Can ISO 16840 Testing Inform About Evidence-Based Wheelchair Cushion Selection?

Nienke Conijn, Vicair BV

Summary

This study leverages ISO 16840 tests to transform wheelchair cushion selection into an evidence-based process. By objectively assessing cushions for immersion, stability, pressure mapping, and other metrics, clinicians can better align choices with individual user needs. Results highlight significant variation in cushion performance, enabling tailored solutions to the users' needs.

Aims and Objectives

This study aims to advance evidence-based clinical practices for wheelchair seating by incorporating ISO 16840 tests to guide cushion selection. The objective is to bridge the gap between subjective clinical assessment and objective, evidence-based evaluation to optimize user-specific outcomes. The ISO tests help to objectively identify the characteristics (like skin integrity and stability) of a wheelchair cushion and rank the degree of a characteristic. Which helps making an informed choice for the best suited wheelchair cushion for a client, based on objective data. The different characteristics/performance aspects (ISO tests) and clinical relevance of the characteristics will be explained.

Background

Wheelchair cushions are integral to seating systems, serving functions such as posture support, skin protection, and comfort (De Jonge, 2007; Brienza et al., 2010; Uehara and Larson, 2019). Historically, cushion selection has been clinician-driven, without robust evidence to validate decisions. The ISO 16840 standards now enable systematic testing of cushion characteristics (The International Organization for Stadardization (ISO), 2018). The Rehabilitation Engineering Research Center (RERC) at the University of Pittsburgh conducted these tests on approximately 50 commercially available cushions, including the Vicair Vector O2 and Vicair Adjuster, offering a foundation for evidence-based decision-making (Pittsburgh University).

Technique

Nine ISO 16840 tests were performed to evaluate cushions, each test assesses specific performance characteristics, such as:

- (Envelopment) Immersion/Loaded Contour Depth: is defined as the depth a person sinks into the cushion. A higher loaded contour depth indicates more immersion into the cushion and a better distribution of pressure on the soft tissue.
- Pressure Mapping: A test that utilizes interface pressure measurements to assess the magnitude and distribution of pressure on a loaded cushion (51kg).
- Envelopment: To evaluate a cushion’s ability to conform to the contour of the body (i.e. immerse and envelop the buttocks) for effective pressure distribution. Off-loading is measured by an envelopment pressure test and evaluates a cushion’s ability to distribute the load of the seated individual.

- Horizontal Stiffness: This test measures how resistant the cushion is to horizontal forces, which results in sliding, a need for repositioning after sliding and loss of posture.
- Lateral Stability: This test characterizes the cushion's ability to stabilize a user when leaning to the side.
- Impact Dampening: Measures how well a cushion absorbs and reduces the force from an impact, basically the amount of shock absorption.
- Hysteresis: is a measure of the energy lost to the cushion during a cycle of loading and unloading. Or it indicates how well the cushion retains its shape and provides consistent support after being loaded and unloaded.
- 10% Force Deflection: is a test to evaluate a cushion's ability to "cushion" or elastically deform by measuring the force necessary to produce a deflection of 10% of the cushion thickness.

Standards/guidelines

All tests adhered to ISO 16840 standards, ensuring reliability and consistency. Clinical relevance is emphasized through alignment with user needs: Skin protection, stability, comfort, off-loading (if necessary), a base of support to move in and out of for functional activities, and ideal seated position.

For instance, envelopment tests evaluate a cushion's ability to distribute pressure evenly, crucial for skin protection. Horizontal stiffness tests mitigate sliding, ensuring user security. Impact damping tests address shock absorption, enhancing comfort and stability during dynamic activities.

Results and Testing

Testing revealed diverse performance across cushion types: High immersion correlated with superior pressure distribution and reduced tissue stress. Cushions with high horizontal stiffness minimized sliding and postural adjustments. Superior lateral stability was demonstrated by cushions with lower tilt angles. Optimal impact damping ratios reduced force transfer, enhancing comfort. Consistent hysteresis results indicated better shape retention and durability.

The Vicair Vector O2 and Vicair Adjuster O2 cushions exhibited strong performance across multiple tests, offering balanced support for various clinical priorities.

Discussion

The integration of ISO 16840 test results into clinical decision-making enhances evidence-based practices in wheelchair seating. These tests provide objective metrics to align cushion characteristics with individual user needs, supporting optimal outcomes in posture, comfort, and functionality. Clinicians are encouraged to adopt these tools to improve care quality. Future studies should explore correlations between test metrics and long-term clinical outcomes.

Email: n.conijn@vicair.com