Wheelchair Cushions for Spinal Cord–Injured Individuals

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Wheelchair cushions are frequently prescribed during the rehabilitation of individuals with paraplegia and quadriplegia secondary to spinal cord injury. The primary purpose of these cushions is to relieve pressure under the person seated in a wheelchair and ultimately to reduce the risk of pressure sores. During the last 25 years, many investigators have attempted to identify the one wheelchair cushion or material that would effectively reduce pressure for all individuals with physical disabilities, especially those with spinal cord injury (1–5). However, it has been determined that no single device is effective for all people and that individual evaluation is essential (6–8).

Before 1970, the selection of wheelchair cushions was usually an arbitrary decision based on the rehabilitation or medical team’s familiarity with and the availability of these devices. Such devices included primarily foams and gels, although some air cushions were also available. In many hospitals, patients were seated on air rings or “doughnuts” with the hope that they would not develop pressure sores. Very little was known about the usefulness or effectiveness of these devices because there was no clinical method of evaluating them. Although some investigators who studied the effect of pressure on tissue developed instruments to measure pressure at the interface of the buttocks and the various wheelchair cushions, few of these instruments were usable in the clinical environment (2, 9). Therefore, clinicians in hospitals and rehabilitation centers developed their own preferences without the benefit of scientific evidence.

In recent years, many new wheelchair cushions have been developed for use by individuals who have spinal cord injury and other neurological and musculoskeletal disorders. These cushions include new and improved types of polyurethane foam, air cushions of various designs, gel cushions of undetermined contents, and combinations of these materials. In addition, clinically useful tools for the evaluation of the pressure exerted...
on the different cushions have been developed (6, 10). These two factors have made it possible for occupational therapists to individualize the prescription of these devices for people with physical disabilities.

This paper discusses the evaluation and prescription of wheelchair cushions for 251 individuals with spinal cord injury. Although the primary factors determining selection of the cushion were the magnitude of pressure and the distribution pattern of the pressure between the patient's buttocks and the wheelchair cushion, other factors are also discussed.

**Methodology**

**Subjects**

Subjects consisted of 251 individuals who had sustained a spinal cord injury. They were males (N = 207) and females (N = 44) whose injuries resulted in paraplegia (N = 145) and quadriplegia (N = 106). All subjects were referred to occupational therapy for a wheelchair cushion evaluation because of a) a prior history of pressure sores, b) an existing sore, or c) the need to correct a pressure sore following surgery.

**Instrument**

The instrument used to measure pressure at the interface of the buttocks and the wheelchair cushions was the Pressure Evaluation Pad (PEP). This device was designed and developed specifically to individualize the prescription of wheelchair cushions. It was the first clinically useful large-matrix pressure-monitoring system that permitted quantification of pressure in large numbers of physically disabled people who sat on a variety of wheelchair cushions. Since 1973, the PEP has been used in research and for the clinical evaluation of more than 800 patients. It is discussed in detail elsewhere (6–8, 11). (The PEP is now commercially available as the Texas Interface Pressure Evaluator (TIPE) through TK Applied Technology, 11915 Meadow Trail Lane, Stafford, TX 77477.)

**Procedures**

The PEP was used to evaluate the magnitude and overall distribution of pressure each subject exerted while seated in his or her own wheelchair or one that closely resembled it in style and size. The two main objective criteria for cushion selection were a) the magnitude and location of maximum and ischial pressure, and b) the overall distribution of pressure. The sensing pad of the PEP was placed between the subject and the cushion being evaluated. Maximum pressure was identified as the pressure, measured in millimeters of mercury (mm/Hg), at which the first light on the readout display became illuminated. Anatomic location of maximum pressure, a bony prominence or soft tissue, was determined by palpation. The large-matrix design of the sensing pad enabled the investigator to determine the overall pattern of pressure distribution.

The selection of currently available wheelchair cushions was determined by evaluating each subject on a maximum of seven cushions. The cushions were divided into three major categories: airfilled (Bye Bye Decubiti and Roho), flotation (Aqua Seat and Stryker Gel), and Foam (Stainless Comfy Hard Foam and Temper Foam) models (12). The remaining cushion (the Jay) is a combination of foam and flotation materials.

**Results**

In this study, the Roho produced the greatest pressure reduction in the majority of subjects. In fact, Roho cushions were prescribed as often as were all other cushions combined and were equally effective in both males and females (see Table 1). The second most frequently prescribed cushion, the Stainless Comfy Hard Foam, was optimal in only 18% of the subjects. There was no substantial difference in the effectiveness of this cushion with respect to male or female subjects. The Jay and Bye Bye Decubiti cushions were prescribed for 14% and 10% of the subjects, respectively. Again, no significant differences were found with respect to male and female

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**Table 1**

<table>
<thead>
<tr>
<th>Cushion Prescribed</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Aqua Seat</td>
<td>5</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Bye Bye Decubiti</td>
<td>18</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Jay</td>
<td>30</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Roho</td>
<td>103</td>
<td>50</td>
<td>24</td>
</tr>
<tr>
<td>Stainless Comfy Hard Foam</td>
<td>38</td>
<td>18</td>
<td>7</td>
</tr>
<tr>
<td>Stryker Gel</td>
<td>6</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Temper Foam</td>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

| Totals                  | 207   | 44      | 251   |
subjects. The remaining cushions were prescribed infrequently.

There were some differences, however, between prescription patterns for paraplegic and quadriplegic subjects (see Tables 2 and 3). Approximately 22% more quadriplegic subjects received Rohos than did paraplegic subjects. In contrast, the Jay cushion was prescribed 170% more frequently for paraplegic than for quadriplegic subjects. No major differences in cushion efficacy were evident for males or females within the paraplegic or quadriplegic subpopulations. Similar frequencies were noted in the prescription of the other cushions studied in both subpopulations.

### Discussion

Subjects were referred to occupation therapy for a wheelchair cushion evaluation because of previous or existing pressure sore problems. In earlier studies that used unselected patient populations, polyurethane foam cushions were the most effective in reducing pressure. In fact, during the early phases of rehabilitation, most subjects were given foam cushions. The foam, a 7.5-cm (3-in.) block of firm polyurethane, enabled the subject to achieve vertical tolerance while distributing pressure, develop transfer skills, and increase sitting tolerance.

This study demonstrates that patients who develop pressure sore complications while using polyurethane foam cushions are best treated with an alternate pressure relief cushion. Indeed, 82% of all patients in the present investigation were best treated with a cushion other than the polyurethane foam type. Of the various cushions tested, the Roho appeared to be optimal in over 50% of the patients. The basis for this is not completely clear.

Factors other than pressure enter into the successful prescription of an effective pressure-relief device. Tables 2 and 3 show a reduced rate of prescription of Roho cushions in paraplegic subjects and an increased use of the Jay and Stainless cushions in this group. Although Roho cushions provide excellent pressure relief, they do not provide lateral stability or maneuverability in some subjects because of the cushion's height and convex surface. In paraplegic patients who have considerable mobility, sensations of decreased stability and impaired transferability were commonly noted in tests using Roho cushions. These sensations were not reported by patients using the Jay and Stainless cushions. Furthermore, many paraplegic subjects tend to use lightweight, more maneuverable wheelchairs, which may have a reduced compatibility with the Roho cushion. On the other hand, most quadriplegic persons must be secured to their chairs with seatbelts and lapboards. These attachments compensate for the reduced stability of the Roho cushion and thus require heavier-duty wheelchairs.

The aspects of clinical judgment must weigh heavily in the creation of a successful cushion prescription. Neither objective criteria,
such as pressure measurement, nor clinical judgment alone can be as effective as both together. Nevertheless, the data demonstrate that no single cushion is uniformly ideal for all subjects. Therefore, this study provides additional evidence that individualized prescription of pressure relief devices must be done using objective criteria, such as that provided by such instruments as the PEP, in combination with clinical assessments.

These data also suggest that reevaluation of patients is essential to adequately treat pressure sores once they have developed. Furthermore, periodic reevaluation may be necessary to prevent the development of pressure sores. The prescriptions may not be static; changes may be necessitated by a patient’s alteration of lifestyle, body build, or activity pattern.

Summary

Patients with a history of tissue breakdown were evaluated to determine wheelchair cushion prescription patterns. Although no differences in cushion selection between male and female subjects were noted, there were differences between paraplegic and quadriplegic subjects. No single cushion was identified as ideal for all subjects, regardless of diagnosis or sex. In many rehabilitation facilities, the occupational therapist is responsible for the prescription of pressure relief devices for individuals with spinal cord injuries. This study demonstrates that both objective evaluation data and careful clinical judgment must be the bases therapists should use for this individualized cushion prescription.

REFERENCES

10. Rogers JE: Program for prevention of tissue breakdown, in *Annual Reports of Progress REC at Rancho Los Amigos Hospital*, Downey, CA, 1974, pp 50–51