FREE PAPER 9

Wheelchair Integrated Occupant Restraint System for Custom Contoured Seating

Presenter: Paul Harrington

Summary
Specialist seating systems are designed and built for posture control, often with little or no consideration to transportation issues, leaving patients dangerously at risk when in transportation. Two types of wheelchair integrated occupant restraint systems, specially designed for custom contoured seating, will be compared.

Aims and Objectives

- Research current practices
- Highlight known limitations in provision and use of equipment
- Define constraints to providing the ideal solution
- Two configurations of integrated occupant restraint systems will be compared by sled tests of custom contoured seating systems attached to a surrogate wheelchair
- Recommendations will be made as to future direction of development of transportation safety equipment for the specialist seating market

Background

Currently there is no agreed protocol for allowing patients issued with specialist seating systems to travel as safely as able bodied passengers.

Although there are a number of International Organization for Standardisation (ISO) standards relating to wheelchairs in transportation, these are market driven, voluntary guidelines and, as such, there is no legally binding statute. This means that people are being transported in many different ways, not always safely.

By following the standards it is possible to improve safety for wheelchair users. ISO 7176-19 sets design and performance requirements as well as test procedures for wheelchairs with seating systems intended to be used as a seat during vehicle transport; whereas ISO 16840-4 is concerned only with the seating system.

The design and performance requirements in these standards include the provision of at least a two point-pelvic and wheelchair integrated occupant restraint, combined with vehicle mounted upper torso restraint.

The main aim of the specially contoured seating is to accommodate and correct severe and complex postural deformities. Therefore the aims of the resulting structure are often at odds with the ability to provide occupant restraints that cross over bony landmarks and avoid soft tissues.

A further constraint is that carers, parents and those working for the transport companies have limited time to provide correct set up of occupant restraint equipment. Furthermore there is often limited appreciation of the consequences of incorrect use of occupant restraint equipment.

Posture belts are frequently fitted to the seating system. These belts cross over bony prominences and are designed into the seating system during manufacture. However they are not designed to offer security in a crash situation. Furthermore they are

specifically designed to break away so that they do not interfere with the functioning of the transport belts.

As the transport belt will only be used on an ad-hoc basis it is inconvenient to use large, metal, crash tested buckling on a day to day basis for the purpose of postural restraints. For one thing this would increase the likelihood of skin irritation and pressure sores.

A possible solution is to mechanically link sections of the vehicle safety restraints with the postural belts so that they provide a safety restraint without compromising the structure of the seat. An added bonus would be to allow the buckling to be interchangeable to suit the function as required.

Method
Limitations in current practices by transport companies and carers of patients with special seating systems have been recorded.

The constraints imposed by the intended purpose of the wheelchair seating that is provided have been considered.

Configurations of wheelchair integrated occupant restraint systems are being developed for special contoured seating systems.

Two sled tests have been organised for March 2012, where the configurations will be compared.

Results
The kinematic and video data from the sled tests will be analysed and included in a report to be submitted by the beginning of April 2012. This is part of the requirements of the Diploma in Rehabilitation Engineering through Coventry University.

Discussion
Research conducted into the current limitations of provision and use of adequate transport safety equipment highlights the need for further understanding of this issue. With consideration to the known constraints, 2 configurations of wheelchair integrated occupant restraint systems have been developed. Although the tests have yet to be completed, the kinematic and video results should give a better understanding as to the direction that future research and development should take.

References
ISO 7176-19:2008 *Wheelchairs - Part 19: Wheeled mobility devices for use as seats in motor vehicles*. Geneva, Switzerland: International Organisation for Standardisation
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Correspondence details
Paul Harrington
Oxford Centre for Enablement
Tebbit Centre
Windmill Road
Headington
Oxford, OX3 7LD

Email: paul.harrington@hotmail.co.uk