachments from the anchor.
16. Remove all temporary anchoring equipment.
17. Rappel and retrieve the rope.

Rappelling – Single-Line Rope-Retrieval Method (Assisted-Braking Device)

1. Stay on belay and communicate.
2. Clip in to the anchor, double check and hang. (A proper partner check is not possible. Two attachment points are recommended because the climber will be off belay.)
3. Communicate to discontinue the belay.
4. Pull up the rope to find the middle.
5. Tie a Figure Eight Loop or an equivalent loop knot in the middle of the rope. (Multi-pitch situations often require the Reepschnur technique, necessitating a second rope or length of accessory cord.)
6. Clip that loop to the anchor. (Do not clip it to a harness gear loop, which could fail by way of a shock-load if one or both halves of the rope were dropped.)
7. Feed one end through the permanent anchor hardware.
8. Ensure than both ends touch the ground. (Tie a stopper knot in the rappel side of the rope if there is any danger of rappelling off that end.)
9. Clip the Figure Eight Loop to the rope arm on the opposite side of the anchor. (Two locking carabiners are recommended. Some climbers elect to use one or no carabiners, relying on the bulk of the loop knot alone to provide security by jamming against the anchor hardware. Occasionally this has led to system failure when knots tied in thinner ropes squeezed through larger diameter anchor hardware.)
10. Ensure that the Figure Eight Loop will not squeeze through the anchor hardware or jam. (This could prevent rope retrieval.)
11. Attach the assisted-braking rappel device to the rappel side of the rope and double check the entire setup. (The Figure Eight Loop is clipped to the rappel side of the line. A proper partner check is not possible.)
13. Take up slack and transfer your weight to the rappel setup.
14. Bounce check the setup to ensure the correct side of the rope has been loaded. (Again, a partner check is not possible.)
15. Unclip harness attachments from the anchor. (Tie a backup knot to secure the rappel device if hands-free actions are required.)
16. Remove all temporary anchoring equipment. (Remove the backup knot if present.)
17. Rappel and retrieve the rope.

Figure 7. Rappelling – Double-Line Method: The rope was fed through the closed anchor system until the halfway point reached the anchors. The Prusik Knot is positioned below the rappel device and it is attached directly to the harness. The rappel device is attached to an extension and it is positioned above the Prusik Knot.

Figure 8. Rappelling – Single-Line Rope-Retrieval Method: The rope was fed through the closed anchor system until the halfway point reached the anchors. The load-bearing side of the rope is secured with a Figure Eight Loop and a locking carabiner. An assisted-braking device secures the harness to the load-bearing side of the rope.

Comparing Lowering to Rappelling

A brief comparison of lowering and rappelling appears in Table 1, and a detailed discussion follows. The presentation order does not imply a hierarchy of prioritization, and some categories overlap:

Table 1. Lowering and rappelling conversion issues using closed-anchor systems.

Some Key Details to Consider	Lowering	Rappelling
1. Gear Needed	Less	More
2. Number of Conversion Steps	Less	More
3. Potential for Task Complexity Error	Less	More
4. Potential for Task Complacency Error	More	Less
5. Force on the Anchor	160%	100%
6. Wear on the Anchor	Higher	Lower
7. Rope Damage and Degradation	Higher	Lower
8. Rope Entanglement Potential	Higher	Lower
9. Rope Detachment Potential	Not Possible	Not Possible

10. Force on Rope Arms	100%	50% or 100%
11. Possibility of Entrapment	Yes	Yes
12. Possibility of the Dropping Rope	Yes	Yes
13. Possibility of Climber Detachment	Yes	Yes
14. Feasibility of Partner and Self Rescue	Yes	Yes

1. Gear Needed – A climber typically needs a leash or a quickdraw and one or two locking carabiners to lower. When rappelling on a doubled line, the climber usually needs one Prusik cord, a leash or personal anchoring system (PAS) of some kind, and two or three locking carabiners in addition to the rappel device. Alternatively, the climber may opt to rappel using the single-line rope-retrieval method, which requires at least two lockers and an assisted-braking device. Note that carabiner manufacturers recommend two locking carabiners rather than one when attaching the harness to the belay line. (See Petzl® 2006 and 2017 for example.) Open-anchor lowers require no extra gear, other than when converting from top-roping.

2. Number of Conversion Steps – The number of steps required to convert from climbing to descending can be broken down in various ways using gross ergonomic steps, topological movement primitives or cognitive sequencing (Chisnall, 2020; Jenkins & Matarić, 2002; Vihn, et al., 2017). Very roughly, a lowering conversion takes approximately nine or 10 steps. Conversion to rappelling requires around 17 steps. Experienced climbers have been timed while performing conversions in various ways. For an able and experienced climber, both lowering and rappelling conversions require about 30 to 60 seconds to execute, excluding one phase of the rappel conversion. It takes additional time to feed half the rope through the anchors when preparing to rappel. Rappelling conversions take longer primarily for that reason. There are specific precautions climbers can adopt to lower the risk of mishap during conversions and descending, whether they elect to lower or rappel (Ciavaldini & Pearson, 2019; Climbing, 2013; Ellison, 2013; Hess, 2012; Poborsky, 2013, 2023; Richard, 2022; Squier, 2022). Those safeguards were briefly summarized previously in the conversion sequences. Open-anchor procedures have fewer conversion steps and a lower potential for error (American Safe Climbing Association, no date cited).

3. Potential for Task Complexity Error – Intuitively, a procedure requiring more gear and more steps should have a higher error potential. Research indicates that, in general, error frequency can increase with task complexity. However, this has not been directly tested empirically with regard to lowering and rappelling conversions, although there are anecdotal accounts of conversion inefficiencies and mistakes prior to rappelling. Additionally, there are two basic lowering conversion methods based on how the rope is inserted into the fixed anchors, as described previously. This may cause confusion and contribute to potential errors. In contrast, there is one basic method of reeving a rappel line. Research focussing on task complexity, error potential and associated issues can be found in the psychology and related literature. (Cheyne, et al., 2009; Globerson, et al., 1989; Maynard & Hakel, 1997; Nembhard & Osothsilp, 2002; Reason, 1990).

4. Potential for Task Complacency Error – Similarly, complacency and decreased focus may occur with simple but repetitive sequential tasks. Again, this has not been directly tested empirically for lowering and rappelling conversions, but there have been anecdotal accounts of errors resulting from inattentiveness. The literature contains research pertaining to distraction and mitigation of focus (Cheyne, et al., 2009; Globerson, et al., 1989; Maynard & Hakel, 1997; Nembhard & Osothsilp, 2002; Reason, 1990). With regard to open-anchor systems, there have been anecdotal reports of leaders clipping mussy hooks and similar hardware incorrectly, thus adding unnecessary wraps and twists.

Accidents in North American Climbing reports about twice as many rappelling accidents as lowering accidents in all climbing disciplines (Takeda, 2023, pp. 124-125). The immediate causes for those events were listed generally as rappel failure/error and lowering error. The contributing causes were listed as: inadequate belay, inadequate backup, rope too short, and a few other factors. Conversion errors were not specifically cited. Further, the information in the ANAC data base cannot provide accurate probabilities. Accidents are under-reported and potentially informative close calls are rarely documented. Another source (Caroom, 2022) drew on ANAC data and parsed it in more detail. The analysis indicated that the incidence of lowering accidents was higher than the frequency of rappel accidents in sport climbing. Insufficient data were provided to discern any statistical significance.

5. Force on the Anchor – When rappelling, the force generated is split between the two arms of a doubled rope. When lowering, the force on the anchors is 160% as a result of the inherent pulley effect and friction or resistance factor (Chisnall, 1985; Filion, 1979). Wexler (1950) and Filion (1979) indicate that the minimum force on an anchor can be at least twice the climber's weight at the moment of load transfer, and even higher during rapid deceleration. Baillie (1982) measured maximum rappel forces on anchors and found them to be around 800 lbf. (about 364 kgf. or 3,56 kN.), which suggests lowering forces on the anchors could increase to as high as 1.300 lbf. (about 589 kgf. or 5,78 kN.) during sudden stops owing to the system pulley effect mentioned. (See Item 10.)

6. Wear on the Anchor – Anchoring hardware is not created equal. Stainless steel rappel rings with a tensile breaking strength of 50 kN. are durable for lowering, but they will need regular replacement as they get worn. Other anchors wear more quickly, especially light-weight aluminum rappel rings. Some climbing areas are dirty and the rope picks up abrasive sand that acts like a file on metal. A moving weighted rope will wear anchor metal faster than an immovable rope or an unweighted moving rope, depending on retrieval drag. (Similarly, rappel devices also wear with substantial use.) This is one of the major issues that quickly decreases the life of permanent anchor hardware and generates sharp-edged notches in anchor gear (Gergich, 2017b). Another tangential issue is worth mentioning, one that is particularly relevant to open-anchor systems as well as closed-anchor situations. Some anchor stations may have aluminium alloy carabiners or similar hardware. Research indicates that as little as one or two millimetres of notching in aluminium alloy carabiners, or similar damage, can decrease their potential failure loads to below their initial yield loads (Blair, et al., 2005; Bressan, 2002; European Standard EN892, 1996; Feryok, 2018; Schambron & Uggowitzer, 2009).

7. Rope Damage and Degradation – This is another key concern. Both lowering and rappelling contribute to rope degradation. Aside from visible damage and obvious mechanical wear, a rope's elasticity and energy-absorbing properties decrease with use. Research has shown that repeated top-rope lowering cycles substantially decrease rope life. In particular, dynamic safety factor, working capacity over an edge and stress hysteresis recovery decrease as load cycles increase (Bedogni & Manes, 2011; Black Diamond®, 2016; Cordage Institute, 1991, 2015; DiMartino & Sandwith, 2009; Harutyunyan, et al., 2016; McLaren, 2006; Microys, 1977, 1998; Emri, et al., 2008; Paul, 1983; Pavier, 1998; Schubert, 2000; Sedláček et al., 2021; Smith, 2005; Vogel & Bocksch, 1996). These are vital rope characteristics for leaders. Of particular note is the quality of those lowering cycles: how much load is involved, the speed of lowering and the number of bends and contact points the rope is exposed to each time. Further, lowering puts all the load on a single rope. (Unreported tests were performed in 1996 on multiple gym top-ropes that had been subjected to about 1.000 lowers each over a six-month period. The tensile breaking strength of the ends and middles was measured. The middles always tested weaker than the ends.) Conversely, when the climber rappels, the rope does not move. The rappel device moves relative to the rope, and each rope arm sustains half the load in double-rope rappels. Hence, there is decreased wear intensity, unless the rappeller swings sideways, thereby subjecting the loaded rope arms to localized abrasion. Several related details will be covered in Items 8, 9 and 10 to follow.

Certain anchor configurations (attachment-point separation and unnecessary changes of rope direction) can cause the rope to flatten, twist and kink, and the inner strands may hockle causing permanent rope damage, which could then contribute to potential jamming. (See Item 8 to follow.) The most critical issue is the damage potential from anchor notching. Sharp edges have shredded sheaths and cut ropes. In particular, if there is potential for the rope to off-track from anchor hardware notches as the gear shifts under load, if the notching is irregular and multiple, and if the rope diameter exceeds the diameter of those notches, the potential for severe rope damage exists.

8. Rope Entanglement Potential – As mentioned above, some anchor configurations can cause rope deformation and damage as the rope feeds through hardware (Black Diamond®, 2016). Such setups as well as climber error can cause rope jams (Kirkpatrick, 2022). The biggest culprit appears to be separated bolt hangers equipped with a single quick link each. Those quick links usually rest flat against the rock and the rope essentially takes four chiral 90-degree bends through those links. Retrieving the rope can be challenging or impossible, and the overall configuration could severely kink and wear the rope. Pairs of quick links on each bolt hanger are better. The lower quick links are orthogonal to the rock and the rope takes only two 90-degree bends through the gear. However, even this can cause problems. A pair of anchors that are separated tend to cause twisting and kinking as the rope moves through those attachment points, especially with chains and small quick links. Even with open-anchor systems there have been reports of entrapment when leaders clipped hardware incorrectly, creating extra friction and pinch points.

To avoid these problems, redundant anchor systems ideally should come to a centralized V configuration or even a single link. (Then there are redundancy issues, but that is not the focus here.) The diameter of a single centralized master point of attachment (MPA) or power point is important. The thinner the diameter of the single MPA, the likelihood of rope deformation and wear increases. Flattening and sheath shifting may occur as the rope moves through a small-diameter MPA. The degree of wear usually depends on whether the rope is loaded or not. Rope twisting and deformation relate to the next item.

9. Rope Detachment Potential – When a rope twists or kinks, it has an increased likelihood of detaching from open-anchor systems as it moves. This has been reported anecdotally. With closed anchor systems, kinking and rope entanglement can cause the rope to jam against the anchor point during rope retrieval, but not detach.

10. Force on Rope Arms – As mentioned earlier, the force exerted on a doubled rappel line is shared by the two arms of the line. The full force is applied to a single line during lowering and single-line rappels. Hence, a doubled rope experiences less potential wear during a rappel compared to a single line moving through a belay device or top anchors – as well as moving over rock protrusions and through draws, if they are present. (Note that clearing sport draws while rappelling or lowering is another area requiring careful attention to details and technique.)

11. Possibility of Entrapment – Anecdotal reports indicate entrapment is possible during either type of conversion. Likelihoods are unknown. A climber's inexperience may be a major factor in this type of scenario, as well as those described in Items 12 and 13 to follow.

12. Possibility of Dropping the Rope – After failing to secure the line during conversion, climbers have dropped the rope during change-overs to both rappelling and lowering. Again, likelihoods are unknown.

13. Possibility of Climber Detachment – There is potential for the climber to become accidentally detached during either type of conversion. The likelihoods are unknown.

14. Feasibility of Partner and Self Rescue – Depending on the situation – whether the rope has been dropped or how the climber may be trapped – self and partner rescues are possible with lesser or greater degrees of difficulty and risk. It would take many pages to discuss the procedures for most general situations. Aside from risk management via prevention, crisis management requires that both the climber and belayer have the skill, experience and equipment to carry out any necessary emergency intervention.

Conclusions

Therefore, based on the above details, it is recommended that lowers be avoided under these very broad conditions:

- The anchor hardware is notched, especially with sharp edges and irregular patterns.
- Anchor integrity and strength are suspect owing to damage and age.
- The attachment points are separated, or the fixed gear is inappropriate for lowering.
- The anchor hardware has narrow-diameter attachment points.
- Local practices and ethics require rappelling.

Lowering is better suited when:

- The anchors and hardware are appropriate, sound and undamaged, and the setup is ideal.
- Speed and efficiency are critical.
- Personal gear is limited.
- The climber's experience is limited.
- Local practices and ethics require lowering.

Since circumstances are not always black and white, some of these requirements may often conflict. Therefore, informed judgment and common sense come into play when selecting the appropriate technique. Prioritizing each of the analyzed factors according to different situations is a beneficial exercise. The following key questions can aid in that process:

- What conditions might lead to immediate and catastrophic system failure?
- What situations might contribute to entrapment or rope jams?
- Which issues could be critical to equipment integrity and longevity?
- Which factors address efficiency and convenience?

Critical decision-making under many circumstances is onerous and fraught with risk, especially when there are multiple details to consider and information is limited. When it comes to risk and crisis management in rock climbing and related fields, cognitive bias, data noise and misinformation abound (Kahneman, 2011; Kahneman, et al., 2021; Ellenberg, 2014). Climbers must consider every relevant issue carefully, practice under controlled conditions, and act prudently at all times.

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