PROBING FOR AVALANCHE VICTIMS REVISITED

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ABSTRACT: A poster presentation that builds upon the results of the Probing for Avalanche Victims (ISSW 2004). This poster explores the common errors of probe lines and how to avoid them, and presents considerations for how to set up and make the most efficient use of a probe line.

KEYWORDS: avalanche rescue, probing, POD, probe line, PROBE

1. REVIEW FROM BALLARD ET AL. (2004)

Experience on avalanche rescues and rescue practices led us to believe that the 70% probability of detection (POD) of a victim in the "average" position, on the first pass, for traditional 75 x 70 cm probe line spacing was optimistic. A computer model, PROBE, was created to simulate a more realistic, body-shaped target constructed of overlapping spheres. Using a standard body 175 cm tall and average build, a file of bodies in random positions was created to use for various test probe lines. And indeed we found a much lower POD (Table 1).

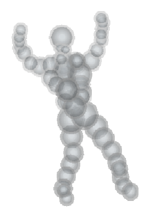
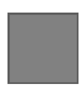
Orientation	Target area m^2	Schild (1963)/Perla(1976)	Schild/ Perla POD	PROBE (2004)	PROBE POD
Vertical	0.10		20%		22%
Prone/ Supine	0.50		95%		74%
Side	0.40		75%		49%
Average	0.37		70%		59%

Table 1. Comparisons of targets (approximately to scale) and PODs for traditional 75 x 70 cm grids. (A typical body generated by PROBE will have a surface area in the prone/supine position of 0.4 to 0.5 m^2.)

Finding an optimal POD is a trade-off between tighter grid spacing and increased time to probe a given area. Tighter spacing means slower progress and a higher POD, while a wider spacing means moving faster and a lower POD.

One technique that can add efficiency is for rescuers to probe more than once per step. This is used in the "open order" coarse probe keeping the same spacing of 75 x 70 cm and probing to the left and right on each step. Atkins (2000) showed three holes-per-step (3HPS) to be even more efficient, and that the traditional 75 x 70 cm spacing was too large for 3HPS. Field tests of how far an average rescuer could reach when probing 3HPS showed the 50 x 50 cm grid was workable. The computer simulation yields a POD of 88% for an average position on the first pass (Table 2).

Technique	POD 1st pass	POD 2nd pass	Time per pass	Average passes	ETD (min.)
50x50	88%	12%	175 min.	0.64	112
75x70	60%	26%	96 min.	1.15	111

Table 2. Comparing 75 x 70 cm (2HPS) and 50 x 50 cm (3HPS) methods.

Even with the advantage of 3HPS, it takes much longer to probe a given area with 50 x 50 cm spacing than the traditional 75 x 70 cm spacing. However, considering what really happens on a

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rescue, we found that the 50 x 50 cm grid with 3HPS compares well with the 75 x 70 cm grid and 2HPS. When a probe line strikes the victim, the line is done. If the line misses the target, the line must finish probing the area, regroup, offset the probe line, and re-probe the area. By simulating this process and calculating the Expected Time to Discovery (ETD), we found the two grids yield nearly the same ETD, with the obvious advantage of the 50 x 50 technique finding the victim on the first pass more frequently, thus avoiding the errors inherent in trying to offset the probe line for the next pass (Table 2).

Based on these results we recommended using the 50 x 50 cm spacing and each rescuer probing three times per step.

How can this recommendation best be implemented in practice? Anyone who has been in a probe line in earnest or for practice knows that probers have a very strenuous, stressful, but monotonous job. Estimating distances on an irregular sloped surface while negotiating avalanche debris and staying alert for clues is a difficult job. Our goal became to help a field team approach the computer-precise 50 x 50 cm grid, but first we had to learn about errors.

2. MEASURING ERRORS

We asked a group of experienced ski patrollers to perform the 75 x 70 cm grid and the 50 x 50 cm grid without using a guidon cord. Searchers were asked to line up wrist to wrist for the 75 x 70 cm grid, and to probe 37.5 cm (15 inches) to their left and right. For the 50 x 50 cm grid, they were asked to line up fingertip to fingertip and to probe 50 cm to either side and in the center. They probed on level terrain in about three inches of undisturbed snow, to make it possible to evaluate. They may have suspected that their spacing was to be inspected, but were not told. We measured where a probe line of 14 patrollers actually placed their probes after being lined up and for their first three steps using each technique.

Gathering and interpreting this data was not easy. Not every probe hole was obvious, so there were gaps in the data. Should one try to compare the holes with the grid as defined by the strict interpretation of the technique, or just look at each incremental step and the spacing, not the accumulated errors?

Figure 1 shows the measurements from one probe line. While some probes are closer, others are further apart. Such gaps decrease the probability of detection.

We located the "probe line" by finding the probe-pole holes at each end, and stretched a measuring tape between these points. Thus, measuring along the probe line, we measured lateral separation between holes (across fall line). For variation perpendicular to the probe line (along fall line), we recorded the distance of each hole from the "average" line as well as the distance that the probe line moved at each end.

Some simple calculations showed the average distance that the probe line moved forward. Since we only measured three steps, the sample can scarcely be considered comprehensive; however, the results are likely indicative of real probe-line problems. Interestingly the three steps in the 75 x 70 cm grid were about 73, 83, and 74 cm. For the 50 x 50 cm grid, the three steps were 65, 102, and 75 cm. This obviously leaves room for improvement, and

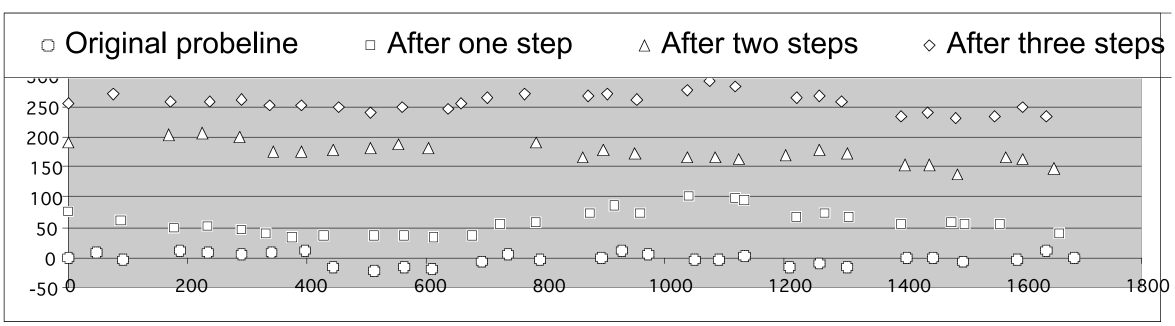

Figure 1. Plotted probes and spacing from trial without using guidon cord.

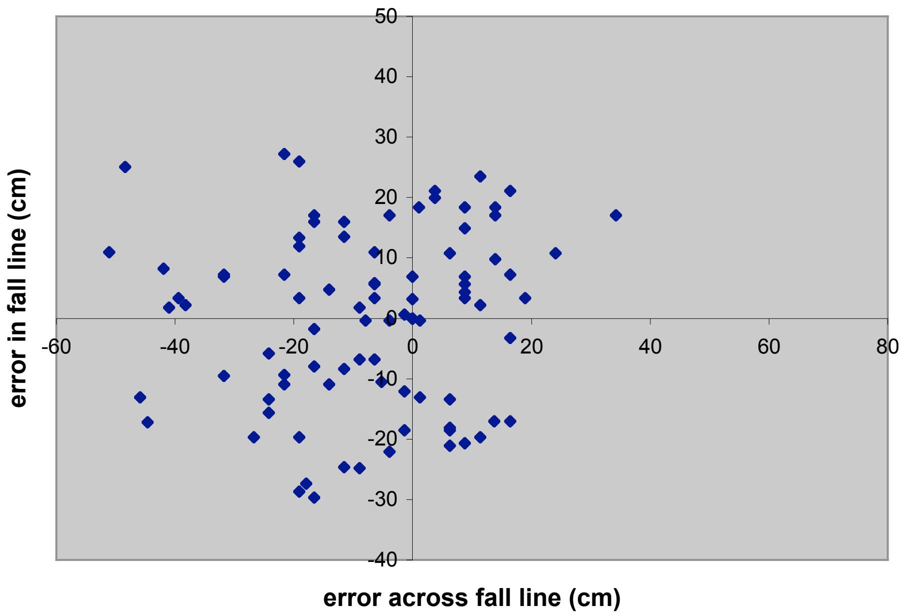

Figure 2. Scattering of probes around target points. (75 x 70 cm grid). More than one half of the probes were off by more than 20 cm.

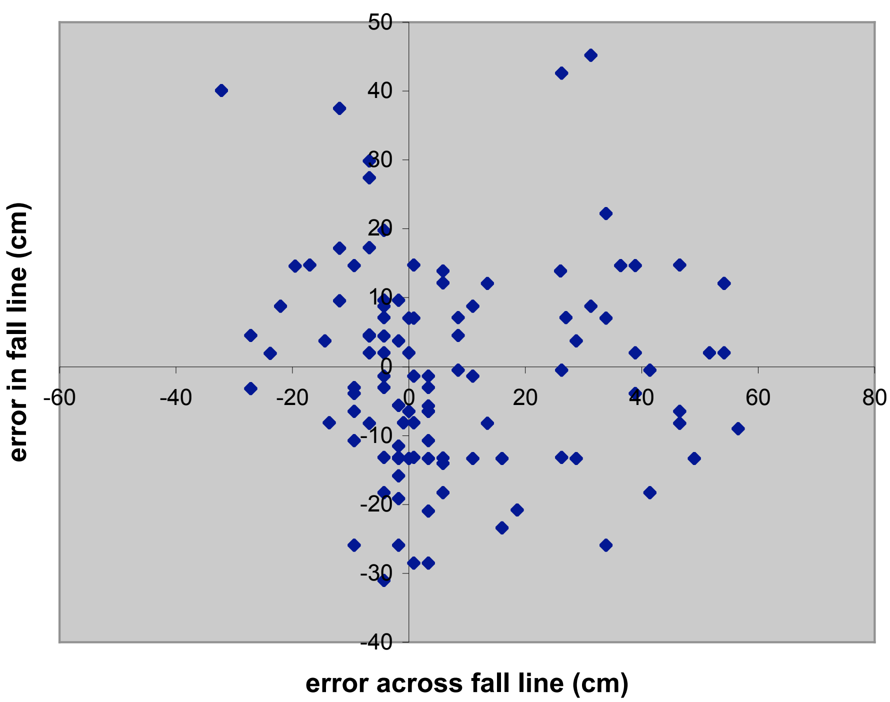

Figure 3. Scattering of probes around target points. (50 x 50 cm grid). Nearly one-third of probes were off by more than 20 cm.

unfortunately, for a buried body to escape discovery. We can only speculate why all of the steps forward were too large. Perhaps people were anxious to finish the job, so they took big steps. Our experience with probe lines from decades of trainings and rescues shows when someone takes a big step, the probers up and down the line are more likely to adjust by catching up rather than lag behind. This makes for a more open grid and lowers the POD. In this study the steps for the 75 x 70 cm grid were reasonable. Perhaps on flat terrain this spacing is more familiar and closer to many people's natural stride. Taking the small steps required for the 50 x 50 cm grid was not an easy adaptation.

Trying to ignore the group's collective errors, we also looked for evidence about individual variation or errors. In Figures 2 and 3, we superimposed all the target points of the grid to show where the probe pole holes were found relative to the target points.

The average error across the fall line for the 75 x 70 grid was about –7 cm. (Figure 2) This must mean that the spacing between probers is not actually 150 cm. (If the spacing were correct, the two probes at the end of the probe line would determine the average error). The initial instructions of wrist-to-wrist resulted in a tighter spacing than intended. Still, more than half of the probes are off by more than 20 cm.

Looking at the 3HPS 50 x 50 cm grid, we found that the average error along the probe line was about +7.5 cm. (Figure 3) The initial instructions to line up finger tip to finger tip resulted in probers being too far apart. The two different probe lines should have been lined up with the same instructions since two 75s is 150 and three 50s is 150. A better approximation appears to be to have probers space themselves palm to palm. This highlights the difficulties of just lining up the probers. In any case, nearly one third of the probe pole holes are more than 20 cm from the intended target

From the above figures, it seems that if there is anything we can depend on, it is a lack of accuracy. Each prober has several factors to consider. While maintaining the spacing between probers and trying to stay in line across the hill, the searcher is trying to probe vertically, making a grid for which the reference points vanish almost as soon as they are made. A probe pole hole may not be easily visible from eye level. Considering all these factors, it is hardly surprising that relying on individual judgment of where to probe next will result in large errors.

3. USING A GUIDON CORD

Guidon cords and wands (or markers) are vital components of organized rescue, but too often are neglected.

The guidon cord is not a new tool, but it is a tool that seems to have fallen out of favor or even into obscurity. Rather, the cords should be considered a critical component for organized rescue teams.

Simple and portable, a guidon cord (2-3 mm in diameter, static—no stretch) should be clearly marked at 50-cm intervals with three marks for each prober plus an extra 50 cm at each end for measuring the next step. Probers stand behind every third mark on the cord, beginning one in from the end (Different colored marks used for the center and two marks to each side will help the prober locate his position easier.) Two rescuers handle the guidon cord and move it in front of the probe line. Probes are inserted just behind the cord, next to the marks on the prober's left, center, and right. While the probe line leader checks the third probe, the cord handlers measure the next step and prepare to move so not to delay the probers. The cord should be kept taut and as close to the snow surface as possible to make probe placement as accurate as possible. The probe line leader must also watch that the probes are kept vertical.

4. MARKING THE AREA WITH WANDS

Placing wands in the last probe hole at each end every fifth step or so, will not only aid the leader in knowing what area has been probed but is needed to correctly offset the probe line, if a second pass is required. An accurate second pass improves the chance of finding a victim from 88% to 99%. Without an accurate offset there may be no gain in POD. To increase POD the second set of holes must fall into the middle of the grid formed by the first set. Since holes may be obliterated, the people managing the guidon cord measure from the wands that were placed on the first pass. Extra wands, in another color (if possible), should be placed during the second pass to show how the offset was implemented.

5. RECOMMENDATIONS

- Use a guidon cord.
- Use wands to mark well the searched areas.

The above recommendations are easy to implement and follow, but sometimes a guidon cord will not be available. If necessary to probe without a guidon cord, line up probers palm to palm. The leader should also have the probers set the probe 50 cm (roughly 20 in) in front before stepping to it to help visualize the correct distance. Probing uphill is preferred as it reduces taking over-long steps.

6. REMARKS

Not only do guidon cords ensure a proper and efficient grid pattern, the cords also allow probe lines to move faster. Trials in Sweden by Peter Mågård demonstrated a 20% improvement in search speed (Mågård, personal communication). The timesaving comes from easier and better management of the probe line. Without a cord the probe line leader too often must stop and redress (realign) the line, wasting valuable time. The cords also save procedural time when used to define search areas and to organize the line.

The Italian mountain rescue service in Courmayeur sometimes uses guidon cords along the flanks of their probe lines. Marked guidon cords—kept on reels—can be lined out to mark search corridors. Probe lines move very quickly along the already marked route.

The use of wands is often overlooked, and most rescue teams probably have too few wands for most medium to large search missions. The International Commission for Alpine Rescue (www.icar-cisa.org) recommends three colors for marking avalanche areas, and European and North American countries have already adopted the color scheme. Red is used to mark searched areas, blue marks clues, and yellow (as a base color) is used to mark the debris perimeter. Rescue teams and organizations can choose other colors for other search jobs, like green or orange for dog search, and white with red for RECCO search.

A tip about wands—learned from the Alta Ski Patrol (Dan Howlett, personal communication)—will help rescuers quickly identify not-probed lanes between probed corridors. As a corridor is being probed the Alta Patrol places several taller wands down the middle of probed corridor. This makes it easy to identify searched areas from not-searched areas, eliminating the potential for missed areas.

7. REFERENCES

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