Clinical Study
The Incidence and Risk Factors for Lower Limb Skin Graft Failure

Sumeet Reddy, Falah El-Haddawi, Michael Fancourt, Glenn Farrant, William Gilkison, Nigel Henderson, Stephen Kyle, and Damien Mosquera

Department of General Surgery, Taranaki Base Hospital, Private Bag 2016, New Plymouth 4342, New Zealand

Correspondence should be addressed to Sumeet Reddy; sumeetreddy@gmail.com

Received 20 June 2014; Accepted 1 July 2014; Published 15 July 2014

Academic Editor: Masutaka Furue

Copyright © 2014 Sumeet Reddy et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Lower limb skin grafts are thought to have higher failure rates than skin grafts in other sites of the body. Currently, there is a paucity of literature on specific factors associated with lower limb skin graft failure. We present a series of 70 lower limb skin grafts in 50 patients with outcomes at 6 weeks. One-third of lower limb skin grafts went on to fail with increased BMI, peripheral vascular disease, and immunosuppressant medication use identified as significant risk factors.

1. Introduction

The use of skin grafts to aid in the healing of wounds was first described by the ancient Indians over 2,500 years ago [1]. Although operative techniques have evolved over time, the principles of successful grafting have remained the same. Intrinsic and extrinsic factors unique to each patient can be the difference between success and failure [2]. This is especially apparent in the lower limb, where skin grafts have higher failure and complication rates than in other areas of the body [3, 4]. Currently, there is a paucity of literature on specific factors associated with lower limb skin graft failure. We present a series of 70 lower limb skin grafts in 50 patients with outcomes at 6 weeks. One-third of lower limb skin grafts went on to fail with increased BMI, peripheral vascular disease, and immunosuppressant medication use identified as significant risk factors.

2. Methods

A prospective observational study of all consecutive patients requiring lower limb skin grafts operated on between December 2012 and December 2013 was undertaken. Skin grafts were performed using well-established techniques. All operations were performed under general or regional anaesthetic with prophylactic antibiotics. Split thickness skin grafts (STSG) were harvested using an air dermatome (Zimmer, Warsaw, IN, USA) and full thickness grafts (FTSG) were harvested using a scalpel with subcutaneous tissue removed prior to application. STSG were typically meshed prior to application and grafts were fixed with sutures, staples, or Dermabond (Johnson & Johnson, Ethicon Inc., Somerville, NJ, USA). Cuticrin (Smith & Nephew, London, UK) was applied over the graft with either a standard sponge bolster or negative pressure dressing (PICO TM, Smith & Nephew, London, UK). Patients were then either admitted to hospital for a 3–7-day period of bed rest with low molecular weight heparin or discharged with immediate mobilisation at the discretion of the surgeon. Grafts were reviewed at 2 and 6 weeks postoperatively. A skin was deemed successful if greater than 80% graft take has occurred on clinical examination. Data was entered into Microsoft Excel (Microsoft Corp., Redmond, WA, USA). Statistical analysis was done with SPSS 21 (Chicago, IL, USA). Normal distribution for statistical analysis was assumed with a parametric t-test and fisher’s exact univariate analysis was used to determine significance.

3. Results

In total, 70 skin grafts were performed on 51 patients; 14 patients had multiple grafts performed. Baseline demographic and comorbidity data is shown in Table 1, the median
Table 1: Baseline factors of patients having lower limb skin grafts, data presented as (n, %) unless otherwise stated.

| Factor                                      | n = 51 |
|---------------------------------------------|--------|
| Age: median (range)                         | 79 years old (56–94 years old) |
| Patients having multiple grafts             | 14 (28%) |
| Sex (male : female)                         | 22 : 29 |
| ASA: median                                 | 2.5 |
| BMI: median (range)                         | 30 (20–69) |
| Venous insufficiency                        | 25 (49%) |
| Ischemic heart disease                      | 25 (49%) |
| Diabetes                                    | 11 (22%) |
| Peripheral vascular disease                 | 11 (22%) |
| Smoking                                     | 9 (18%) |
| Continued on anticoagulation/antiplatelet agent | 10 (20%) |
| Immunosuppressant medication                | 4 (8%) |

Table 2: Operative details of lower limb skin grafts, data presented as (n, %) unless otherwise stated.

| Indication                  | n = 70 |
|-----------------------------|--------|
| Type of graft               |        |
| (i) Split thickness         | 64 (91%) |
| (ii) Full thickness         | 6 (9%) |
| Type of dressing            |        |
| (i) Vacuum                  | 49 (70%) |
| (ii) Sponge                 | 21 (30%) |
| Management                  |        |
| (i) Bed rest                | 48 (69%) |
| (ii) Immediate mobilization | 22 (31%) |

In our experience, one-third of lower limb skin grafts failed at 6 weeks. Literature has reported rates of failure in lower limbs grafts of between 0 and 33% [6]. However, these rates are in a heterogeneous population with a variety of different indications, operative techniques, and follow up. In addition to PVD and immunosuppressant use, we found increased BMI to be strongly associated with skin graft failure. The association of increased BMI and skin graft failure has not been described before. Penington and Morrison had identified waist to hip ratio to be associated with FTSG failure in the head and neck region in 14 patients [7]. Obese individuals are at increased risk of wound complications including wound infection, dehiscence, hematoma, and seroma formation [8]. Local and cellular factors including reduced microperfusion and decreased tissue oxygenation have been thought to play a part in this [7, 8]. Studies to explore specific mechanisms and impact of obesity as independent risk factor for poor operative outcome are still a much needed area for future research.

In our study, there was no difference in graft success rates between STSG and FTSG. To our knowledge, no study has directly compared outcomes between STSG and FTSG in the lower limb. A prospective study randomised 68 patients undergoing elective operations requiring radial forearm free flaps into receiving STSG or FTSG to the radial forearm free flap donor site [9]. No difference in outcomes was seen between the two groups, although patients with STSG required significantly more wound dressing changes compared to those who had FTSG. FTSG are thought to be superior to STSG in terms of cosmesis and decreased donor site complications [1]. However, STSG remain the most common method of skin coverage in grafting of the lower limbs owing to better scar quality than healing by secondary intention, ease of use, and ability to expand coverage through meshing [10]. The wound defects in the lower limb are often too large to be closed primarily and local flap repair can be difficult to achieve especially in elderly populations. It is also simpler to undertake revision surgery and oncological surveillance in patients who have had skin graft repairs compared to those with local flap repairs [10].

No difference in outcomes or complications was seen between patients placed on bed rest and those immediately mobilised. The vast majority of patients requiring lower limb grafts were placed on bed rest by the operating surgeon in our study. Bed rest is still widely used throughout the world despite an increasing body of evidence showing no significant benefit in outcomes [11]. Its popularity may be partly due to the clinical observation of decreased tissue oedema and perceived less graft disruption with limb elevation and bed rest, especially in this population with high rates of venous insufficiency. Similarly, no benefit in graft success rate was associated with graft failure were PVD, increased BMI, and use of immunosuppressant medications (Table 3). All failed skin grafts have gone onto to heal by secondary intention and no patients have required revision skin grafting procedures.

4. Discussion

In our experience, one-third of lower limb skin grafts failed at 6 weeks. Literature has reported rates of failure in lower limbs grafts of between 0 and 33% [6]. However, these rates are in a heterogeneous population with a variety of different indications, operative techniques, and follow up. In addition to PVD and immunosuppressant use, we found increased BMI to be strongly associated with skin graft failure. The association of increased BMI and skin graft failure has not been described before. Penington and Morrison had identified waist to hip ratio to be associated with FTSG failure in the head and neck region in 14 patients [7]. Obese individuals are at increased risk of wound complications including wound infection, dehiscence, hematoma, and seroma formation [8]. Local and cellular factors including reduced microperfusion and decreased tissue oxygenation have been thought to play a part in this [7, 8]. Studies to explore specific mechanisms and impact of obesity as independent risk factor for poor operative outcome are still a much needed area for future research.

In our study, there was no difference in graft success rates between STSG and FTSG. To our knowledge, no study has directly compared outcomes between STSG and FTSG in the lower limb. A prospective study randomised 68 patients undergoing elective operations requiring radial forearm free flaps into receiving STSG or FTSG to the radial forearm free flap donor site [9]. No difference in outcomes was seen between the two groups, although patients with STSG required significantly more wound dressing changes compared to those who had FTSG. FTSG are thought to be superior to STSG in terms of cosmesis and decreased donor site complications [1]. However, STSG remain the most common method of skin coverage in grafting of the lower limbs owing to better scar quality than healing by secondary intention, ease of use, and ability to expand coverage through meshing [10]. The wound defects in the lower limb are often too large to be closed primarily and local flap repair can be difficult to achieve especially in elderly populations. It is also simpler to undertake revision surgery and oncological surveillance in patients who have had skin graft repairs compared to those with local flap repairs [10].

No difference in outcomes or complications was seen between patients placed on bed rest and those immediately mobilised. The vast majority of patients requiring lower limb grafts were placed on bed rest by the operating surgeon in our study. Bed rest is still widely used throughout the world despite an increasing body of evidence showing no significant benefit in outcomes [11]. Its popularity may be partly due to the clinical observation of decreased tissue oedema and perceived less graft disruption with limb elevation and bed rest, especially in this population with high rates of venous insufficiency. Similarly, no benefit in graft success rate was associated with graft failure were PVD, increased BMI, and use of immunosuppressant medications (Table 3). All failed skin grafts have gone onto to heal by secondary intention and no patients have required revision skin grafting procedures.

4. Discussion

In our experience, one-third of lower limb skin grafts failed at 6 weeks. Literature has reported rates of failure in lower limbs grafts of between 0 and 33% [6]. However, these rates are in a heterogeneous population with a variety of different indications, operative techniques, and follow up. In addition to PVD and immunosuppressant use, we found increased BMI to be strongly associated with skin graft failure. The association of increased BMI and skin graft failure has not been described before. Penington and Morrison had identified waist to hip ratio to be associated with FTSG failure in the head and neck region in 14 patients [7]. Obese individuals are at increased risk of wound complications including wound infection, dehiscence, hematoma, and seroma formation [8]. Local and cellular factors including reduced microperfusion and decreased tissue oxygenation have been thought to play a part in this [7, 8]. Studies to explore specific mechanisms and impact of obesity as independent risk factor for poor operative outcome are still a much needed area for future research.

In our study, there was no difference in graft success rates between STSG and FTSG. To our knowledge, no study has directly compared outcomes between STSG and FTSG in the lower limb. A prospective study randomised 68 patients undergoing elective operations requiring radial forearm free flaps into receiving STSG or FTSG to the radial forearm free flap donor site [9]. No difference in outcomes was seen between the two groups, although patients with STSG required significantly more wound dressing changes compared to those who had FTSG. FTSG are thought to be superior to STSG in terms of cosmesis and decreased donor site complications [1]. However, STSG remain the most common method of skin coverage in grafting of the lower limbs owing to better scar quality than healing by secondary intention, ease of use, and ability to expand coverage through meshing [10]. The wound defects in the lower limb are often too large to be closed primarily and local flap repair can be difficult to achieve especially in elderly populations. It is also simpler to undertake revision surgery and oncological surveillance in patients who have had skin graft repairs compared to those with local flap repairs [10].

No difference in outcomes or complications was seen between patients placed on bed rest and those immediately mobilised. The vast majority of patients requiring lower limb grafts were placed on bed rest by the operating surgeon in our study. Bed rest is still widely used throughout the world despite an increasing body of evidence showing no significant benefit in outcomes [11]. Its popularity may be partly due to the clinical observation of decreased tissue oedema and perceived less graft disruption with limb elevation and bed rest, especially in this population with high rates of venous insufficiency. Similarly, no benefit in graft success rate was associated with graft failure were PVD, increased BMI, and use of immunosuppressant medications (Table 3). All failed skin grafts have gone onto to heal by secondary intention and no patients have required revision skin grafting procedures.
Table 3: Analysis of success grafts versus failed grafts, data presented as (n, %) unless otherwise stated.

|                          | Graft success (n = 48) | Failure (n = 22) | P value |
|--------------------------|------------------------|-----------------|---------|
| Age (median)             | 79 years old           | 78 years old    | 0.908   |
| Sex (male : female)      | 21 : 27                | 8 : 14          | 0.753   |
| Venous insufficiency     | 25 (52%)               | 15 (60%)        | 0.547   |
| Ischemic heart disease   | 24 (50%)               | 13 (59%)        | 0.702   |
| Diabetess                 | 11 (23%)               | 8 (36%)         | 0.374   |
| Peripheral vascular disease | 20 (42%)               | 16 (73%)        | 0.030   |
| Smoking                  | 7 (15%)                | 5 (23%)         | 0.605   |
| BMI (median)             | 30                     | 42              | 0.007   |
| Bed rest                 | 32 (67%)               | 16 (73%)        | 0.829   |
| Vacuum dressing          | 30 (63%)               | 19 (86%)        | 0.093   |
| Split thickness skin graft | 44 (92%)               | 20 (91%)        | 0.999   |
| Immunosuppressants       | 1 (2%)                 | 5 (22%)         | 0.020   |
| Acute operations         | 7 (14.5%)              | 4 (18%)         | 0.951   |
| Graft size (median)      | 0.94 cm²               | 1.28 cm²        | 0.331   |

seen with the use of negative pressure dressings; a recent Cochrane review found no evidence to support or refute the effectiveness of commercial negative pressure dressing to improve healing rates of skin grafts [12].

5. Conclusion

Lower limb skin grafts have high failure rates. Increased BMI, immunosuppressant use, and PVD appear to be significant risk factors associated with graft failure. Knowledge of these factors is important in preoperative assessment to identify patients at increased risk of postoperative complications. A larger prospective trial assessing the comparative effectiveness of different strategies aimed at minimising complications of lower limbs is needed.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

References

[1] D. Ratner, “Skin grafting: from here to there,” *Dermatologic Clinics*, vol. 16, no. 1, pp. 75–90, 1998.
[2] J. Southwell-Keely and J. Vandervord, “Mobilisation versus bed rest after skin grafting pretibial lacerations: a meta-analysis,” *Plastic Surgery International*, vol. 2012, Article ID 207452, 6 pages, 2012.
[3] N. J. Henderson, M. Fancourt, W. Gilkison, S. Kyle, and D. Mosquera, “Skin grafts: a rural general surgical perspective,” *ANZ Journal of Surgery*, vol. 79, no. 5, pp. 362–366, 2009.
[4] S. Paradela, S. Pita-Fernández, C. Peña et al., “Complications of ambulatory major dermatological surgery in patients older than 85 years,” *Journal of the European Academy of Dermatology and Venereology*, vol. 24, no. 10, pp. 1207–1213, 2010.
[5] S. H. Wood and V. C. Lees, “A prospective investigation of the healing of grafted pretibial wounds with early and late mobilisation,” *British Journal of Plastic Surgery*, vol. 47, no. 2, pp. 127–131, 1994.
[6] T. O. Smith, “When should patients begin ambulating following lower limb split skin graft surgery? A systematic review,” *Physiotherapy*, vol. 92, no. 3, pp. 135–145, 2006.
[7] A. J. Penington and W. A. Morrison, “Skin graft failure is predicted by waist-hip ratio: a marker for metabolic syndrome,” *ANZ Journal of Surgery*, vol. 77, no. 3, pp. 118–120, 2007.
[8] J. A. Wilson and J. J. Clark, “Obesity: impediment to postsurgical wound healing,” *Advances in Skin & Wound Care*, vol. 17, no. 8, pp. 426–435, 2004.
[9] A. J. Sidebottom, L. Stevens, M. Moore et al., “Repair of the radial free flap donor site with full or partial thickness skin grafts: a prospective randomised controlled trial,” *International Journal of Oral and Maxillofacial Surgery*, vol. 29, no. 3, pp. 194–197, 2000.
[10] K. Rao, O. Tillo, and M. Dalal, “Full thickness skin graft cover for lower limb defects following excision of cutaneous lesions,” *Dermatology Online Journal*, vol. 14, no. 2, article 4, 2008.
[11] B. Luzak, J. Ha, and R. Gurfinkel, “Effect of early and late mobilisation on split skin graft outcome,” *Australasian Journal of Dermatology*, vol. 53, no. 1, pp. 19–21, 2012.
[12] J. Webster, P. Scuffham, K. L. Sherriff, M. Stankiewicz, and W. P. Chaboyer, “Negative pressure wound therapy for skin grafts and surgical wounds healing by primary intention,” *Cochrane Database of Systematic Reviews*, vol. 4, Article ID CD009261, 2012.
