
Two Simple Leg Net Devices Designed to Protect Lower-Extremity Skin Grafts and Donor Sites and Prevent Decubitus Ulcer

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Burn therapists routinely are tasked to position the lower extremities of burn patients for pressure ulcer prevention, skin graft protection, donor site ventilation, and edema reduction. We developed two durable and low-maintenance devices that allow effective positioning of the lower extremities. The high-profile and low-profile leg net devices were simple to fabricate and maintain. The frame was assembled using a three-quarter-inch diameter copper pipe and copper fittings (45 degrees, 90 degrees, and tees). A double layer of elasticized tubular netting was pulled over the frame and doubled back for leg support to complete the devices. The devices can be placed on any bed surface. The netting can be exchanged when soiled and the frame can be disinfected between patients using standard techniques. Both devices were used on approximately 250 patients for a total of 1200 treatment days. No incidence of pressure ulcer was observed, and graft take was not adversely affected. The devices have not required repairs or replacement. Medical providers reported they are easy to apply and effectively maintain proper positioning throughout application. Neither device interfered with the application of other positioning devices. Both devices were found to be an effective method of positioning lower extremities to prevent pressure ulcer, minimize graft loss and donor site morbidity, and reduce edema. The devices allowed for proper wound ventilation and protected grafted lower extremities on any bed surface. The devices are simple to fabricate and maintain. Both devices can be effectively used simultaneously with other positioning devices. (*J Burn Care Res* 2007;28:115–119)

Positioning patients with medical or surgical conditions that reduce mobility is critical for the prevention of pressure decubitus. Pressure ulcer is a serious health problem and can cause pain, suffering, disability, and even death.^{1,2} The cost of treatment for a single pressure decubitus has been estimated to be as high as \$70,000.³ Therefore, prevention is paramount. The prevention of pressure ulcers is far less costly than treatment of pressure ulcers and represents a significant challenge in burn care.⁴

The burn patient has many risk factors that predispose him or her to the development of pressure ulcers.⁴ The forces causing pressure are linked to shear, friction, and unrelieved pressure.^{5,6} Risk factors that increase a person's susceptibility to forces causing pressure decubitus seem to follow five key themes: mobility, nutrition, perfusion, age, and skin condition.⁷ Other studies have identified immobility,^{8–10} moisture⁸ or incontinence,¹⁰ nutritional deficit,⁸ friction and shear,⁸ and decreased level of consciousness⁸ or mental conditions¹⁰ as risk factors. Fritsch et al¹¹ noted that patients with burns have a number of features that traditionally have been used to identify risk for pressure ulcer. Burn clinicians should be cognizant of the features unique to the burn population that may contribute to pressure sores.⁴

Proper positioning is a fundamental tenet of a successful burn rehabilitation program.¹² Burn therapists routinely are tasked to position the lower extremities of

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burn patients for pressure ulcer prevention, skin graft protection, donor site ventilation, and edema reduction. An appropriate positioning program prevents pressure⁴ and postoperatively minimizes graft loss and donor site morbidity.¹³ Several devices have been described in the burn literature for use with the upper extremities.^{12,14,15} However, the most common anatomic sites at risk for pressure decubitus are the sacrum, coccyx, heels, ankles, buttocks, and occiput.^{11,16–20} In fact, the Agency for Health Care Policy and Research reports that immobilized patients require a plan to relieve heel pressure.²¹ Despite this, only a few devices described in the burn literature meet this need for the lower extremities.^{12,22}

One such device, a suspension net constructed of three-quarter-inch diameter PVC, PVC connectors, and elasticized tubular netting was described by Serghiou et al¹³ as an effective and cost-efficient alternative to skeletal suspension for the prevention of pressure decubitus and the protection of skin grafts. However, we experienced limitations related to this device. It did not provide the necessary rigid support for the proper positioning of larger individuals or extremities with the severe edema formation common in burns. The device lacked durability and required frequent replacement in our setting. The lightweight nature of the device allowed agitated patients to easily move the device in bed. The device limited treatment flexibility because it only allows for a single leg position. The resultant leg elevation of 12 inches is unnecessary when treating only to prevent pressure decubitus or to protect lower leg grafts and donor sites because prolonged use of the device could potentially result in decrease tissue perfusion and increase shear forces at the sacrum. Appropriate disinfecting protocols tended to break down the cement used to construct the device. This resulted in the need for more frequent repairs and is a potential patient safety risk.

We developed two alternative positioning devices, the high-profile and low-profile leg nets, constructed of copper pipe and fittings, to address the limitations of the PVC device. The enhanced construction of the high-profile leg net resulted in improved rigidity, durability, stability, and infection control. The development of the low-profile leg net increased available treatment options for therapists and provided for more goal-specific treatment.

METHODS

The high-profile and low-profile leg net devices were simple to fabricate and maintain. The frame was assembled using a three-quarter-inch diameter copper pipe and copper fittings (45 degrees, 90 degrees, and



Figure 1. All required copper pipe and fittings for construction of one high-profile and one low-profile leg net.

tees; Figure 1). A complete list of parts is found in Table 1. The copper pipe was cut to specific lengths using a pipe cutter or other appropriate metal cutting tool. The pipe ends and fittings were prepared for adhesion by using either a fine grit sandpaper or three-quarter-inch diameter wire brush to scratch the bonding surfaces to remove any dirt, oil, or other debris that may interfere with adhesion. To ensure a good fit at each joint, a dry fitting was performed after all pieces were prepared before soldering any of the joints. A portable gas torch, lead-free pipe solder, lead-free tinning flux, and a typical pipe sweating technique were used to assemble the frame forming a trapezoid-shaped wedge (high profile; Figure 2) and a rectangular-shaped block (low profile; Figure 3). Pipe flux was applied, using a brush, to the end of the pipe and the fitting positioned. Each joint was posi-

Table 1. Complete part list for the fabrication of the high- and low-profile leg nets

Comprehensive Parts List			
High-Profile		Low-Profile	
Item	Qty	Item	Qty
12.5" pipe	2	16" pipe	2
11" pipe	4	10" pipe	2
10" pipe	2	4" pipe	4
6.75" pipe	2	90° fitting	8
5" pipe	2		
3" pipe	4		
90° fitting	6		
45° fitting	4		
Tee fitting	4		

All pipe is cut from three-quarter-inch copper tubing and used with three-quarter-inch fittings. The construction of the nets also requires a portable gas torch, solder, and tinning flux.

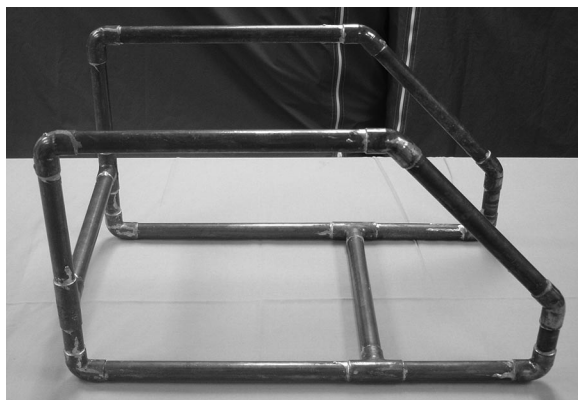


Figure 2. High-profile leg net frame.

tioned with the edge of the fitting facing up for soldering, which facilitated the solder being drawn into the fitting for a more secure bond. The pipe was fitted in place on both sides of a fitting when soldering. Because one joint was soldered, solder sometimes ran off into the other side of the fitting and affected the fit without the pipe in place. The pipe and fitting was heated with the gas torch until the copper began to discolor and the tinning flux bubbled. As the frame was constructed, it was necessary to rotate the frame to position the fittings for the soldering process. Enough solder was applied to a joint when run-off was observed or it no longer was being drawn into the fitting. Any excess solder was sanded off after cooling. The device was completed by pulling a double layer of elasticized tubular netting over the frame and doubling it back for leg support (Figure 4). Plastic tie wraps were used to secure the elasticized netting to the frame and to draw the netting taut for additional support.

The devices are compatible with any bed surface. The high-profile leg net was used for posterior thigh graft protection and donor site ventilation (Figure 5). The low-profile leg net was used for posterior lower-leg graft protection, donor site ventilation, and pres-

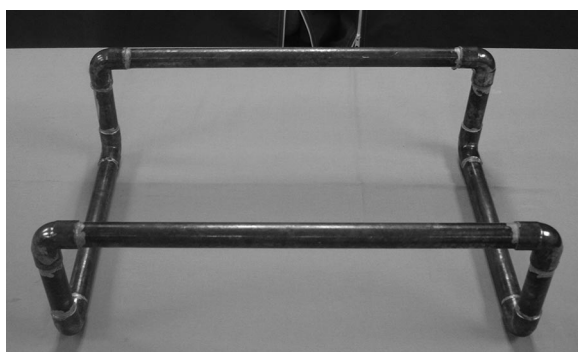


Figure 3. Low-profile leg net frame.

sure decubitus prevention (Figure 6). Both devices elevated the lower extremities and assisted with edema reduction. The devices were implemented unilaterally on a rotating schedule to prevent excessive pressure and/or shear forces on the sacrum. The netting was exchanged when soiled or visibly stretched. The frame was soaked in a solution of hot water and an enzymatic cleanser for a minimum of 20 minutes and then wiped down with a disinfecting solution between patient use. Swab cultures obtained from the devices postdisinfection yielded no evidence of contamination.

RESULTS

Both leg net devices were used on more than 250 patients for a total of more than 1200 treatment days since January 2004. No incidence of pressure decubitus was observed, and graft take was not adversely affected. The improved frame strength and netting maintained proper positioning throughout application regardless of the patient's size. None of the devices required repairs or replacement. Medical providers reported the devices are stable on all bed surfaces and the option of one device or the other allowed for more specific treatment. The improved construction of the devices allowed for thorough disinfection without compromising the integrity of the device.

DISCUSSION

Prevention of pressure decubitus in the burn patient is critical. Providers need treatment devices that not only position the patient correctly and safely, but are also readily available, durable and versatile. The enhanced construction of the high-profile leg net addresses the limitations found in other similar devices. The improved rigidity and stability of the device allowed for better positioning of patients in the supine position throughout the entire application period of the device. The improved durability of the device resulted in fewer required repairs and thorough disinfection without compromising the integrity of the device.

Prevention strategies for pressure decubitus can be costly; however, prevention of pressure decubitus is far less costly than the treatment of pressure decubitus.⁴ The PVC version of the leg net costs approximately four times less than the copper version for initial fabrication. However, our experience with the PVC version resulted in an average replacement rate of two PVC leg net devices a month. Since our implementation of the copper version more than 2 years ago, we have not had to repair or replace any of the copper leg net devices. The initial cost of the copper

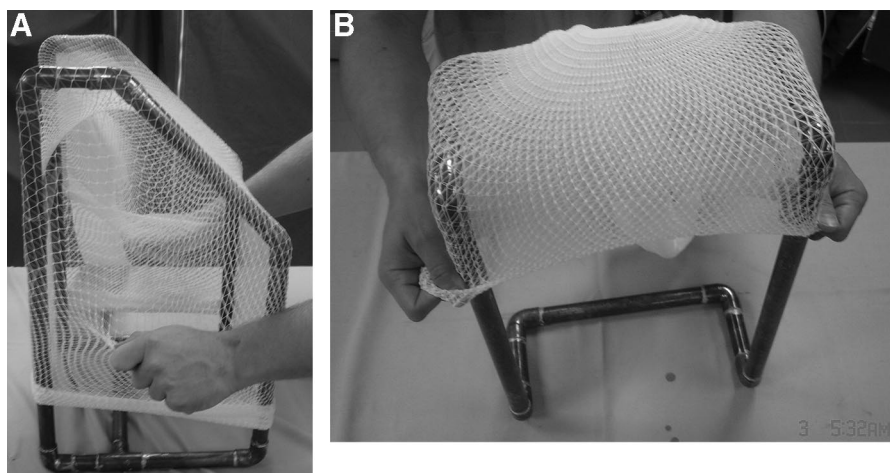


Figure 4. Pulling the elasticized netting over the high- and low-profile leg net frames.

leg net devices was disproportionate; however, when the additional supply and manpower costs for replacing the PVC leg net devices was considered, we estimated the increased cost of the copper leg net devices can be recovered in 6 months.

On the basis of our experience, we maintain one high-profile leg net for every two burn beds and two low-profile leg nets for every three burn beds. For example, a burn center experiencing an average daily census of 25 patients would need to have 12 high-profile and 16 low-profile leg nets on hand. When compared with the PVC version, the same facility would need to maintain an additional two leg nets each month to account for equipment failure. Our facility has not experienced any leg net shortages based on these ratios.

Neither the high- nor the low-profile leg net devices adversely affected graft take at our facility. Documented provider wound assessments suggested that the net suspension design of the devices enhanced wound ventilation and assisted in controlling wound

moisture levels. Moisture contributes to pressure decubitus development by removing oils on the skin and making it more friable.⁴ No change in the incidence of pressure decubitus was observed since the implementation of the devices. Patients report that the devices are comfortable and simple to manage. Providers also report that the devices are easily implemented and managed throughout the course of application. The development of the low-profile leg net increased available treatment options for therapists and permitted more goal-specific treatment. The low-profile leg net also was used as a head net device when placed upside down and perpendicular to the head, providing pressure relief and wound ventilation to the posterior scalp. Further examination using the device in this manner is needed.

The intent of this informational report is to present these devices to the burn community for review. As such, future prospective studies need to be performed to examine these devices. Areas of specific interest would include establishing decubitus incidence rates,



Figure 5. High-profile leg net placement with posterior thigh donor site.



Figure 6. Low-profile leg net placement with posterior lower leg donor site.

skin graft/donor site healing times, edema reduction, and pain when using these devices.

CONCLUSIONS

Both positioning devices were found to be an effective method of positioning lower extremities to prevent pressure ulcer, minimize graft loss and donor site morbidity, and reduce edema. The devices allowed for proper wound ventilation and protected grafted lower extremities from shear forces on any bed surface. It appears that the resulting position, in conjunction with the enhanced ventilation and shear protection, prevented pressure ulcers during periods of immobilization in the supine position. The devices are simple to fabricate, maintain, and require few repairs. The devices can be used on multiple patients once appropriately disinfected.

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