

Report of Fatal Climbing Accident: Happy Hour Crag, Boulder Canyon

20 April 2000

Notes:

- A brief report on this accident was published in AAC *Accidents in North American Mountaineering 2001*, p. 61.
- This report is part of the ongoing Safety Education activities of the Rocky Mountain Rescue Group, Inc. (RMRG).
- Factual material in this report came from interviews with the climber's partner and other witnesses, and from direct observations and measurements made by RMRG.

Disclaimer:

- Subjective conclusions are drawn by RMRG in the analysis and discussion of this accident.

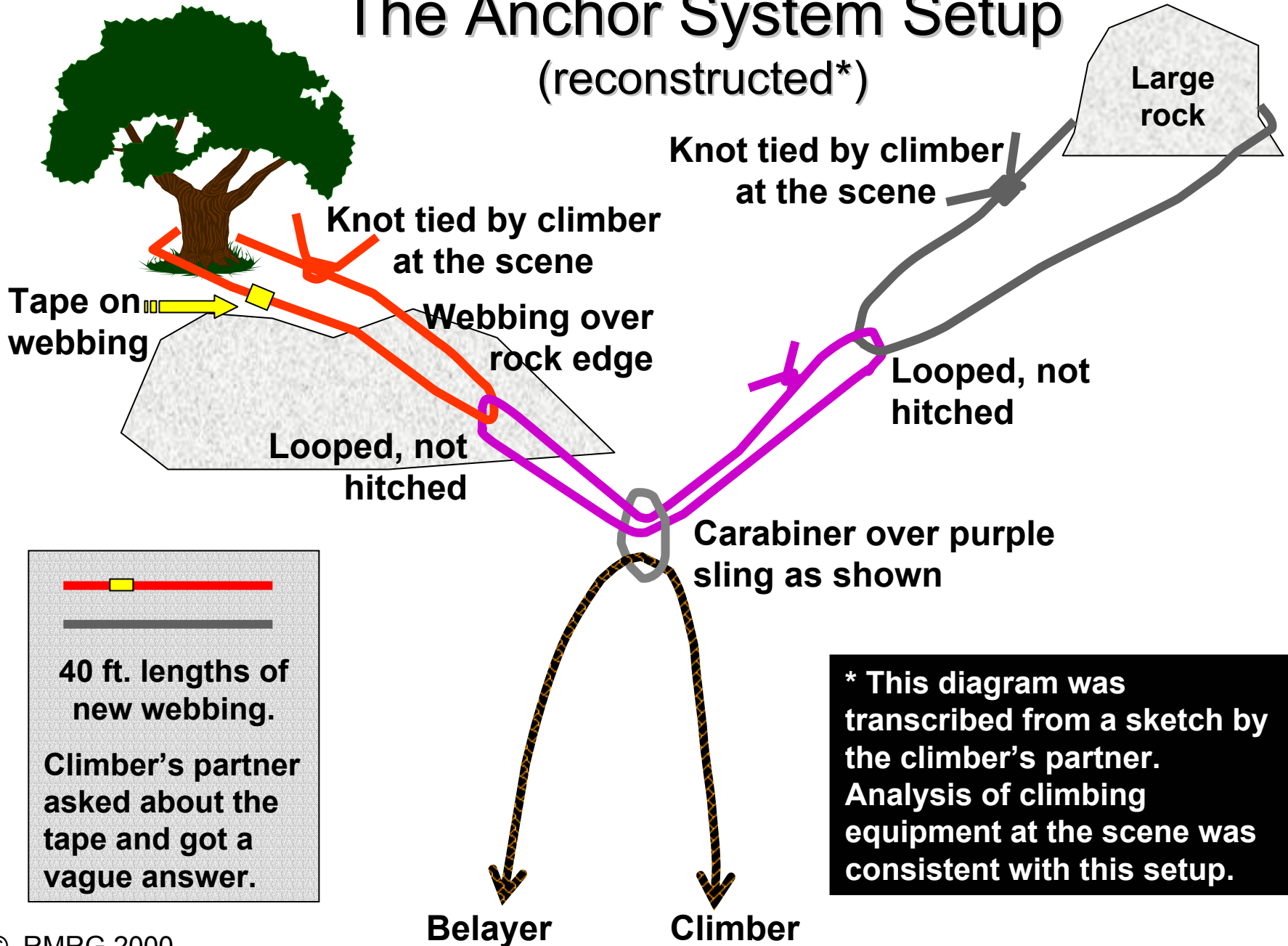


Part I: Accident Description

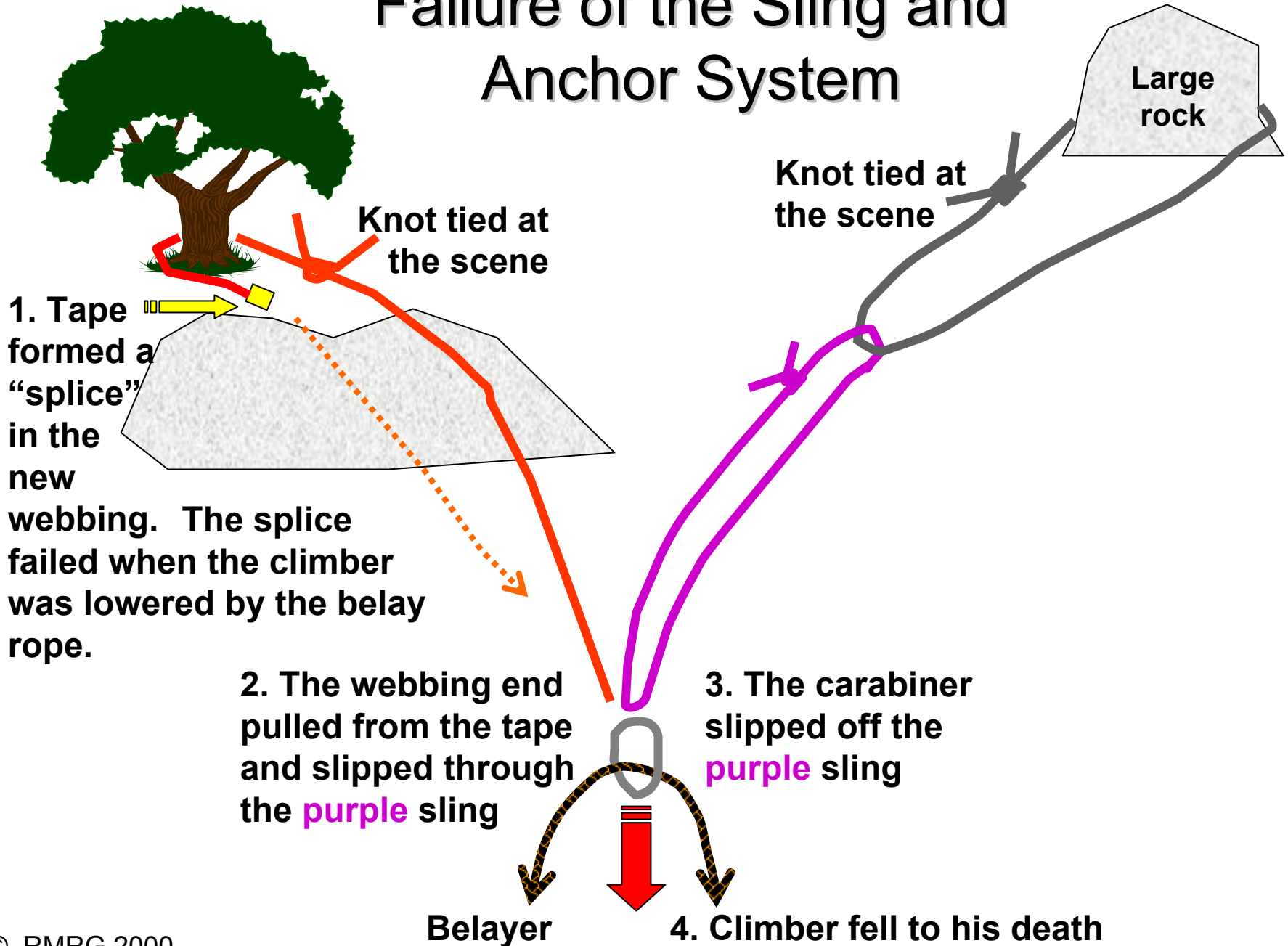
The upper anchor system, set up for a “top-rope, bottom belay” on *Dementia*, failed while a climber was being lowered, resulting in the death of the climber. Both the climber (victim) and partner reportedly had years of active experience at 5th class climbing.

- The anchor system was rigged by the climber using webbing purchased by the climber the day before—specifically for this climb. The knots in this webbing were tied by the climber at the anchor just prior to the climb.
- The climber had reportedly put his weight on the belay rope, and thus on the anchor, during the climb.
- The anchor system failed as the climber was being lowered. The climber fell 60 ft. and was fatally injured.

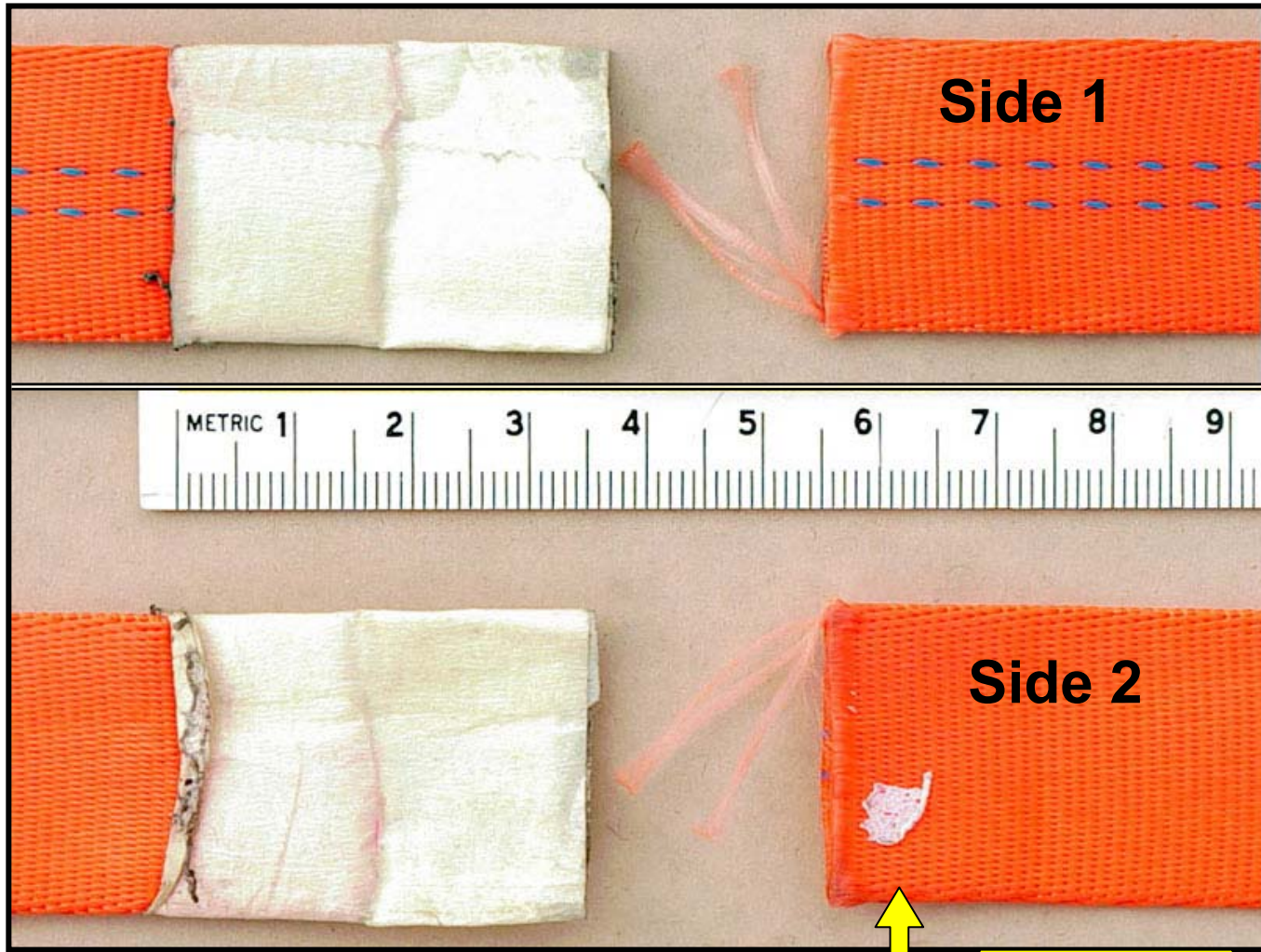
The Anchor System Setup (reconstructed*)



Failure of the Sling and Anchor System



Photographs of both sides of the actual “splice” in the webbing—after the accident:



Side 1

METRIC 1 2 3 4 5 6 7 8 9

Side 2

Adhesive



This is the actual spool from which the webbing was purchased on the day before the climb.

Every spool of webbing in the store where the webbing was purchased was labeled in the manner shown.

See *Accidents in North American Mountaineering 2001*, p. 61, Editor's Note: "It is- or should be- fairly common knowledge that webbing, unlike rope, comes packaged in this manner".

Part II: Accident analysis and discussion

Error 1: Tape “splice” on anchor sling

- The orange webbing purchased by the climber had a “splice” of masking tape placed visibly by the webbing manufacturer merely to hold two lengths of webbing together on the spool, not as a high-strength bond.

Discussion:

- The climber did not adequately investigate the reason for the tape on the new webbing.
- Climbers and retailers should be aware of the common industry practice of spooling together several lengths of webbing joined by small tape “splices”; the spool may have a warning label such as “CAUTION CONTAINS SPLICES”.

Error 2: Flawed Anchor Sling Configuration

- When the climber was being lowered with full body weight on the belay rope, the tape “splice” on the orange webbing failed, allowing the purple connecting sling, in its flawed configuration, to complete the anchor failure as shown in an earlier diagram.

Discussion:

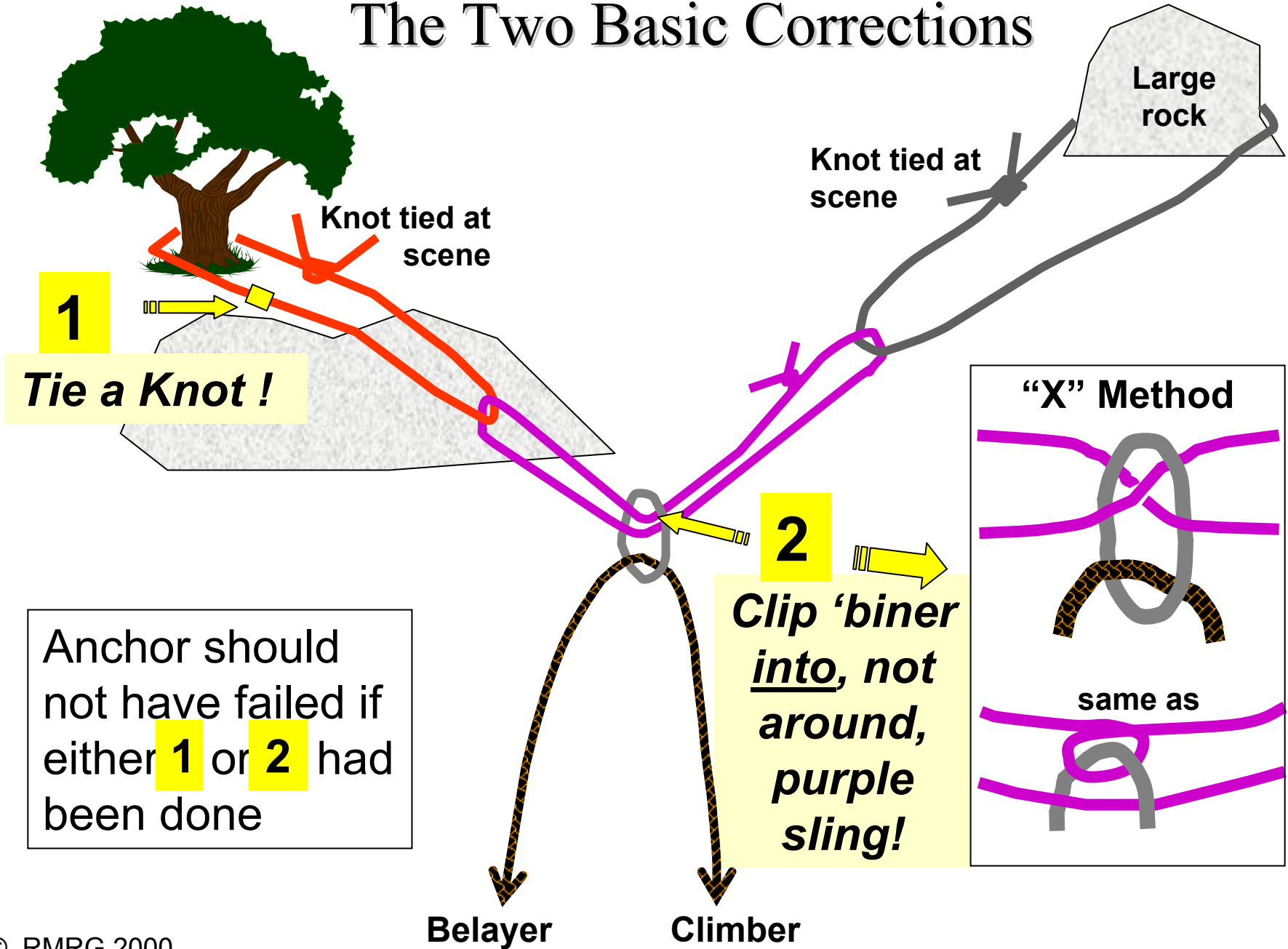
- The climber did not consider the implication of clipping his carabiner *around* rather than *through* the purple (connecting) sling.
- The “X” method (or equivalent) of clipping into slings, as shown for the purple sling (see “Two Basic Corrections” slide, below), is widely known and used in rock climbing activities for its security.

Part III: Conclusion & Recommendations

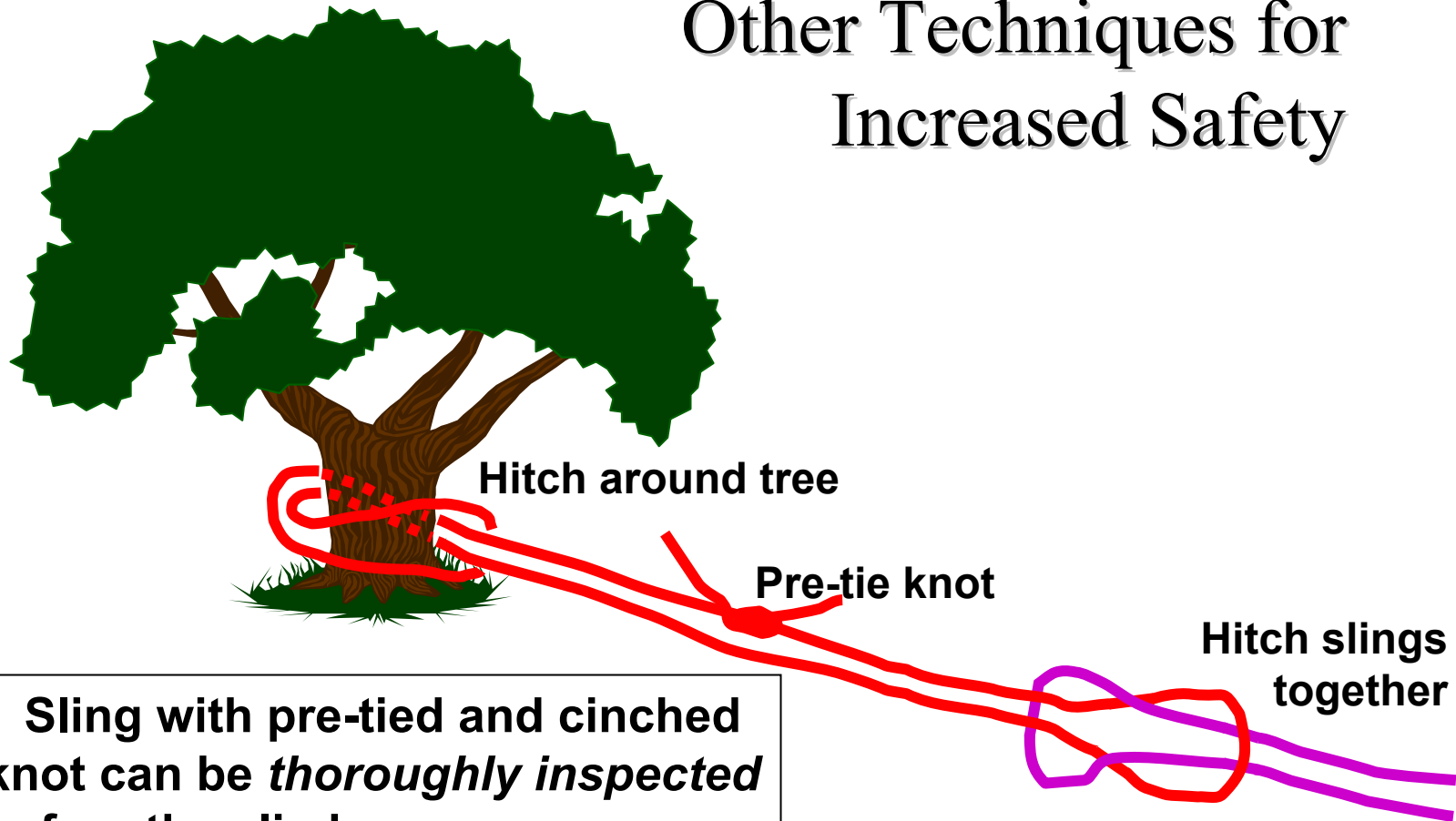
Conclusion: Catastrophic anchor failure was due to the combination of two errors *together*:

- The “tape splice” could have been eliminated from the orange sling to avoid failure and separation from the purple (connecting) sling.
- Failure of the tape alone should not have caused complete anchor failure, *because*:
Separation of the carabiner from the purple sling could have been prevented with different rigging.

The Two Basic Corrections



Other Techniques for Increased Safety



• Sling with pre-tied and cinched knot can be *thoroughly inspected* before the climb.

- Hitches are easily and securely made at the climb.
- Hitches may not slip apart, even with webbing failure.

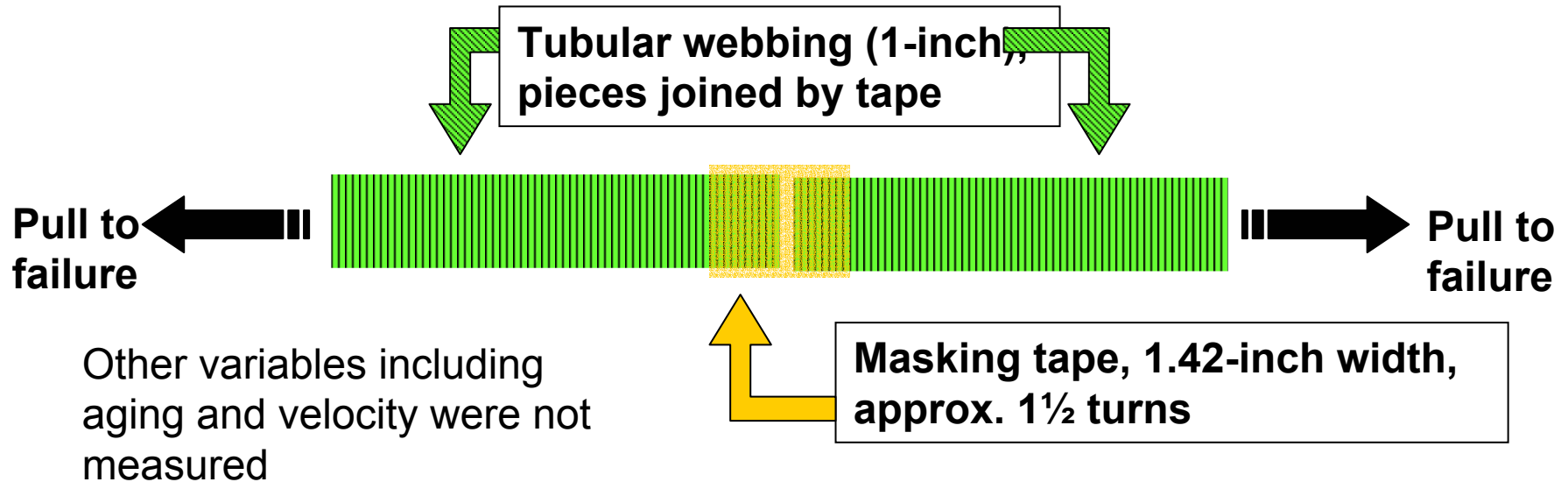
Part IV: Further Investigations by RMRG

This part summarizes RMRG's further inquiry into the nature of the anchor failure.

- **Question 1**: How strong is a tape “splice”?

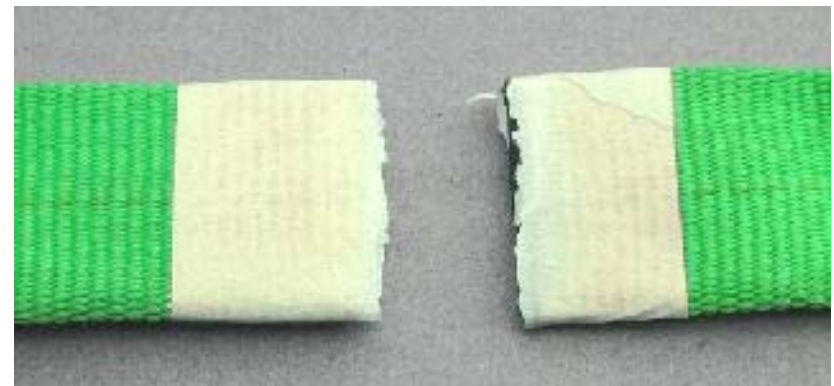
Answer: Not very. (See next slide.)

Masking Tape “Splice” Strength Tests: Straight Slow Pull on New Webbing



Tests were repeated several times, with two failure modes: (i) shear failure of the adhesive, and (ii) tensile failure of the tape, both at ~25 lbs. pull:

- **Result 1:** Adhesive failure, tape intact, webbing pulled out, 20-25 lbs. (Same failure mode as for accident.)
- **Result 2:** Tape tore (see photograph), adhesive held, 24-28 lbs.

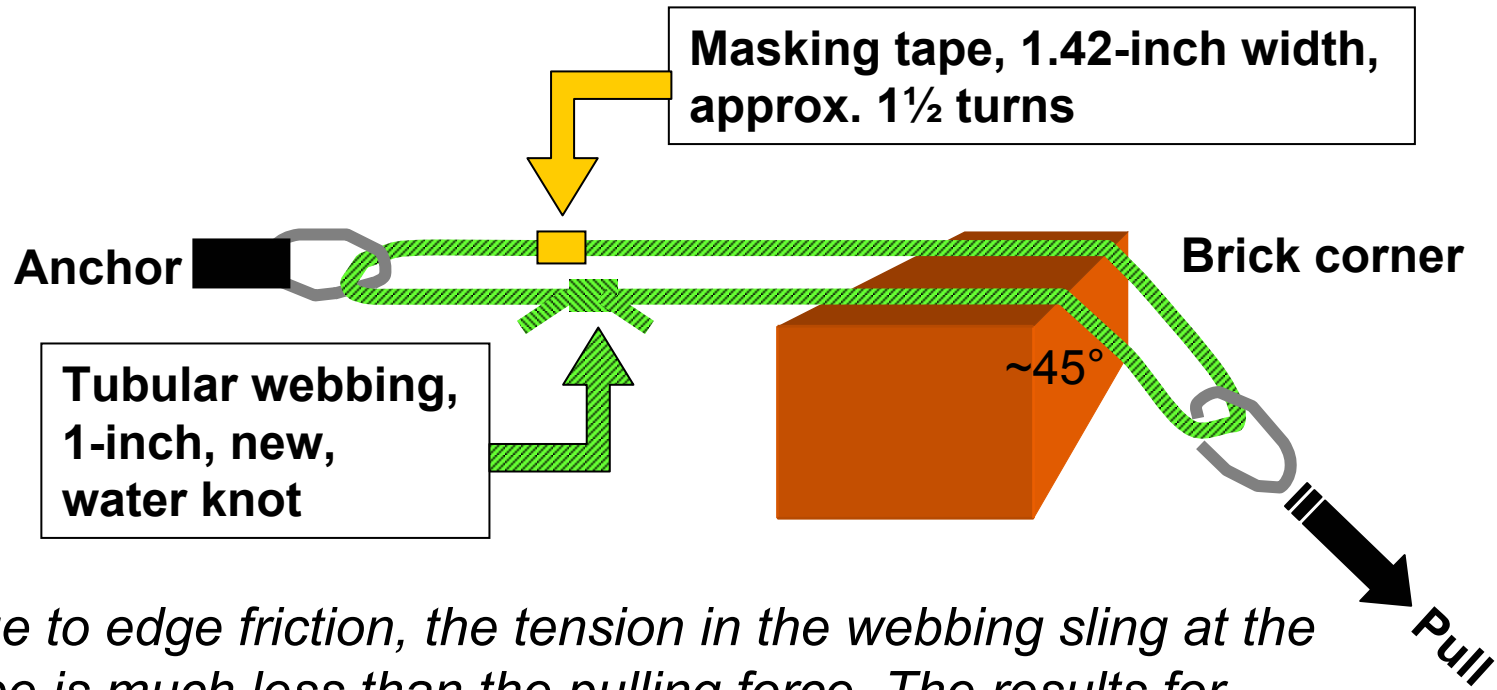


When the climber was first lowered, the anchor system reportedly *did* hold the climber's body weight momentarily.

- **Question 2**: If a tape “splice” fails at ~25 lbs., how could the anchor system shown earlier have held the climber's body weight—even momentarily?

Answer: (See next two slides.)

Masking Tape “Splice” Strength Tests: Importance of Edge Friction



Due to edge friction, the tension in the webbing sling at the tape is much less than the pulling force. The results for several tests with Pull forces up to 100 lbs. were:

- **Result 1:** Tape intact, adhesive failure, webbing pulled away, 80-85 lbs. (Same failure mode as accident.)
- **Result 2:** No failure at 100 lbs., test terminated.

Discussion:

- The Climber's weight was distributed (unknown details) among four strands of webbing, two of which were the orange webbing, and one of those strands failed at the tape "splice". The experiment sketched on the previous slide shows that **edge friction** plays a major role in the distribution of forces.
- The climber's orange sling (two strands) would be expected to support more than half of the climber's weight. The previous edge-friction experiment suggests that indeed as much as 100 lbs. might be supported by two web strands that include a tape "splice", with the substantial edge friction that was present in the anchor geometry.

Conclusion:

- The reported brief support of the victim's body weight by the anchor (and in part by the orange sling) before system failure is consistent with the findings of this edge friction experiment.

Part V: Safety Lessons

Even highly skilled and experienced climbers can benefit from reviewing techniques and learning new concepts.

- **The Basics** should be second nature, routine, and worth occasional review and evaluation by all members of a climbing party together (perhaps during a recap of the day's activities?).
When the situation gets difficult or rushed (due to darkness, weather, injury or exhaustion), questionable techniques and shortcuts may not save time- better to use the basics that all the climbing partners recognize.
- **The Obvious:** Some "obvious" techniques may be inappropriate under some circumstances. Consider the implications. Criticize or question your own and your partner's methods, *regardless of experience levels*, for any critical setup.
- **Details Matter:** Proper equipment and technique are critically important. Climbers *must* learn the appropriate details and to apply them correctly. A mistake may cause severe consequences.
- **After the climb**, and before the next one, check the integrity of your equipment.