A Review of Compression Glove Modifications to Enhance Functional Grip: A Case Series

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A common complaint among patients with burns is their inability to grasp items while wearing compression gloves. Recent technological innovations permit the addition of grip-enhancing material to garment fabric. The purpose of this case series was to describe the course of development of compression gloves with enhanced grip modifications. Five different types of grip modifications were made during a period of 18 months. Five subjects who were prescribed compression gloves tested each type of glove. The gloves were fabricated with grip-enhancing material on the palmar surface in five ways: 1) rectangular rubber tabs; 2) honeycomb pattern silicone; 3) wave-like pattern silicone; 4) line pattern silicone beads; 5) line pattern silicone beads embedded into the fabric. Each glove was evaluated on a three-point Likert scale (0 = poor, 1 = moderate, 2 = good) for grip-enhancing qualities and durability. All five subjects reported similar experiences with each glove type: 1) the rectangular rubber tabs demonstrated poor grip and moderate durability; 2) the honeycomb pattern provided good grip but poor durability; 3) the wave pattern had good grip and moderate durability; 4) the silicone beads adhered to the fabric had moderate grip but poor durability; 5) the silicone beads embedded into the fabric had moderate grip and good durability. The wave pattern provided the best gripping capability and silicone embedded into the fabric demonstrated the best durability. A wave-like pattern silicone material embedded into the fabric seems to provide the best combination of grip and durability to enhance activities of daily living performance. (J Burn Care Res 2007;28:888–891)

Scar compression is a widely accepted treatment modality used to control hypertrophic scarring after a severe burn or skin grafting.[1] The natural surface and texture of compression garment material makes it difficult for patients with hand burns to grasp objects during activities of daily living (ADL). Our patients reported difficulties similar to previously cited complaints stating that the lack of friction on the palmar surface of compression gloves interfered with ADL performance.[2] Rock et al[3] reported that wearing gloves of various types diminished grip strength and three-point pinch strength. O'Brien et al[2] reported that the addition of suede material on the palmar surface of compression gloves enhanced functional use when performing gross and fine motor activities. As a pilot study we set out to design and test a compression glove that improved grip. The purpose of this case series was to test a variety of grip-enhancement materials and patterns on the palmar surface of compression gloves to improve hand function.

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METHODS

Five subjects who were prescribed compression gloves tested each type of grip-enhancement pattern. The customized pressure garment gloves and grip enhancements were developed and manufactured by Medical Z Inc. (Saint Avertin, France) who is our regular supplier of pressure garments. Coolmax® fabric (Medical Z) was used to fabricate the gloves. Grip enhancement was achieved by using either rubber or silicone bonded to the material on the palmar surface of the gloves. Gloves customized with open finger tips were used in all cases. The open fingertip design is our typical style used based on clinical experience as

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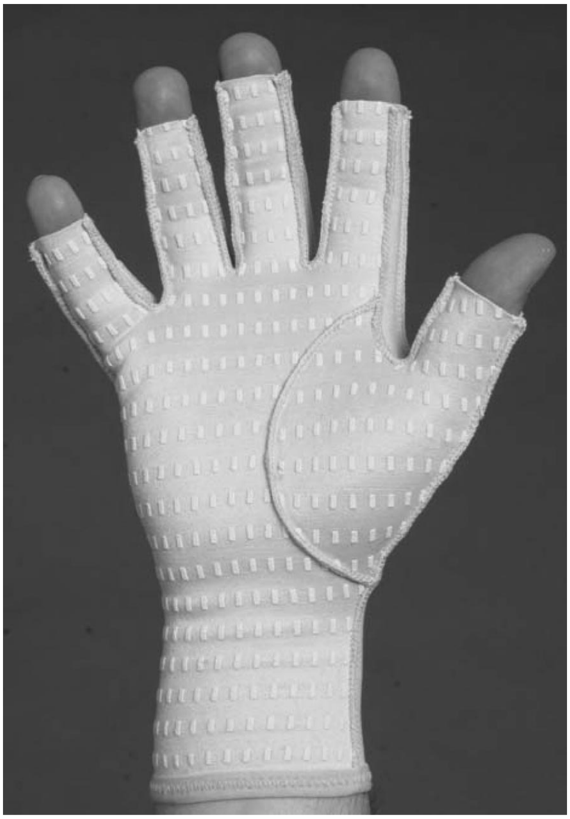

Figure 1. Compression glove displaying 4 × 2 mm rubber tabs.

it provides patient's with improved tactile sensation. The gloves were provided by Medical Z at no charge.

The gloves with palmar grip-enhancement material were designed and combined in five different ways: 1) 4 mm × 2 mm rectangular rubber tabs equally spaced

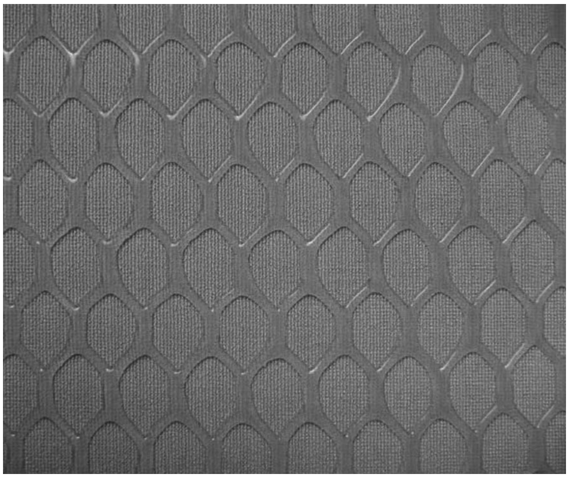

Figure 2. Compression glove material displaying honeycomb pattern silicone adhered to fabric.

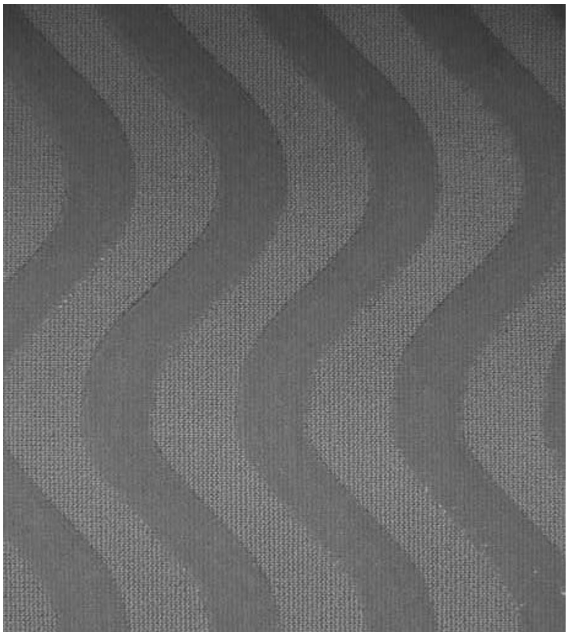

Figure 3. Compression glove material displaying wave pattern silicone adhered to fabric.

5 mm apart were screen printed onto the gloves and then cured using a conveyer dryer at 200°F to 250°F (Figure 1); 2) warmed silicone was machine-extruded onto the glove fabric in a honeycomb pattern using a 2-mm-wide nozzle and then placed in a cooling chamber to seize the silicone onto the fabric surface (Figure 2); 3) by adhering the silicone in the preceding manner, a wave-like pattern 7 mm wide and spaced at 1 cm intervals was created and cured as described in process 2 (Figure 3); 4) a line pattern of silicone beads spaced 4 mm apart were adhered to the fabric surface as previously described (Figure 4); and 5) a line pattern of silicone beads were embedded into

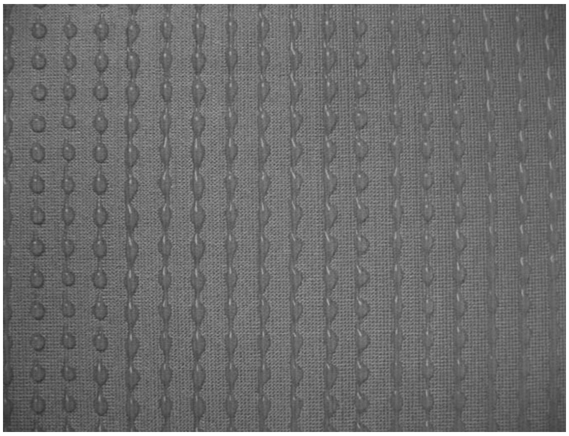

Figure 4. Compression glove material displaying silicone beads adhered to fabric.

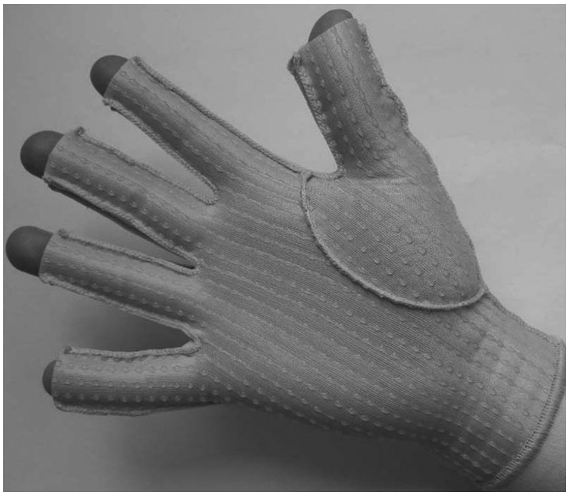

Figure 5. Compression glove displaying silicone beads embedded into the fabric.

the fabric (Figure 5). To embed the silicone, the fabric was modified through a softening and stretching process of the material.

Each subject trialed the five different types of grip modifications in a sequential manner during an 18-month period. Subjects overlapped one another in time. The first design tested was the rubber tabs, progressing to the silicone patterns and eventually to the silicone bead designs and ending with the embedded method of silicone adherence. As each design fell short of an ideal adaptation, another alternative design was tried. Each subject wore each glove design as part of a normal wearing schedule that consisted of 23 hours a day for a period of 3 months or until the grip adaptation wore off, whichever came first.[4] After the trial periods, feedback from subjects was solicited. Subjects were informally questioned on each enhancement based on their individual use of the glove. Responses were collectively rated and scored on a three-point Likert scale (0 = poor, 1 = moderate, 2 = good) for grip-enhancing qualities and durability.

RESULTS

A summary of the subjects' ratings for grip and durability of each glove design is shown in Table 1 and Figure 6. Each subject described similar characteristics for each glove type. The rectangular rubber tabs demonstrated poor grip and moderate durability overall (combined score average = 1). The honeycomb pattern supplied good grip but poor durability (combined score average = 2). The wave pattern showed good grip and moderate durability (combined score average = 3). The silicone beads adhered to the fabric had moderate grip and poor durability (combined score average = 1). The silicone beads embedded into the fabric provided moderate grip and good durability (combined score average = 3).

Table 1. Likert scale results for each glove adaptation

Grip Adaptation	Grip	Durability
Rectangular rubber tabs adhered to fabric	+	++
Honeycomb pattern silicone adhered to fabric	+++	+
Wave pattern silicone adhered to fabric	+++	++
Silicone beads adhered to fabric	++	+
Silicone beads embedded into fabric	++	+++

+, poor (=0); ++, moderate (=1); +++, good (=2).

DISCUSSION

The intent of this case series was to investigate ways to improve hand function while wearing gloves. This nonrandomized pilot case series reinforced that grip adaptations to compression gloves enhance functional ADL performance and that further evaluation of specific grip enhancements is warranted. Grip as an isolated maneuver was not tested separately but rather evaluated as a component needed to perform ADL. Our findings paralleled those of O'Brien et al[2] who reported that functional tasks were made easier and performed more rapidly after the addition of suede to a compression glove. Rubber and silicone were chosen over suede for this case series because they are less bulky, more flexible, and provide greater tackiness.

The rubber tabs lasted through the 3-month trial period but provided poor grip as reported by the subjects. A change to silicone on the palmar surface of the glove improved gripping capability. However, all silicone "adhered" designs wore off before the end of the 3-month trial period. The poor durability of silicone adhered to the fabric led to the design process of "embedding" the silicone into the fabric. The embedded silicone process demonstrated enhanced durability of the grip adaptation.

Although we found concordance among the subjects in terms of how they evaluated the various designs, a limitation of this case series is that subjects were able to discuss their experiences with each glove style. Nonetheless, the open discussion allowed us to discern that the honeycomb and beaded silicone was of higher profile than the wave form. The subjects reported that the low-profile characteristic of the wave pattern improved gripping capability during any type of grasping task compared with the other types. Furthermore, the width (amount) of silicone that the

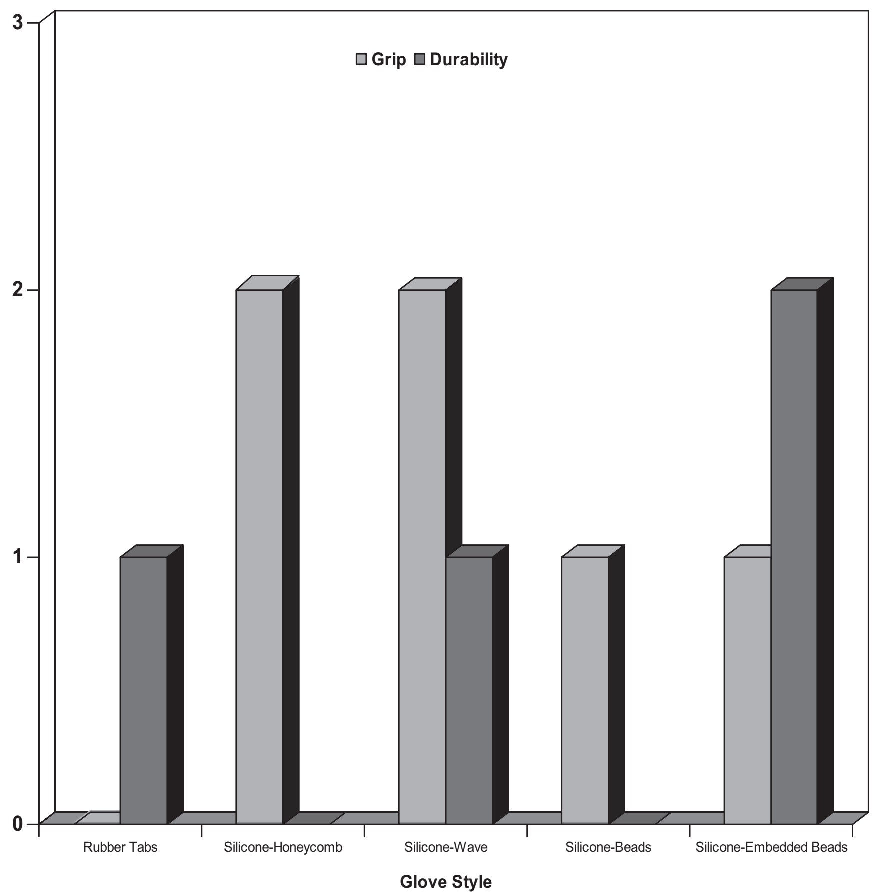

Figure 6. Likert scale results for each glove adaptation.

wave pattern provided also was reported by the subjects to improve their grip capability. Based on subject's feedback and scoring as seen in Table 1 and Figure 6, we deduced that the wavy silicone pattern embedded into the fabric could provide a more ideal grip-enhancement combination. This combination was not tested in this case series but warrants further investigation. The embedded wavy silicone is the basis for future study that will include specific grip and ADL measurements and a larger sample size.

CONCLUSION

The addition of grip-enhancement material to the palmar side of compression gloves improves patients' grip. The combination of silicone embedded into the fabric in a wave pattern should provide the best grip and durability for enhanced ADL performance. Studies are underway to compare wave vs bead designs using embedded silicone in a larger sample size. Furthermore, these studies will test these newly designed glove patterns using standard hand function tests. Grip enhancements on custom compression gloves are made commercially available by the following companies: Barton-Carey (Perrysburg, OH), Bioconcepts (Phoenix, AZ), Gottfried Medical (Toledo, OH), Medical Z (Saint Avertin, France), Torbot (Toledo, OH).

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