Experimental Evaluation of Wheelchair Cushions
Report of a Pilot Study
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A REVIEW WITH PRACTICAL ASPECTS

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This review summarizes the Report in terms of its practical medical application. All statements made by the reviewer are supported by the original article unless so noted.

Summary of Wheelchair Cushion Requirements

The basic function is to diffuse and distribute pressure. Obviously, a cushion must not "bottom out;" this means that a cushion must provide free movement in both horizontal and vertical directions beneath the patient when the pad is in use.

Direct pressure and shear forces must be kept low.

A stable base must be provided for patients with impaired trunk control to prevent falling and to reduce the energy needed to propel the chair.

Cover must not act like a stressed skin in order to keep shear forces low.

The surface cover should be absorbent and permit air circulation to dissipate moisture and heat.

Ability to wash, sanitize and sterilize are important.

Cost, weight, size and durability are important.

PERFORMANCE ULTIMATELY RESTS WITH THE MATERIAL USED INSIDE THE CUSHION.

Summary of Testing Methods and Scoring

The protocol for testing comprised Laboratory and Clinical tests which were then combined for an overall score for each cushion tested.

Laboratory Tests

Engineering tests simulated, in part, the forces, motions and pressures, in magnitude and duration, developed by patients sitting on cushions. The reactions of the cushions were recorded when such tests were made. The aim was to determine which cushion best minimized and distributed the pressure and lowered the shear on the patient's skin. The cushions were rated A (above average), B (average), C (below average) compared to the others tested in the same way.

Clinical Tests

Paraplegics, Quadriplegics and other wheelchair patients were used. Tests included measurement of sitting pressures under the patients, observation of patient skin reaction using the cushions, and evaluation of the cushions by the patients themselves based on sitting stability, pressure sensation, skin moisture and temperature, ease of handling, ease of cleaning and maintaining and general comfort. The cushions were rated A, B, or C as in the laboratory tests.

Overall Scores

Combined scores were expressed as numbers, highest score for best cushion.

Summary of Tests Relating to the Action® Contoured Flotation Pad

The **ACTION** Pad was given the highest score out of about two dozen cushions which were tested. It was rated A in laboratory and in clinical tests and given a numerical score of 196 which was the highest. Although the report lists the cushion as an "elastomer gel" the manufacturer clearly states in its literature that the pad is not a gel, but that it is a synthetic elastomer or rubber-like material with unique properties ideally suited for cushions.

The physical engineering tests showed that the **ACTION** Pad distributes pressure very well about a localized, concentrated load; this corresponds to the effect when a patient moves, shifting his weight unevenly. In the rapid loading test the **ACTION** Pad received the highest score; this corresponds to the effect of quick movements by the patient and shows that the cushion is very effective in preventing undue stress on the skin under such conditions. The tests also showed that very large changes in localized weight applied to the **ACTION** Pad by patients sitting in different positions made very small changes in the resulting pressure on the patient's skin. This result shows that the pad is very beneficial in the prevention and management of decubitus ulcers.

In the clinical tests the **ACTION** Pad received the highest score. In the patient reaction evaluation test the patients themselves gave the **ACTION** Pad an overwhelming score of 200 compared to a score of 175 for the nearest competitor.

Not mentioned in the Report, the Elastomeric* material inside the **ACTION** Pad cannot flow, and therefore, it provides a safe, stable base for sitting and propelling a wheelchair. A firm base reaction point is required when patients with borderline trunk control and weakness attempt to propel their wheelchairs; much more energy is required when sitting on a fluid-filled or gel cushion. Furthermore, since the **ACTION** Pad material does not flow, no change in the center of gravity occurs when the cushion is picked up to be moved, and the danger of a patient being thrown off balance and falling as a result is eliminated.

The **ACTION** Pad has an elastic skin with a tensile strength of 6,000 psi and the ability to stretch many times its length. Though not mentioned in the Report, the high elongation greatly minimizes the "stressed skin" effect because exceedingly little force is required to stretch the film to conform to the patient's body, thus reducing shear forces to a minimum. The knit outer cover supplied with **ACTION** Pads also reduces shear and helps ventilation to reduce moisture and heat.

Summary of Materials and Properties Leading to Low Scores in the Report And Shortcomings of Various Types of Cushions

Foam Types

Urethane foam cushions have not established a particularly good reputation in the prevention of pressure sores as shown by past clinical experience. The tests of this Report coincide with this, and imply that small changes in patient motion result in large changes in sitting pressure and possible bottoming out. Cored latex cushions are above average.

Vinyl Gel Types

This kind of pad received an average rating in the tests. However some facts not mentioned in the Report follow:

(a) This type has a long history of leaking and bursting when dropped.
(b) They contain a high percentage of liquid plasticizer, and if not exactly formulated, are either

fluid or stiff-like hardened gelatin.

(c) Pads generally have a tough, "boardy" cover like Naugahyde to keep them from bursting or disintegrating. Such covers produce a "stressed skin" effect which is not beneficial to the patient.

(d) Vinyl gel readily absorbs urine, and once saturated, retains a strong odor which cannot be removed.

Commercial Cushions of this type: Bio-Clinic
Orthopedic Equipment Co.
Medcom

Silicone Gel Type

This type has a history of leaking and instability and tends to bunch up and form lumps. The price is very high. Mooney, et. al, in Bulletin of Prosthetics Research 10-15, pp 129-143, states that this type has had severe handling problems because it is very heavy and extremely unstable as a mass. Its instability was so bad that one patient fell out of the chair while using it, and most patients thought it was too unstable to use when propelling a wheelchair.

Commercial Cushions of this type: Stryker

Akton is now a trademark for elastomeric material.

Liquid or Air-Filled Types

The Report states that any cushion requiring a specific filling of fluid or air will be useless, and even dangerous, if improperly filled or leaking, circumstances which inevitably seem to occur. Difficulties of water-filled pads are legion. Since a very strong envelope is required, the properties of the envelope determine the properties of the cushion. Among the many problems are instability for wheelchair sitting, leaking, bottoming out, excessive weight and absorption of urine. It is clearly obvious that many of these deficiencies would apply to all fluid or air-filled and to combinations of liquid and foam or gel filled cushions. These types were among those receiving the poorest rating in the tests.

Commercial Cushions of these types:	3M Reston Pad	- liquid-filled sponge
	Bio-Clinic	- fluid filled
	Jobst	- water-filled foam
	Spenco	- fluid colloid
	Aqua Mate	- water, vinyl and foam
	Aqua Rest	- water-filled
	Lyn-Bar	- water-filled
	Trenchard	-water added to make gel
	Bye Bye Decubiti	- air filled
	ROHO	- air filled

Impact Absorbing or Memory Types

It is debatable whether or not the characteristics of this type are desirable for a cushion. Scores were not particularly good for these types. They exhibited high sitting pressures, and some bottomed out like ordinary urethane foam with a sharp rise in sitting pressure.

Commercial cushions of this type:	T-Foam	Alimed
	Adaptair	Everest & Jennings
	Frost Foam	Everest & Jennings

Pads with Varying Inflation or Cut-Outs

Pads with varying pneumatic pressure or with cut-out sections decrease the sitting pressure in certain areas while increasing it in others. The purpose of negating the pressure is obviously negated unless the patient's position is constantly changed on the cushion.

Bucket Seat Cushions

This type presents difficulties unless the patient is precisely repositioned each time he sits down.