Meshed Skin Graft *versus* Split Thickness Skin Graft in Diabetic Ulcer Coverage

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Abstract

Objective : To compare results of skin graft healing in diabetic ulcers between the meshed skin graft method and split thickness skin graft method. Duration of complete skin graft healing in both groups was recorded. The relations between ulcer size and complete skin graft healing duration were analyzed.

Patients and Method : This research used a prospective randomized controlled study with 80 diabetic ulcer patients from January 2002 - June 2003. Thirty-eight cases were treated by the meshed skin graft method with expansion ratio 1 : 3 and another 42 cases were treated with the ordinary split-thickness skin.

Results : The means of complete healing duration were 19.84 ± 7.37 days in the meshed skin group and 20.36 ± 7.21 days in the normal split-thickness skin graft group. There was no statistically significant difference between the groups in duration of complete graft healing and efficacy of treatment. The cosmetic result was accepted in both skin graft methods. There was no statistically significant difference between wound size and complete skin graft healing duration.

Conclusion : The meshed skin graft method is as good for diabetic ulcer coverage as the ordinary split thickness skin graft.

Key word : Meshed Skin Graft, Split Thickness Skin Graft, Skin Graft Healing, Wound Size

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The meshed skin graft is useful for coverage of a wound and was first described in 1964 by Tanner [1]. Expansion of split-thickness skin graft by meshing with expansion ratios from 1 : 1.5 to 1 : 9 is useful for the coverage of large wounds. The meshed graft has the advantages of improving graft bed drainage through the numerous holes and a very convoluted surface and saving donor skin of the patients. Healing of the meshed skin graft follows the same sequence as the ordinary split sheet graft. The meshed graft (1 : 3) heals and grows as other grafts do. Epithelization of the open spaces in the absence of infection is complete in 7 to 14 days as observed in experimental animals and humans[1].

Lower extremity ulcers represent the most common source of complications and hospitalization in the diabetic population. Infection of feet and legs is commonly found in Thai diabetic patients and ends up with amputation or chronic ulcers. Salvage of the lower limb is necessary for these patients. Wounds after debridement must be closed with skin grafts as soon as possible and the meshed skin graft may be a good method for that.

This prospective randomized control study presents the duration of complete skin graft healing that takes in diabetic wounds by the meshed skin graft method and split-thickness skin graft method from January 2002 - June 2003. The results of skin graft in both groups are compared and analyzed for statistical difference. The relations between complete healing duration and size of diabetic wounds were reported.

MATERIAL AND METHOD
Sample

From January 2002 - June 2003 80 patients with diabetic ulcers participated in the present study. All patients had developed infected wounds of lower extremities or feet. The wounds included deep abscesses, gangrene of the toes or feet and necrotizing fasciitis of the lower legs. Local wounds had been debrided and dressed with the wet to dry method until they were covered with granulation tissue. Cultures and sensitivities were made from time to time until bacterial contamination was rare. There were 36 patients treated by the meshed skin graft and 44 patients treated by ordinary split-thickness skin graft. All patients had controlled FBS 150-200 mg per cent, hematocrit ≥ 30 per cent and rare bacterial colonization ($< 10^5$ micro-

organism/g tissue). Size of the ulcers were measured in both groups before the skin graft methods proceeded.

Surgical procedures

The thighs were used for donor site of skin graft. They were applied with Lidocaine-Procaine cream (EMLA cream 5%) in thick layer ($1.5 g/10 cm^2$) under occlusion with plastic films (household plastic wrap) for 2 hours as local anesthesia. After removing of the anesthetic cream and disinfecting the donor site, 0.35 mm (0.014 inches) split-thickness skin was harvested with a dermatome. Two types of free hand knives were used, the Humby knife for the large skin sheet and the De Silva knife for the small sheet (Fig. 1). In the meshed skin graft group, the split thickness skin was meshed with skin graft mesher with an expansion ratio of 1 : 3 and applied to the wound (Fig. 2). For the normal split-thickness skin graft group, full sheet of skin was used (Fig. 3). After skin graft coverage in both groups was established, the dressings consisted of non-adhesive gauze, wet swab with NSS and mild pressure outer layer.

Post-operation care in both groups was the same. Dressings were changed everyday. Moreover, percentage of epithelization or healing of graft, dates of complete healing were recorded. In 6 months of follow-up, sequelae and complications such as infection, prone to minor trauma, hypertrophic scar, keloid, scar or joint contracture were recorded for criteria of efficacy of treatment.

Evaluation of the healing graft

Graft healing was evaluated grossly by the presence of the dry white opaque surface with glossy epithelium. The grafts survived on their new bed wounds and pink color as the circulation returned. The percentages of wound healing were recorded weekly and the days of full wound healing were noted in both groups.

Evaluation of efficacy of treatment

In 6 months of follow-up, the graft wounds were evaluated with these criteria

Excellent

Skin grafts epithelized or healed 95 per cent within 14 days with a smooth scar.

Good

Skin grafts epithelized or healed 95 per cent within 21 days/hypertrophic scar subsided within 6 month.

Fair

Skin grafts epithelized or healed 95 per cent after 21 days/prone to abrasion from minor trauma/ minor infected wounds/obvious hypertrophic scar after 6 months.

Poor

Skin grafts epithelized or healed 95 per cent after 28 days/keloid/contracture of toes or joints/ recurrent ulcer.

Statistical analysis

Equal variances assumed, independent, two-tailed t-test for analysis was used to determine the statistically significant difference of the date of complete graft healing between the two groups. Pearson product moment coefficient analysis and ANOVA analysis were used to compare duration of complete graft healing and size of wounds. Pearson Chi-square test was used to determine the efficacy of treatments between both skin graft groups. The p-value of less than 0.05 was considered to be statistically significantly different.

RESULT

A total of 80 cases of diabetic ulcers were all healed completely after grafted with meshed and
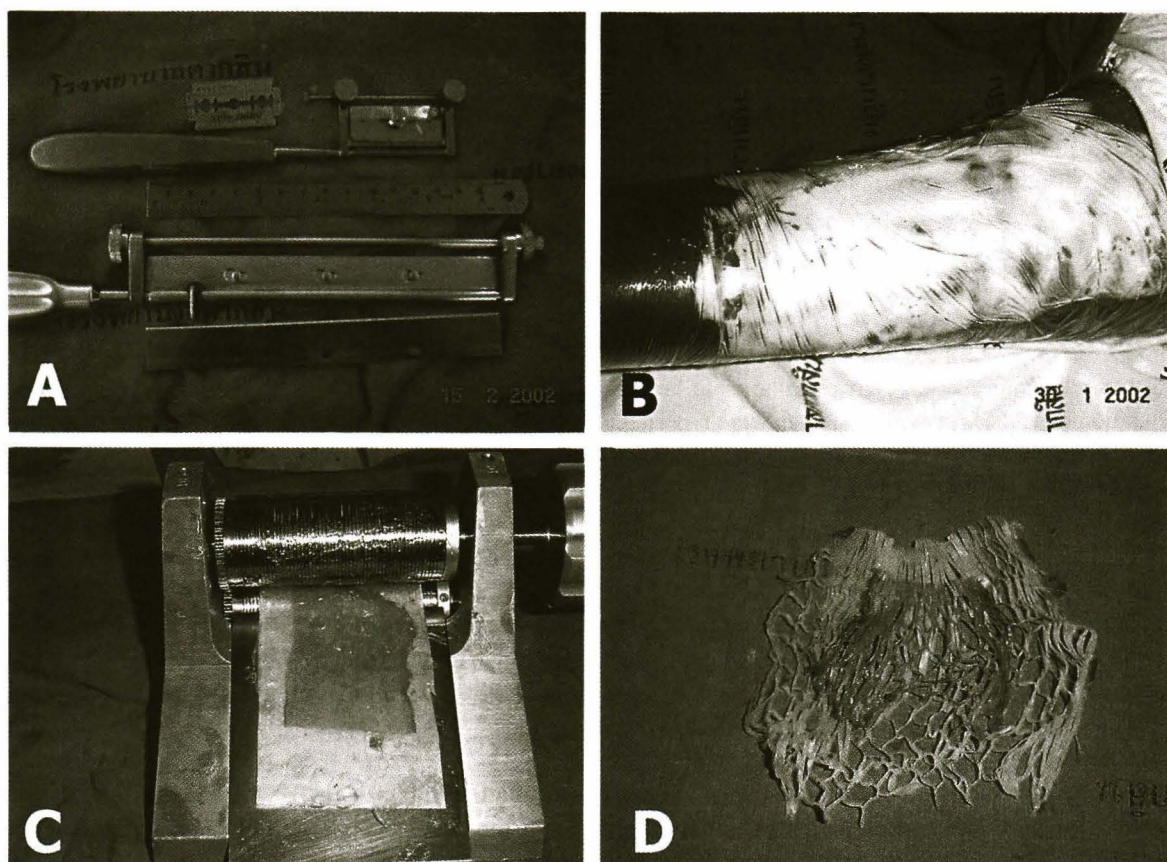

Fig. 1.　A) Two types of dermatome, small one is De Silva knife and large one is Humby knife. B) Topical anesthesia with EMLA cream 5 per cent under occlusion with plastic films. C) The skin mesher. D) A meshed skin with expansion ratio 1 : 3.

split skin grafts. The means of complete healing duration were 19.84 ± 7.37 days in the meshed skin group and 20.36 ± 7.21 days in the split thickness skin group (Table 1). According to the skin graft epithelization and skin healing, both groups had complete healing mostly in the period of 14 to 21 days (Fig. 4). There was no statistically significant difference in duration of complete skin graft healing ($p = 0.282$ by t-test analysis) and efficacy of treatments between both groups ($p = 0.327$ by Chi-square analysis). The size of ulcers and complete graft take in both groups had no statistically significant differences both for Pearson product moment coefficient correlation ($p = 0.219$) and ANOVA analysis ($p = 0.287$). More than 80 per cent of each group had excellent and good grade of efficacy treatment (Table 2). The cosmetic results in both groups were very satisfactory at 6 months with-

out the mesh pattern recognizable in the meshed skin group or keloid formation. There were two cases prone to abrasion but they spontaneously healed after local dressing. There were a few hypertrophic scars in both groups which subsided with 6 months. In the split-thickness skin graft group, there was a case of recurrent ulcer and a case of toe contracture. There was bacterial contamination and delayed skin graft healing (more than 21 days) due to some graft loss. Common bacteria were Pseudomonas aeruginosa and methieillin-resistant Staphylococcus aureus (MRSA).

DISCUSSION

The meshed skin graft in diabetic ulcer of the lower extremities in the present study grew as other grafts did and took 20 days for complete skin graft healing and the split thickness skin graft group took
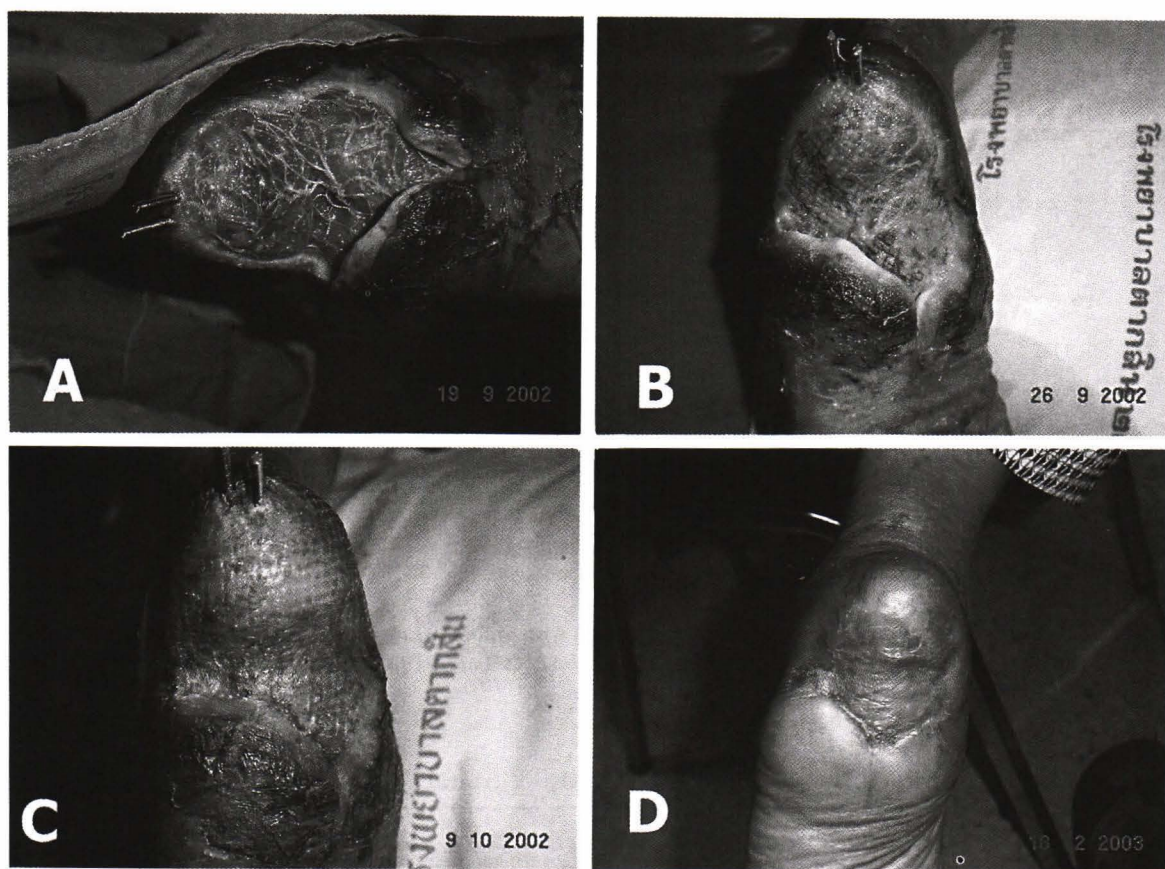

Fig. 2.   Diabetic ulcer at heel of foot was grafted with a piece of meshed skin. A) Grafting with a piece of meshed skin. B) After one week. C) At 3 weeks. D) Healing with smooth surface at 5 months.

about 21 days. There was no statistically significant difference (p = 0.282 by *t*-test analysis) between the groups. Poor drainage and minor infection were the causes of some graft loss and took more time in complete healing in the split thickness skin graft group. Noninfected wounds treated by meshed skin graft took only 10 to 14 days for complete epithelization of the open space[1]. The reasons for delayed graft healing of diabetic ulcers were infection, contamination and unhealthy granulation bed of the wounds. There was a report of increasing skin graft healing in the recipient bed of early granulation tissue rather than chronic granulation wound[2]. The technique such as using the meshed split thickness skin graft with porcine
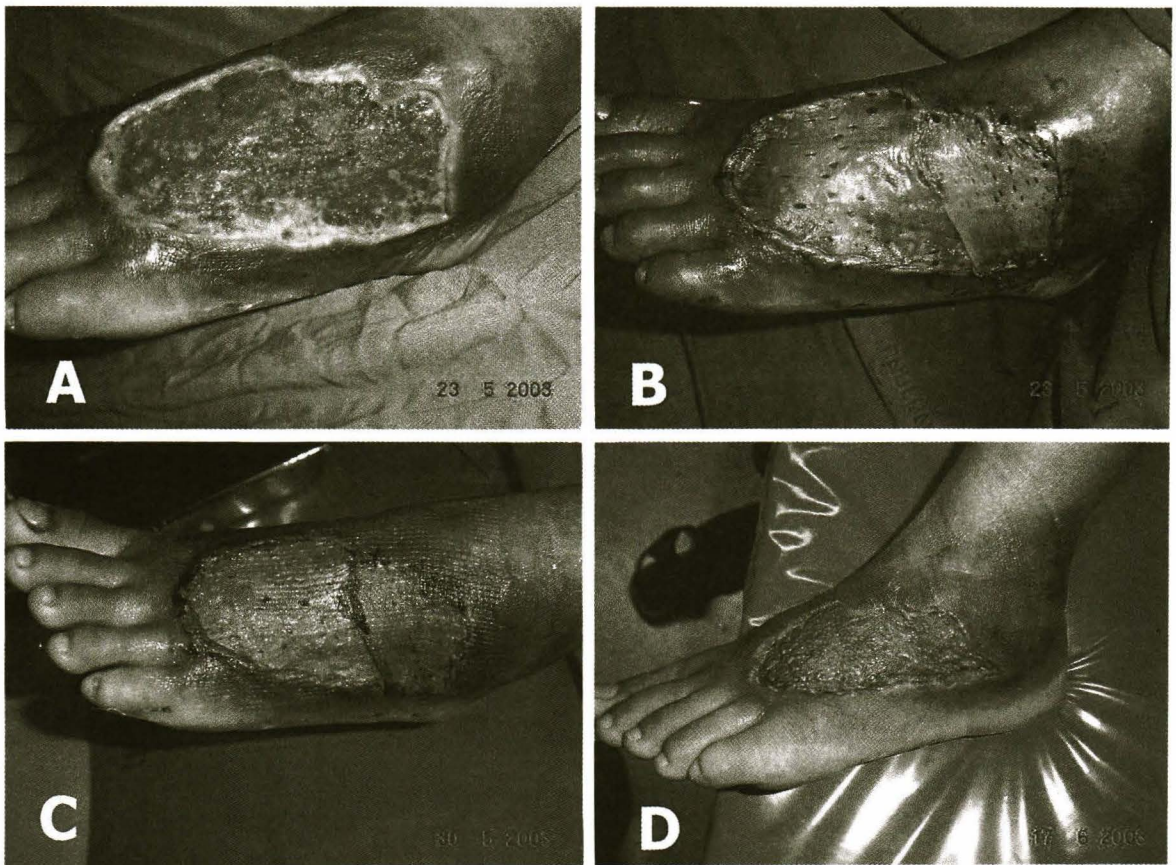

Fig. 3. Diabetic wound on dorsum of foot was grafted with split thickness skin graft. A) Before grafting. B) Two small pieces of skin graft were applied. C) 7 days after grafting. D) Full skin graft take with hypertrophic scar in first month.

Table 1. Characteristics of baseline and results of treated diabetic patients.

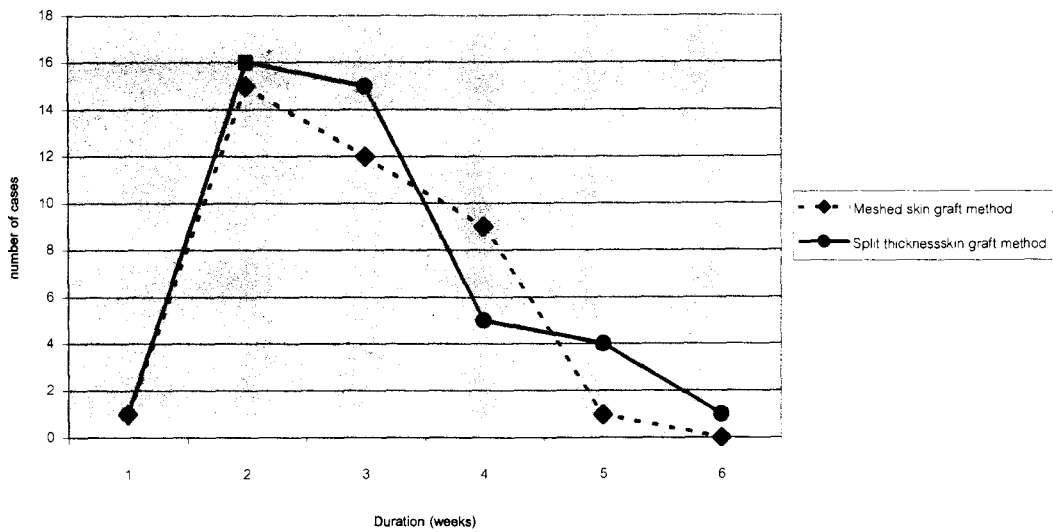|	Meshed skin graft (n = 38)		Split-thickness skin graft (n = 42)	
	Mean	Range	Mean	Range
Age (yr)	56.84 ± 8.96	40-74	55.02 ± 10.12	37-74
Size of ulcer (cm^2)	104.24 ± 152	12-600	82.00 ± 73.07	24-420
Complete graft healing (days)	19.84 ± 7.37	9-35	20.36 ± 7.21	9-45

Fig. 4.   Frequency and complete skin graft healing.

Table 2.   The efficacy of treatment.

	Meshed skin graft group (n = 38)		Split-thickness skin graft group (n = 42)	
	Cases	%	Cases	%
Excellent	19	50	17	40.5
Good	12	31.6	18	42.9
Fair	7	18.4	5	11.9
Poor	0	0	2	4.8

dermis as a template has been shown to improve healing in comparison to split skin graft alone[3]. The size of the ulcer had no effect on duration of complete skin graft healing in both groups.

Expansion ratio of the meshed skin graft can be used from 1 : 1.5 to 1 : 9 with successful graft healing[4]. The 1 : 3 expansion ratio was easily made either with skin graft mesher or free hand methods[5, 6] and had adequate drainage of serum from under skin graft.

Topical local anesthesia at the donor area with Lidocaine-Prilocaine (EMLA) cream was good for split thickness skin harvesting even in geriatric patients[7]. This was cost-saving[8], efficious safe and prolongation of analgesia[9].

The meshed skin graft technique needs less skin than ordinary split-thickness skin graft, so a small free hand knife with a razor blade can harvest the skin graft. This may save hospital costs at this present time in Thailand.

Hypertrophic scar and infection were not problems in the meshed skin graft in diabetic ulcers. There was no contracture in the meshed graft group, which could explain the phenomenon of rapid epithelization related to the huge increase in graft border surface from numerous cuts.

SUMMARY

The meshed skin graft for diabetic wound coverage had the same healing success as the ordinary split thickness skin graft. Both groups took 20 days for complete skin graft healing. All wound scar appearances were accepted with smooth surface and results of the treatment were good. The size of the diabetic ulcer had no correlation with complete skin graft healing duration.

ACKNOWLEDGEMENT

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เปรียบเทียบผลการรักษาแผลด้วยการปิดหนังขยายและหนังเต็มแผ่นในแผลผู้ป่วยเบาหวาน

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วัตถุประสงค์ : ศึกษาเปรียบเทียบผลการรักษาแผลในผู้ป่วยโรคเบาหวานโดยวิธีปิดด้วยหนังที่ขยายและหนังเต็มแผ่น ระยะเวลาการหายของแผลจากการปิดหนังของทั้งสองวิธี และความสัมพันธ์ของขนาดแผลกับการหายของแผล

วิธีการศึกษา : ศึกษาผู้ป่วยแผลอักเสบในโรคเบาหวานบริเวณขาและเท้า 80 รายตั้งแต่ มกราคม 2545 – ธันวาคม 2546 แบ่งรักษาด้วยการปิดหนังที่ขยาย ขนาดขยาย 1 : 3 จำนวน 38 ราย และอีก 42 รายปิดรักษาด้วยหนังไถเต็มแผ่น

ผลการศึกษา : แผลกลุ่มปิดหนังขยายมีระยะเวลาการหายหลังการปิดหนัง 19.84 ± 7.37 วัน กลุ่มปิดหนังเต็มแผ่น ใช้เวลา 20.36 ± 7.21 วัน การหายของแผลทั้งสองกลุ่มไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติ แผลที่หายด้วยหนังขยาย มีลักษณะเรียบดี และขนาดของแผลไม่มีความสัมพันธ์กับระยะเวลาการหายของแผล

สรุป : การรักษาแผลผู้ป่วยเบาหวานด้วยวิธีปิดด้วยหนังที่ขยายได้ผลดีเท่ากับการรักษาด้วยหนังเต็มแผ่น

คำสำคัญ : หนังที่ขยาย, หนังเต็มแผ่น, การหายของหนังปิดแผล, ขนาดของแผล

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