Review Article

Full-thickness Skin Graft Fixation Techniques: A Review of the Literature

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Abstract

Multiple techniques for skin graft fixation have been proposed, but the evidence underlying these techniques is unclear. This study aimed to review the literature for full-thickness graft fixation techniques. PubMed was electronically searched to identify relevant studies. The search strategy identified 91 relevant articles. These consisted of 2 randomised controlled trials (RCTs), 10 observational cohort studies (8 retrospective, 2 prospective), and 79 descriptive studies (case series, case reports, or expert opinion articles). Both identified RCTs compared the tie-over dressing against a modified tie-over dressing. The tie-over dressing was also included in all identified observational studies, and comparisons were made against quilting/mattress suturing (4 studies, 181 grafts in total), simple pressure dressings (3 studies, 528 grafts), non-tie-over dressings non-specifically (1 study, 71 grafts), hydrocolloid dressings (1 study, 62 grafts), and double-tie over dressings (1 study, 43 grafts). No significant differences were found between fixation methods for graft take, haematoma rate, and infection rate. No studies have found a significant difference between tie-over dressings and alternative graft fixation technique, with the most evidence for simple pressure dressings and quilting/mattress suturing. However, the evidence base consists mostly of small, retrospective observational studies. This article describes the current evidence base and this should be considered when planning future reports in the field.

Keywords: Cyanoacrylates, negative-pressure wound therapy, silicones, skin transplantation, sutures

Key messages:
• There is a paucity of evidence for full-thickness skin graft (FTSG) fixation techniques.
• No studies have found significant benefit for tie-over dressings compared to simpler skin graft fixation techniques such as quilting/mattress suturing (4 studies, 181 grafts in total) and simple pressure dressings (3 studies, 528 grafts).

INTRODUCTION

For a skin graft to survive on its wound bed, adequate stabilization of the graft is imperative. The most frequently used technique for graft fixation has been the tie-over dressing, in which threads are individually tied to their opponent threads over a bolus dressing after suturing. Despite evidence suggesting that it is not needed first arising more than three decades ago,10 the tie-over dressing is frequently reported in the contemporary literature.

Many alternative graft fixation techniques have been proposed, but there is no consensus as to which is the optimal graft fixation method. This review aimed to assess the evidence base for skin graft fixation techniques in order to help inform current practice and future studies.

MATERIALS AND METHODS

Search strategy

PubMed was electronically searched to identify relevant studies. A broad search strategy was used, with a search term of: (Graft[title/abstract] or grafts[title/abstract] or grafting[title/abstract] or FTSG[title/abstract]) AND skin[title/abstract] AND (technique[title] OR

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How to cite this article: Steele L, Brown A, Xie F. Full-thickness skin graft fixation techniques: A review of the literature. J Cutan Aesthet Surg 2020;13:191-6.
techniques[title] OR fixation[title] OR application[title] OR suture[title] OR suturing[title] OR bolster[title] OR tie-over[title/abstract] OR mattress[title/abstract] OR quilting[title/abstract] OR thermoplastic [title/abstract] OR negative-pressure[title/abstract] OR staple[title/abstract] OR stapling[title/abstract] OR success[title] OR successful[title] OR take[title] OR octyl cyanoacrylate[title] OR adhesive[title] OR strip[title] OR tape[title] OR glue[title] OR aquaplast[title] OR band[title] OR rubber[title] OR hydrocellular[title]. Web of Science was used to identify further papers from the citing literature of papers included from the search (data of last electronic search 19 May 2019). Using the same search term on Embase identified no additional full texts.

Selection criteria
Abstracts and full papers were reviewed independently by two authors (LS and FX). Full-text studies were included if they reported on the effect of graft fixation method for full-thickness skin grafts. If both full-thickness and partial-thickness skin grafts were included, this was made clear in the presentation of results. Only English articles, human studies, and full-text articles were included. Studies assessing radial forearm, penile, and buccal flaps, or areolar graft fixations alone, were excluded.

Data extraction
For analytic studies, the authors recorded the study design; the graft fixation methods assessed; the number of grafts included; the site of grafts; randomization; blinding; and the outcomes for graft take, hematoma/seroma formation, and infection. For descriptive studies, the study type, technique reported, number of patients, and site of graft fixation were recorded.

Results
The literature search identified 1619 unique abstracts. A total of 151 reports were considered: 46 were subsequently excluded because they assessed split-thickness skin grafts only,[2-28] and 14 abstracts could not be accessed—none of which were analytic studies.[69,70] The final 91 papers studied consisted of 12 analytic studies and 79 descriptive studies (case series, case reports, or expert opinion articles).

Analytic studies
Of the included 12 analytic studies, 2 were randomized controlled trials (RCTs) and 10 were observational studies [Table 1]. One RCT was not adequately powered and blinding was not consistently performed.[69] The other did not assess graft take or hematoma rate.[84] Both RCTs assessed a tie-over dressing against a modified tie-over dressing rather than an alternative graft fixation technique. As such, the relevance and reliability of these RCTs was limited.

Of the 10 observational studies, 8 were retrospective and 2 were prospective. Sample sizes ranged from 40 to 266 (mean 89; median 66). The most common site assessed for graft fixation was the head and neck region. All studies included the tie-over dressing as one of the comparator groups [Table 1].

Four observational studies compared the tie-over dressing to quilting/mattress suturing.[1,65-67] These studies included 181 grafts in total, and no significant differences were found between groups for graft take, hematoma/seroma formation, and infection.

Three observational studies compared tie-over dressings to simple pressure dressings.[68-70] These studies included a total of 528 grafts and did not find any significant differences in graft take, hematoma/seroma formation, nor infection. Although it has been proposed that pressure dressings may provide less adherence at anatomically complicated sites compared to tie-over dressings, De Gado et al.[68] assessed grafts at these “high-risk areas” and found no benefit for tie-over dressings.

The remaining three studies compared the tie-over dressing against “non-tie-over dressings” (n = 71),[71] hydrocolloid dressings (n = 62),[72] and double-tie-over dressings (n = 128).[73] No significant differences were found between groups.

Descriptive reports
For descriptive reports, 29 were case series and 50 were case reports/expert opinions (Table S1). These reports included some graft fixation methods that have not yet been assessed in analytic studies, including cyanoacrylate glue, negative-pressure dressings, and silicone net dressings. There was duplicity in the reporting of graft fixation techniques, especially for the tie-over dressing (or variants), which made up the bulk of reports (53.2%)—even in the contemporary literature [Table 2].

In most studies graft success was measured by clinical assessment of the healing graft, but there was heterogeneity in this grading. This included grading into good, moderate, and poor:[74] defining partially taken as those with >60–<100% graft take rate;[69] rating graft take as 0%–100%[68] and separating graft take into groups, such as 0%–24%, 25%–49%, 50%–74%, and 75%–100%, with the latter group defined as complete take.[63,69]

Discussion
The most commonly assessed graft fixation method was the tie-over dressing technique. This was assessed in all analytic studies and made up the majority of descriptive reports. No studies have shown superiority for the tie-over dressing compared to alternative graft fixation techniques, but the evidence base is limited. There are no RCTs
| Name                  | Study type           | Intervention 1                          | Intervention 2                          | Significant difference in graft take \((P < 0.05)\) | Graft take intervention 1 | Graft take intervention 2 | Hematoma/seroma | Infection | Sample size | Location | Blinding (evaluator) | Randomized |
|----------------------|----------------------|-----------------------------------------|-----------------------------------------|-------------------------------------------------|---------------------------|---------------------------|---------------------|------------|-------------|----------|---------------------|------------|
| Atherton et al.\(^{63}\) | RCT                  | Tie-over dressing with Jellonet/proflavin | Tie-over dressing with Allevyn          | NS                                              | 63.3% complete            | 62.1% complete            | Not assessed       | NS (3.3% vs. 3.4%) | 51 (plus 8 partial thickness) | Head and neck Limbs | When able but not always possible | Yes        |
| Saleh et al.\(^{64}\)    | RCT                  | Tie-over dressing soaked with polyhexamethylene biguanide (PHMB)-based solution | Tie-over dressing soaked with sterile water | Not assessed                                    | Not assessed              | Not assessed              | Not assessed       | Significantly favored intervention 2 (40% vs. 10%) | 40 | Face | Yes | Yes |
| Davenport et al.\(^{1}\) | Prospective observational | Tie-over dressing Mattress/quilting    | Mattress/quilting                       | NS                                              | 95% complete              | 95% complete              | NS (5% vs. 5%)      | Not assessed | 40 | Head and neck | No | Yes |
| Keh et al.\(^{65}\)     | Retrospective observational | Tie-over dressing Mattress/quilting    | Mattress/quilting                       | NS                                              | 76% complete              | 82% complete              | Not assessed       | NS (0% vs. 0%)      | 125 | Head and neck | No | No |
| Dhillon et al.\(^{66}\) | Retrospective observational | Tie-over dressing Mattress/quilting    | Mattress/quilting                       | NS                                              | 80% complete (94% partial) | 89% complete (100% partial) | Not assessed       | NS (9% vs. 26%)      | 70 | Head and neck | No | No |
| Akhavani et al.\(^{67}\) | Retrospective observational | Tie-over dressing Mattress/quilting    | Mattress/quilting                       | NS                                              | 90% complete              | 100% complete             | Not assessed       | NS (10% vs. 0%)      | 40 | Hand | No | No |
| De Gado et al.\(^{68}\) | Prospective observational | Tie-over dressing Simple pressure dressing | Simple pressure dressing                | NS                                              | 89.6% graft success       | 97.1% graft success       | Not assessed       | Not assessed | 212 | “High-risk areas” Nose dorsal hand, tibial plane Wrist Neck Limbs Hands + feet | No | Yes (poorly described) |
| Yuki et al.\(^{69}\)    | Retrospective observational | Tie-over dressing Simple pressure dressing | Simple pressure dressing                | NS                                              | 90% (defined complete as 75 + % take) | 88% (defined complete as 75 + % take) | NS (7% vs. 10%)     | NS (6% vs. 3%)      | 220 (plus 46 partial thickness) | Head and neck Trunk Limbs Hands + feet | No | No |
| Shimizu and MacFarlane\(^{70}\) | Retrospective observational | Tie-over dressing Simple pressure dressing | Simple pressure dressing                | NS                                              | 85.1% complete            | 83.70%                     | Not assessed       | Not assessed | 96 | Head and neck Trunk Arm + hand | No | No |
| Jeong et al.\(^{71}\)   | Retrospective observational | Tie-over dressing Hydrocolloid dressing | Hydrocolloid dressing                   | NS                                              | 74.2% complete            | 100% complete             | NS (9.7% vs. 0%)   | NS (3.2% vs. 0%)      | 62 (including partial thickness) | Not specified | No | No |
| Goto et al.\(^{72}\)    | Retrospective observational | Tie-over dressing Non tie-over dressing | Non tie-over dressing                  | NS                                              | 70% success rate          | 75% success rate          | Not assessed       | Not assessed | 71 | Foot | No | No |
| Lee and Kim\(^{73}\)    | Retrospective observational | Tie-over dressing Double tie-over dressing | Double tie-over dressing               | Not assessed                                   | Not assessed              | Not assessed              | Not assessed       | Not assessed | 43 (plus 85 split thickness) | All | No | No |

NS = no significant difference \((P \geq 0.05)\)
that have compared tie-over dressings to non-tie over techniques, and only a small number of observational studies are available.

The original purported advantage of the tie-over dressing was downward pressure, to promote revascularization and prevent hematoma and seroma formation.\cite{75} However, it has been suggested that the downward pressure of the tie-over dressing does not exceed capillary pressure, thus not reducing complications.\cite{76} Further criticisms of the tie-over dressing are that it is complex, prolongs operative time, often requires an assistant, and may hinder inspection and wound care in the postoperative period.

A strength of this study is that it included all methods of full-thickness graft fixation. A previous review assessed the evidence for only two fixation techniques: tie-over dressings and quilting/mattress suturing.\cite{77} Our study is novel in reporting at least equal evidence for simple pressure dressings, which were not included in this previous review. A further strength of this study is that it defines the current evidence base for full-thickness skin graft fixation techniques. A significant factor contributing to research waste is that researchers are unaware of the available evidence,\cite{79} leading to unnecessary duplication of existing studies. The presented body of evidence should thus be considered when future research is reported in this field.\cite{79}

Limitations of the study are that the evidence for split-thickness skin grafts were not assessed, although these differ from full-thickness skin grafts in that they can survive in conditions with less vascularity.\cite{79} The authors also did not analyze other parts of the study methodology that may affect reliability of results, such as number of surgeons, experience of surgeons, and number of centers. The search was also restricted to English language publications, although no relevant non-English publications were identified from the search.

To improve standards in evaluating surgical methods, the Idea, Development, Exploration, Assessment, Long-term (IDEAL) study framework has been developed.\cite{79} This study did not identify any of the alternative study designs suggested—such as controlled interrupted-time series studies, step-wedge design studies, and tracker trials. There was also a failure to progress evidence through the phases of the IDEAL framework, with multiple case series for tie-over dressings reported and a paucity of comparative studies.

In conclusion, the most commonly assessed skin graft fixation technique is the tie-over dressing. The current evidence base does not suggest a benefit for tie-over

| Graft fixation technique | n (%) before 2010 | n (%) since 2010 | % of descriptive reports |
|-------------------------|------------------|-----------------|------------------------|
| Tie-over dressing modification | Series 4 (7), Case reports or expert opinion 26 (48) | Series 6 (24), Case reports or expert opinion 6 (24) | 53.2 |
| Quilting sutures (± ointment) | Series 3 (6), Case reports or expert opinion 3 (6) | Series 1 (2), Case reports or expert opinion 1 (2) | 10.1 |
| Cyanoacrylate glue | Series 1 (2), Case reports or expert opinion 1 (2) | Series 3 (12), Case reports or expert opinion 0 (0) | 6.3 |
| Polyurethane foam dressing / sponge bolster or gauze and tape | Series 1 (2), Case reports or expert opinion 1 (2) | Series 1 (4), Case reports or expert opinion 1 (4) | 5.1 |
| Thermoplastics | Series 1 (2), Case reports or expert opinion 3 (6) | Series 0 (0), Case reports or expert opinion 0 (0) | 5.1 |
| Silicone net dressing | Series 0 (0), Case reports or expert opinion 1 (2) | Series 1 (2), Case reports or expert opinion 1 (2) | 3.8 |
| External wire frame | Series 1 (2), Case reports or expert opinion 1 (2) | Series 1 (4), Case reports or expert opinion 1 (4) | 3.8 |
| Negative-pressure dressing | Series 1 (2), Case reports or expert opinion 1 (2) | Series 0 (0), Case reports or expert opinion 1 (4) | 2.5 |
| Steri-Strips/sterile adhesive tape | Series 1 (2), Case reports or expert opinion 0 (0) | Series 1 (2), Case reports or expert opinion 1 (4) | 2.5 |
| Fibrin glue | Series 1 (2), Case reports or expert opinion 1 (2) | Series 0 (0), Case reports or expert opinion 0 (0) | 2.5 |
| Circumferential suture | Series 0 (0), Case reports or expert opinion 1 (2) | Series 0 (0), Case reports or expert opinion 1 (4) | 2.5 |
| Antibiotic ointment ± light dressing | Series 1 (2), Case reports or expert opinion 1 (2) | Series 0 (0), Case reports or expert opinion 0 (0) | 1.3 |
| Surgical glove | Series 0 (0), Case reports or expert opinion 0 (0) | Series 1 (4), Case reports or expert opinion 1 (4) | 1.3 |
dressings compared to simpler fixation methods for full-thickness skin grafts, most frequently for mattress/quilting sutures and simple pressure dressings. A caveat of this is that the current evidence base is limited. Future studies are needed to ensure practice is evidence-based, and these should consider the existing evidence base to prevent duplicity and ensure future research is most informative.

**Acknowledgement**

We thank the UK Dermatology Clinical Trials Network (UK DCTN) and other UK DCTN group members: L Webber, S Ziaj, LF Soriano, P Jayasekera, J Ingram, and E Pynn.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

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For descriptive reports, 29 were case series and 50 were case reports/expert opinions (Table S1).

| Study type | Intervention                                                                 | Sample size | Site            | Reference               |
|------------|------------------------------------------------------------------------------|-------------|-----------------|-------------------------|
| Case series| Quilting sutures                                                             | 327         | Periocular      | Kashkouli 2017\[^1\]    |
| Case series| Cyanoacrylate glue                                                           | 5 full-thickness (4 partial) | Periocular | Jackson 2017\[^2\]     |
| Case series| Tie-over dressing modification (bottle cap)                                  | 4           | Torso           | Wani 2017\[^3\]         |
| Case series| Tie-over dressing modification (bottle cap)                                  | 8           | Torso           | Singh 2015\[^4\]        |
| Case series| Tie-over dressing modification (hydrogel-impregnated dressing)               | 2           | Face            | Choi 2015\[^5\]         |
| Case series| Silicone net dressing                                                        | 50          | Lower leg       | Audrain 2015\[^6\]      |
| Case series| Tie-over dressing modification (barbed suture)                               | 30 (including partial-thickness) | H+N Limbs | Joyce 2015\[^7\]       |
| Case series| 2-octylecyanacrylate and adhesive strips +/- basting suture                  | 12          | Face            | Ranario 2014\[^8\]      |
| Case series| External wire frame fixation                                                 | 5           | Digits          | Huang 2014\[^9\]        |
| Case series| Tie-over dressing modification (nylon tie strips and skin staplers)          | 20          | Scalp Limbs     | Praveen 2014\[^10\]     |
| Case series| Surgical glove dressing                                                      | 6           | Hand            | Mashiko 2013\[^11\]     |
| Case series| Tie-over dressing modification (multiple loop silk sutures)                  | 4           | Scalp Limbs     | Jo 2013\[^12\]          |
| Case series| Cyanoacrylate glue                                                           | 5 (+ 7 split-thickness) | H+N | Habib 2013\[^13\]      |
| Case series| Multilayered polyurethane foam dressing                                      | 26          | H+N 19          | Nakamura 2012\[^14\]    |
| Case series| Quilting and chloromycetin ointment                                          | 92          | Leg             | Harvey 2009\[^15\]      |
| Case series| Tie-over dressing modification (rubber bands)                                | 20 full thickness (5 partial) | Arm | Sakurai 2007\[^16\]    |
| Case series| External wire frame fixation                                                 | 5           | Digits          | Ogawa 2007\[^17\]       |
| Case series| Quilting and chloromycetin ointment                                          | 82          | H+N Hand        | Patterson 2006\[^18\]   |
| Case series| Tie-over dressing modification (light dressing)                              | 1 (+1 partial thickness) | Neck | Dogan 2006\[^19\]      |
| Case series| Negative-pressure dressing                                                   | 8 (full-thickness and partial) | Neck Torso/pelvis | Chang 2002\[^20\]     |
| Case series| Thermoplastic                                                                | 38          | Eyelid          | White 2001\[^21\]       |
| Case series| Cardinal sutures and n-butyl-2-cyanacrylate                                  | 21          | Head and neck   | Craven 1999\[^22\]      |
| Case series| Interrupted sutures, antibiotic ointment, +/- light dressing                | 30          | Head and neck, finger | Langtry 1998\[^23\] |
| Case series| Tie-over dressing modification (rubber bands)                                | >100        | Head and neck   | Johnson 1998\[^24\]     |
| Case series| Autologous fibrin glue                                                       | 50          | Not stated      | Chakravorty 1989\[^25\] |
| Case series| Tie-over dressing modification (pressure disc)                               | 15          | Not stated      | Silfverskiold 1986\[^26\] |
| Case series| Tie-over dressing modification (stapled Renton material)                     | >150        | Not stated      | Weiner 1984\[^27\]      |
| Case series| Quilting (central and paracentral suture in addition to usual marginal sutures) | 109        | Periocular (oculoplasty) | Mehta 1979\[^28\]       |
| Case series| Steri-strips                                                                 | 27          | Digits          | Efron 1968\[^29\]       |
| Case report| Negative-pressure wound therapy                                              | 1           | Finger          | Niimi 2018\[^30\]       |
| Expert opinion| Tie over dressing modification (3-Way Stop-Cock)                          | Not stated  | Not stated      | Yontar 2017\[^31\]     |
| Case report| Silicone dressing                                                            | 1           | Face            | Rennie 2016\[^32\]      |
| Case report| Sterile adhesive tape                                                        | 1           | Face            | Ohn 2016\[^33\]        |
| Case report| Tie-over dressing modification (suture technique)                            | 1           | Finger          | Patil 2016\[^34\]      |
| Expert opinion| Running suture and ointment                                                  | Not stated  | Face            | Chasapi 2016\[^35\]    |
| Expert opinion| Tie-over dressing modification (suture technique)                            | Not stated  | Not stated      | Macdonald 2014\[^36\]  |
| Expert opinion| Quilting sutures (through and through basting suture) with straight needle | Not stated  | Ear             | Travelute 2013\[^37\]  |
| Case report| Tie-over dressing modification (twist-over: stainless steel suture technique) | 1           | Scalp           | Shokrollahi 2013\[^38\] |
| Case report| Tie-over dressing modification (sandwich suture)                             | 1           | Nasal ala       | Hussain 2012\[^39\]    |
| Expert opinion| Tie-over dressing modification (stapled bolster)                             | Not stated  | Ear             | Golda 2010\[^40\]     |
| Study type          | Intervention                                                                 | Sample size | Site        | Reference          |
|---------------------|-----------------------------------------------------------------------------|-------------|-------------|--------------------|
| Expert opinion      | Tie-over dressing modification (Lilliputian technique)                       | Not stated  | Not stated  | Srivastava 2009[41]|
| Expert opinion      | Silicone net dressing                                                       | Not stated  | Not stated  | Roh 2008[42]       |
| Case report         | Tie-over dressing modification (U-shaped stitches)                          | 1           | Ear         | Cigna 2008[43]     |
| Case report         | Tie-over dressing modification (star tie-over)                              | 1           | Scalp       | Coban 2007[44]     |
| Expert opinion      | Thermoplastic bolster dressing                                              | Not stated  | Not stated  | Meads 2006[45]     |
| Expert opinion      | Tension suture                                                              | 22          | Limbs Trunk | Ergen 2006[46]     |
| Expert opinion      | Quilting                                                                    | Not stated  | Not stated  | Nassab 2006[47]    |
| Expert opinion      | Tie-over dressing modification (rubber bands and bra hooks)                | N/A         | N/A         | Cheng 2006[48]     |
| Expert opinion      | Tie-over dressing modification (Speedo technique)                           | N/A         | N/A         | Lapid 2005[49]     |
| Expert opinion      | Tie-over dressing modification (criss cross suture)                         | N/A         | N/A         | Gandhi 2005[50]    |
| Expert opinion      | Tie-over dressing modification (running suture)                             | N/A         | N/A         | Adams 2004[51]     |
| Expert opinion      | Interrupted waved round block suture                                        | N/A         | N/A         | Gargano 2004[52]   |
| Expert opinion      | Cyanoacrylate                                                               | 1           | Foot        | Kilic 2002[53]     |
| Expert opinion      | Tie-over dressing modification (loop suture)                                | 1           | Hand        | Misra 2002[54]     |
| Expert opinion      | Fibrin glue                                                                 | Not stated  | Not stated  | Kubo 2000[55]      |
| Expert opinion      | Tie-over dressing modification (herniotomy approach)                        | 1           | Face        | Choudhary 1999[56] |
| Expert opinion      | Sponge bolster and adhesive dressing                                        | N/A         | N/A         | Egan 1998[57]      |
| Expert opinion      | Gauze dressing and Steri-strips                                              | N/A         | N/A         | Orenko 1998[58]    |
| Expert opinion      | Tie-over dressing modification (staples on foam)                            | N/A         | N/A         | Pennington 1998[59]|
| Expert opinion      | Tie-over dressing modification (staples on Renton foam)                     | N/A         | N/A         | Saltz 1997[60]     |
| Expert opinion      | Thermoplastic dressing                                                      | N/A         | N/A         | Ducic 1997[61]     |
| Expert opinion      | Tie-over dressing modification (shortened disposable syringe)               | N/A         | N/A         | Amir 1996[62]      |
| Expert opinion      | Tie-over dressing modification (double bolster)                              | N/A         | Ear         | Manstein 1996[63]  |
| Expert opinion      | Tie-over dressing modification (staple on polyurethane foam)               | Not stated  | Not stated  | Wells 1995[64]     |
| Expert opinion      | Tie-over dressing modification (transparent gasbag)                          | N/A         | N/A         | Ren 1995[65]       |
| Expert opinion      | Thermoplastic dressing                                                      | N/A         | N/A         | Fish 1994[66]      |
| Expert opinion      | Tie-over dressing modification (stopper)                                     | N/A         | N/A         | Koldas 1992[67]    |
| Expert opinion      | External wire frame fixation                                                | N/A         | N/A         | Hirai 1991[68]     |
| Expert opinion      | Tie-over dressing modification (Staples on Renton foam)                     | N/A         | N/A         | Larson 1990[69]    |
**Table S1: Continued**

| Study type        | Intervention                                                                 | Sample size | Site               | Reference                      |
|-------------------|------------------------------------------------------------------------------|-------------|--------------------|--------------------------------|
| Expert opinion    | Tie-over dressing modification (Stapled Telfa bolster)                        | N/A         | N/A                | Hoffman 1989[77]               |
| Expert opinion    | Tie-over dressing modification (Stapled foam dressing)                        | N/A         | N/A                | Kaplan 1989[72]                |
| Expert opinion    | Tie-over dressing modification (rubber bands)                                | N/A         | N/A                | Iacobucci 1987[73]             |
| Expert opinion    | Basting suture                                                               | N/A         | N/A                | Adnot 1987[4]                  |
| Case report       | Tie-over dressing modification (aluminium collar and plastic beak)          | 1           | Scalp              | Niranjan 1985[58]              |
| Expert opinion    | Tie-over dressing modification (pressure button)                              | N/A         | N/A                | Burd 1984[70]                  |
| Expert opinion    | Tie-over dressing modification (stent and tape)                               | N/A         | N/A                | Thomas 1982[71]                |
| Expert opinion    | Tie-over dressing modification (foam rubber sponge)                          | N/A         | N/A                | Wexler 1972[70]                |
| Expert opinion    | Tie-over dressing modification (rubber bands)                                | N/A         | Chest wall         | Rees 1969[79]                  |

H+N = head and neck. N/A = not applicable

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