

Comparison of the characteristics and features of pressure garments used in the management of burn scars

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Abstract

Two companies provide custom-made pressure garments to clients with burn scars at Westmead Hospital. This prospective study was completed in order to make objective decisions about which garments were most appropriate and cost effective to provide to clients. Issues such as cost, durability, fit and client preferences were investigated. Data were collected from 43 clients; at the time of initial fitting, at a follow-up appointment 4–6 weeks later, and at the time one of the garments required replacement. One Second Skin and one Jobst garment were provided to each client and the garments were compared using therapists' evaluation and clients' perspectives on a number of variables. Second Skin garments had significantly more favourable results on the variables of time for delivery, fit at follow-up, garment design, quality of fabric and seams, overall satisfaction and garment preference for ongoing wear. On all other variables there was no significant difference between the garments. Second Skin provided the most optimal and appropriate option for pressure garments in the management of burn scars for our clients. © 1998 Elsevier Science Ltd for ISBI. All rights reserved.

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1. Introduction

Custom-made pressure garments are used extensively by occupational therapists and physiotherapists in the management of clients with burn scars. Pressure garments control hypertrophic and keloid scarring by exerting an external force. The pressure applied by the garments increases the scar maturation rate, prevents contracture formation and enhances cosmetic appearance.

Optimal scar management requires that pressure garments be worn at all times to provide adequate, consistent and sustained pressure. Each client is supplied with two garments, to allow one to be worn while the other is being laundered. It is preferable that the garments are custom made to fit individual clients and be of a high quality to provide the necessary pressures. For optimal scar outcome a strong commitment is required from treating therapists and clients to

ensure the garments fit, are worn diligently and are replaced when required. As the garments are expensive for clients or the healthcare facility to purchase, it is essential that the best possible product is supplied to clients.

There are two brands of pressure garments currently used for burn clients of the Occupational Therapy Department of Westmead Hospital (Sydney, Australia), providing a choice of pressure garments which are designed for the purpose of burn scar management. Occupational therapists at Westmead Hospital require objective data to assist in selecting the most appropriate, optimal quality and cost effective style of garment.

This study compared the characteristics and features of Jobst and Second Skin pressure garments. Clients' and therapists' evaluations, as well as measurement of pressures applied by the garments, were used to make these comparisons. The enlisted subjects were supplied with one pressure garment from each company. Therapists gathered data at initial fitting of garments, 4–6 weeks later and when garments required replace-

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ment. Clients also completed a questionnaire to determine their perceptions of garment features. Some of the variables examined were fit, cost, time taken for delivery, ease of cleaning, ease of donning/doffing, comfort, satisfaction, pressures applied by garments, life of garments, and alterations required.

2. Literature review

Hypertrophic scarring is likely to result from deep partial thickness or full-thickness burns [1]. There are many hypotheses about the precise mechanism of hypertrophic scar formation [2–4]. It appears, however, that scarring is due to increased vascularisation of the burnt area with abnormally large vessels, and to the abnormal orientation and synthesis of collagen fibres [2–5]. Hypertrophic burn scars may result in cosmetic disfigurement, pruritis, skin hypersensitivity, joint contractures and functional disability [4, 6].

Various forms of scar management are available. Most authors agree that custom-made pressure garments when compared with other forms of therapy are the most effective in the control of scar formation [1, 7–10]. One study, however, suggests that pressure garment therapy does not influence scar maturation [11]. Proponents of pressure therapy argue that provision of pressure therapy using customised garments increases the maturation rate of scars, decreases the vascularisation, promotes the correct alignment and synthesis of collagen fibres and provides a more acceptable cosmetic outcome [3–5, 7, 12, 13].

There is consensus that early application of pressure is necessary for optimal outcome [6, 7, 12, 14]. Pressure is applied as soon as re-epithelialisation has occurred, and is maintained until scar maturation. It is recommended that pressure garments be worn at all times, removing only for hygiene and laundering.

The means for determining scar maturation is subjective, requiring an evaluation of scar colour, texture and height. Authors report different lengths of time for pressure garment wear, ranging from 4 months to 3 years [6, 8, 9, 15]. There appears to be consensus, however, that pressure is applied until subjective evaluation determines that the burn scar has matured.

There is debate surrounding the therapeutic level of pressure required between the scar and garment to provide optimal scar maturation. Various authors report that the therapeutic pressure ranges from 5 to 55 mmHg, with most recent studies indicating 15–40 mmHg as the necessary pressure range [4–6, 15–18].

Pressure between the garment and scar can be measured using electropneumatic pressure transducers. This type of apparatus enables determination of the

pressure exerted by garments at different anatomical sites. Variations in pressure exerted by garments over time and pressure differences related to garment manufacture can also be assessed [6]. Alternative methods of assessing pressure are more subjective, for example, 'feeling' at the seams [16]. At present, there is no standardised procedure to measure the overall fit of pressure garments. The experience of the burns therapist is therefore crucial in making this assessment [1].

Only one study has attempted to address issues of comfort, colour, ease of cleaning and client satisfaction with pressure garments [19]. This study retrospectively compared Jobst and Second Skin custom-made pressure garments used with children. Pressure was measured and a parent questionnaire examining other variables was completed. Results provided some guidelines for prescription of either Second Skin or Jobst garments. The study reported that both brands were given similar ratings by parents for ease of donning/doffing garments, children's ability to tolerate wearing the garments, fit and ease of cleaning. It was found that Second Skin garments required fewer alterations and were less likely to stretch or have component parts deteriorate. Second Skin was also noted to have a greater range and flexibility of design options, the individual garments were less expensive (by 20–30%) and were less likely to need replacement within a 3-month period. Jobst garments, however, were reported to provide a better fitting glove for infants and toddlers, and were made from fabric which was softer and less irritating for sensitive skin.

One other recent study used a questionnaire to survey burns centres in the USA to determine the variables deemed important when selecting a manufacturer of pressure garments [20]. The main factors identified included accessibility of the company for ordering garments, ease of measurement and reliability of fit of the first garment received. These variables tended to be those that facilitated an efficient garment provision process. The actual services provided were also important including companies' ability to provide non-standard options or garments. Cost was not as significant a variable in manufacturer selection possibly because of purchasing contracts entered into by hospitals with particular manufacturers, limiting the choices of prescribing clinicians. Speed of receipt of orders and durability of garments were variables not surveyed by the study but identified by respondents as important in influencing selection of manufacturers.

No study has prospectively compared different brands of pressure garments in order to identify characteristics which facilitate objective selection of garments. This study aims to address this gap in the research literature and thus to enhance the quality of care provided to people with burn scars.

3. Methodology

3.1. Subjects

Forty-three subjects were recruited from February 1994 to November 1996. Subjects were inpatients and outpatients of occupational therapy at Westmead Hospital who required pressure garments to manage burn scars and who agreed to participate in the study.

3.2. Procedure

Approval for the study was obtained from the Western Sydney Area Health Service Human Research Ethics Committee. Once the subject was identified as having burn scars warranting pressure therapy (i.e. generally subjects with partial to full-thickness burns), informed consent to participate in the study was obtained. Subjects were measured for the necessary pressure garment. As two garments are necessary for adequate scar management each client was supplied with one garment from Second Skin and one from Jobst. Experienced occupational therapists prescribed and measured pressure garments and collected all the data.

There were three stages of data collection; at initial fitting, 4–6 weeks following initial fitting and at the time garments required replacement. At initial fitting, the therapist checked the garments for adequacy of fit. Subjects were given standard written and verbal instructions on the wearing regime, washing instructions and garment and skin care. Clients were instructed to wear the garments equally by alternating garments every 24 h. Therapists completed a data collection sheet, recording information about the garments ordered, time for delivery, the cost of each garment and the pressures exerted by each garment on standard anatomical sites.

At follow-up, 4–6 weeks after initial fitting, the garments were evaluated by the therapist. In addition to reassessing data gathered at the initial fitting, information about alterations required, and the quality of the fabrics and fastenings was collected. Subjects were also interviewed using a standard questionnaire to obtain their perceptions about the garments from each company. Features such as colour, comfort, ease of donning, design options and ease of cleaning were rated by the subjects.

Clients continued to be reviewed on a regular basis until one of the garments required replacement. At this stage the client was provided with a new set of garments of the brand chosen in collaboration with the therapist. The length of the garment life, reasons for replacement and final garment preference were recorded at this point.

The entire procedure, including data collection forms and the questionnaires, was pretested prior to the commencement of the study. This resulted in refinement of the procedure and data collection tools.

3.3. Data collection tools

3.3.1. Data collection form

The variables were developed using information obtained from the Beurteaux [19] study and from the researchers' experiences. The variables included:

1. At initial fitting,
 - (a) type of garment prescribed, e.g. armsleeve, glove, vest;
 - (b) time from ordering to delivery (working days);
 - (c) total cost of the garment (Australian dollars, \$A);
 - (d) therapist evaluation of the fit of the garment (adequate, loose, tight);
 - (e) measurement of pressures (mmHg).
2. At follow-up, 4–6 weeks after initial fitting,
 - (a) Therapist evaluation of:
 - (i) whether alterations were required to maintain adequacy of garment fit;
 - (ii) quality of fabric (adequate, stretched, deteriorated, other);
 - (iii) quality of zippers, velcro and seams (intact, need replacement/repair);
 - (iv) fit of garments (adequate, loose, tight).
 - (a) Measurement of pressures (measured prior to alterations)
3. At remeasurement/garment replacement,
 - (a) time since initial fitting (days);
 - (b) garment requiring replacement (Jobst, Second Skin, both);
 - (c) reasons for replacement (too big, too small, tear/holes, wear/friction);
 - (d) brand of garment selected for ongoing wear.

3.3.2. Pressures

A list of standard anatomical sites was adapted from the Beurteaux [19] study. Pressures (mmHg) were measured at each of the sites that fell under a pressure garment. A pressure monitor, Talley Model SD500 Digital Skin Pressure Evaluator, was used to measure the pressure between the body surface and pressure garment. Three measurements were taken at each anatomical site following standardised administration procedures. The average readings for each site were totalled and this total used for statistical purposes. Pressures were recorded at initial fitting and at follow-up prior to any garment adjustment to identify pressure changes which may have occurred.

3.3.3. Questionnaire

A questionnaire consisting of two parts was designed to rate subjects' or parents' perceptions of, and satisfaction with, the pressure garments. The questionnaire was completed at the follow-up appointment 4–6 weeks following initial fitting.

Part one recorded demographic details such as age, sex, cause and date of burn. Subjects were asked whether they wore the Second Skin and Jobst garments equally and 24 h a day to judge whether each garment was exposed to similar conditions.

The second part of the questionnaire was administered by the therapist. It consisted of 21 questions asking subjects and parents to rate both Second Skin and Jobst garments on each of the variables: design, fit, colour, ease of donning and doffing, cleaning, comfort and satisfaction with the garment. Rating scales were three to five points depending upon the information sought e.g. How would you rate the design of your garment? (1 very good to 5 very poor); How well did your garment fit when you first received it? (too tight, adequately, too loose). Subjects were also asked to specify which brand of garment they preferred on each of the variables. Finally subjects were asked to select which garment they preferred for future wear.

3.4. Statistical analysis

The statistical software package SPSSPC+ for Windows was used to analyse the data. Within patient differences between the rating using one garment and that using the other were analysed by Wilcoxon Signed Rank Test.

4. Results

4.1. Subject characteristics

Forty-six subjects were recruited for the study with 43 having complete data sets to be used for data analysis. The three subjects who had incomplete data sets consisted of two who failed to attend follow-up appointments and one who failed to wear the garments supplied. The 43 subjects were aged between 1 and 61 years (mean, 32 years; SD, 17.3 years) and were predominantly male (91%). The most common causes of burns in the subjects studied were flame (49%), contact with hot surfaces (16.2%), and contact with hot oil (19%). Other causes were hot water (13.9%) and electrical (2.3%). The garment types most frequently prescribed for subjects were gloves (21%), vests with sleeves (19%), armsleeves (16%) and gauntlets (9%).

4.2. Initial fitting

Garment delivery time (i.e. time taken from faxing order to receipt of garment) for Second Skin varied from 1 to 6 working days (mean, 3.5 days; SD, 1.2 days). Jobst delivery times ranged from 2 to 14 working days (mean, 5 days; SD, 2.7 days). The difference in delivery times between Second Skin and Jobst was statistically significant ($P < 0.001$).

There was no significant difference between the total purchase cost of garments (including options and freight). The average costs for Jobst and Second Skin garments were \$A276 and \$A256 respectively.

There was no significant difference between Jobst and Second Skin in the initial fit of the garments. Ninety-five per cent of Second Skin and 91% of Jobst garments were assessed as fitting adequately.

4.3. Follow-up

4.3.1. Questionnaire

At follow-up, 93% of subjects reported that the garments were worn equally. The 7% ($N = 3$) of clients who did not wear garments equally reported ill-fitting Jobst garments as the reason for wearing Second Skin garments only. Eighty-four per cent wore the garments at all times, as directed. Sixteen per cent ($N = 7$) of clients chose not to wear the garments consistently (both Second Skin and Jobst) due to discomfort at night or social/other reasons.

Clients were asked to rate various garment features. Second Skin was rated significantly higher on the variables: design ($P = 0.005$), current fit ($P = 0.006$) and overall garment satisfaction ($P = 0.003$). There were no significant differences in the ratings of initial fit, ease of movement, comfort, ease of donning, doffing and cleaning (Table 1).

Clients were also asked to specify which particular garment they believed was 'best' on each of the variables. Clients rated Second Skin as 'best' significantly more frequently than Jobst on the variables: design ($P = 0.001$), initial fit ($P < 0.001$) and current fit ($P < 0.001$). There was no significant difference for the variables of comfort, ease of movement, colour, ease of donning, doffing and ease of cleaning (Table 2).

Clients selected Second Skin garments as the garments with which they were most satisfied (Second Skin: 70%; Jobst: 28%; both: 2%; $P = 0.005$). Clients also selected Second Skin garments significantly more often as the garment they would prefer to wear in the future (Second Skin: 70%; Jobst: 28%; both: 2%; $P = 0.005$).

4.3.2. Therapist evaluation

At follow-up therapists again assessed garments for adequacy of fit. Eighty-one per cent of Second Skin

Table 1
Proportion of subjects' ($N = 43$) responses to the most favourable ratings on the scales for each variable

Variables (Ratings)	Second Skin	Jobst	<i>P</i> -values
Design (V. good/good)	88%	60%	0.005 ^a
Current Fit (Adequate)	93%	42%	0.006 ^a
Satisfaction (V. satisfied/satisfied)	91%	60%	0.003 ^a
Initial Fit (Adequate)	84%	63%	0.8
Ease of movement (Unrestricted)	70%	70%	0.9
Ease of donning (V. easy/easy)	63%	58%	0.5
Ease of doffing (V. easy/easy)	84%	81%	0.9
Ease of cleaning (V. easy/easy)	72%	70%	0.5
Comfort (V. comfortable/comfortable)	69%	60%	0.2

^aSignificant difference

and 51% of Jobst garments were fitting adequately, which is a significant difference ($P = 0.006$). Most of the inadequacy of fit was due to loose garments. Twenty-six per cent of Second Skin and 37% of Jobst garments required alterations. Significantly more Second Skin garments (77%) retained adequate quality of fabric than did Jobst garments (44%; $P = 0.003$). Most of the difficulties resulted from stretched or deteriorated fabric.

The majority of zippers and velcro closures remained intact and did not require replacement in either garments. There was a significant difference ($P = 0.03$), however, in relation to the quality of seams. Sixteen per cent of Jobst garments and no Second Skin garments required repair or replacement due to seam breakdown.

Table 2
Proportion of subjects' selection of 'best' garment for each variable

Variables	Second Skin	Jobst	Both	<i>P</i> -values
Design	67%	21%	12%	0.001 ^a
Initial Fit	74%	19%	7%	<0.001 ^a
Current Fit	72%	16%	12%	<0.001 ^a
Comfort	56%	30%	14%	0.07
Ease of Movement	28%	33%	40%	0.7
Colour	37%	23%	40%	0.2
Ease of Donning	42%	33%	26%	0.5
Ease of Doffing	35%	26%	40%	0.4
Ease of Cleaning	21%	23%	56%	0.8

^aSignificant difference.

4.4. Pressures

Pressures were measured for a small sample of garments only, due to persisting difficulties with the Talley Pressure Evaluator. There was no significant difference between the pressures exerted by Jobst and Second Skin garments at initial data collection or at follow-up (Table 3). The changes in the pressures exerted by the respective garments from initial fitting to follow-up were not significant. Pressures were not used as a variable in any further analyses due to the small sample size.

4.5. At garment replacement

The time from garment provision to garment replacement varied from 22 to 200 days (mean, 90 days). Jobst garments (49%) necessitated supply of a new set of garments significantly more often than Second Skin (7%) ($P < 0.001$). Both Second Skin and Jobst garments required replacement in 29% of cases and in 15% of cases neither garments required replacement. The reasons for garment replacement included deterioration of garment (46%), garments too big (27%), garments too small (17%) and other (10%).

Second Skin was selected significantly more often (73%) than Jobst (12%) as the garment for ongoing wear ($P < 0.001$). Garments did not require replacement in 15% of cases due to scar maturation or clients choosing to discontinue treatment.

5. Discussion

The aim of this study was to prospectively gather objective information to enable us to prescribe the most appropriate, optimal quality and cost-effective pressure garments for our clients. We compared characteristics and features of Jobst and Second Skin garments to achieve this aim. Overall, 14 of the 32 variables studied favoured Second Skin garments. These included variables such as time for delivery, fit at follow-up, garment design, quality of fabric and seams, overall satisfaction and garment preference for ongoing wear.

Variables for which there was no significant difference (18 of 32) between Jobst and Second Skin were cost, pressures, initial fit, ease of cleaning, movement, donning and doffing, comfort, colour, need for alterations and repair or replacement. Responses to these variables suggested general satisfaction with both the garments.

Similar to the Beurteaux study [19], our subjects reported that Second Skin and Jobst garments were equivalent for ease of donning and doffing and ease of

Table 3
Pressure values recorded for Second Skin and Jobst garments at initial fitting and follow-up

Time of collection	No. of garments	Mean (mmHg)	SD (mmHg)	Min. (mmHg)	Max. (mmHg)
Second Skin Initial	10	8.5	6.4	3.0	25.4
Jobst Initial	9	9.7	8.6	2.6	31.1
Second Skin Follow-up	6	6.3	5.0	1.4	15.0
Jobst Follow-up	6	9.1	6.2	2.8	20.8

cleaning. Like Beurteaux, we found Second Skin garments maintained fabric quality and were less likely to require replacement than were Jobst garments. We did not find, as Beurteaux did, that Second Skin required fewer alterations and were less expensive.

Beurteaux drew conclusions about preference for individual garment types. Unfortunately we had insufficient numbers to allow us to draw conclusions about this. Trends in the raw data for individual garment types, however, suggested that Second Skin garments, with the exception of armsleeves, tended to be higher on the variables of satisfaction and preference, and were selected more often for ongoing wear. In direct contrast to Beurteaux who preferred Jobst gloves for children, our results found that Second Skin gloves were more frequently rated as the preferred garment by both adults and children. The reasons for the tendency to prefer Jobst armsleeves were not clear. After examining individual client data it appears the reasons why clients had an overall satisfaction with Jobst armsleeves were comfort (fabric feel), ease of movement, ease of donning and colour.

Similar to Beurteaux, who also used the the Talley Pressure Evaluator, our pressure readings rarely approached the generally accepted level of 25 mmHg. The average pressures we obtained were similar to those of Beurteaux, who found a non-significant trend for Second Skin garments to provide higher pressures. We observed a non-significant trend for Jobst garments to have higher pressure readings. There is, however, no validity, inter- or intra-rater reliability estimate for the Talley Pressure Evaluator. It also proved to be unreliable, at times recording wide variability for the three readings taken at each site. Furthermore, the pressure sensor pad required repair and was unavailable for many measurements. Therefore the results of our pressure readings need to be considered with extreme caution.

Ward [10] found that prescribing clinicians' choice of pressure garment supplier was influenced by three factors: company accessibility, ease of measurement and reliability of initial fit of garment. Each of these factors were seen to facilitate an efficient garment provision process. The only one of these factors which was measured in our study was initial fit of garment. We found there was no significant difference between

Jobst and Second Skin garments in the reliability of initial fit at the time of initial garment fitting.

Respondents in Ward's [10] study identified speed of receipt of orders and durability of garments as important in influencing manufacturer selection. Second Skin delivered their garments, on average, in 70% of the time it took for Jobst delivery. The variables we evaluated that relate to garment durability include fabric quality, fit at follow-up, quality of seams, pressures at follow-up and need for alterations and/or repairs. Second Skin garments rated significantly better than Jobst on the first three of these five factors. There was no significant difference found between Second Skin and Jobst on the other two factors relating to garment durability.

There were two limitations to this study. Firstly there were insufficient garment numbers to be able to make decisions about the relative merits of each company for individual garment types. Our discussion regarding the preference for Jobst armsleeves was based solely on examining raw data for individual garments.

Secondly, data collectors were unable to be blinded to the supplier of the garments they evaluated. There was no feasible solution to this limitation.

We did not measure the impact of the garments on scar maturation. Although our results favour Second Skin on many of the variables studied, we do not attempt to draw any conclusions regarding the relative efficacy of the garments in terms of scar maturation. Our clinical impression is that both Jobst and Second Skin garments contribute to adequate scar maturation.

We have suggestions for further research. Firstly, our results apply solely to the caseload in our setting at the time of data collection. As manufacturing practices and corporate policies of the garment suppliers change, each service will need to evaluate various suppliers according to the needs of their own setting.

Second, we found that Jobst armsleeves tended to be preferred over Second Skin. Beurteaux [19] reported a preference for Jobst gloves. It would therefore be useful to compare larger numbers of individual garment types to determine if these trends continue. Other differences between garment types could also be explored.

In conclusion, our results indicate that Second Skin provided us with the most optimal and appropriate

option for pressure garments in the management of burn scars. At the time of the study the possible exception is armsleeves. We encourage therapists to evaluate the relative features of pressure garments in their own settings and according to their own requirements.

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