Effectiveness and Safety of Immobilisation in Mountain Rescue: Research on rescue in difficult terrain with biomechanical sensor technology

Richard F. Kraus[1,3], Maximilian L. Knipfer[1], Matthias Jacob[3,5], Baerbel Kieninger[4], Jasmine Alikhani[4], Parham Heydarzadeh Ghamsary[4], Lukas Reinker[2], Ina Adler[2], Sebastian Dendorfer[2], Martin Kieninger[1]

BACKGROUND

Even though injuries to the cervical spine are not the most common in alpine sports, these cases require, due to possible secondary damage caused by transportation, immediate prehospital care at the accident site by means of immobilization techniques. Using special sensor technology, our study investigated whether a cervical spine orthosis (cervical collar, Stifneck collar (Laerdal Medical GmbH, Puchheim, Germany)) provides additional benefits for stabilization compared to a vacuum mattress.

Methods

We simulated a transport of a spinal injured patient in steep alpine terrain. To document the movements of the cervical spine, a wireless motion capture system (Xsens Technologies, Movella™ Inc., Henderson, USA, Figure 1) was used to record motion in three-dimensional space within a standardized environment. Immobilization was performed by applying cervical spine collar on the one and sole vacuum mattress technique on the other hand by trained mountain rescuers of the Bavarian Mountain Rescue Service. All tests were performed on the set course, starting with the test subject lying on the mountain rescue stretcher and immobilized as follows: rescue vacuum mattress with/without rigid cervical collar (Figure 2). Thereby, the axes of movement of the cervical spine were analyzed individually.

Results

There were no significant differences between immobilization with and without cervical orthosis with regard to lateral flexion (max. 3.7° compared to 3.0°) in the frontal plane and maximum excursion in flexion (max. 1.6° compared to 2.8°) or extension (max. -1.6° compared to -1.7°). Examining the rotation around the craniocaudal axis, it was observed that significantly greater movements occurred without a cervical spine orthosis (max. 2.4° compared to 1.3°).

Conclusion

Immobilization of the cervical spine can be achieved without the use of rigid cervical spine orthoses under difficult challenges of mountain rescue environment. Future research should explore the fundamental benefits of cervical spine immobilization, while the findings of this work contribute to safe patient care by avoiding the disadvantages associated with rigid cervical orthoses.

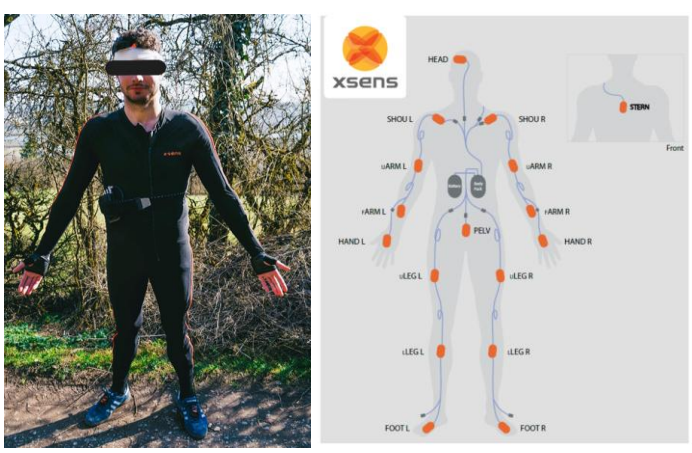

Figure 1: Test person with Xsens motion capture system.

Figure 2: Transportation of the test person

[1]Department of Anaesthesiology, University Hospital Regensburg
[2]Laboratory for Biomechanics, Ostbayerische Technische Hochschule (OTH) Regensburg,
[3] Bavarian Mountain Rescue Service
[4]Department of Infection Prevention and Infectious Diseases, University Hospital Regensburg,
[5]Department of Anaesthesiology, Barmherzige Brüder St.-Elisabeth-Hospital Straubing