TILT-IN-SPACE WHEELCHAIRS: PRESSURE MANAGEMENT FOR PERSONS WITH SPINAL CORD INJURY

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Spinal cord injury (SCI) is a traumatic event that can compromise function, role performance and meaningful activity and often results in a dependence on others for many daily activities. SCI occurs when lesions to the spinal cord impair the conduction of sensory and motor signals resulting in functional impairment. A complete injury is the most severe type and describes as absence of both sensory and motor function in the lowest sacral segment1. In an incomplete injury, there is partial preservation of sensory and/or motor function below the level of injury and the lowest sacral segment².

Pressure ulcers are a common problem for persons with spinal cord injury (SCI) due to long periods of immobilization. A pressure ulcer is a “localized injury to the skin and/or underlying tissue over a bony prominence, as a result of pressure, or pressure in combination with shear and/or friction”³. The development of pressure ulcers is typically avoided due to frequent position changes that normal, healthy individuals instinctively engage in throughout the day. The ability to weight shift and change positions for pressure management may be difficult or impossible for persons with spinal cord injury (SCI) to engage in, due to sensory and motor deficits⁴. Muscle atrophy and loss of body tissue associated with SCI also increase susceptibility to pressure ulcer development⁵.

The primary factor contributing to pressure ulcer development is interface pressure resulting from the load of the body against a support surface⁶. The ischial tuberosities are regions of focal contact with the supporting surface, and are the most susceptible areas for the development of pressure ulcers’. Prolonged pressure applied on soft tissue results in capillary occlusion, depriving surrounding tissues of oxygen and nutrients⁷. Higher pressure increases the risk of a pressure ulcer developing. Landis (1930) identified 32 mmHg as the average intracapillary pressure, suggesting that external pressure above this level would result in capillary occlusion⁸. Keeping interface pressures below this threshold is impossible in a seated position. The literature also identifies an inverse relationship between this magnitude of pressure and the length of time before development of a pressure ulcer⁹,¹⁰. Strategies clinicians use to prevent the development of pressure ulcers include both to reducing the pressure magnitude and reducing the amount of time that pressure is exerted on tissues.

Tilt-in-space (TIS) wheelchairs are sometimes prescribed for individuals at high risk for pressure ulcers (e.g., SCI) as a pressure-management strategy. TIS wheelchairs reduce pressure on the ischial tuberosities by tilting the user back in space and redistributing to other areas. Based on the research indicating that decreasing pressure increases the time before tissue breakdown, TIS wheelchairs may allow individuals with SCI to remain in their wheelchairs longer enabling them to engage in meaningful and fulfilling activities.

Current Study

Recruitment and study criteria

Eighteen individuals with SCI were recruited for this study. Two strategies were used to recruit participants: (a) advertisement posters and (b) database search through the outpatient spinal cord injury clinic at the Health Sciences Centre in Winnipeg. Individuals were eligible to participate in this study if they: (a) had a complete spinal cord injury or ASIA ‘A’ or ASIA ‘B’ classification, (b) were between the ages of 18-65, (c) currently used a wheelchair no wider than 18 inches, and (d) had no current pressure ulcers.
Equipment and Procedures

A Quickie Iris TIS wheelchair with an 18" seat width was used. A Jay J2 pressure-reducing wheelchair cushion was used on the TIS wheelchair. Data collection occurred using the Force Sensitive Application (FSA) pressure mapping system. The FSA consists of a thin pressure sensitive mat, which is placed between the individual and the support surface and is connected to an interface module. The mat has 256 sensors arranged in an array. The FSA was calibrated using an automatic method at the beginning of the data collection process. The FSA was calibrated to allow up to 300 mmHg of pressure.

An overhead lift and sling was available to transfer participants from their own wheelchair to the TIS wheelchair. Once the participant transferred into the study wheelchair, the investigators waited approximately eight minutes before taking a pressure reading to accommodate for errors of creep during initial settling of the cushion and pressure mapping equipment. A 10 second reading with the FSA was then taken. The participant was then tilted backward 10°, using an inclinometer for confirmation. After one minute, another 10 second reading was taken with the FSA. This process was repeated until the participant has reached 50° of tilt, after which time the TIS wheelchair was slowly returned to the upright position. The entire process took between 20-45 minutes.

Purpose

Previous studies investigating the relationship between tilt and interface pressure examined between one and three different tilt positions. The current study systematically examined the relationship between tilt and interface pressure at six different tilt positions (0-50°). Horsman, Kendzierski and Giesbrecht conducted an unpublished pilot study using healthy non-wheelchair users. However, persons with SCI may respond differently due to physical and sensory changes resulting from their injury and consequently, there is a need for evidence of the relative effectiveness of TIS in reducing pressure at the pelvis for this population. This evidence can then be used to inform best practice among clinicians when they make recommendations regarding wheelchair prescription for persons with SCI.

Objectives of presentation

1. The participant will be able to discuss the relative benefit of pressure reduction between successive tilt positions.
2. The participant will be able to discuss the benefits vs. limitations of using tilt as a pressure relieving strategy.
3. The participant will be aware of the differences between conducting research using individuals with SCI and individuals with no SCI. Participants will be able to use this information when conducting future studies using participants with SCI.

Discussion

Effectiveness of tilt in reducing pressure

Pressure reduction patterns were similar to that of the pilot study. The findings indicate that 10° and 20° of tilt are insufficient to offer substantial pressure reduction. Pressure reduction becomes considerable at 30° of tilt and becomes increasingly greater at each subsequent 10° increment. It is important to consider the functional limitations associated with greater tilt angles. Clinicians should be aware of these functional limitations and weight out the benefits/costs of using tilt when making recommendations.

Differences using tilt with SCI vs. healthy participants
Maximum pressure values tend to be significantly higher for participants with SCI vs. healthy participants. Higher maximum pressure values occur under the ischial tuberosities due to muscle atrophy resulting in less padding for bony prominences. In order to accommodate for these differences, the pressure mapping system in the current study was calibrated to allow for 300 mmHg of pressure compared to 200 mmHg used in the previous study. Several participants in the current study did exceed a maximum pressure value of 200 mmHg beneath the ischial tuberosities. Preliminary evidence suggests that there may be a greater overall reduction of pressure from 0° to 50° of tilt in participants with SCI vs. healthy participants.

TIS wheelchairs offer individuals with SCI additional benefits and advantages for postural support and positioning. It was noted in the study using individuals with SCI that several participants were unable to sit with the chair between 0° and 10° of tilt due to limited postural control. These finding indicate that TIS is not only beneficial for pressure reduction, but also accommodates for diminished truck control by providing postural support, which allows individuals with SCI independence to interact in their surrounding environment in their wheelchair.

Recruitment challenges

Recruitment of 20 participants in the previous study was successful and achieved more quickly than the present study. In the current study, recruitment challenges were encountered due to greater difficulties contacting potential participants, difficulty finding individuals that fit the study criteria, transportation issues, difficulty finding individuals who were interested and available, and health concerns associated with their compromised nervous system.

Conclusion

This study provides evidence to suggest that at least 30° of tilt is required to be of value as a pressure ulcer prevention strategy. Clinicians need to be aware of costs/benefits of using larger angles of tilt when making recommendations to clients. TIS wheelchairs may allow individuals with SCI to lead more independent and fulfilling lives through managing pressure and providing support. The recruitment challenges encountered in this study can provide valuable information for researchers conducting future studies with participations with SCI.

References


**Speaker Bio**

Haley Tencha is a recent graduate of the Master's of Occupational Therapy program at the University of Manitoba. Through the Occupational Therapy program Ms. Tencha has developed a strong interest in seating and mobility and the link to Occupational Therapy practice. Ms. Tencha is currently working as an Occupational Therapist at St. Boniface Hospital in Winnipeg in acute care medicine and is a member of the St. Boniface seating committee.

Stephanie Lacasse graduated from the Occupational Therapy program at University of Manitoba, completing her studies in summer of 2009. She is currently working at Riverview Health Centre in Winnipeg on the traumatic brain injury unit. Ms Lacasse is a member of the dysphagia team at Riverview Health Centre, and has a strong interest in seating and positioning.