Elastic Bandage Stabalizer

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Abstract

In order to treat severe wounds, burns, and other cases where serious injuries have caused damage to the body's peripheral tissue, skin grafting is utilized. The typical donor site for these skin grafts is the thigh. To provide additional stability to the donor site dressing, ACE bandages are currently used within the medical industry. However, ACE bandages prove to be ineffective because they commonly slip off the application site. Therefore, the design team has developed an elastic leg wrap. Testing was conducted with various prototypes and compared against the effectiveness of an ACE bandage. After testing, the final device proved to be fully effective. However, future work can be done to refine the exact dimensions and strap locations of the device.

Background and Current Practices

Skin grafting involves transplantation of skin from one area of the body to another in order to treat serious injuries to the skin such as lacerations or extensive burns. Benefits of skin grafting include reduction in the required treatment time and improvement in function as well as appearance of the wound site. The type of skin graft that is considered the most durable and has the broadest range of application is the split thickness skin graft [2]. A split thickness skin graft contains the epidermis and a portion of the dermis and is removed using a dermatome[1]. After removal of the skin graft, the donor location still contains a dermal layer that contains hair follicles and sebaceous glands which are important for healing. The graft is typically taken from the upper thigh due to the ease of concealing the scar[2]. The skin removed may be meshed in order to prevent buildup of edema under the graft. After removal of the graft, the donor site is dressed, typically with occlusive polyurethane. This dressing is further stabilized using ACE bandaging [2]. However, the ACE bandage often slips down the leg, increasing recovery time for the patient. To counteract this problem, patients often use methods that are not medically standardized nor comfortable, such as tapes or adhesives.

Figure 1: A split thickness skin graft that underwent meshing followed by transplantation to the recipient site [1].

Design Requirements

Primary Requirements

- Must hold dressings in place on thigh
- Must be easily applied by the patient without help
- Cannot cause a tourniquet effect or excessive chaffing and/or rubbing
- Tension and size should be customizable
- Must be hypoallergenic

Secondary Requirements

- Allow for varying aesthetics
- Can be machine washable
- Can be applicable for arms or legs
- Can be applied to animal surgeries

Alternative Designs

Compression Shorts

Compressive shorts designed with a breakaway system for improved ergonomics.

Slip Guard

Device which attaches above the knee to catch ACE bandage from slipping down leg.

Elastic Leg Wrap

Elastic compressive wrap which is attached and tightened with four Velcro strips.

Design Matrix

Criteria		Possible Designs		
Considerations	Weight	Elastic Wrap	Compression Shorts	Slip Guard
Feasibility	20	19	16	5
Ease of Fabrication	10	9	6	9
Durability	10	8	8	9
Ergonomics	20	19	13	15
Safety	15	15	15	15
Adjustability	10	9	6	8
Client Preference	15	15	12	10
Total	100	94	76	71

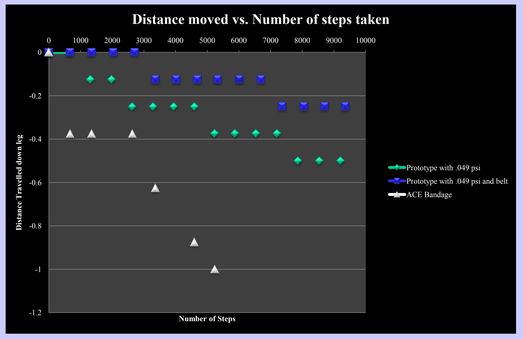
Final Design

Features

- Elastic fabric
- Hypo-allergenic
- Clip attachment
- Ladder lock tightening
- Supportive belt
- Vinyl coating

Testing and Future Work

Preliminary testing of early generation prototypes involved testing the effectiveness of the wrap during walking and regular movement. Results from these tests dictated further changes. Once a final prototype was established, the device was tested against an ACE bandage by walking and doing exercises while wearing the device.



After testing was completed, it was determined further work could be done on the exact shape and dimensions of the device as well as the belt attachment location on the device. Further testing could also be conducted to provide further data given different situations (e.g. walking up and down stairs, sitting down, tight verse loose clothes, etc.)

Cost Analysis

This prototype cost $13.41 in direct material cost. Given factory discounts on bulk materials, labor costs, and market mark up, this device could feasibly be sold for $40. There are more than 215,000 split thickness skin grafts per year which would result in $8,600,000 of sales per year within this specific area of interest. This figure could realistically be increased by a significant amount due to the various other applications the device can satisfy.

Acknowledgements

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References

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