

2nd Edition

SKI TOURING

Bruce Goodlad



A PRACTICAL MANUAL



ESSENTIAL KNOWLEDGE FOR OFF-PISTE, BACKCOUNTRY, SKI TOURERS AND SKI MOUNTAINEERS



SKI TOURING

Bruce Goodlad

Second edition 2018

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The techniques, skills and routes in this book have been gleaned from years of sharing days out on skis in the mountains with friends and clients.

I owe a huge debt of gratitude to my wife Kate who took most of the technical photographs and toiled late into the night battling with my terrible grammar and spelling. I would also like to thank Mike Austin who has helped review drafts, made valuable suggestions, then hung on a rope to be photographed. Mike and I first skied together over 20 years ago in Antarctica and have been sharing great days out ever since. We have also been developing and delivering American Avalanche Association courses to the public in the Alps and Scotland.

Brian O'Connor has been a huge help with advice, suggestions and comments.

I felt a chapter on ski technique was essential, and there was only one person I wanted to work with; Alison Thacker.

The avalanche chapter was a big challenge, we decided to re-write it for the second edition based on the knowledge we had gained teaching avalanche education over the years separating the two editions of the book. There have been large advances made in the teaching of avalanche education and the importance of the "Human Factor", this is reflected in the new chapter.

When it came to the photography Mike and Mark gave their time freely to get in front of the camera, James Thacker very kindly spent time dangling on a rope and Andy Perkins got behind the lens when Kate was unable to do so as we had just had our son Finn.

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A final thanks to everyone not mentioned who contributed ideas and who have shared great days in the mountain.

Photographs

Most of the photographs in the book have been taken by the author or Kate Scott unless otherwise credited in the book. I would also like to thank the following who have generously donated pictures. Mark Charlton, Mike Austin, Bruce Duncan, Andy Perkins, Neil Stevenson, Andy Teasdale, Rob Jarvis and John Dallinson.



Bruce Goodlad

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Bruce Goodlad has been an International Federation of Mountain Guides Association (IFMGA) guide since 2001 and worked as a mountaineering instructor in the UK prior to that. He has guided on skis and foot all over the world working from Antarctica in the south to Greenland in the north. He spends about 100 days a year guiding on skis; there's nothing he loves more than sharing his time in the mountains with like-minded people. He has a special interest in avalanche education and works each year on a number of avalanche courses for professional and recreational skiers.

This is the second book Bruce has written. The first was *Alpine Mountaineering* – an introduction to alpine mountaineering techniques and the routes to develop them on, also by Pesda Press. Bruce was the Technical Director for British Mountain Guides between 2012 and 2016 when he was responsible for the organisation of training for guides. He is a professional member of the American Avalanche Association (AAA) and a partner in the avalanche education business Avalanche Geeks.

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Mike and Bruce are partners in Avalanche Geeks, a Scotland and Alps based avalanche school. Mike co-authored the avalanche and avalanche rescue chapters of this second edition.

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The Author and Publisher of this book would remind the reader that:

Ski touring and ski mountaineering are activities with a danger of personal injury or death. People participating in these activities should be aware of and accept these risks and be responsible for their own actions.

Every effort has been made to ensure that the content and instructions in this book cover all aspects of personal safety skills and techniques required in ski touring at beginner and up to intermediate level. The Author and Publisher cannot accept any responsibility for any accident, injury, loss or damage sustained while following any of the techniques described within.

If you feel that you need additional instruction in order to use this book then it is advised that you employ a suitably qualified and experienced mountain guide.



Avalanche Rescue

The aftermath of an avalanche – no one was injured.

Being avalanched is a bad thing – at best it's scary, at worst fatal. As skiers and ski tourers we have a responsibility to those with whom we ski to know how to search for and rescue someone buried in an avalanche. They have the same responsibility to you, so I would suggest not skiing with people who do not take the need for avalanche rescue techniques seriously and practice it on a regular basis.

If you are not killed by the trauma of an avalanche you have a 92% chance of being dug out alive, if you are rescued in the first 15 minutes of burial. This drops steeply after 15 minutes, to a 37% chance at 35 minutes, and continues to drop after that. Statistics from the American Avalanche Association.

It is the party who you are skiing with who **must perform the rescue**; if you rely on outside assistance you will be looking for dead bodies. We are going to look at a standard method for searching and recovering an avalanche victim, using some standard terms to refer to the different phases of a rescue. They may sound a bit North American, because they are! North America leads the way in considering avalanche education a necessary and integral part of ski touring. In Europe, we could do with accepting that we don't know as much as we should, and invest in some avalanche education. This chapter will provide you with the basic information you need, but it is no substitute for on snow training and practice. Don't assume that just because the people you're with ski a lot they know how to use all of their equipment or make good decisions, and even if they do it's essential that you all practise together throughout the season.

What we are going to talk about in this chapter is a system for rescue that will work with any avalanche transceiver. The principles can be applied to any rescue scenario; it is commonly referred to as 'companion rescue'. Once you have mastered the techniques here, it may not be long before you are teaching them to other people.

Top Tip

Swiss avalanche educator and researcher, Manuel Genswein, has worked out an efficient step-by-step way of teaching a new user the basics of companion rescue in about 15 minutes. This was designed so that guides could pass on the basics to their clients in a clear, structured way to give them some chance of digging out a guide should he be avalanched. I have outlined this method in the Appendices. I would suggest using it as a basis for training friends who have not done any rescue training before you ski off-piste with them.

Transceivers



Transceiver worn under a layer of clothing.

The transceiver should be worn under a layer of clothing; this allows quick access but reduces the chance of the unit being ripped off the body in an avalanche. Each unit has a different harness system so follow the manufacturer's instructions. An accepted alternative is to carry the unit in a zippered pocket with the retaining strap clipped to something and the screen facing the body for protection.

There is considerable evidence that the effectiveness of your transceiver can be significantly reduced (potentially fatally) by electronic interference. This can be from any electronic device: mobile phones, Go Pros, GPS units, etc. The recommendation is that the electronic device should be at least 40cm away from your transceiver. Smartphones are particularly guilty of causing interference.

Transceiver check

When you head out every morning make sure you check your transceiver's battery power before you leave the house. If you don't manage this, at least check it before you leave the car. I always have spare batteries and usually a spare transceiver in the car.

Start of tour transceiver check

It is essential to check at the start of each tour that everyone's transceivers are working and that everyone can hear everyone else's. This is especially

the case if you have any people in the group with older analogue transceivers, which may have drifted off signal and not be detected or not be able to detect modern digital units. Both situations have happened to me at the start of tours. Now I won't ski with clients who have analogue transceivers and am reluctant to ski with anyone who is not using a three-antenna transceiver.

I will perform this check once at the start of a tour, or if I am skiing with people where I do not know if their transceivers work or not.

The easiest way to check that everyone's transceivers is working is to stand the team in a line with their units on 'receive' mode; one person walks away with their unit switched off until they are over 50m away. That person stops, turns their unit to send and slowly walks back towards the line, as the unit is detected the detector puts their hand up. This gives a visual indicator of the range of a unit. Walk in until the units all read ten metres, this is a further check that all the units are working the same.

To check that units are sending, everyone turns their unit to send, the same person who walked away last time walks 50m away and turns their unit to receive. The team walk towards them one at a time, the receiver can note when they first picked up the unit. Make sure there is at least a 50m gap between each person to ensure the correct units are being detected. The person can walk on by and get ready to go skiing.

This way the send and receive function on everyone's unit is checked.

If you are skiing with the same team regularly or for a week I will only perform this at the start of skiing time together.

Daily transceiver check

I do this **every day** before skiing. If leaving from the car with or without a lift, it is best done in the car park so something can be done if you discover a faulty transceiver.

The test is a simplified version of the previous test. One person is chosen to perform the test. They stand about 50m from the group and turn their unit to receive. The group then turn their units to send and come past one at a time; this can be performed on foot, skin or ski. If on ski just make sure the group come past slowly enough to confirm the test for each person, and keep far enough apart to check one person at a time.

Some transceivers have a group check function which reduces the range to one metre, so that the checker can go round the group, and easily check one transceiver at a time.

Daily transceiver check best done next to the car or hut where you can sort a problem if you discover one.



Most modern transceivers have a group check function; this reduces the range to 1m, which makes it much easier to check that everyone is in send mode. The checker can stand still and get his group to come past one at a time; the sending unit should be picked up at 1m distance. When all is done the checker turns his unit to send and shows it to one of their team as confirmation.

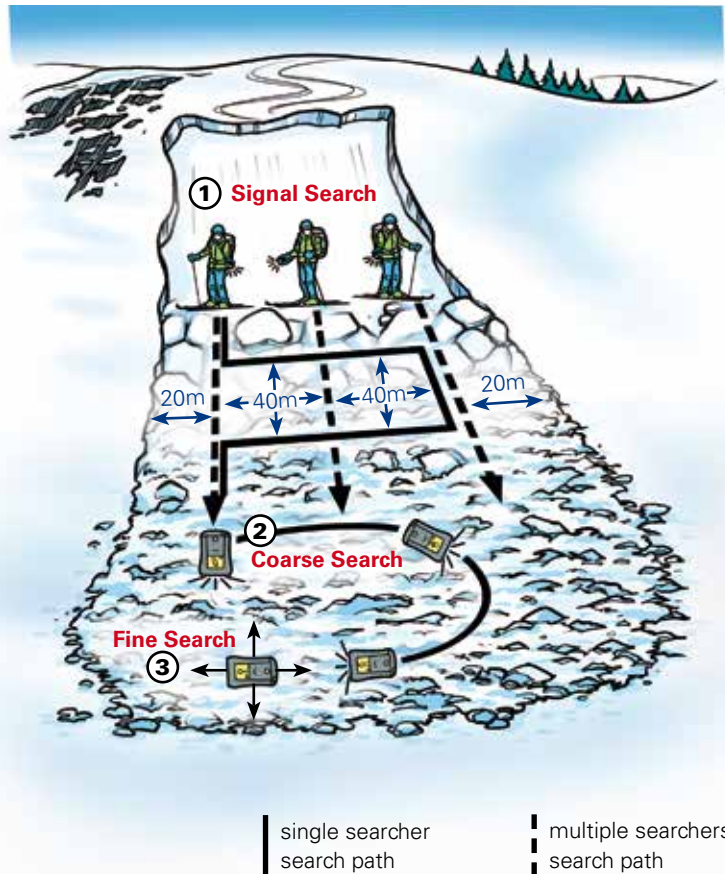
Companion rescue

The exact organisation of a rescue will depend on the number of victims, rescuers and the situation. We will start with the most basic, one-to-one rescue and build from there. We will look at managing a rescue once we are comfortable with the techniques. You will hear this referred to as 'companion rescue', and if you read more into the subject you will hear the actual search referred to as the 'induction method'.

There are two possible scenarios; the first, where you witness someone being avalanched, the second, where you come across a situation where someone has been avalanched.

Let's start with the first. If you see someone being avalanched watch where they go, if they vanish under the snow mark in your mind the last point where you saw them. If you deem it safe to enter the area, ski in and mark that point; a vertical ski pole is ideal. Now you do not need to search the area above that point. Look for visual clues; it is easy to get focused on your transceiver and miss the foot, glove or hand sticking out.

Avalanche search pattern showing the different search phases. This diagram has been reproduced with kind permission from Backcountry Access Copyright © Backcountry Access Inc 2014.



If you come across an avalanche incident, hopefully a search will already be under way. If not, find out **how many** people are buried, and ask the witnesses to turn their transceivers off and get out their shovels and probes. If they haven't already started searching they probably don't know how to, so don't waste time finding out.

Make sure all the other transceivers on site are switched off, and ask someone to make a manual visual check so you don't waste time following a false signal.

Avalanche on Mont Blanc du Tacul with searchers choosing to accept the risks involved in being in the line of any debris falling from seracs above. They have made the decision to get involved in the rescue.



Take care!

Only perform a search if you feel it is safe to do so; do not put yourself or your team in danger. Adding more victims is bad. In most scenarios once an avalanche has occurred the slope is stable, but there are occasions when this may not be the case. The most common situation where you may choose not to perform a rescue is if there is a risk of a secondary avalanche, or you have to go under a serac (unstable ice cliff) to perform a rescue.

Signal search

This is the first phase of the search, and you need to make sure you cover all the debris (if you have marked the last seen point you can start there). Traverse the slope on foot or ski depending on whichever is easiest. Move horizontally across the top of the search area 20m in from the edge, drop down 40m then traverse again until you are 20m from the other side. You have to assume that the victim is buried deeply, is lying on top of their transceiver, and has weak batteries; all of these factors will reduce the signal strength. This search pattern will ensure that the victim is not missed on the first pass. Move quickly looking for visual clues. You may pick up an intermittent signal at extreme range which can be confusing. Keep going with your signal search until you have a solid lock – you are unlikely to get this until you are within 40m of the victim. Keep moving until the unit reads less than 40 metres.

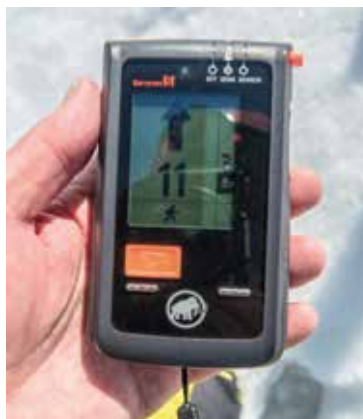
Coarse search

Once you have detected the signal follow the direction and distance indicator on your transceiver. Keep moving quickly.

The coarse search done is on skis if the terrain allows.



Mammut Barryvox S showing distance and direction.





Fine search

As you reach 3m from the victim, move your transceiver down next to the snow and use the distance display to find the minimum reading. Mark the minimum point on the snow. Keep your unit in the *same orientation* (i.e. always pointing the same direction) during this phase. When you get close the easiest way to get the minimum reading is to use a system referred to as 'bracketing'. Get as low a reading as possible on your unit as you come in – you may go past the victim and the numbers will increase. If this happens go back to the minimum and, keeping your unit in the same orientation, move the unit from side to side again looking for the minimum. You may have to repeat this procedure a couple of times to reach the minimum. When you have found it mark the point with a hat or glove so you don't lose it while you are getting your probe ready.

Fine search with transceiver close to the snow and always in same orientation.

Pinpoint search

Get your probe out and probe *perpendicular to the surface of the snow*. Start at the lowest reading you got from your transceiver, then if you don't get a positive strike move out 25cm and probe in concentric circles. Each new circle should be 25cm out from the last one.

When you probe, stand with your legs apart and probe vertically between your feet at right angles to the surface of the snow, Always use gloves to protect your hands from a cold injury, and to avoid the probe warming up and getting snow stuck to it which will reduce its efficiency.

Once you have got the lowest reading deploy your probe.



Probing using a hat to mark the lowest transceiver reading. This avoids confusion in the debris.



When you get a positive probe strike (it will feel like a body, not a rock or snow – practise on a buried rucksack to get the feel) **leave the probe in place**. This does two things; it reassures the victim that you have not missed them and that you are starting to dig, and the probe also gives a visual reference. Once you start digging the snow all looks the same so you need a reference point.

Shovelling

With modern transceivers and practice the search phase of any companion rescue should be fast; digging the victim out is what takes time and is really hard work.

A lot of research has been done in this area to find the most efficient way to dig a victim out of an avalanche. As a general principle you want to avoid moving snow more than once, so efficiency is everything. Start by 'paddling' the snow to the side, this is best done from a kneeling position, once you can't effectively move any more snow this way change to classic digging.

Avalanche debris is usually pretty solid so you may find the best way to move snow is to block it using your shovel then move it. Even dry snow compresses into a solid, hard-to-dig mass, and wet snow sets like concrete. Effective digging in avalanche debris requires a metal-bladed shovel. Plastic shovels flex and bend, they do not cut into the debris and are ineffective in digging. If someone comes skiing with me with a plastic shovel I will swap it with my metal shovel, that way at least they will have the best tools to dig me out.

SKITOURING

If the probe strike is less than 1m deep (markings on the probe) start digging one pace downhill from the probe. If the victim is deeper, move 1.5 times the burial depth downhill, and start digging into the hillside towards the victim. Think about digging a ramp down towards the victim, this is the most efficient way to move snow. The advantages of starting downhill are that there is less snow to move and you won't compact the snow on top of the victim so compressing their airspace.

There have also been lots of tests done as to the most efficient use of manpower if there is more than one rescuer. The consensus seems to be:

One rescuer. As above.

Two rescuers:

< 1m burial, start just below the probe then work side by side.

>1m burial, one rescuer just downhill of the probe, the second downhill 1.5x the burial depth.

Three rescuers:

<1m burial, one rescuer digs down just below the probe and the other 2 rescuers dig in from 1.5x burial depth downhill.

>1m burial, two rescuers 1.5x burial depth downhill and the third rescuer clearing snow below them.

Padding snow to the side,
then blocking snow and
rolling it out of the way.



Four rescuers:

<1m burial, two rescuers work downhill of the probe then the second two work 1.5x the burial depth.

>1m burial, start as above, as the hole gets deep you may want to pull one person out of the hole to create space to work, they can then rotate back into the team as people tire.

Five rescuers:

<1m burial as with four, but the extra person prepares for the victim and rotates in as the shovellers get tired.

>1m as with <1m.

If you have more rescuers they can rotate in as the team tire, rotating every minute seems the most efficient. When digging there is no point in making the front any wider than 2m; when you find the victim work out which way round they are facing and dig towards the head.

Once you have got to the head, clear the airway (this may involve scooping snow from their mouth), reassure them, and dig the rest of their body out as quickly as possible as it is common for people to be in a panicked state. Turn off their avalanche transceiver as soon as possible, so it doesn't interfere with the search for any other victims. If they are unconscious you will have to go through your standard first aid and look after their airway. You can assume a degree of hypothermia as well.

You must practice this regularly; by practice I mean realistic scenarios on difficult ground with deep burials. Burying transceivers under leaves in the park is no substitute for avalanche education and regular practice.

Managing a rescue

If there is more than just you to perform a rescue then there is a degree of management and teamwork required to carry out an efficient rescue.

We will consider one buried victim and multiple rescuers to begin with, then we will move onto multiple burials.

Whether you arrive on scene or if it is one of your party who has been avalanched, the most important thing is the safety of the whole party; there is no point adding to the victim list. If you don't feel it is safe to enter the area of the avalanche you will have to make that horrific decision.

Managing a rescue –
teamwork is the key.



Start by appointing a leader. This person needs to manage those on the surface to ensure efficient use of manpower, and keep track of victims as they are dug out. This may not be the most experienced person, whose expertise in the use of a transceiver may be best used in the actual search.

Identify your searchers and manually check that everyone else has turned off their transceivers. Less is often more here as too many people with beeping transceivers will confuse the search. If you have enough people, you could send someone down straight away to ski across the debris looking for visual clues. They can have their transceiver on receive while they do this, but their focus should be on the visual.

Depending on the size of the debris and the number of people you have available, you should have two people splitting the search pattern described earlier, or have people spread at 40m intervals across the debris starting and finishing 20m in from the edge.

Once a signal is detected, it is the leader's role to ensure that the search pattern is reorganised to make sure the whole debris is checked on the first pass.

While the searchers are getting to work, the rest of the team can be assembling shovels and probes ready for the pinpoint search and the recovery. If you have multiple victims it is the leader's job to keep track of the number of people rescued.

It is normal practice to perform the companion rescue, then call for outside help when everyone has been accounted for. In the case of a big team someone could be doing this while the team search and begin the recovery phase. If you don't have the manpower, focus on the rescue first, remember the victims have 15 minutes.

Multiple burials

This is the worst-case scenario when you end up with a number of people buried under the snow. The search is set up as described above. Once the first victim is discovered the people not searching can be straight in with a probe and shovels while the rescuer(s) search for the next victim. You should know there are multiple burials from witnessing the avalanche or interviewing a survivor. If you have arrived on scene and your transceiver is detecting multiple burials then you know to continue the search after the first victim has been found. If you suspect a multiple burial but don't know for definite if this is the case, find the first victim, then once recovery of the first victim is underway search the rest of the debris using the signal search method described earlier.

Research has shown that the best way to ensure the maximum number of survivors is to practice what is known as reverse triage. In a normal first aid situation you go to the quiet unconscious people first. In an avalanche rescue situation you check those on the surface first, they may have a serious bleed that can be easily treated where as those buried under the snow are an unknown quantity until they have been found and dug out. If everyone is buried then digging the shallower burials out first will increase the chance of rescuing some people, whereas if you commit to a deep burial then you will easily use up your 15 minute rescue window before you get to the first victim. If you dig out any shallow burials first you may end up with another digger to help with any deeper burials.

There are a number of possible techniques to deal with a multiple burial situation depending on the type of transceiver you have. We have outlined the two most common multiple burial features, then described two methods that do not rely on any specific transceiver feature.

Mammut Barryvox S transceiver showing the mark function.



Multiple with mark function

The 'mark function' on a transceiver has been a big step forward in effective searching for multiple avalanche victims; however it doesn't always work. Make sure you read and practise the 'micro search strip' and 'three circle' methods outlined below.

If your avalanche transceiver has a mark function, once you have a probe strike on the first victim, hold the unit about 1m above the snow and press the mark button. The unit will then ignore that signal and immediately begin to search for the next unit. When it has found it, follow the unit as per the first victim. If no signal is detected then return to the signal search phase.

Three circle method

If during the coarse search you detected more than one buried victim and don't have, or are struggling with, the Mark Function, then the 'three circle method' may help find a second victim. Find the first victim as normal, then using the probe on the first victim as a central point move out 10m and walk in a circle with a 10m radius. You are looking for a signal on your unit that is not the person currently being dug out. If you don't detect a second signal move out a further 5m and repeat, then a further 5m. If you haven't detected a second signal at this stage return to your signal search at 40m spacing. You may find that certain transceivers won't let you do this so it is worth making sure you have practised and are very comfortable with the nuances of your particular device.

Any avalanche situation is going to be incredibly stressful, so make sure you have practised it thoroughly so all the elements discussed here become second nature.

Three circle method.



Micro search strip

An alternative technique to the three circle method, which also works really well if you have multiple burials in a small area, is the 'micro search strip'. This is effectively a scaled-down version of the signal search with two main differences – the size of the pattern, and the function of the transceivers you are going to use. To make sure the second victim is not going to be missed we use a spacing of 3 to 4m, about the length of two skis end to end. Start about this distance uphill from the first victim. When using the transceiver you are now going to ignore the direction arrow and concentrate on the distance and audible signal.

Move horizontally across the slope until you are 3m in from the edge of the debris, then up or down the debris depending on which direction you have already searched (down if you have already searched the debris above the victim). Move down 3m, then across the slope until you are 3m in from the edge, then down again. It is important to keep the search pattern as rigid as possible and keep the search lines straight. You are looking for a change in the distance reading that will indicate the proximity of a new transceiver. Once this is detected, use the induction method to find the victim. If there are further victims, return to the point where you deviated from the micro search strip pattern and continue with the search pattern.

What to do if you are the victim

Being avalanched is one of the most stressful things that can happen in the mountains. It has happened to me once, I was buried to my waist and don't want to go through that again.

If you are caught, give a big shout so people know you have been caught and they can watch where you go. Try to hold onto anything, or if there is nothing you can claw at the bed surface, or try to dig your ski poles in. Any delay you can make before being swept off will allow snow to move past you. The closer you are to the top of the avalanche the more likely you will be on the surface.

If you have an airbag, deploy it. If you have an Avalung, fight to get the tube in your mouth.

Get rid of your poles, and if possible your skis, as quickly as possible as they will drag you down (I don't use the wrist loops on my poles for this reason). Fight to stay on the surface. As you feel the avalanche slowing down, make a huge effort to get clear. If you can move your arms, try to get them in front of your face to create an air pocket. If you are buried, try not to panic. Easy to say I know, but panicking will use up your oxygen supply more quickly. Finally, hope that your team's avalanche rescue training has been effective and worthwhile.

First Aid

Using tactical digging you are digging a trench towards the victim. When you arrive at the victim slow down and work out where the head is. Clear the head as quickly as possible. Your priority is to clear the airway as quickly as possible. If you can't get to it do not try and pull them out of the snow – clear the snow around them and roll them out of the snow into the trench.

If they are not breathing then you need to consider the following:

- Obvious lethal trauma or body completely frozen; do nothing and look after your team.
- If clear airway but not breathing commence CPR but consider reverse triage. At some point you may not be able to continue and need to look after yourself and your team.
- No pulse AND airway packed with snow and burial time of 35 minutes you need to consider whether it is realistic to start CPR. If you do how long can you continue before effecting you and your teams well being?

Some final thoughts

Now think back to the Kittelfjäll case study in the previous chapter. What about first aid, and what will you do to stop your casualty becoming hypothermic? Are you able to contact the emergency services in a foreign country and guide them precisely to your location? Is there a suitable place to land a helicopter at the accident site? How do you prepare an appropriate landing zone for a rescue helicopter?

Now with all that in mind, doesn't looking for your friends' beacon under some leaves in the park seem pretty inadequate? We recommend that you take a one-day avalanche rescue course where all of these skills get taught and you'll practise complex in-depth staged rescue scenarios. Having the right equipment alone is simply not enough if you're going to give yourselves a fighting chance of a successful rescue. Having the right equipment and these skills honed gives us an important margin of safety in the mountains.