TO PROBE OR NOT TO PROBE: EVALUATING FINE SEARCH STANDARDS AND THE ROLE OF PROBING IN SHALLOW BURIAL PROFESSIONAL RESCUE SCENARIOS

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ABSTRACT: The first thirty minutes of the avalanche burial survival curve are the steepest, and even small time savings in gaining airway access can improve patient outcomes. During rescue practice competitions at Mt Hutt, New Zealand, the fastest times were consistently recorded by searchers who skipped probing and began shoveling when their transceiver indicated the burial target was less than approximately half a meter deep. This observation sparked the question: does skipping the probing step result in faster airway access times for shallow burials? This study analyzed rescue times for single professional rescuer, shallow burial scenarios (60 centimeters) in a relatively flat, artificial debris field, comparing times with and without probe use. Rescuers (n=25) accessed the burial target's simulated airway faster when skipping the probing step, saving an average of 39 seconds with a standard deviation of 70 seconds. This finding prompts a holistic risk benefit analysis to see if the benefits of the shorter time to airway access outweigh the extra training, additional rescue decisions, and potential for physical trauma to buried subject. We recommend that professional rescuers carefully consider this tactic's advantages and disadvantages before implementing it operationally.

KEYWORDS: Avalanche rescue, Professional rescue, Shallow burial, Probe, Fine Search

1. INTRODUCTION

The success of an avalanche rescue is highly time-dependent. Reiweger (2017) wrote in their study, "The first 35 min of an avalanche accident are most critical because the completely buried subjects with an obstructed airway suffocate quickly." Rogora and Ercolini's study (2023) found within the first fifteen minutes, every extra minute decreases survival chance by 2.8%. With so much importance on being timely, rescue standards should be continually reevaluated to keep pace with our evolving technology and ensure the fastest methods are being used to rescue. Current rescue protocols dictate that a probe is invariably used during the pinpoint phase of the search. However, field observations indicate that some professionals intuitively skip this step when excavating shallow burials, despite a lack of published evidence supporting the practice. A study by Stumpert (2002) concluded that when nonprofessional rescuers with two antenna transceivers had to excavate a one meter burial they took almost 10 minutes longer when they were not allowed a probe compared to when they could use a probe. This study differs in the focus on professional rescuers, with modern 3 antenna transceivers, and shallow burials of 60 cm. Companion rescue competitions at Mt Hutt, New Zealand, provided the catalyst for the question: does skipping the probing step result in faster recovery times for shallow burials? To answer this question, the author set up a simulated rescue scenario and filmed professional rescuers locating and excavating a backpack buried 60 cm beneath the snow surface. This study also generated discussions surrounding transceiver height during fine search as well as the pros and cons of adding another decision point into the rescue algorithm.

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2. METHODS

Professional rescuers (primarily ski patrollers from Copper Mountain and Mt Hutt) were asked to perform two simulated rescues: one in which they were allowed all their standard avalanche rescue equipment (transceiver, probe, and shovel), and one in which their probe was withheld. Participants were randomly assigned which scenario they would perform first to reduce the learning impact on the data Participants were given at least 15 minutes of rest between trials. Each of their two trials were completed on the same day to eliminate environmental and snowpack variations between scenarios. The target was moved to a different location within the study site after their first trial. Participants were given standardized instructions immediately before each trial run. They were told either that they had

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unrestricted use of their standard rescue equipment, or that they were to forego use of their probe.

The target was a backpack, approximately 30x70 cm, with a clearly marked “airway” (a length of flagging tape with the word ‘airway’ written on it). The transceiver was centered in the pack, approximately 30 cm from the airway indicator. The target was buried 60 cm beneath the snow surface.

The designated search plots had a slope less than 15 degree inclination, 15 m x 15 m, with an average total snow depth of 1 m and average hand hardness of 4 finger to 1 finger. Because a continental snowpack is often softer, the search plots in Colorado were in machine made, groomed, or wind driven snow to ensure this debris hardness. The search plots in New Zealand’s maritime snowpack were located in out-of-bounds terrain.

The participants were asked to vocalize their transceiver readings three times during the search: immediately at both 10 and 3 meters, and the lowest reading upon conclusion of the fine search. They were also instructed to verbally indicate when they had a probe strike (in the scenario allowed a probe) and upon visualization of the simulated airway when digging. The study recorded time stamps at 10 m, 3 m, conclusion of fine search, probe strike, and airway visualization.

This study evaluated performance differences between probe-permitted and probe-restricted trials. The primary metric evaluated across trials was the time elapsed between the end of the fine search and airway visualization. The onset of this duration was defined by the participant's declaration of their lowest reading, and the termination was established when the participant shouted 'airway' upon visualization of the ‘airway’ flagging.

Two behavioral metrics were also recorded: the rescuer's experience with excavating without first obtaining a probe strike and their transceiver distance from the snow surface during the fine search. Rescue times between probe-permitted and probe-restricted conditions were compared using paired two tailed t-test with a significance of $p < 0.05$. Significant outliers were included.

3. RESULTS

The study shows a statistically significant 39 second reduction in duration from lowest reading to airway visualization when a probe was not used for burial depths of 60 cm. The mean time from lowest reading to airway visualization with probe was 138 seconds and mean time from lowest reading to airway visualization without probe was 99 seconds. This represents an average time savings of 39 seconds when the probing is omitted. ($p =.01$)

Table 1: Summary statistics

	Probe	***No Probe***	***Difference***
Mean time from lowest reading to airway visualization	138	99	39
Standard deviation of lowest reading to airway visualization	75	63	70
Median time from 3 meters to airway visualization	170	129	41
Mean time from lowest reading to probe strike	45	-	-
Standard deviation of lowest reading to probe strike	20	-	-

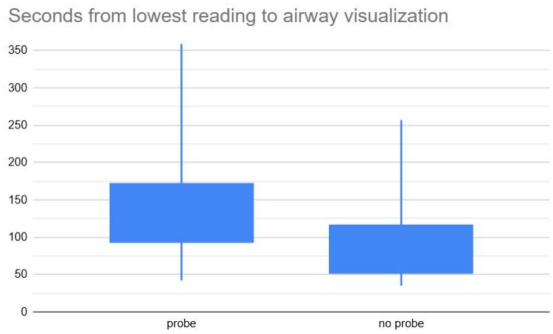
Table 2: Participant times in seconds

ID	*Lowest reading to Airway visualization (Probe)*	*Lowest reading to airway visualization (No Probe)*	*Difference*
1	67	98	-31
2	87	55	32
3	171	103	68
4	213	116	97
5	99	53	46
6	97	91	6
7	359	239	120
8	118	88	30
9	248	90	158
10	158	64	94
11	159	180	-21
12	117	52	65
13	180	124	56
14	106	68	38
15	139	170	-31
16	55	39	16
17	177	257	-80
18	235	51	184
19	97	55	42
20	94	203	-109
21	69	51	18
22	42	35	7
23	160	48	112
24	64	49	15
25	103	107	-4

This table depicts all trial runs for the participants, including outliers.

33% of fine searches were conducted from distances greater than approximately 10 cm above the snow surface. The rest were performed on or very near the snow surface. When searching more than about 10 cm off the snow, the median time from transceiver reading of 3 m to lowest reading at conclusion of fine search was 34 seconds. When searching on or very near the snow surface, the median time was 41 seconds. This represents a time difference of 7 seconds in a fine search. (p = .01)

Chart 1: Box plot of seconds from lowest reading to airway visualization for probe and no probe trials

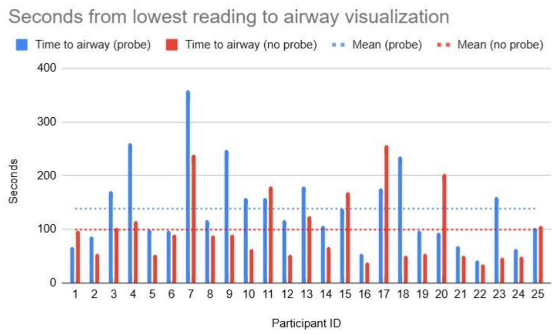


This box plot represents all n=25 participant trials. The long lines represent maximum and minimum. The box spans from the first quartile to the third quartile.

Table 3: Seconds from lowest reading to airway visualization for probe and no probe trials

	Min	*Q1*	*Q3*	*Max*
Probe	42	94	171	359
No probe	35	52	116	257

Chart 2: Bar chart of seconds from lowest reading to airway visualization for probe and no probe trials



Another representation of all participant trials. Each blue and red pairing is one participant's trial run. The blue line represents the time from lowest reading or conclusion of fine search to airway visualization when using a probe. The red line represents the time from lowest reading or conclusion of fine search to airway visualization without using a probe.

4. DISCUSSION

4.1 Origins of the study

The driving force of the question 'does probing slow us down in shallow burials' comes from the anticipated scenario of performing a companion rescue and getting a relatively low transceiver reading in your fine search, such as ".6". This represents at most a 60 cm burial depth, which is in the 40th percentile of depth for all burials in the SLF avalanche database. (Reiweger et. al, 2017) As a practitioner, intuitively there exists a burial depth where probing is unnecessary due to the proximity of the buried subject and their size. While there was anecdotal evidence of this through companion rescue drills at Mt Hutt, there was no formal data to back this claim or to promote this rescue choice.

4.2 Scenario considerations

In a real rescue, there are many complicating factors that could alter or negate the benefit of the time savings revealed in this study.

A real buried subject would be much larger than the backpack used in the scenario. This means probe strikes would likely occur more quickly, but also excavation without probing would be more likely to expose a part of the buried subject.

In rescue, shoveling is not complete when you first see the buried subject; it continues until they are able to be extricated. There is significantly more digging required for a body than for a backpack. This trial does not factor in the potential hinderance to the rest of the rescue from additional fatigue should the rescuer excavate in the wrong direction first.Still, speed in excavation means you will get to see a part of the buried subject sooner and can determine which way to dig to expose the airway.

The artificial nature of the debris fields utilized in this study represent a limitation as they may not fully replicate the physical properties and operational challenges of natural avalanche debris.

4.3 Outliers and participant data

In the trials executed with the use of a probe, the outlier times were composed of false positive probe strikes leading to wasted digging and participants repeating the fine and pinpoint searches. In those without a probe, the outliers were attributed to practitioners digging inaccurately towards their lowest reading, necessitating a repeat of their fine search.

21 of the participants in this trial (84%) had no experience with this rescue method. It was their first time foregoing probing to excavate a target, and they did no practice runs.

In post-trial interviews with practitioners, there was rarely ambivalent feedback. People were either excited and felt they could go much faster to rescue the target without probing or adamantly opposed feeling that they were slower and digging 'blindly'.

4.4 Transceiver height

There are various recommendations from manufacturers on transceiver height from the snow surface during a fine search. While Backcountry Access and Black Diamond recommend a vague 'close to the snow surface' height, Mammut states 'During this search phase hold the transceiver at knee height!'. A study by Wallner et al. (2025) which focused on transceivers with voice navigation also published data surrounding transceiver height in fine search. They found that 'fine search not on the snow surface' increased time to probe strike dramatically: "not on snow 106.6 +- 28.9s, correct fine search 44.5 +- 3.6s p = 0.001" (Wallner et al, 2025).

The data from our study found a 7 second time savings by staying off the snow surface during the fine search but nothing ultimately compelling to form a recommendation either way for transceiver height during fine search.

For geometric reasons, having the transceiver closer to the surface would result in more precision in the fine search. However, if the debris is rough and the transceiver moves up and down over the debris, this would likely be negated. A potential remedy to the manufacturers' mixed messages would be to search on a level plane with the highest piece of debris within your fine search cross section to eliminate transceiver movement up and down as it contours over debris. This, combined with remaining in an ergonomic position that allows efficient movement in all directions, should set the practitioner up for success.

4.5 Practitioner considerations

The UIAA probe standard requires a color change for the last segment of the probe to indicate proximity to the target. By foregoing probing you lose an indication of just how close you are to the target when digging. This indication helps the rescuer switch to a more careful mindset in their shoveling to prevent physical trauma to the buried subject. Without this indication there is a greater likelihood of the subject being struck with the shovel and causing injury.

If the rescue is outside the timeframe of a normal companion rescue (less than thirty minutes), patients are more likely to be hypothermic or otherwise compromised. The potential time savings is likely not worth the increased chance for mechanical trauma through a shovel blow due to lack of awareness on exact location of buried target.

The hardness of debris makes a difference in the physical cost of shoveling. While this scenario did ensure debris was at least 4 finger (and often harder), a rescue in extremely hard debris may fall outside of the bounds tested here.

Precision matters more in the fine search if electing not to probe. It is beneficial to find the center point of the lowest reading.

The confidence to shovel without probing should increase as the number on the lowest reading at conclusion of fine search decreases below 0.6 meters. There is not evidence to support this decision above a reading of 0.6 meters at the conclusion of the fine search.

4.6 Organization considerations

This skill is not always faster or easier than traditional rescue methods. It can, when employed by an experienced practitioner, result in rapid excavations. However, the decision to skip probing and move directly to shoveling when under stress in the field could contribute to additional stress and decrease the mental band width of the rescuer.

A potential benefit to this tactic is that novel ideas can drive more engagement in training. In addition, shoveling without probing engages the practitioners ability to visualize the burial based on their fine search.

Many operations that train for rescue use shallow burials because they are easier to get practitioners through on a limited time frame. Because of this, there is the potential for rescuers choosing to forego probing in shallow burials to get less frequent training with their probe. It is important to recognize this and ensure that trainings challenge the practitioner to use all their tools. To ensure practitioners continue to improve skills in a variety of scenarios, deeper burials scenarios where this skill is not applicable should be set or participants could be required to alternate using their full kit despite shallow burials.

When discussing a new skill, it is important to consider the impact of extra training required and decision fatigue that can slow down a rescue. It is convenient to draw on how emergency medical directions categorize skills and interventions as an example of how to enable those with more advanced skill and training without ‘deep ending’ those with less training. For example, in Colorado, EMTs would be trained and expected to put in a simple airway adjunct to protect an unconscious person’s airway, but a paramedic would be trained and expected to be able to intubate them. Because they have more training, they are able to perform different skills. At the end of the day, whether it is a medical problem or avalanche rescue, it will be the basic skills that save lives.

5. CONCLUSION

The goal in avalanche rescue is more than a backpack. It is potentially a colleague, friend, or family member. The potential time savings of 39 seconds may improve patient outcomes but if the rescuer is not feeling confident, defaulting to probing is never wrong. For practitioners looking to expand their toolbox for their rescue response, extricating without probing is an advanced rescue technique to practice and see if it works for them. For operations, it could be beneficial to support the development of new skills and tactics within your teams’ rescue kit without changing your rescue matrix to ‘mandate’ this one-off skill.

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