International Handbook of Occupational Therapy Interventions

Chapter 7
Optimal Positioning: Wheelchair Seating Comfort and Pressure Mapping

May Stinson and Shelley Crawford

> Pressure sores probably have existed since the dawn of our infirm species. They have been noted in unearthed Egyptian mummies, and scientific writings have addressed them since the early 1800s.
>
> (Revis, 2005)

Abstract Pressure ulcers remain a common problem, incurring great cost to both clients and the health care system. The predominant risk factor for pressure ulcers is interface pressure, that is, the pressure exerted between the body and the seating surface. Interface pressure can be measured by pressure mapping systems, and can assist with pressure ulcer risk assessment by identifying areas of high pressure and postural abnormalities, which both increase the risk of pressure damage. Pressure mapping systems are clinically useful for assisting with cushion selection. In the clinic, the pressure-measuring mat is placed between the client and a variety of seating surfaces in turn. The seating surfaces showing high interface pressure or poor pressure distribution are eliminated. Selection is then further refined on consideration of factors such as comfort, ease of transfers, and maintenance. Pressure mapping is also a valuable tool to guide therapists in the adjustment of complex seating systems. The color-coded pressure maps provide useful biofeedback to clients, caregivers, and health professionals on the importance of weight shifts and optimal postural alignment.

Keywords Biofeedback • Healthcare • Pressure ulcers • Technology

Definition

Pressure mapping systems measure interface pressure, that is, the pressure between the body and the seating surface. Interface pressure is the predominant risk factor associated with pressure ulcers (Geyer et al., 2001). A pressure mapping system consists of an array of pressure sensors connected via an interface module box to computer software (Fig. 7.1).

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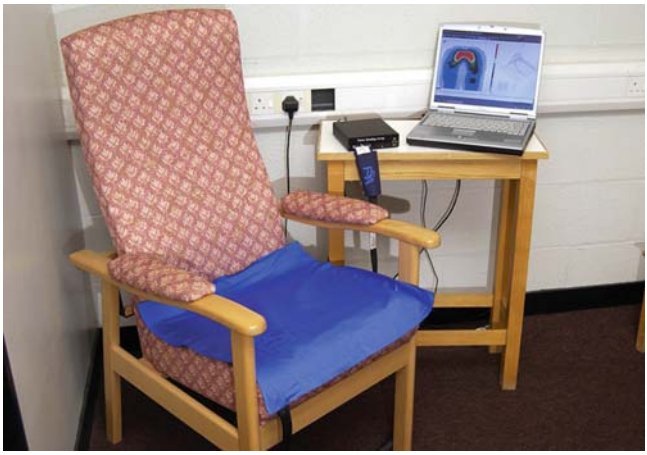

Fig. 7.1 The pressure mapping system.

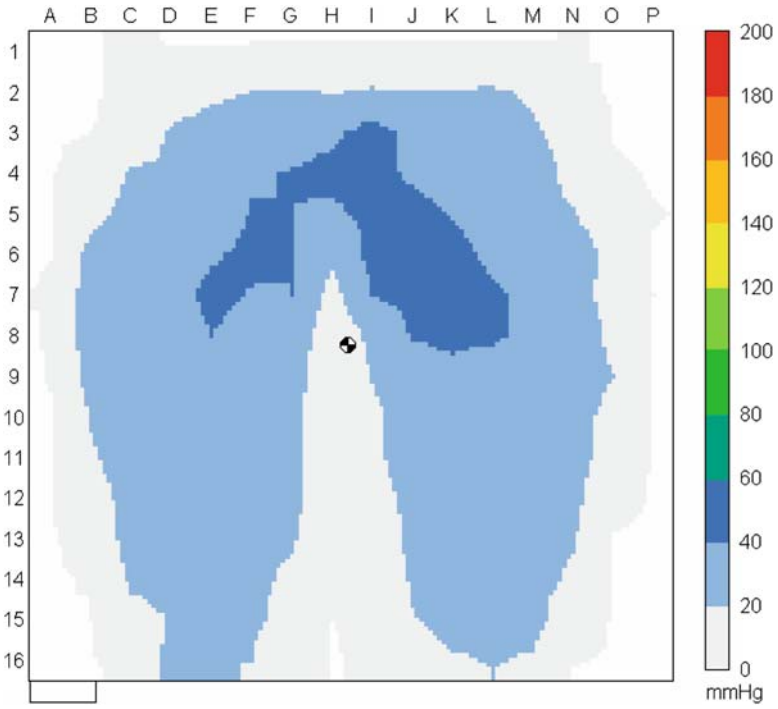

Fig. 7.2 Example of a good pressure map. There are no areas of excessively high interface pressure, and a good spread of pressure across the seating surface.

The system output is displayed numerically and visually as color-coded maps of pressure distribution. Examples are shown as "good" results, no need for interventions occur (Fig. 7.2) and "bad" results (Fig. 7.3), adaptive interventions is needed.

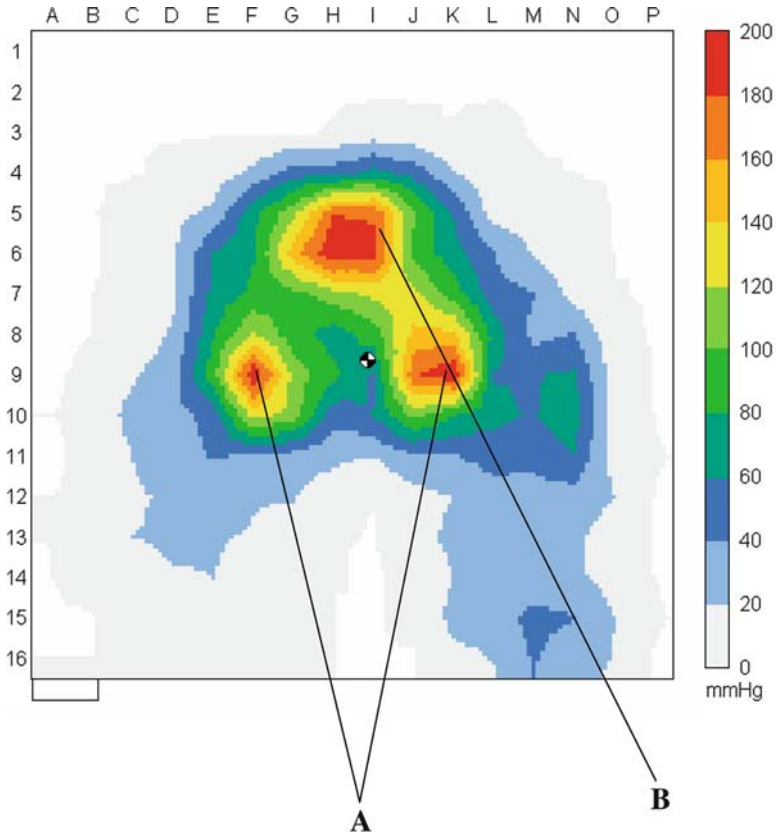

Fig. 7.3 Example of a 'poor' pressure map. There are areas of high interface pressure over the buttocks (ischial tuberosities) (A) and sacrum (B) and an uneven spread of interface pressure across the seating surface.

Pressure mapping arrays for clinical use have evolved from the early 1990s, and with advances in technology have become increasingly reliable. Designed as an objective method to measure interface pressure, they complement pen-and-paper pressure ulcer risk assessment tools, such as the Braden Scale (Bergstrom et al., 1987).

Purpose

The purpose of interface pressure mapping is to assist with the risk assessment of pressure ulcer and to educate clients, caregivers, and healthcare professionals in pressure care prevention.

Method

Candidates for Pressure Mapping

Pressure mapping can be used with children or adults at risk of pressure ulceration, particularly those with reduced mobility, poor nutrition, lack of sensation, and acute or chronic illness. Examples are people who are sitting in a wheelchair or chair for most of the daytime.

Epidemiology

Pressure ulcers remain a common problem. European prevalence rates vary from 8.3% to 22.9% (Defloor et al., 2002) and 38.1% in nursing homes (Defloor et al., 2005). The cost of pressure ulcers is immense, both to the client in terms of pain and decreased quality of life, and to health care resources in terms of financial expenditure.

Settings

Pressure mapping systems are portable and can be used in hospitals, clinics, and community settings.

The Role of the Occupational Therapist in Applying the Intervention

The role of the occupational therapist (OT) is to managing the assessment process of pressure mapping. The aim is to adapt the most appropriate wheelchair or sitting cushions and to teach clients and caregivers how to prevent pressure ulcers. This process is as follows:

- Clients are initially positioned on a firm surface, such as a mat table. This position is used for establishing a baseline of pressure distribution. Any postural abnormalities are identified.
- Clients are positioned on a selection of seating surfaces with the pressure-sensing mat placed between the buttocks and each of the surfaces in turn. Clients are requested to maintain their optimal seating position.
- The pressure maps are recorded after a consistent period of sitting time, preferably 8 minutes (Crawford et al., 2005b; Stinson et al., 2002) on each seating surface. The OT visually ranks the maps from best to worst pressure distribution. Good pressure distribution is characterized by an even spread of pressure, including

good femoral loading and no areas of excessively high pressure (Stinson et al., 2003) (Fig. 7.2).

- Bad pressure distribution (Fig. 7.3) requires inventions characterized by the selection of optimal seating surfaces from those remaining and include the consideration resulting in the client's comfort, maintenance, optimal transfers, posture, and stability (Sprigle, 2000).
- The process of testing seating positions on various surfaces (Fig. 7.4) continues until the seating surfaces showing poor pressure distribution have been eliminated.

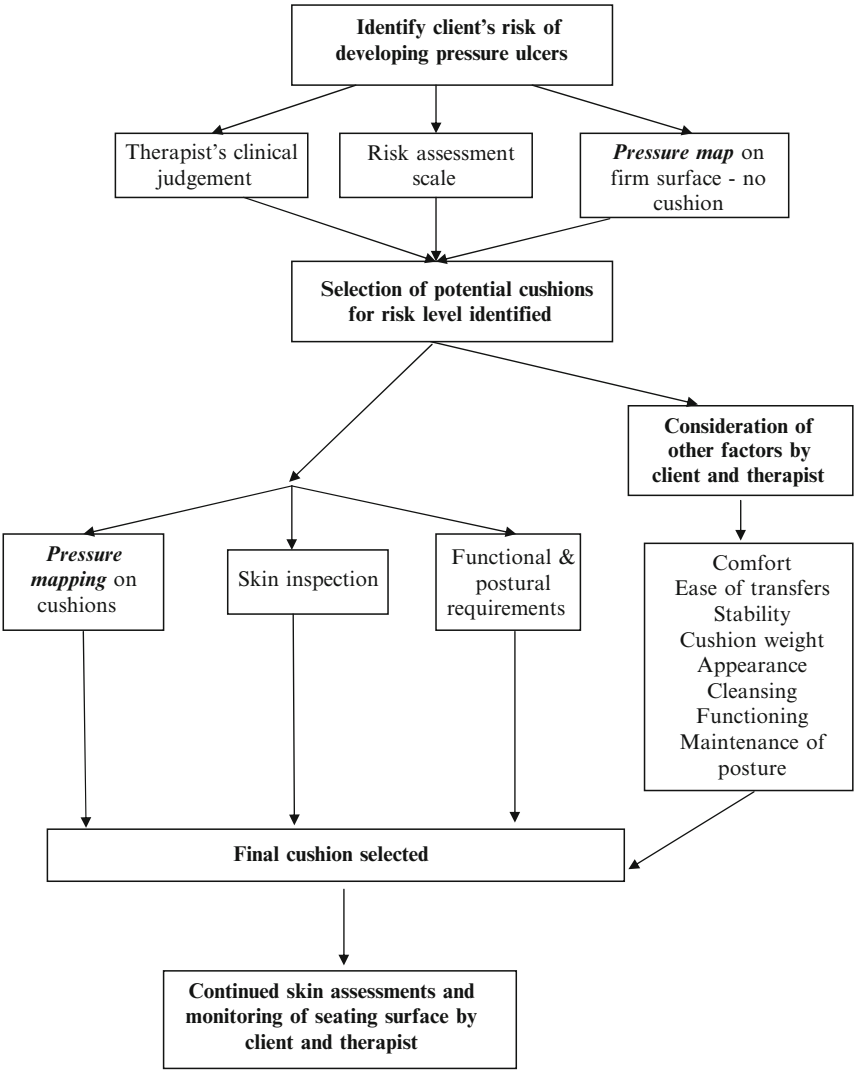

Fig. 7.4 The role of pressure mapping systems in cushion selection.

- The OT uses the results of pressure maps to educate clients, caregivers, and health professionals. This education concerns the importance of clients learning to shift weight between the buttocks, and explains what an ergonomic postural alignment entails.

Results

Clinical Application

The pressure-mapping system is used to assist clinicians and clients in eliminating unsuitable sitting surfaces aimed at preventing and healing sitting ulcers.

The results of a pressure mapping assessment demonstrate (1) sitting areas of high interface pressure, such as over the buttocks (ischial tuberosities); and (2) postural abnormalities, such as pelvic obliquity/rotation. The OT uses the results of the mapping for a comparison of seating surfaces. This procedure determines the optimal sitting surfaces for each client (Crawford et al., 2005a; Sprigle, 2000). The results are used for adapting the sitting cushions. The views of the results of the mapping system (Figs. 7.2 and 7.3) give clients, caregivers, and health professionals feedback on the differences between sitting with a risk of ulcers and sitting with the cushion and sitting position optimally adapted.

The intervention includes sessions where the clients learn the habits of optimal sitting position. The biofeedback apparatus is used by the clients for visualizing the present sitting position. Here, the OT demonstrates the benefits of shifting weight between the buttocks, and the effect of poor posture or incorrect placement of cushions. The client is informed about the importance of adjusting other components of the seating systems, such as the use or adjustment of wheelchair footplates and the use of tilt and recline functions (Stein et al., 2006). The apparatus also permits optimal cushion settings for high-risk clients, for example air-filled cushions or cushions with accessories.

How the Intervention Eases Impairments, Activity Limitations, and Participation Restrictions

Pressure mapping systems provide valuable information regarding maintenance of skin integrity (International Classification of Functioning, Disability, and Health [ICF] code b810–b849). They provide biofeedback on pelvic alignment (ICF b7201) and on the effects of changing and maintaining body position (ICF d410–d429), hence assisting clinicians in the overall management and prevention of pressure ulcers.

Evidence-Based Practice

The link between high interface pressure, as measured with pressure mapping systems, and pressure ulcer incidence has been demonstrated in randomized controlled trials. Interface pressures were significantly higher (p <.01) for participants who developed pressure ulcers than for those who did not (Brienza et al., 2001; Conine et al., 1994).

Numerous research studies have used pressure-mapping systems to compare pressure-reducing cushions based on interface pressure measurements (Ferrarin et al., 2000; Geyer et al., 2001; Shechtman et al., 2001; Tanimoto et al., 2000). For example, the study by Ferrarin et al. (2000) of ten wheelchair users showed that the Roho Low Profile and the Jay2 cushions had significantly lower peak pressure (p <.05) over the buttocks than two polyurethane gel–filled foam-based cushions had.

Discussion

Pressure-mapping systems require expertise in operation and output interpretation. Although expensive to purchase, the mapping system has potential benefits in pressure-ulcer management. Above all, the prevention of pressure ulcers is becoming increasingly valued. Further research should focus on the clinical applications of this technology with disabled clients and on the development of standard protocols for its use.

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