KLINIK LINDENPLATZ

Protective Effect of Hip and Back Protectors in Alpine Winter Sports

Keywords: alpine skiing, protecting style, joint complaints, osteoarthritis, orthopaedics, biomechanics

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Introduction

At overall declining injury rates in alpine winter sports, traumatic brain injuries, spinal cord injuries and poly traumata have increased (Knöringer 2013). After wearing of helmets has become normality, now back and hip protectors especially for younger skiers and snowboarders becoming increasingly widespread. But also for the growing group of older skiers protectors appear sensible to reduce the risk of injury from falls in relation to the age-related reduced bone density. Studies show that force which leads to a pelvic or hip fracture is between 3.6kN and 8kN (Etheridge at al., 2005, Song et al., 2006). Tests have shown protective effects similar to wearing a backpack (Knöringer 2013). Therefore the protective effect of available hip and back protectors regarding force reduction and delay of impact energy should be examined.

Methods

For this purpose, 4 hip (7-13mm, soft-shell, 2 cert. EN 1621/1) and 8 back (15-29mm, 3 hard-shell, 5 soft-shell, EN 1621/2) protectors for winter sports were analysed by an impact test. Therefore a bowl (Ø17cm, 31N) was dropped from heights of 25, 45, 65, 80 and 100cm (H25-H100), 3 times each with different impact points on the protectors placed on a force plate (Kistler, range 20kN, frequency 20kHz, and time 2s, temp. 20°).

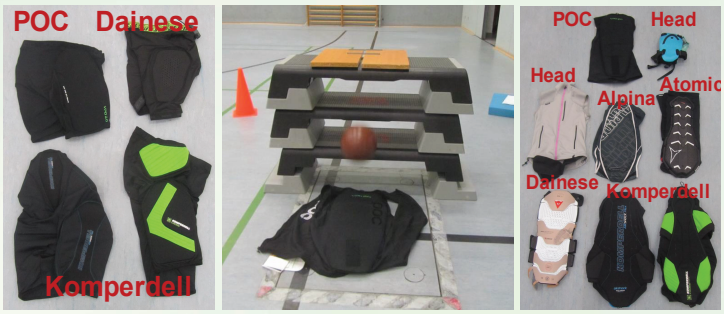

Fig. 1: proved hip- (left) and backprotectors (right), measurement setup (middle; H65)

Results

At bowl impact on force plate without protector force peaks and delays of 9.2kN/1.38ms (H25) and 17.4kN/1.25ms (H45) inside measurement range were measured. At back protectors tested, maximum impact forces at different drop heights were reduced on average to 2.0kN (H25) resp. to 7.1kN (H100) and showed a large scatter range between protectors (H25: 1.5-2.5kN; H100: 5.1-9.8kN). 1 hard-shell protector exceeded EN 1621/2 (H100: 9.8kN). The delay of the impact energy ranged from 9.3ms (H25: 4.5-16.9ms) to 5.8ms (H100: 2.8-8.7ms). Averaged results were protector type independent. At hip protectors tested, maximum impact forces were reduced to 4.2kN (H25) resp. to 14.7kN (H100), 1 inside EN 1621/2, 1 exceeding EN1621/1, and showed a large scatter range between protectors (H25: 3.1-6.0kN; H100: 8.2-22.1kN). The delay of impact energy ranged from 4.2ms (H25: 1.7-6.9ms) to 2.8ms (H100: 2.1-3.6ms).

Results

Protective effect of winter sports hip protectors was significantly lower than that of recently tested orthopaedic hip protectors (H25: 1,9kN; H100cm: 9,6kN).

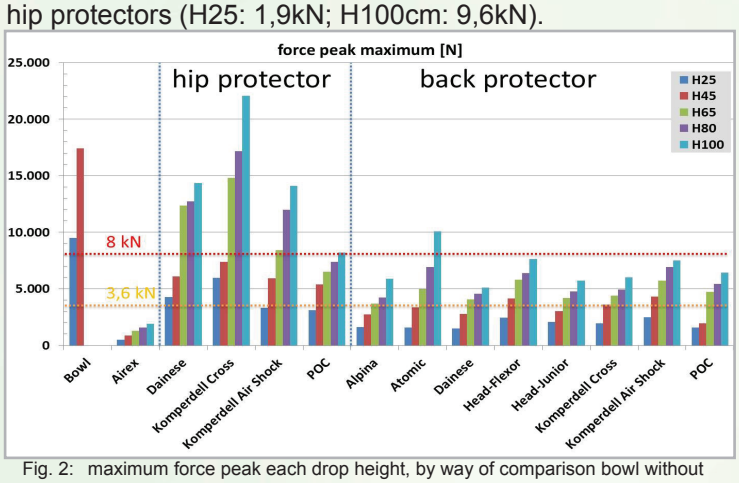

Fig. 2: maximum force peak each drop height, by way of comparison bowl without protector left (just H25/H45) plus Airex-pad

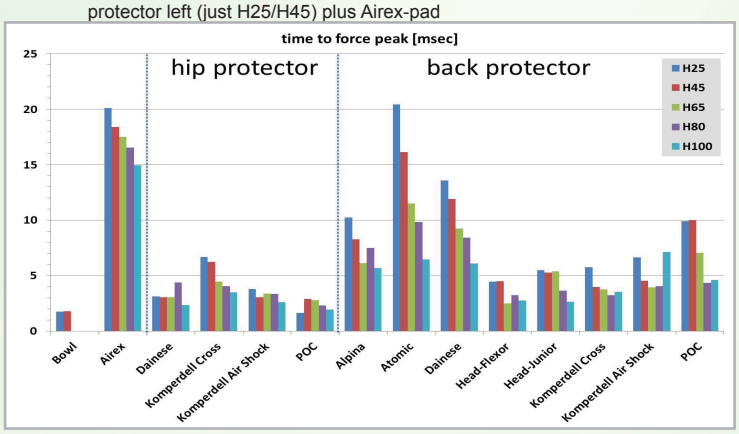

Fig. 3: deceleration from ground contact to force peak [ms] each drop height, by way of comparison bowl without protector left (just H25/H45) plus Airex-pad

Discussion and Conclusion

Back and hip protectors can reduce higher force actions from impacts and falls distinctly and are recommended as additive safety component. But remaining forces on hard impacts often and quickly exceed the supposedly acceptable extent of maximum 3.6 to 8kN, so that a sufficient safety seams not yet achieved. Despite testing with a lighter bowl than in EN 1621 test, only 1 of 4 hip protectors accomplishes and 1 back protector exceeds EN 1621/2. In addition, back protectors can protect thoracic und lumbar spine only in direct contusion, but not against torsional and axial compression and not cervical spine. Most hip protectors tested provide only limited protection distinctly worse than orthopaedic protectors.

References

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