Evidence supporting the efficacy of Avalanche Airbags and the development of the remote Airbag Activation on Snowmobiles

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Evidence supporting the efficacy of the Avalanche Airbag
This paper will look at the efficacy and limitations of the Avalanche Airbag for Backcountry skier, Freerider and Snowmobiler using current statistics and selected analyses of avalanche accidents in winter 2012/2013. The primary subject of this examination will be the burial area and behaviour of the individuals involved in order to give recommendations to prevent errors using the Avalanche Airbag.

Developments in the remote Airbag Activation for snowmobilers
Snowmobilers top the statistics of lethal avalanche accidents in the USA based on an annual average every year until 2009/2010. From 2010/2011 snowmobilers are clearly overrepresented with approximately 1/3 of all lethal avalanche accidents. From winter 2013/2014 they can activate their ABS-Airbag via Remote Activation on their snowmobile.

KEYWORDS: Avalanche Airbag, Effectiveness, Snowmobile, Remote Activation, Wireless Activation, Rate of Burial, Rate of Survival

Evidence on the efficacy of the Avalanche airbag

1  INTRODUCTION

Theo Meiners described in his 2012 article the poor chances of skier to escape a slab avalanche.

The escape off the slab, grab a tree, dig into the bed surface, fight back on top of the debris and try to protect mouth and nose and creating an air pocket seem to be the only realistic options. In an interview, the author expressed the following opinion: The most important thing is not to get buried.

The most promising concepts on the prevention of avalanches are currently based on the increased and successful efforts of public avalanche warning services, intensive and continuous education, the use of rule-based behavioural patterns, respect for potential avalanche areas and times/phases and the successful use of avalanche airbags and emergency equipment (Avalanche Transceiver, probe and shovel) and a little luck.

The decisive functions of avalanche airbags – supporting segregation and preventing sinking – have been theoretically and practically investigated and proven, as has been the prevention of sinking into an avalanche by an activated airbag has.

The SLF statistics (Figure 8) supports the theory that a in-time activation of the avalanche airbag prevents injury in the head and spine area and victims have a 97% chance of survival.

Experts have held that the efficacy of activated avalanche airbags may be doubted where the avalanche enters areas with a large number of obstacles. These may be justified in individual cases, whereas in most cases the injury patterns observed when an avalanche airbag was activated in an area with a large number of obstacles (rocks, trees) were minor. We can therefore assume that there is a major difference in the effect of the avalanche on injury patterns between a situation where a person IN the avalanche snow is being pushed against an obstacle with a velocity v[x] and a situation where a person is being transported ON the snow, thereby coming into contact with an obstacle and being pushed further it. While in the first situation the impetus of the packet of snow is being increased this effect of the snow is missing. In addition there is a possibility of escape. In the first case the forces at work are much stronger. An activated avalanche airbag can with a high probability prevent burial and injury, also in areas with a large number of obstacles

Case 4 shows the advantages of ABS-Airbag-Use in areas with a large number of obstacles.

A final evaluation of airbags in areas with a large number of obstacles is not possible, as there are not enough examples and evidence from the field. For a further reliable and extensive evaluation of the effect of avalanche airbags information from
the field is required. For information on avalanche airbags, comments and feedback please contact info@abs-airbag.com

2 AVALANCHE ACCIDENT STATISTICS

Every winter approx. 140 persons are killed in avalanche accidents worldwide. In the winter of 2009/2010 more than 244 persons died in avalanche accidents. Victims of catastrophes were not included.

The number of lethal avalanche accidents is stagnating. This positive development is mainly the result of intensive education work by associations, the sensitization of target groups, the improvement of public information and -warning institutions and the increased use of avalanche airbags.

3 ROAD ACCIDENT STATISTICS

Taking a look at the EU road safety statistics shows its success in improving road safety by safety promoting measures such as speed limits, intensifying controls, information and improved driving training, especially for younger drivers, as well as improvements of automobile engineering

In the USA the efforts to increase road safety by conducting more controls and improving automobile engineering has also resulted in a considerable decrease of fatal accidents, considering the developments of 1965 and 2009.

4 SUCCESSFUL USE OF ABS AVALANCHE AIRBAG

The most recent examination of avalanche accidents WITH and WITHOUT avalanche airbags show considerable success.
Brugger-Falk and Brugger-Etter-Zweifel (2007) show, “that avalanche airbags and beacons can significantly decrease the mortality rate.”

The study is based on a total of avalanche accidents with 1,504 persons. (Switzerland: 1990 – 2004, n= 1,296; Austria: 1998 – 2005, n= 208).

1,469 persons WITHOUT avalanche airbag were involved in avalanche accidents. 500 persons completely buried (=34%) and 18.9% dead.

35 persons WITH avalanche airbag were involved in avalanche accidents. 6 persons completely buried (=17%) and 2.9% dead.

5 RESULTS SLF-STUDY, DAVOS; 2010

The study is based on 249 documented accidents with 295 persons getting caught in an avalanche and shows the positive correlation between not getting buried and the survival rate.

Burial rate WITH ABS Airbag
262 persons WITH an inflated ABS Airbag were involved in avalanche accidents. 240 persons (=97%) remained on the surface or the airbag was visible. 7 persons (=3%) were completely buried albeit wearing an avalanche airbag.
Survival rate WITHOUT ABS-Airbag
Of 67 persons WITHOUT ABS-Airbag (same accidents/same area) 50 persons (= 75%) survived and 17 persons (= 25%) did not survive.

Rate of survival WITHOUT ABS-Airbag; sample: 67 persons
- survived: 50 persons (= 75%)
- dead: 17 persons (= 25%)

Figure 9: Survival rate WITHOUT avalanche airbag

LIMITATIONS OF AVALANCHE AIRBAGS
295 persons were involved in 249 documented accidents.

In 24 cases of the 295 persons involved the cause was human failure, in 8 cases the reason was technical failure.

Limits - Avalanche Airbags: human (24) or technical (8) failure
- Airbag not activated: 4
- Airbag ripped off: 2
- Airbag activated partially: 2
- No activation intentionally: 2
- Mental, physiological or mechanical reason: 18
- Missing cylinder or handle: 4

Figure 10: Limitation of Avalanche Airbags

Human failure (24 cases)
In 4 cases the gas cylinder or the trigger handle was missing; in 18 cases the airbag could not be activated for mental, physiological or mechanical reasons and in 2 cases was consciously not activated.

Technical failure (8 cases)
In 4 cases the airbag was not filled, in 2 cases it was only partly filled and in another 2 cases the airbag was being torn off.

Regarding the use of avalanche airbags human failure (24 cases) outweighs technical failure (8 cases) by far.

The limits in the use of airbags are approached in areas such as cliffs and very deep burials and also in situations where the skier is not transported (i.e. effect of roof avalanche).

CASE ANALYSIS, WINTER 2012-2013

Case 1
Zischges – 3.004m (Austria, Central-Alps, Group: Sellrain)
The Zischges Tour is a very popular and frequently taken tour in the area around Innsbruck. On December 29, 2012 an avalanche accident with at least 4 persons involved took place there.

Result:
- 1 person without avalanche airbag: 30 minutes completely buried and dead.
- 1 person survived – escaped.

Conditions
Avalanche report: CONSIDERABLE (3) for December 26 until 30, 2012
Aspect: North-East
Slope angle: 36°
Size of avalanche: width: 100m; length: 300m; Crown at 2.740; the end is at 2260;

Analysis
The high number of visitors (30 – 80 persons a day) suggests an unsubstantiated sense of security, especially at the beginning of the season or after snowfall and at the same time prevents a structured and security oriented approach to ascent and descent.

Often numerous persons are in an area at the same time, which require structured and adapted behaviour and actions. The large number of visitors leads to displacement effects and individual skiers get to more dangerous parts of the slope, searching for independent tracks.

The large number of skiers on the same parts of the slope results in skiing inappropriate parts of the slope – apart from the higher additional weight.

Tours that attract a large number of visitors are usually safe – because hundreds of tourist skie and compress the slopes. In early winter and right after storms there is almost no difference compared to areas less travelled. These routes require exactly the same safety procedures and the same emergency equipment with ABS-Airbag, Avalanche Transceivers, probes and shovels as “normal” ski tours.
Case 2
Mosermandl – 2.680m; Jakoberkar, Austria, Central-Alps, Group: Niedere Tauern

On March 28, 2013 an avalanche accident took place with 3 persons involved in the descent from the Mosermandl to South East. The upper layers of the snow slab consisted of dry snow; the lower layers consisted of wet snow.

Result
1 person survived with inflated ABS-Airbag.
1 person (without airbag) died.
1 person (without airbag) completely buried but survived injured.

Conditions:
Avalanche report: LOW (1), excellent conditions in the morning and instructions that the avalanche risk would rise with the warming during the day to MODERATE (2)
Aspect: South-South-East
Slope angle: approx. 41°  degree
Size of Avalanche: width 50 up to 300m; length: 600m
Crown at 2.500m
Begin of descent: 1.30PM
Avalanche run: smooth largely free of obstacles and without obvious deposit areas.
Other: Skied one by one

The 3 backcountry skier were together more than 200 years young and have more than 140 years of experience in extreme mountaineering. Each of the 3 persons owns an Airbag pack. Only one person brought the Airbag along on this day. This person enters the slope last and releases the slab avalanche, can activate the airbag and survives the incident without burial and injuries.

The skier in the middle is getting caught by the snow slab and being buried 75 cm. A tiny airway saves his life. The third skier is also getting caught, being buried and fatally injured.

Analysis
The early descent is essential for this tour. The south-south-east aspect and the slope angle with 41° degree and the season considerably progressed result in a quick softening of the upper snow layers. Even more than 140 successful years of experience in extreme mountaineering still requires an early descent ahead of the softening phase.

The positive effect of the ABS-Airbag in comparison to self-rescue shows in a direct comparison: one person with airbag – not buried and not injured – survived, one person without airbag – completely buried and located and rescued by Ski Patroller, one person without avalanche airbag completely buried and dead.

Case 3
Glöcknerin - 2.433m; Felseralm
Austria, Central Alps, Group: Niedere Tauern

2 backcountry skier intend ascent of „Glöcknerin“ on March 5, 2013. During the ascent the two release a slab avalanche at approx. 1.750m in an area with light forest. Both are getting caught by the avalanche.

Result
1 person mostly buried – dead (head injuries - tree)
1 person survived – not buried.

Conditions
Avalanche report: MODERATE (2);
Aspect: North West
Slope angle: 27° degree
Size: width approx. 50m; length approx. 200m
Height: approx. 1.750m
Other: extreme strong wind (south) with widely and heavily wind loaded snow pack.

Both skier own airbags since more than 10 years – but never activated/ tested their airbags.

Analysis
The sparsely-wooded larch forest, the low angle and the close proximity to the near-by ski-area suggests relative and deceptive safety.

The avalanche hit both skiers completely unprepared: „We never thought this is a place for an avalanche and we never thought about activating the airbag“.

The mental training with the option of triggering an avalanche and with anticipated patterns of behaviour provides the decisive asset in case of an avalanche.

The activation of the avalanche airbag should be tested and trained before season starts.

Even during walks or while skiing it would be more than appropriate to catch the handle and realize and learn the position of this handle.

The activation of Airbags may even provide better results in unfavourable terrain like wood or Avalanche runs with rocks.

The skier will be transported on top of the debris with reasonable likelihood and the impact on the obstacle will probably be reduced compared to the impact when the skier is transported IN the depth of the debris.
The specific design of the ABS double airbags performs protection of head and cervical spine; both of the lateral fixed airbags provide effective impact protection.

Function and effectiveness of single head airbags can not be evaluated because of the lack of data.

Case 4
Scheblingskogel – 2.289m (Austria, Northern Alps, Group: Tennengebirge)

On March 5, 2013 two backcountry skier went up „Wies“, direction to Scheblingskogel and triggered a small slab avalanche.

Result
1 person without avalanche Airbag completely buried and killed; debris stowed on big rock up to 100cm. Fatality was located and excavated after 15 minutes – not alive.
1 Person with activated ABS Airbag is transported on top of the avalanche onto a tree, carried past this tree and survived with some minor injuries.

Conditions
Avalanche report: MODERATE (2);
Aspect: NE; sharp terrain edge
Slope angle: >35° degree
Size: width appr. 40m, length approx. 60m;
crown: 50cm
Height: approx. 1.700m;
Other: Extreme wind (south); gusts: 100 up to 120 km/h with widely and sensitive, wind loaded snow pack

Analysis
Both skier are caught and transported for <50m. The deposit terrain is unfavourable (trees and rock).
This short distance is long enough to activate and inflate the airbag. Also segregation of the avalanche debris worked.
The skier with the inflated airbag is transported on top of the debris, pushed onto the tree and transported past this tree. He survived!
The surviving skier was injured on leg and arms; however he got NO head or cervical spine injuries!

Design and placement of both airbags are protecting head and cervical spine even in unfavourable burial terrain.

The second person, caught without avalanche airbag was transported IN the debris, pushed and buried on a big rock. He got totally buried (100cm) und got killed.

The surviving user of the airbag points to the high importance of using the hip belt and the leg loops.
Hip belt and leg loops should be closed while ascending and descending.

8 DEVELOPMENT OF AIRBAG-ACTIVATION FOR SNOWMOBILES

Avalanche Fatalities statistics for USA shows a strong rising curve until 2009/ 10. The actual statistic shows a nice decrease of fatalities.

Figure 11: Avalanche Fatalities USA, CAIC
Snowmobilers are leading statistics of fatalities until 2009/ 2010. Starting in 2010/ 11 Snowmobiler are still overrepresented with a third of fatalities.

Figure12: Comparison of fatalities (Snowmobiler vs. Skier; USA)

For Backcountry Skier, Mountain Guides, Skipatroller, Freerider and worker in avalanche prone areas the ABS Wireless Activation Unit is available right now. This Wireless Activation Unit activates ABS-Airbags remote controlled, even at distances of some hundred meters.
Three configurations are provided:
A) Group leader activates every Airbag.
B) Every group member activates his/ her Airbag ONLY.
C) Group leader activates specific Airbags ONLY (only airbag of skier on the slope is activated).

New for Snowmobiles starting in winter 2013/2014

Snowmobiler are able to activate their Airbag by pushing the Activation button on the handle bar of the Snowmobile.
Many of the rider are equipped with the Avalanche Airbag.
If a snowmobiler triggers a slab avalanche the escape ride might be an option. Nevertheless it needs to be possible to activate the Airbag and still keep both hands on the handle bar.

The new remote controlled trigger for Snowmobiles is the most innovative solution right now.
The remote controlled trigger is packed in a bomb-proof box (battery powered, size: 100 x 60 x 40mm; 150 Grams).

The remote controlled trigger for Airbags is one more safety feature which makes snowmobiling safer.
The rider is able to keep control of his snowmobile while trying to escape and simultaneously is able to inflate the Airbags.

If the escape ride is not successful, the rider may be dropped off the snowmobile while he is still in the fast flowing part of the avalanche. To catch the release trigger would mostly be impossible or at least very difficult.

Survival chances of the rider are significantly higher and burial of the rider is eliminated with high likelihood.

9 CONCLUSIONS

Few realistic chances to escape and survive an avalanche are known: escape off the slab, grab a tree, dig into the bed surface, fight back on top of the debris and try to protect mouth and nose.

The most effective way to survive an avalanche is using the Avalanche Airbag.

Activated Avalanche Airbags with their specific size, number and placement including the specific design are able to protect against burial and injuries even in unfavourable terrain (rocks, trees) and offer better survival chances.
New for Snowmobiles starting in winter 2013/2014

Snowmobilers are now able to activate their Airbag by pushing the Activation button on the handle bar of the Snowmobile. Many of the riders are equipped with the Avalanche Airbag. If a snowmobiler triggers a slab avalanche the escape ride might be an option. Nevertheless it needs to be possible to activate the Airbag and still keep both hands on the handle bar.

Reducing mortality rate in avalanche accidents needs to increase education for backcountry skier, freerider and snowmobiler. Also it needs to use Avalanche Airbags as standard equipment.

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