in vivo *22*: 503-508 (2008)

Skin Grafting: Comparative Evaluation of Two Dressing Techniques in Selected Body Areas

FEDERICO DE GADO[1], STEFANO CHIUMMARIELLO[2], CRISTIANO MONARCA[1], LUCA ANDREA DESSY[1], MARIA IDA RIZZO[1], CARMINE ALFANO[2] and NICOLÒ SCUDERI[1]

[1]*Department of Plastic and Reconstructive Surgery, La Sapienza University, Rome;*
[2]*Department of Plastic and Reconstructive Surgery, Perugia University, Italy*

Abstract. *Background: Skin grafting is a frequent surgical procedure used to reconstruct a soft-tissue deficit. Tie-over bolster dressing is the traditional technique made to fix the graft to the recipient area. This dressing does not always provide satisfactory results in some difficult body areas, with poor skin graft taking as an outcome. Here, we used a soft "polyurethane sponge" as a compressive tool. Materials and Methods: A therapeutic protocol was used to select patients, splitting them into 2 groups: tie-over bolster dressing versus polyurethane sponge. Data analysis and calculation of sample size were performed using the Statistical Package for the Social Sciences Windows version 13.0. Results: Of the 106 patients treated by traditional compressive dressing, 11 had complications, thus achieving a success rate of 89.6%. Of the 106 patients treated by polyurethane sponge dressing, 3 had complications, providing a success rate of 97.1%. Conclusion: Compared with the conventional tie-over dressing, the sponge dressing technique was demonstrated to be more successful in graft taking in selected areas.*

Skin grafting is a frequent surgical procedure used in plastic surgery to reconstruct a soft-tissue deficit or to repair a wound. Cutaneous grafting is a surgical transplant of variable derma-epidermis thickness in order for it to be set in a recipient area. Tie-over traditional bolster dressing with rolled-up gauzes is the traditional and most commonly used technique to achieve a secure skin graft adherence and immobilization at the wound bed (1). Blair and Brown in 1929 (2) emphasized that requirements for successful skin grafting were exact approximation to the wound rim and application of even pressure to the graft by an adequate dressing. The correct pressure range on the graft is from approximately 15 to 30 mmHg in order to ensure satisfactory adhesion without liquid collection between the recipient area and the graft itself, which could compromise transplant survival (3). Adequate pressure can be obtained by various kind of materials such as surgical gauzes, cotton, sponges, wax moulds, plastic disks and other materials.

Many similar methods have been proposed to achieve a good skin grafting outcome, such as modified tie-over dressing, stapled tie-over stent and transparent gas bag tie-over, to maximize the possibility of graft adhesion to the wound bed (4-6) but a comparative study of two different dressing techniques for the same anatomic body area has not been reported.

In this study we have selected the anatomic areas to treat by skin graft, considering topographic criteria such as heavily irregular concave or convex anatomic locations, lack of structural support for the graft (*i.e.* surgical excision of a cutaneous lesion of the ear and its cartilage), areas with bony or tendinous subcutaneous prominences. These characteristics were found in nose, hand, ear, leg, wrist and neck, and we consider these "selected areas" as more risky and difficult in their treatment. We decided to compare traditional bolster dressing with the polyurethane sponge dressing technique, in order to evaluate the success of the graft, costs, admission and operative times and patient discomfort at dressing removal.

In fact, after the graft is placed carefully into such selected recipient areas, the most important issue is to provide an efficient compressive dressing to improve contact between the skin graft and the wound bed and to allow appropriate angiogenesis and ensuring graft survival in the first days. Therefore, in four to five days, even adhesion of the graft will improve its taking, reducing the occurrence of seromas, haematomas or displacements, partial or total graft loss, macerations, or graft wrinkling.

Here, we used a soft polyurethane sponge as a compressive dressing, as it is already well known in treatment of various injuries such as pressure sores, and infected and secreting wounds (7, 8). This dressing material has suitable modelling

Correspondence to: Dr. Cristiano Monarca, Via R. Bracco 3, 00137 Roma, Italy. Tel: +393383820254, Fax: +39098342250, e-mail: cmonarca@alice.it / mariaidarizzo@alice.it

Key Words: Polyurethane sponge, tie-over, skin graft, wound bed, difficult body areas.

Table I. *Oncological aetiology and surgical areas.*

Group	Oncological aetiology (no. pts)	Areas, no. pts					
		Nose	Hand (Dorsum)	Ear	Leg (Tibial plane)	Wrist	Neck
A	Precancerous lesions (30)		16		5		9
	Basal cell carcinoma (70)	Dorsum 8 Ala 5 Tip 3		Auricular 15 Retroaur 3 Concha 2	10	15	9
	Squamous cell carcinoma (6)		4			2	
B	Precancerous lesions (30)		16		5		9
	Basal cell carcinoma (70)	Dorsum 8 Ala 5 Tip 3		Auricular 15 Retroaur 3 Concha 2	10	15	9
	Squamous cell carcinoma (6)		4		2		
Total	212	32	40	40	34	30	36

properties and high fluid absorption; it does not stick to the wound bed, allowing a homogeneous pressure distribution and, at the same time, retains its soft consistency long-term.

Materials and Methods

The study was performed at the Department of Plastic and Reconstructive Surgery, La Sapienza University, between 2004 and 2006, with at least six months follow-up (until April 2007).

Patients had to be willing and able to comply with treatment and to give consent. A therapeutic protocol was developed to select patients, characterized by inclusion and exclusion criteria, and splitting the patients into 2 groups with common features in a random manner.

This study was conducted in accord with ethical standards of the Helsinki Declaration.

Inclusion criteria. Age range 18 to 80-years-old, Caucasian, grafting for oncological aetiology, presence of previously untreated lesions, medical history of good compliance with medical treatment, and lesions sited only in the selected areas.

In our study, 6 selected areas were defined: nose (dorsum, ala, tip), hand dorsum, ear (auricle, concha, retroauricular region), tibial plane, wrist and neck (Table I). Patients were randomly assigned to group A and group B, treating group A by traditional tie-over bolster dressing and group B by sponge dressing.

Exclusion criteria. As well as not fulfilling the inclusion criteria, patients were also excluded if lesions were clinically infected, massively secreting in exudate, cellulites were present around wounds, patient's condition was clinically deteriorating, if the patient was diabetic or had any haematological disease or was taking anticoagulant or cortisone-based drugs.

Operative technique. Two techniques were performed by the same senior Author to secure skin grafts as follows. The first technique was a skin graft was harvested, fenestrated and laid onto the wound defect. The graft was tacked down to the recipient bed with a continuous circumferential 4-5/0 reabsorbable suture; a tie-over dressing was prepared comprising a rolled length of first soaked then dried gauzes, overlapped to a sheet of tullegras, to avoid sticking to the graft. The width and length of the dressing corresponded approximatively to the graft size. The needle was then placed through the graft on its corresponding opposite edge to emerge at its adjacent wound edge. This results in a loop of sutures (Figure 1 A).

The second technique used was a skin graft was harvested, fenestrated and laid onto the wound defect. The graft was tacked down to the recipient bed with a continuous circumferential 4/5–0 reabsorbable suture. A polyurethane sponge dressing was prepared. The sponge was cut by pair of scissors or a scalpel in order to reduce the sponge thickness from 1 to 2 cm according to the desired thickness (Figure 2). The split polyurethane sponge, previously sterilized or re-sterilized by cobalt-60 gamma-radiation, and surgical staples were utilized to firmly fix the graft dressing to the recipient site. Grafts selected were half/full thickness to achieve an adequate cover of the recipient area and/or a better aesthetical outcome. A sponge surplus of diameter approximatively 0.3-0.5 cm larges than the graft size was modelled to allow overlap of graft margins (Figure 3). The skin graft dressing was allowed to remain on the recipient site for 5 days on the head, 6 days on the upper arm and trunk, and 7 days on the lower limb. All patients underwent a postoperative antibiotic therapy for 5-7 days. Patients with lower limb skin grafts were mobilized the following day.

Evaluation. The purpose of this study was to compare for each area the two different graft dressing techniques, bolster dressing *versus* polyurethane sponge dressing (Figure 2). Patients treated by the

Table II. *Evaluation*.

	Group A Bolster dressing	Group B Sponge dressing	*p*-Value
Graft success	89.6%	97.1%	NS
Hospitalization	162 days	138 days	0.04
Discomfort/Pain on removal	63.2%	19.8%	0.02
Surgical procedure duration	22 min	12 min	0.01
Material cost	€ 445,2	€ 447	
Cost effectiveness	€ 36,500	€ 24,500	

Table III. *Graft success*.

	Group	
	A	B
Area		
Nose	12/16 (75%)	15/16 (93.7%)
Hand	17/20 (85%)	20/20 (100%)
Ear	18/20 (90%)	19/20 (95%)
Leg	16/17 (94.1%)	16/17 (94.1%)
Wrist	15/15 (100%)	15/15 (100 %)
Neck	17/18 (94.4%)	18/18 (100%)
Total	95/106 (89.6%)	103/106 (97.1%)

skin graft procedures were evaluated for graft success, post-operative duration of hospitalization, discomfort/pain on removal, duration of surgical procedure, cost effectiveness, material cost (Table II). The Visual Analogue Scale was used for pain analysis (VAS) (9). Patients drew up a document related to their personal feelings regarding pain and discomfort at dressing removal with a graduated scale ranging from 0 to 10.

Statistical analysis. All data analysis and calculation of sample size were performed using the Statistical Package for the Social Sciences Windows version 13.0 (SPSS, Chicago, Illinois, USA). According to the statistician's evaluation, the sample size was sufficient to evaluate the hypothesis. Descriptive statistics for quantitative continuous variables were the mean and standard deviation after confirmation of normal distribution. Normality assumptions were demonstrated with histograms, Q-Q plots, skewness and kurtosis, Kolmogorov/Smirnov and Shapiro Wilk testings. Descriptive statistics for qualitative categorical variables were performed with frequencies. Comparisons between groups were conducted with Student's *t*-test for continuous variables and the Chi-Square test for categorical variables. All *p*-values were considered significant if inferior to 0.05.

Results

According to our criteria, we selected 212 patients, affected by oncological disease, requiring a surgical reconstructing skin graft procedure. Table I shows the patients grouping according to aetiology and grafting site. Patients were distributed in a totally random manner but according to aetiology and site: 106 patients (group A) were treated by traditional tie-over compressive dressing (64 male and 42 female; mean age 58.3 years), and 106 (group B) by polyurethane sponge dressing (66 male and 40 female; mean age 57.9 years); overall mean age was 58.1 years (age range from 18 to 80 years).

Patients treated by traditional bolster dressing, on the whole, required 140 days of hospitalization and an additional 32 days for taking care of graft complications (172 days). Patients treated by sponge dressing, on the whole, required 128 days of hospitalization and an additional 10 days for taking care of graft complications (138 days).

The traditional tie-over bolster dressing global cost in the post-operative days was 36,500 €, while that of the sponge dressing was 24,500 €. The cost of bolster tie-over dressing was 4.2 € overall for each; the overall cost for 106 patients was 445.2 €; the cost of sponge dressing material was 4.5 € overall for each; the overall cost for 106 patients was 477 €.

The tie-over bolster dressing required on average 22 min (range 12-39 min) to carry out while the ame surgeon required on average 12 min (range 10-16 min) to carry out the same procedure. Of 212 patients treated, 20 patients in group A reported high discomfort, 9 medium discomfort, 38 slight discomfort and 39 with no discomfort, while in group B 21 patients reported slight discomfort and 85 no discomfort (Table II).

In our series of 106 patients treated by traditional compressive dressing (group A), 11 had complications (104%) (Figure 1B) which were distributed as: 4 nose dorsum, 3 hand, 2 ear, 1 tibial, 1 neck; this gave an overall success rate of 89.6%. Of the 106 patients treated by polyurethane sponge dressing (group B) 3 had complications (2.9%): 1 nose, 1 auricular and 1 tibial giving a success rate of 97,1% (Table III).

Discussion

Exact approximation to the wound rim and application of even pressure by an adequate dressing to the graft was introduced and underlined in 1929 by Blair and Brown (2). Over time many dressing methods have been described to optimize the chances of a successful graft outcome (10-15). The various tie-over techniques, in which gauze and paraffin gauze are used, however, are difficult to apply to selected difficult areas and the absorbency of the gauzes is limited. Bolster dressing may be applied to ensure skin graft success and this technique is very useful in ensuring pressure over the graft on many anatomic sites of the body awaiting neoangiogenesis. However, good surgical skill and experience in such areas is

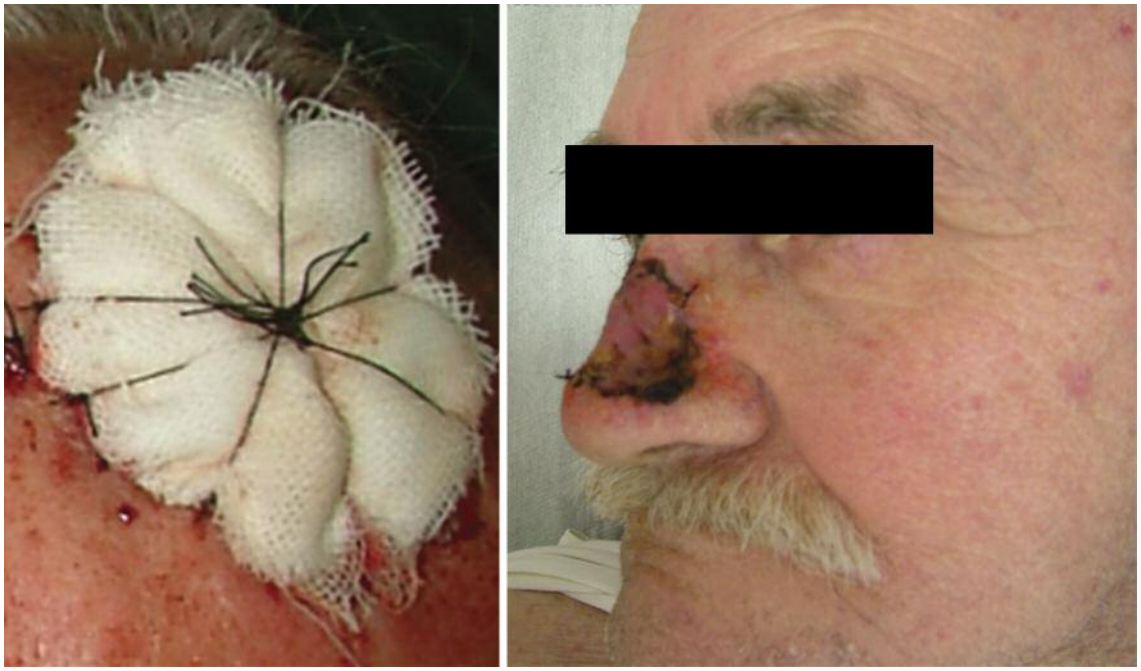

Figure 1. *A) Moulage bolster dressing and B) complication.*

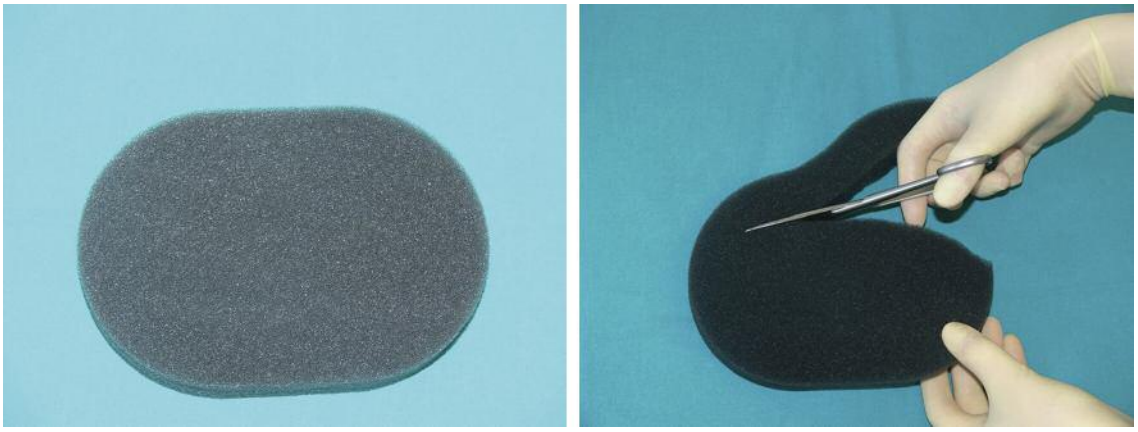

Figure 2. *Polyurethane sponge dressing.*

required, especially in heavily irregular concave or convex anatomic locations such as the nose dorsum, hand, or ear.

Dressing may cause unnecessary trauma to the graft when removed (10, 12). On occasions, in fact, fixation is insufficient and/or the pressure is unequal, with dead spaces forming which can result in graft contact loss with the wound bed (11, 12). Moreover, blood-soaked gauzes inevitably get hard quickly and stick to the skin graft, causing pain and discomfort when they are removed and, furthermore, a higher risk of graft displacement from the wound bed.

In our series, the polyurethane sponge dressing exhibited a very high absorbance capacity in all the patients under evaluation. Of the 106 patients treated by sponge dressing, none experienced seroma or hematoma. It is worthwhile noting that the use and removal of this dressing did not cause any damage to the wound. Another interesting benefit was the absence of pain on dressing removal. In contrast the tie-over bolster dressing was of lower absorbance capacity in the patients, had a higher complication rate, more pain on dressing removal and often caused damage to the graft. The sponge dressing could be used for prolonged time if necessary. The

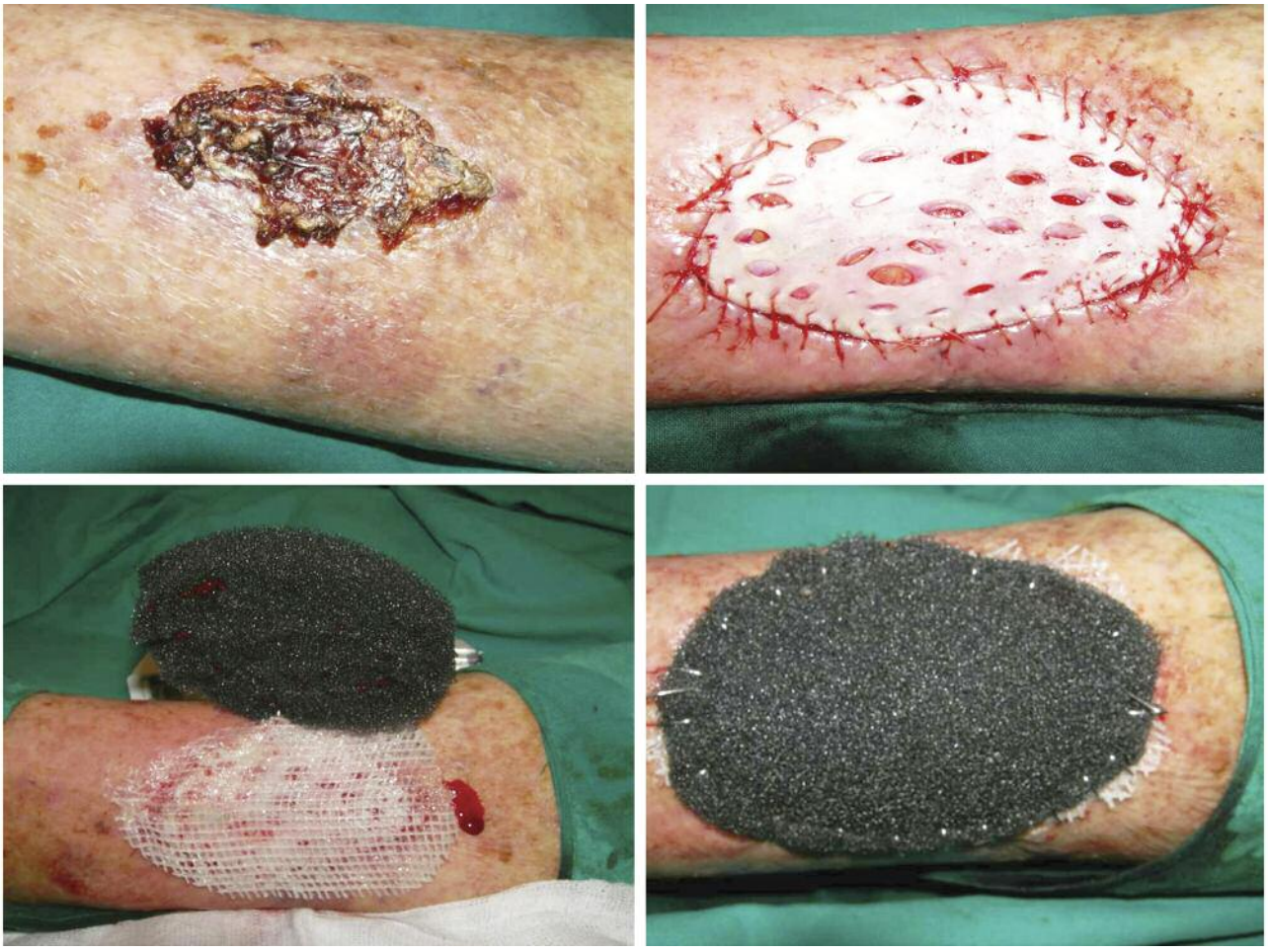

Figure 3. *Sponge dressing operative technique. A) Lesion, B) skin graft, C) sponge modelling and D) sponge fixation.*

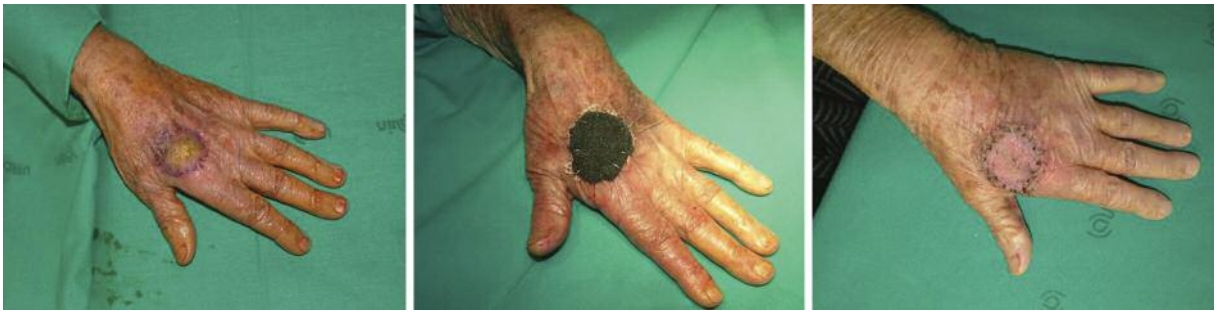

Figure 4. *Sponge dressing pre-operative and post-operative outcome. Note the absence of seroma, haematoma or graft damage at dressing removal.*

spongy material if left longer does not give rise to ischemia or decubitus, whereas traditional dressing does and more easily produces a pressure sore or sticks to the graft.

Our series analysis demonstrated a higher complication rate (10.4%) in tie-over bolster dressing than in patients who underwent polyurethane sponge dressing (2.9%), showing the suitability of this dressing technique.

Furthermore, in our series, the dressing technique comparison highlighted some points as follows. Traditional bolster gauze dressings even if highly popular have some

disvantages the surgical procedure: is longer and more complicated and the dressing does not provide appropriate protection from impact, probably due to the gauze swiftly hardening. Moreover, when saturated with blood, the dressing becomes hard and may stick to the graft, causing damage to the wound bed and pain on removal; in some irregular convex or concave areas, even pressure is not guaranteed; it is more difficult to remove and, furthermore, gauze hardening caused a higher risk of graft displacement from the wound bed. Finally, the dressing cost is more expensive than that with the sponge method.

The polyurethane sponge technique in skin graft dressing seems to offer some advantages to selected difficult areas when compared with the traditional dressing. In fact, it is a quick and easy surgical procedure; it is not expensive in its material; sponge is mouldable and adaptable, and fits into various forms and adjusts to the anatomical zones of concavity or convexity. Hence the main advantages of this technique are convenient contour adjustment and the ability to generate various pressures over the body structures, especially in difficult areas.

Moreover, the sponge dressing exerted an even pressure on the graft over the entire surface. It was very easy to remove and did not cause postoperative pain or discomfort to the patient, and had a lower risk of graft displacement. The sponge did harden nor adhere to the graft, thus minimizing the risk of raising it from the wound bed (Figure 4).

In conclusion, in our series, the sponge dressing technique was shown to be more successful in graft taking in selected difficult areas compared with the conventional tie-over dressing. The results show that the sponge technique compared to conventional dressing guarantees adhesion between the graft and the wound bed in difficult areas; moreover it allows better fluid collection absorption and it appears more suitable for secreting or infected wounds. Being inexpensive, quick and requiring no great surgical skill, makes this material greatly suitable for use not only in the difficult areas described here but also in other areas.

References

1 Cheng LF, Lee JT, Chou TD, Chiu TF, Sun TB, Wang CH, Chien SH and Wang HJ: Experience with elastic rubber bands for the tie-over dressing in skin graft. Burns *32(2)*: 212-215, 2006.

2 Blair VP and Brown JP: The use and uses of large split skin grafts of intermediate thickness. Surg Gynecol Obstet *49*: 82-97, 1929.

3 Zanini M, D'Apparecida Santos Machado Filho I C and Timoner F: Surgical sponge as a pressure dressing for skin grafts. Ann Bras Dermatol *79(3)*: 359-362, 2004.

4 Westerband A and Fratianne RB: Stapled tie-over stent: a simplified technique for pressure dressings on newly applied split-thickness skin grafts. J Burn Care Rehab *14*: 463-465, 1993.

5 Ren J, Yiang QJ, Deng B and Yiang YN: Transparent gasbag tie-over for persistent pressure and inspection in free skin grafting. Plast Reconstr Surg *95*: 396-399, 1995.

6 Rudolph R and Ballantyne DL: Skin Graft. *In*: Plastic Surgery, Vol. 1 McCarthy J G (ed.). Philadelphia, Saunders, pp. 180-191, 1990.

7 Martini L, Reali UM, Borgognoni L, Brandani P and Andriessen A: Comparison of two dressings in the management of partial-thickness donor sites. J Wound Care *8(9)*: 457-460, 1999.

8 Di Benedetto G, Pierangeli M, Scalise A, Andriessen A, Rowan S and Bertani A: An improved tie-over dressing technique for skin grafts using a hydrocellular dressing. Plast Reconstr Surg *106(2)*: 507-509, 2000.

9 Lee V C and Rowlingson: J C Chronic Pain Management. *In*: Quality of Life Assessments in Clinical Trials. Spilker B (ed.). New York, Raven Press, 1990.

10 Blackburn JH 2nd, Boemi L, Hall WW, Blackburn JH 2nd, Boemi L, Hall WW, Jeffords K, Hauck RM, Banducci DR and Graham WP 3rd: Negative-pressure dressings as a bolster for skin grafts. Ann Plast Surg *40(5)*: 453-457, 1998.

11 Avery C, Pereira J, Moody A and Whitworth I: Clinical experience with the negative pressure wound dressing. Br J Oral Maxillofac Surg *38(4)*: 343-345, 2000.

12 Isago T, Nozaki M, Kikuchi Y, Honda T and Nakazawa H: Skin graft fixation with negative-pressure dressings. J Dermatol *30(9)*: 673-678, 2003.

13 Misra A and Belcher HJ: A new loop suture tie-over technique for skin graft dressings. J Hand Surg [Br] *27(2)*: 129-133, 2002.

14 Prunes F and Asbun F: A simplified stent dressing technique using elastic rubber bands. Ann Plast Surg *23*: 84, 1989.

15 Kurring PA, Roberts CD and Quinlan D: Evaluation of a hydrocellular dressing in the management of exuding wounds in the community. Br J Nurs *3(20)*: 1049-1050, 1994.

Received January 18, 2008
Revised March 18, 2008
Accepted March 27, 2008