ISSN: 2755-0176

Journal of Cancer Research Reviews & Reports

SCIENTIFIC Research and Community

Review Article

Open Access

The Management of Skin Defects at the Extremities Secondary to Malignant Cutaneous Tumor Resection by Split-Thickness Skin Grafts

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ABSTRACT

We report in the light of a literature review the results of 20 patients treated by split-thickness skin grafts (STSG) at the extremities to cover skin defects secondary to malignant cutaneous tumor resection between 2012 and 2016 with a view to a prospective study with longer following up and a greater number of patients.

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Received: May 26, 2021; **Accepted:** June 07, 2021; **Published:** June 11, 2021

Keywords: Split-Thickness Skin Grafts, Malignant Cutaneous Tumors, Extremities

Introduction

A skin graft is defined as a cutaneous free tissue transfer that is intentionally separated from a donor site and transplanted to a recipient site [1]. It remains the gold standard of care in the treatment of large skin defects not amenable to secondary healing, primary closure, or local tissue rearrangement [2]. Commonly, different types of grafts possesses are employed for cutaneous surgery each with its avantages and disadvantage : epidermis skin grafts (0.2-0.3 mm), thin split-thickness skin grafts (0.4-0.5 mm), medium split-thickness skin grafts (0.6-0.7 mm), thick split-thickness skin grafts (0.8-1.1 mm), full-thickness skin grafts (FTSG) and composite grafts [3].

In our context, we adopt skin graft after skin cancer removal, in leg ulcers to expedite healing and in the case of extensive post traumatic wounds or burns. We share through this article our experience concerning the management of skin defects secondary to malignant cutaneous tumor resection by skin graft in 20 patients with a literature review.

Patients and Method

Twenty patients (12 men, 8 women) were treated by split-thickness skin grafts (STSG) at the extremities between 2012 and 2016 at the department of orthopaedic surgery in collaboration with dermatologic departement. We included patients who presented a skin defect after primary resection of a malignant skin tumor (Figure 1), which were distributed as follows : 10 cases of basal cell carcinoma, 6 cases of malignant melanoma and 4 cases of Bowen's disease.

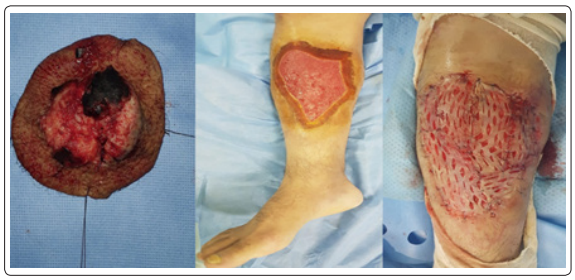

Figure 1: Intraoperative view of a STSG after cutaneous tumor resection

The excision shape was circular or approximately circular with a diameter average around 10 cm (range 8–14 cm). A STSG of 0.4 mm thickness was harvested from the donor site using an electric dermatome. The grafts were fenestrated to a mesh in order to increase graft surface size and to allow sufficient wound drainage. The graft was fixed with unabsorbable sutures or skin staples when these are available and covered with absorbent non adherent pads for five to seven days depending on the vascular health of the wound base.

To test the patient's subjective opinion regarding the postoperative result we used the Patient and Observer Scar Assessment Scale (POSAS) (Figure 2 and 3) in which the patients assess their scar with regard to pain, itchiness, colour, stiffness, thickness and irregularity while the observer evaluates vascularity, pigmentation, thickness, relief, pliability and the surface area of the scar [4]. All criteria are compared to intact skin. In addition, we had recourse to the Dermatology Life Quality Index (DLQI) (Figure 4) that was developed to measure with 10 questions the impact of skin

conditions for several skin diseases on the patients' life. To obtain a focussed assessment of protective tactile sensations with simple tools, two-point discrimination (TPD) and fine cotton touch (CT) tests were performed. Range of motion (ROM) of joints next to the graft were measured using a goniometer [5].

Figure 2: Patient Scar Assessment Scale (PSAS) [4]

	No, no complaints	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Yes worst imaginable**
Is the scar painful ?		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Is the scar itching ?		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
	No, as normal skin											Yes, very different
		1	2	3	4	5	6	7	8	9	10	
Is the color of the scar different ?		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Is the scar more stiff ?		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Is the thickness of the scar different ?		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Is the scar irregular ?		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Total score												

Figure 3: Observer Scar Assessment Scale (OSAS) [4]

	Normal skin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Worst scar imaginable**
Vascularisation		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Pigmentation		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Hypo ☐
Thickness		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Mix ☐
Relief		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Hyper ☐
Pliability		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
Total score												

Figure 4 : Dermatology Life Quality Index (DLQI) [5]

1) Over the last week, how itchy, sore, painful or stinging has your skin been ?	Very much A lot A little Not at all	☐ ☐ ☐ ☐	
2) Over the last week, how embarrassed or self conscious have you been because of your skin	Very much A lot A little Not at all	☐ ☐ ☐ ☐	
3) Over the last week, how much has your skin interfered with you going shopping or looking after your home or garden ?	Very much A lot A little Not at all	☐ ☐ ☐ ☐	Not relevant ☐
4) Over the last week, how much has your skin influenced the clothes you wear ?	Very much A lot A little Not at all	☐ ☐ ☐ ☐	Not relevant ☐
5) Over the last week, how much has your skin affected any social or leisure activities ?	Very much A lot A little Not at all	☐ ☐ ☐ ☐	Not relevant ☐

6) Over the last week, how much has your skin made it difficult for you to do any sport ?	Very much A lot A little Not at all	☐ ☐ ☐ ☐	 Not relevant ☐
7) Over the last week, has your skin prevented you from working or studying ?	Yes No	☐ ☐	
If "No", over the last week how much has your skin been a problem at work or studying?	A lot A little Not at all	☐ ☐ ☐	Not relevant ☐
8) Over the last week, how much has your skin created problems with your partner or any of your close friends or relatives ?	Very much A lot A little Not at all	☐ ☐ ☐ ☐	 Not relevant ☐
9) Over the last week, how much has your skin caused any sexual difficulties ?	Very much A lot A little Not at all	☐ ☐ ☐ ☐	 Not relevant ☐
10) Over the last week, how much of a problem has the treatment for your skin been, for example by making your home messy, or by taking up time ?	Very much A lot A little Not at all	☐ ☐ ☐ ☐	 Not relevant ☐
SCORING : The scoring of each question is as follows : Very much scored 3 A lot scored 2 A little scored 1 Not at all scored 0 Not relevant scored 0 Question 7, 'prevented work or studying' scored 3	The DLQI is calculated by summing the score of each question resulting in a maximum of 30 and a minimum of 0. 0 – 1 no effect at all on patient's life 2 – 5 small effect on patient's life 6 – 10 moderate effect on patient's life 11 – 20 very large effect on patient's life 21 – 30 extremely large effect on patient's life		

Results

Between 2012 and 2016, 20 patients received STSG. The mean age of the patients was 49.2 years (range : 18-66 years). The mean duration of hospitalization was 8.6 days (range : 8-12 days). For all patients, the follow-up period was 1 years. Scars length ranged from 8 to 14 cm with an average of 10 cm while the width of scars was on average 6 cm.The total scar size was on average 89 cm2. Most of the STSG scars were located on the lower limb (60%). The POSAS scores were 22 and 26 for patient (PSAS) and observer (OSAS) scores respectively. In the DLQI, the total score was an average 6 (range : 0-20).

Recovery of two point discrimination (TPD) in the margins of the STSG was observed as early as 1 week in 23.9% patients. In the subsequent follow up periods, 67%, 80.3% and 81.1% cases had recovery of TPD at 1 month, 6 months and 1 year respectively. At the centre of the graft, recovery of TPD was noted in 4.3%, 20% and 60% at 1 month, 6 month and 1 year follow-up respectively. In the CT test the return of sensation was found as early as 1 week in 61.4% cases at the margins of the graft. During the period of observation, 80%, 89% and 92.8% cases developed CT margin of the graft at 1 month, 6 months and 1 year respectively. At the centre, patients developed recovery of CT in 4.3%, 35.7% and 67% cases at 1-month, 6-month and 1-year follow-up respectively (Table 1). In terms of complications we identified 3 cases of wound dehiscence (15%) and 2 cases of infection (10%).

Table 1: the return of TPD and CT in the periphery and the center of the STSG in the follow-up period

Follow-up period	Ruturn of TPD (%)		Ruturn of CT (%)	
	Periphery	Center	Periphery	Center
1 week	23.9	No recovery	61.4	No recovery
1 month	67	4.3	80	4.3
6 months	80.3	20	89	35.7
12 months	81.1	60	92.8	67

Discussion

Skin grafting is thought to have originated in India about 2,500 years ago [6]. In 1823, Bünger, a German physician, was the first to report the successful procedure of human skin grafting by transferring skin from the buttock to the nose [7]. A few years later, Ollier then Wolfe described respectively the first STSG and the first FTSG [8,9].

From a constitutional point of view, we distinguish three primary types of skin grafts: the FTSGs which consist of both the entire

epidermis and dermis of the skin and may contain small amounts of subcutaneous tissue, the STSGs which include the entire epidermis of the skin with a variable amount of dermis and are generally classified by thickness and finally the composite grafts which contain tissue from two or more germ layers, and which usually consist of skin and cartilage in the context of dermatologic surgery [1].

Graft survival depends on the establishment of a blood supply from the recipient site. Initially, the viability of the graft has been maintained by plasmosis until the inosculation of the pre-existing graft vessels that serve primarily as nonviable conduits through which the endothelium of the ingrowing vessels may progress from the host vessels. Initial flow within the graft occurs in an immature plexus of thinwalled, dilated vessels without smooth muscle elements which evolve to mature complex of arterioles, capillaries, and venules over a period of 4 days [10,11,12].

The selection of a graft donor site is based on three factors : thickness of skin graft to use, the color correspondence betweew donor and recipient bed site and potential morbidity of graft harvest at the donor site. For STSG, its usually harvested from the outer thigh, while common full-thickness graft donor sites are the groin, postauricular area, and clavicular region. Yildirim and coworkers also recommend the preputium as a source of graft skin in children [13,14]. In our context, we have harvested all our STSG from the outer thigh taking into account its technical ease and its convenience of intraoperative positioning and postoperative dressings.

For sizing skin grafts, available materials are usually used such as cardboard and latex which are placing in the wound to develop a blotter pattern. Then the cutout is applied over the donor site, traced with a marking pen and the graft of the outlined area is resected [15,16,17].

A wound is reepithelialized from the edges toward the center, therefore the perimeter of the graft is the only part that contributes to the epithelialization process. Therefore an expanded graft presents a larger perimeter through which an optimal epithelial outgrowth can proceed while allowing to cover a larger areas with smaller sections of skin [18,19,20,21]. Various techniques to expand skin for grafting have been described, including pinch grafts, relay transplantation, meshing, Meek island grafts, microskin grafts and the Chinese technique of intermingling autografts and allografts [22,23,24]. In our daily practice, we use an effective modification of the common method of meshing the split-thickness skin graft which is time consuming and remains impractical because of the difficulty in keeping the graft stretched and immobile while making the cuts. During harvesting the STSG, the last border of the graft is leaved attached to the donor site while free corners are maintained stretched with the use of two skin hooks. This method makes easy manual meshing of the STSG with a no. 11 blade. After proper meshing the graft is separated from the donor site using scissors.

Adherence of the graft to its bed is essential for skin graft take. This process goes naturally by two phases, first through the bond formed by the fibrin layer then by the fibrovascular ingrowth and vascular anastomoses established between the graft and the host [25,26]. To improve the stability of the graft we can distinguish between 3 main methods each with its advantages and disadvantages. The most cost-effective and common method is to fix the skin grafts with unabsorbable sutures which are very time consuming during sewing and stitches removal that will be difficult when the sutures are buried in the skin because of epithelialization. To avoid these issues, the absorbable sutures represent a real alternative. The second method of fixation corresponds to surgical stapler which has the advantage of that it is not time-consuming. However, staple removal is often painful and can also become difficult because of epithelialization [27]. Concerning the third fixation methods, several authors suggested the use of special dressing such as silicone rubber dressings, silicone gel sheets, rubber band stents, transparent gasbag tie-over dressings, Coban self-adherent wrap, thin hydrocolloid dressings and assorted Silastic and foam dressings. Recently, modern technologies of skin graft fixation replace progressively the sutures and the staples with fibrin glue or octyl-2-cyanoacrylate applied on the edges of the graft. This procedure can be performed in a short time and provides strong fixation, hemostasis without interfering with healing [28,29,30,31,32,33,34,35]. This method that produces better esthetic results, is suitable for children and has the major disadvantage of an expensive cost [27]. In our context, we prefer depending on availability and for the sake of saving time, fixing by surgical staples which allowed the graft take in all our patients.

The dressing of a skin graft has more influence on graft survival than on graft fixation. In this context, various dressing methods have been descriped. We report first the simple pressure dressing which consists of placing a silicon gauze on the skin graft which is compressed with tapes or bandages [27]. We describe secondly the tie-over dressing considered, despite the long sutures require time, as the most optimal and reliable technique that is fashioned by placing silk sutures around the periphery of the skin graft, which are then tied over a bolster made up of Vaseline-impregnated gauze. This method is basically indicated for locations where tapes are difficult to attach, including mobile areas such as the shoulders, concave and convex surfaces such as the face and the scalp [27]. The comparison between simple pressure dressing and the tie-over dressing in terms of graft survival reported no significative difference [36]. Finally we can have recourse to negative-pressure dressings which enhance graft adherence and survival espacially in difficult-to-bolster areas such as the hand and axilla. Basically, negative pressure of about 25 to 75 mmHg is applied for 5 consecutive days and a pressure of 30 mmHg which completely compresses veins and partially compresses arterial vascularization is optimal for graft take [27,37]. In our practice, we used a chlorhexidine acetate-containing gauze dressing which is soft, pliable and easily configurable according to wound surfaces and which its adherence to wounds is low making it easy to remove. To reduce dead space, formation of haematomas or seromas and prevent shearing forces, fixation and stabilisation of skin grafts in the simple pressure dressing is assured by skin surgical staples.

Immediately after harvest, a skin graft begins to shrink and this primary passive contraction is probably due to the recoil of the dermal elastic fibers. Indeed, a full-thickness graft loses about 40% of its original area as a result of primary contraction, a medium thickness graft about 20% and a thin split-thickness graft about 10%. After transfer to a recipient site, the skin graft continues to shrink as it heals defining secondary contraction which is greater in the case of split thickness grafts and almost absent in the case of full thickness grafts. This degree of secondary graft contraction depends of the proportion of dermis in the graft and can be manipulated of that fact by adjusting the graft thickness. This phenomenon of contraction is also observed at the level of the wound. It is a critical part of the healing process and is clinically useful by reducing wound size [38,39,40,41,42].

Nerves grow into skin grafts from wound margins and the graft bed.The timing of neural invasion and disposition of nerves within a skin graft vary according to the graft thickness and recipient site. Generally, human skin grafts begin to show sensory recovery at 4–5 weeks postgrafting and The return of normal sensation is usually complete by 12–24 months [43]. Weis-Becker and coworkers note better reinnervation of split skin grafts placed on intact muscle fascia than if the fascia had been removed [44]. In our series and in accordance with different literature studies, recovery of sensation in STSG begins at the periphery in the region of the proximal nerve supply and spreads distally.

Immediately after harvesting, a skin graft blanches from circulatory interruption by the loss of the melanoblast content. With the reestablishment of the graft revascularization, the normal equilibrium of the melanocyte population is restored in view of successful repigmentation [45]. In termes of complications, literature has reported rates of failure in lower limbs grafts of between 0 and 33% [46]. The Obesity, wound infection, dehiscence, hematoma, seroma formation, peripheral vascular disease and immunosuppressant medication use are identified as significant risk factors [47]. In addition to a meticulous surgical technique, Flowers recommends to prevent graft failure a number of measures to enhance the survival of skin graft including the quality of the graft bed that must be clean, free of dead tissue with an appropriate substrate, careful hemostasis, postoperative immobilization of the graft recipient site and no excessive pressure on a fresh graft [48]. Because strep and staph produce streptokinase and other enzymes that break down the fibrin clot and decrease adherence of the graft to its bed, Hill proposes the administration of low-dose erythromycin for the first 5 days after grafting to combat potential bacterial colonization [49]. Patients should also take vitamin C and zinc for a week to 10 days to promote healing, and should abstain from using alcohol which decreases the initial phase of wound healing for at least 2 days before and 5 days after surgery [49]. In terms of complications we had noted 3 cases of wound dehiscence (15%) and 2 cases of infection (10%) which makes us an overall complication rate of around 25% comparable to those reported in the literature.

In special circumstances when the standard wound coverage with standard therapies is not desirable, Skin substitutes are a real alternatives to the skin graft. These materials may be classified according to their origin (autologous, allogeneic, xenogeneic, or recombinant) or whether they are used for wound cover when they provide a barrier against infection, control water loss and create an environment suitable for epidermal regeneration or wound closure when the materials aim to restore the epidermal barrier and become incorporated into the healing wound [50,51]. Dermal skin substitutes have been commonly used in acute and chronic reconstructive burn surgery. The Food and Drug Administration (FDA) more recently extended the indications of dermal skin substitutes to include non-burn-related, traumatic and chronic extremity wounds without establishing clear guidance on the exact indications of these medical devices [52]. In the littérature, a multicenter study of 13 study centers in the United States, France, Germany and the United Kingdom was conducted to evaluated the outcomes of 127 wound coverage procedure by dermal skin substitutes in the case of burn injuries. Physician ratings in range of motion or function were rated as good to excellent in 75% of the cases. Patient reported outcomes showed 82% of satisfaction with postoperative range of motion, aesthetic appearance and pain relief [53]. To cover defects following tumor resection, dermal skin substitutes may be a reasonable alternative for a temporizing soft-tissue reconstruction whilst awaiting formal histology. They can act as a temporizing reconstruction whilst awaiting formal histology particularly in elderly patients and patients deemed of a higher anesthetic risk [55,56]. In our context and by the unavailability of dermal skin substitutes, we are used to waiting for the result of the pathologist as to the quality of the resection margins before performing the STSG on an adequate granulation tissue formation free of infection.

Conclusion

Skin grafting is a valuable and reliable reconstructive option of skin defects secondary to malignant cutaneous tumor resection at the extremities that provides good to excellent functional and aesthetic outcomes in properly selected patients and should considered particularly when fewer postoperative interventions may be preferred.

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