Improving quality of dermatologic surgery: from different points of view

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Chapter 6

TO TIE or NOT TO TIE-over full-thickness skin grafts in dermatologic surgery: a systematic review of the literature

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ABSTRACT

Tie-over dressings are frequently used for skin grafts. Although a dressing is necessary for split-thickness skin grafts, their use in full-thickness skin grafts (FTSGs) is questionable.

This review was conducted to investigate the influence of different tie-overs and dressings on graft take for FTSGs in cutaneous surgery.

An electronic database search was performed in Medline, Embase, Web of Science, and the Cochrane library. The following search terms and comparable were used: skin transplantation, tie-over, fixation, sutures and take.

Fifteen articles met the inclusion criteria. Eight studies describe no use of tie-over for FTSGs. Dressing types included: antibacterial dressings, foam or sponges, and bolsters. The lowest graft take was 80% (with a tie-over dressing). The highest graft take 100% (with and without a tie-over dressing).

The results show that, regardless of the technique used, the overall graft success rate is high. Although a definite recommendation could not be made, it seems that a graft without a tie-over can suffice in certain circumstances.

INTRODUCTION

Skin grafts are used when wounds are too large for primary closure and when reconstruction by skin flaps or healing by secondary intention is unfavorable. In some cases, skin grafts are used in combination with a local, regional, or free flap to close secondary donor defects.[1] There are 2 different techniques for skin grafts: full-thickness skin grafts (FTSGs) and split-thickness skin grafts (STSGs).[2] To provide a maximum chance of survival for skin grafts, a tie-over dressing is usually administered. There is an overall consensus that dressings are necessary for STSG (especially to prevent friction), but there is doubt whether this is the case for an FTSG.

FTSGs are harvested with the full dermis intact in comparison to STSGs, which are harvested at the dermal level with a small portion of the upper dermis. The advantage of STSGs is that they can be meshed to a larger size[3,4] to cover larger defects and to be placed on acceptor sites with less vascularity. Split-thickness skin grafts are more susceptible to scarring and contractures than FTSGs[5] and, therefore, are more pragmatic than aesthetic. In facial reconstructive surgery, FTSGs are preferred because of their superior cosmetic outcome.

Both skin grafts rely in the first 24 hours on 'plasmatic imbibition'[6] and eventually on revascularization of the graft to survive.[7,8] A complication that can occur is (partial) graft failure if revascularization is obstructed by seroma or hematoma formation.[9,10] To enhance the successful take of the graft, numerous dressings and fixating techniques have been suggested in the literature.[11,12] They are used to provide equal pressure on the graft surface to prevent friction and to improve the attachment of the graft in the wound bed.

A well-developed method for securing skin grafts is negative-pressure therapy.[13] A review of the literature showed that this technique is associated with lower re-operation rates compared to the standard dressing group.[14] Negative-pressure therapy is usually conducted in larger defects such as burn wounds,[15] areas with motion,[16] or for closure of myocutaneous flaps on the extremities and trunk[17] and is not a preferred method for facial reconstructive surgery.

Other graft fixation techniques for FTSGs include bastings sutures,[18] tie-over bolsters (e.g., non-adherent gauze, sometimes drenched in antibacterial solutions),[19] (hydrocolloid) foam,[20] and surgical sponges.[21] However, other authors claim that a simple tulle gras dressing is sufficient enough[22] and question the pressure exerted on the graft by tie-over dressings.[23]

This review investigates the graft failure rate of different tie-over and skin graft dressings used for FTSGs to identify the most optimal method.

METHODS

Search strategy and study selection

PubMed, MEDLINE, EMBASE and the Cochrane database were searched from inception to 9 April 2018. English, Dutch, and Spanish language articles were selected.
The following search terms and comparable were used: skin transplantation, tie-over, fixation, sutures, and take. To avoid missing articles that use different names for full-thickness grafts, skin transplantation were used as a search term covering all types of skin grafts. Details of the search can be found in Appendix 1, supplemental digital content 1. Titles and abstracts of retrieved articles were screened by 2 authors (K.B. and S.A.M.V). The full text of any potentially relevant article was examined using the inclusion and exclusion criteria (N.M. and R.E.G). Any discrepancy was resolved by consensus of the authors (N.M., R.E.G., and K.B.).

Inclusion and exclusion criteria

We included studies that met the following criteria: (1) patients receiving an FTSG, (2) studies reporting on the use of wound care of the FTSG, (3) studies reporting on the success/outcome of FTSGs and (4) studies containing 10 cases or more. Exclusion criteria were (1) studies containing previously published data, (2) studies lacking an objective outcome measurement (graft take), and (3) for our study, we focused on the outcome of FTSG used in dermatologic surgery after removal of benign or malignant skin tumors and excluded articles which exclusively used FTSGs for indications such as ulcers, burns, hand and foot surgery, radial forearm flap, fibula and other defects. The study design for this review was registered on PROSPERO (CRD42018095586).

Data collection process and risk of bias assessment

Methods for qualitative data analysis were specified in advance. Data extraction was performed by 2 reviewers independently (K.B. and N.M.). The following information was extracted from each included study: (1) study design, for example, the number of patients, the type of graft and fixation, hospital center and location, years of data collection, and use of antibiotics; (2) patient selection, for example, age and indication for surgery; and (3) outcome, for example, graft take, graft failure, and complications. The corresponding authors from 4 studies were contacted for missing study details and 3 responded.

A modified quality assessment tool was used (Figure 1). A total of 6 points were divided into 6 questions. A positive bullet was scored for each feature if mentioned in the article.[24] Descriptive statistics were used for analyzing the data.

Domain	Quality assessment
Selection	1. Does the patient(s) represent(s) the whole experience of the investigator (centre) or is the selection method unclear to the extent that other patients with similar presentation may not have been reported?
Ascertainment	2. Was the technique adequately ascertained? 3. Was the tie-over removal time adequately ascertained? 4. Was the graft take evaluation adequately ascertained?
Causality	5. Was follow-up long enough for the evaluation?
Reporting	6. Is the case described with sufficient details to allow other investigators to replicate the research or to allow practitioners make inferences related to their own practice?

Figure 1. Quality assessment tool (modification).

RESULTS

Search results

A flowchart of the selection process is shown in Figure 2. A total of 1,411 articles were found in the literature search. Screening of titles and abstracts reduced the number to 362 articles. The full article read retrieved 67 articles mentioning a skin graft and take. Fifteen articles met the inclusion criteria involving only skin surgery (Table 1).[25-39] Three studies used randomization,[28-30] and 4 studies compared a no tie-over dressing with a tie-over but did not always specify the materials used for the bolster.[27,29,31,33] Two articles mentioned both STSGs and FTSGs and did not subdivide the graft take per technique.[28,38] Because the ratio FTSGs used in these articles (over 80%) was high, they were found suitable to include in this review.[28,38] Thirteen studies used only FTSGs.[25-37,29-37,39]

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Table 1. Details of the studies included in the analysis.
Legend: PT = patients; SG = skin grafts; N = number; R = range; NM = not mentioned; loc = local/topical antibiotics; NS = not specified; ir = not consecutive for all patients; sys = systemic antibiotics; SP = split skin graft; SkinM = skin malignancy; FT = full thickness skin graft; NOT = no tie-over group; TO = tie-over group; BCC = basal cell carcinoma; SO = sofratulle; FM = polyurethane foam; HN = head and neck; Ex = extremity; * graft assessment per 10%; ** 9 patients with non-adherent gauze and 1 patient with proflavin wool; *** cartella shields and eye pads; **** 75-100% graft take

Author, year, country	Study period	PT or SG	Median age (R)	use of ab	Indication for surgery (N)	Type of graft (N)
Atherton 2007, UK	2004 - 2005	59	76 (40-95)	NM	Lesions	SP (8) FT (51)
Audain 2015, UK	2009-2014	50	75 (49-96)	NM	SkinM	FT
Chasapi 2016, UK	NM	27	NM	Yes (loc)	SkinM	FT
Davenport 1988,UK	NM	38 (40SG)	NM	Yes (loc only NOT)	SkinM (37), other (3)	FT
Dhillon 2014, UK	2006 - 2008	70	62	Yes (loc)	SkinM	FT
de Gado 2008, IT	2004 - 2006	212	58.1 (18-80)	Yes (NS)	SkinM	FT
Harb 2010, UK	2001 - 2008	79	NM	NM	SkinM	FT
Keh 2017, UK	NM	128	71	Yes (loc)	SkinM 57.6%, other 42.4%	FT
Langtry 1998, UK	NM	30	69 (39-95)	Yes (loc ir)	Skin tumors	FT
Mehta 1979, UK	1973 - 1977	109	NM	Yes (sys)	SkinM (87, other (22)	FT
Nakamura 2011, JP	2007 - 2008	26	73.5 (38-97)	Yes (NS)	Skin tumors	FT
Sapountzis 2011, KOR	NM	23	73	NM	SkinM	FT
Shimizu 2013, USA	2010-2011	96	71	Yes (loc only NOT)	SkinM	FT
Struk 2017, FR	2011-2016	70	70 (17)	NM	SkinM	FT
Yuki 2017,JAP	2009 - 2014	266	76 (26-99)	NM	SkinM (188) other (78)	SP (46) FT (220)

Dressing (N)	Graft/ defect size (R)	Graft take in percentage	Incomplete (I) graft take or failure (F)	Complications (N)	Location
Jellonet/profalvin (30) vs Allevyn (29)	NM	92.3 % vs 90.3%*	2 out of 51 (Allevyn group)	Poor graft (2) Infection (1 vs 1)	HN (50) Ex (9)
Mepitel bolster	52.4cm^2	96%	4%	Infection (1) Bleeding (1)	Leg
NOT	NM	100%	NM	NM	HN
NOT (20) vs TO (materials NS; 20)	NM	95% vs 95%	5% (I) vs 5% (F)	None	HN
NOT (35) vs proflavin wool (35)	225-3600 mm^2	89% vs 80%	11% (I) vs 6% (F) and 20% (I)	Infection (9% vs 26%)	HN
dried gauzes (106) vs polyurethane sponge (106)	NM	89.6% vs 97.1%	NM	NS 10.4% vs 2.9%	HN (99) Ex (113)
NOT	31 mm (20-53mm)	100%	None	Redness (3) Suture reaction (1)	Nose
NOT (100) vs TO (materials NS; 25)	187 mm^2 (SD 414.7)	82% (NOT vs 76% TO)	13.6% (<60% take)	12% incomplete excision	HN
NOT**	20mm (8-45)	93%	2 out of 30	None	HN (27) Ex (3)
NOT***	1.2 - 3.5 cm	100%	NM	Poor color match (1)	Orbita
multilayered polyurethane foam	17.4 cm^2 (3-80)	88.9% (23.1-100)	1 out of 26 (4%)	NM	HN (19) other (7)
Surgical scrub sponge	3.8 cm (2.4-6.1)	90%	NM	NM	HN
NOT 49 vs TO (petrolatum gauze) 47	1.9 vs 2.0 cm	84% vs 85%	8 vs 7	Generalized crusting or sloughing	HN (74) Other (22)
TO (NS)	12 cm^2 (18)	91.4%	8.6%	Hematoma (8) Infection (1) Venous thrombosis (2)	Leg
Sofratulle (148) vs polyurethane foam (118)	4 cm (1.4 - 29)	90 % vs 88 % ****	10% vs 11%	Infection (SO=7 FM=10) Hematoma (SO=6 FM=3)	HN (120) Ex (146)

The graft defect size was described in different measurements of length (mm and cm) or surface area (mm^2 and cm^2) and varied from 8 mm in length (smallest)[34] to 52.4 cm^2 (largest area).[25] Nine studies reported the use of additional antibiotics: systemic[35] and local.[27,29-31,33,34,39] Antibiotics were however, not used consecutively in all patients[27,29,34] and the used drug was not always specified.[30,36]

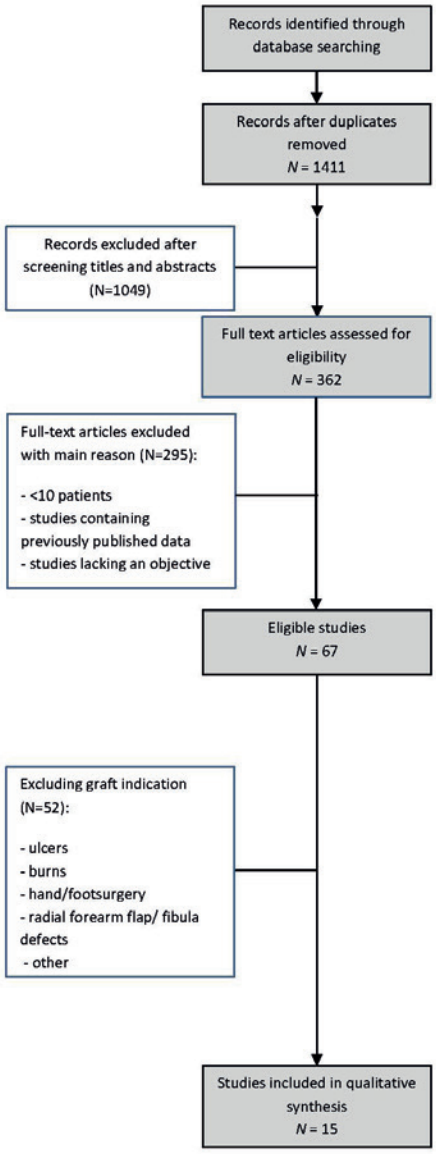

Figure 2. Flow chart (PRISMA styled). Details of the selection process for eligible studies.

Dressings with tie-over

Antibacterial dressings

Four studies reported the use of an antibacterial dressing.[28,31,34,38] One study[34] only noted this dressing in 1 patient as a light dressing. Three comparative studies used an antibacterial dressing (versus no tie-over and foam dressing) which was secured over the graft using radially arranged sutures[28,31] or tie-over sutures.[38]

Sponge or foam

Four studies reported the use of a polyurethane foam dressing.[28,30,36,38] One study stacked a larger sheet of foam on top of other foam sheets and secured the border with sutures.[36] Another study cut foam to fit the shape of the graft and secured it in a radial spoke design.[28] A third study used a polyurethane sponge with a surplus of 0.3 to 0.5 cm larger than the graft and secured it with staples.[30] One study did not use a tie-over dressing but used a polyurethane foam dressing that was secured using layers of gauze and elastic tape.[38] One study used a surgical scrub sponge saturated with povidone-iodine. The sponge was secured using the ''Lilliputian technique''.[37]

Other techniques

Other techniques described were a Mepitel bolster dressing combined with a 3-layer compression bandage system (only legs)[25] and a tie over bolster with a noncircular above-knee plaster cast (only lower legs).[26]

Dressings without tie-over

Nine studies reported using no tie-over dressing.[27,29,31-35,39] Four studies used basting sutures: through and through sutures in the middle[33] or central,[29] paracentral,[35] or quilting sutures[31] to maintain approximation between the graft and recipient bed. One study[31] only used sutures to approximate the wound edges; they did not use any basting sutures. A light dressing was applied in addition to an antibiotic ointment. The other study only applied a paraffin-impregnated gauze with adhesive strips after circumferentially suturing the graft to the wound bed (but 6/79 patients did have quilting sutures).[32]

Graft take and complications

Graft take was described in all 15 studies (Table 1). The lowest mean graft take score was 80%.[31] The highest reported graft take score was 100%.[32,35,39] Ten studies indicated a complication after surgery, with 20% as the highest reported complication rate.[31] Reported complications of FTSG were poor color match,[35] reddening or duskiness,[32,34] reaction to suture material,[32] wound infections,[25,26,28,31,38] hematoma/bleeding,[25,26] crusting or sloughing,[27] and venous thrombosis.[26] In one study, complications were not specified.[30]

Additional topical antibiotics (chloromycetin ophthalmic ointment 1 %,[31] polymyxin B and bacitracin ointment,[30] chloramphenicol ointment [25, 27, 39], were frequently used directly postoperatively but did not result in a better outcome. Only 1 study prescribed systemic antibiotics (co-trimoxazol twice daily for 5 days).[32]

Risk of bias assessment

The risk of bias assessment was conducted on the selected articles (Table 2). Two articles scored the maximum total of 6 points[25,28] Two articles scored[28,30] 5 points, both lacking a description of the evaluation assessment for graft take. In 10 studies patient selection was not specified,[27,31-34,36-39] and 7 studies did not describe how they evaluated the graft survival.[29,30,32,33,35,37,39] Eight studies reported a follow-up evaluation besides the post-operative removal.[25,26,28-30,34,35,39]

Table 2. Quality assessment.

Author year, country	Patient selection	Ascertainment exposure (technique, removal)	Ascertainment outcome	Follow up	Reporting	Total
Atherton 2007, UK	Yes	Yes, Yes	Yes	Yes	Yes	●●●●●●
Audain 2015, UK	Yes	Yes, Yes	Yes	Yes	Yes	●●●●●●
Chasapi 2016, UK	No	Yes, No	No	Yes	Yes	●●●○○○
Davenport 1988, UK	Yes	No, Yes	No	Yes	No	●●●○○○
Dhillon 2014, UK	No	Yes, Yes	Yes	No	Yes	●●●●○○
de Gado 2008, IT	Yes	Yes, Yes	No	Yes	Yes	●●●●●○
Harb 2010, UK	No	Yes, Yes	No	No	Yes	●●●○○○
Keh 2017, UK	No	Yes, Yes	No	No	No	●●●●○○
Langtry 1998, UK	No	Yes, No	Yes	Yes	No	●●●○○○
Mehta 1979, UK	Yes	Yes, Yes	No	Yes	Yes	●●●●●○
Nakamura 2011, JP	No	Yes, Yes	Yes	No	Yes	●●●●○○
Sapountzis 2011, KOR	No	Yes, Yes	No	No	Yes	●●●○○○
Shimizu 2013, USA	No	Yes, No	Yes	No	Yes	●●●○○○
Struk 2017, FR	Yes	No, Yes	Yes	Yes	No	●●●●○○
Yuki 2017, JAP	No	Yes, No	Yes	No	No	●●○○○○

DISCUSSION

This study aimed to review the literature on the use of a tie-over dressing and to define the most optimal dressing for FTSGs in cutaneous surgery, defined as the highest graft take and lowest complication rate. Despite all efforts, a meta-analysis could not be performed due to the heterogeneity of the data. However, our findings suggest that the overall take of grafts is more than 80%, irrespective of the technique. The rate of infection and hematoma were not always mentioned.

In 3 studies a graft take of 100% was observed,[32,35,39] but the authors did not describe how their graft take was evaluated, quantified or at which time point of follow-up the take was measured. Based on the articles with the highest quality assessment score, the bolster dressing has a high success rate (>90%).[25,28] One of these articles investigated the bolster dressing versus foam and found no significant difference.[28] The foam dressing was significantly more comfortable than the bolster.[28] This finding was also seen in another study (comparing polyurethane sponge versus a tie-over bolster).[30]

An interesting observation from our results is graft take rates of more than 80% with no tie-over dressing. It should be mentioned that 2 of these 8 studies only reported on FTSGs around the orbita and nose, which are anatomically curved locations and generally difficult areas to apply a tie-over bolster.[32,35] Although these authors did not use a tie-over to secure their graft, they used a wound dressing which applied some pressure to ensure graft take. The hypothesis of using no tie-over for FTSGs has been previously advocated by measuring the wound bed pressure generated by a bolster tie-over in various skin grafts ranging from 1 to 15 cm.[23] This research showed that there was no significant pressure generated by the dressings. The highest measured pressure was 4 mm Hg. To decrease hematoma and seroma formation, a pressure of 25 to 30 mm Hg is required for capillary closing. It is therefore unlikely that any of the tie-over dressings described in this review creates a high enough pressure to reduce hematoma and seroma. A hypothesis that could be proposed on the mechanism of graft take is that eliminating dead space between the graft and wound bed is more important than reducing hematoma and seroma formation by using pressure. This principle applies to both the no tie-over group and the tie-over group because most in the no tie-over groups used basting sutures.

Topical antibiotics and antibacterial dressings are frequently used. However, their use was inconsistently reported, and an infection rate was not mentioned in most articles, making it difficult to draw any conclusions on their usefulness. In another study[40] an infection rate of 23.7% was mentioned related to graft-loss (found in FTSGs and STSGs used for other indications than facial reconstructive surgery). This high rate was not

seen in the articles included in this review. Based on our findings, a recommendation on the use of antibiotics could not be made.

Multiple quality assessment tools were evaluated for use in our review, including the Newcastle-Ottawa Scale (NOS), ROBINS-I tool (the Cochrane group), STROBE statement, and the GRADE approach (the Cochrane group). However, these were not found suitable for observational studies only including case series. Murad and colleagues[41] proposed a tool to evaluate the methodological quality of case reports/series based on the domains: selection, ascertainment, causality, and reporting. A modified version was created as a quality assessment tool. The tool however, has not been validated.

The quality of the evidence was considered low because of several reasons. Most studies showed a lack of detail concerning the assessment of skin graft take. The patient selection was poorly described in most articles. A standardized protocol should be conducted to effectively evaluate the results of the different tie-over dressings. Different elements such as erythema, color match, texture match, telangiectasia, necrosis, blisters, hematoma should be evaluated to quantify and qualify graft take.[42] Finally, a sufficient follow-up time of at least 2 weeks is needed to fully evaluate the results of a skin graft take.

Current studies have a high risk of bias and therefore lack reliable evidence to support a tie-over technique over another dressing for full-thickness grafts. The results, however, do show that despite the technique used, there is an overall high graft success rate. Further randomized controlled studies are needed to elucidate this question. In daily practice, a custom-made decision based on the anatomic location, graft size, and patient-related factors should be made when choosing whether or not to use a tie-over dressing.

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