Primary closure of cutaneous abscesses: a systematic review

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Abstract
Background: Cutaneous abscesses have traditionally been treated with incision and drainage followed by secondary healing. Primary closure after incision and drainage is an alternative mode of therapy practiced in some parts of the world. The current study reviews the experience with primary closure of abscesses.
Methods: A systematic literature review was conducted using search terms abscess and primary closure. The databases searched included MEDLINE, PubMed, EMBASE, CINHAL, and the Cochrane Library between 1950 and 2009. The reference lists of the retrieved studies were also manually searched for additional studies. We performed a meta-analysis of all randomized clinical trials in which patients were randomized to either primary or secondary closure of incised and drained abscesses using Review Manager software.
Results: Of 33 articles retrieved, there were 7 randomized controlled trials in which 915 patients were randomized to primary (n = 455) or secondary (n = 460) closure. Many abscesses were located in the anogenital region and drained by surgeons. The time to healing after primary closure (7.8 days [95% confidence interval (CI), 7.3-8.3]) was significantly shorter than that after secondary closure (15.0 days [95% CI, 14.3-15.7]; absolute difference, 7.3 days [95% CI, 6.9-7.6]). The rates of abscess recurrence after primary closure (7.6% [95% CI, 4.6-10.6]) were similar to those after secondary closure (11.1 days [95% CI, 7.5-14.7]; odds ratio, 0.66 [95% CI, 0.35-1.15]).
Conclusions: Studies from 4 countries suggest that primary closure of incised and drained abscesses results in faster healing and similar low abscess recurrence rates than after secondary closure. These studies provide a foundation for which clinical trials can be conducted in the United States.

1. Introduction

Over the last decade, the number of patients presenting annually to an emergency department (ED) in the United States with a cutaneous abscess has more than doubled from 1.2 million in 1996 to more than 2.6 million in 2006 [1].

During this period, there has also been an increase in the number of abscesses caused by community-acquired methicillin-resistant Staphylococcus aureus (CA-MRSA) [2], renewing the interest in the optimal management of cutaneous abscesses.
During the middle ages, many wounds were intentionally contaminated with dung and urine to promote suppuration that was thought to be essential for wound healing [3]. However, over the last century, a basic surgical premise has been that highly contaminated and/or infected wounds...
should never be closed by primary intention (in which the injured wound edges are approximated immediately after injury) because of the risk of infection [4]. As a result, the conventional treatment of cutaneous abscesses has been incision and drainage (I&D) followed by secondary healing in which the open wound is allowed to heal by granulation tissue formation and reepithelialization. This long-held dogma was first challenged by Ellis [5] in 1951 who described primary closure of incised and drained abscesses in 30 patients with anorectal abscesses. The majority of these patients healed uneventfully within 1 to 2 weeks with very few complications. Since this report, many others have described the successful use of I&D followed by primary closure for a variety of abscesses including those of the head and neck, breast, axilla, trunk, and extremities [6-19]. Although this method of treatment has been described in Europe, Africa, Asia, and Australia, we are unaware of similar reports from the United States.

Treatment of appropriately incised and drained abscesses by primary closure has the potential to speed healing, reduce pain, and improve scarring when compared with traditional secondary closure. However, most physicians in North America are unfamiliar with this mode of therapy. The goal of this study is to conduct a meta-analysis of randomized clinical trials comparing the healing and recurrence of incised and drained abscesses treated by primary or secondary closure. We hypothesized that primary closure would speed healing without resulting in an increase in the rates of recurrence.

2. Methods

2.1. Inclusion and exclusion criteria

Inclusion criteria were established before the search. Randomized controlled clinical trials that compared the time to healing (efficacy) and recurrence rates (safety) of primary and secondary closure of incised and drained skin abscesses were considered for inclusion. Non–English-language articles were not excluded. Review articles, retrospective analyses, noncomparative studies, and abstracts were not included. Studies were excluded from the analysis if it was impossible to extract or calculate the appropriate data from the published results.

2.2. Identification of trials and search strategies

All randomized controlled clinical trials citing the use of primary closure of abscesses were identified by conducting a search on MEDLINE (PubMed), EMBASE, and the Cochrane Library using the keywords primary closure, abscess, incision and drainage, and soft tissue infections. A comprehensive search of reference lists of published articles and review articles was also performed to ensure inclusion of all possible studies.

2.3. Data extraction

Two reviewers extracted data independently from every study using a predefined review form. To reduce bias, one of the reviewers was blinded to the source of the publication and the authors’ names. Inconsistencies between reviewers’ data were resolved through discussion until a consensus was reached. The randomized controlled trials were scored for quality to assess validity using the Jadad scoring system [20], which evaluates the studies based on perfect randomization, proper blinding, and an adequate description of withdrawals and dropouts. If the Jadad score of a study was at least 3, we considered the study to be of high quality.

2.4. Statistical analysis

Meta-analysis was performed according to recommendations from the Cochrane Collaboration and the Quality of Reporting of Meta-analyses guidelines [21]. The effect measures for continuous data were the mean with 95% confidence intervals (CIs). The effect measures estimated for binomial data were the odds ratio (OR) reported with 95% CIs. The level of significance was set at \( P < .05 \).

For the analysis of continuous data, means and standard deviations were used in the meta-analysis. For studies that only reported medians and interquartile ranges (IQRs), the median was used as the mean; and the standard deviation was estimated as 0.75 times the IQR, where the minimum IQR was assumed to be 1. One study (Leaper) only reported means and a \( P \) value, and the standard deviation was back-calculated assuming the \( P \) value was obtained from a \( t \) test with equal group standard deviations.

Heterogeneity was evaluated by using the \( \chi^2 \) test. A value of \( P < .1 \) was considered significant for heterogeneity. Fixed-effect models were used unless statistical heterogeneity was significant, in which case a random-effects model was used. Analysis was performed using the statistical software Review Manager Version 4.2 (Cochrane Collaboration, Software Update, Oxford, United Kingdom).

3. Results

Our search strategy identified 543 articles whose titles and abstracts were reviewed. Thirty-three studies described the use of primary closure after I&D of skin abscesses in nearly 2000 patients. From these articles, we identified 7 randomized controlled clinical trials that met study inclusion criteria (Table 1) [7,8,15-19]. These studies were conducted in Britain, Australia, and Nigeria during the years 1976 to 2001. There were 915 patients randomized to primary (\( n = 455 \)) or secondary (\( n = 460 \)) closure. Of the 915 cases included, the specific anatomical site of the abscess was reported in 696 cases. Nearly half of these cases (337) were located on sites other than the anogenital region (head and neck, trunk, and extremities; Table 1). Only one study that included 59
patients specifically excluded patients with systemic signs of infection [14]. None of the studies specifically excluded patients with underlying comorbidities. The use of preoperative antibiotics, analgesia/anesthesia, and type of suture used in patients assigned to the primary closure group are detailed in Table 2.

The main results of the meta-analysis are presented in Table 3 and Figs. 1 to 4. The time to wound healing after primary closure (7.8 days [95% CI, 7.3-8.3]) was significantly shorter than that after secondary closure (15.0 days [95% CI, 14.3-15.7]). The time to return to work was also shorter after primary (4.1 days [95% CI, 2.3-5.9]) than secondary (14.6 days [95% CI, 11.7-17.5]) closure. The rate of abscess recurrence and other complications was similar in the 2 treatment groups (Table 1).

Bacterial cultures were not obtained or reported in 3 of the 7 studies. In one study, cultures were obtained in 92 of 114 cases, of which 46% were gram positive (S aureus, S albus, hemolytic streptococci), 15% were mixed gram-positive aerobes/anaerobic mixed, 16% were anaerobes alone (Peptostreptococcus/Bacteroides), 5% were anaerobe/coliform mixed, and 3% were coliforms [19]. In the second study, 43% were nonspecified gram-positive aerobes, 23% were nonspecified gram-negative aerobes, 20% were anaerobes, and the rest were mixed [17]. In the third study, bacteria were only reported in patients with recurrent abscesses, of which most were S aureus [17]. In the last study, coagulase-positive S aureus was isolated from 69% of the cultures obtained; and 21% of the cultures were sterile [14].

**Table 1** Randomized clinical trials included in meta-analysis

<table>
<thead>
<tr>
<th>Source</th>
<th>Location of abscesses a</th>
<th>Primary closure (no. of abscesses)</th>
<th>Secondary closure (no. of abscesses)</th>
<th>Outcomes</th>
<th>Jadad score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abraham et al [15], 1997</td>
<td>Head and neck (8), trunk and limbs (13), buttoc, anogenital region, groin (33), axillary (4), breast (3)</td>
<td>32</td>
<td>29</td>
<td>Healing at 1 wk, healing at 1 mo</td>
<td>2</td>
</tr>
<tr>
<td>Edino et al [8], 2001</td>
<td>Breast (35), gluteal 29), head and neck (14), muscle (10), perianal (10), axilla (2), inguinal(1), trunk (4), pilonidal (1)</td>
<td>51</td>
<td>55</td>
<td>Time to healing, recurrence rate, quality of scars, cost</td>
<td>0</td>
</tr>
<tr>
<td>Leaper et al [16], 1976</td>
<td>Perianal, ischiorectal</td>
<td>110</td>
<td>109</td>
<td>Time to healing, time off work, recurrence rate</td>
<td>2</td>
</tr>
<tr>
<td>Macfie and Harvey [17], 1977</td>
<td>Limbs, perianal, breast, axilla, face, neck, buttock</td>
<td>121</td>
<td>98</td>
<td>Time to healing, recurrence rate</td>
<td>1</td>
</tr>
<tr>
<td>Simms et al [19], 1982</td>
<td>Anogenital (39), head and neck (21), axilla (27), breast (5), trunk/limb (22)</td>
<td>54</td>
<td>60</td>
<td>Time to healing, no. of return visits, recurrence rates</td>
<td>0</td>
</tr>
<tr>
<td>Stewart et al [7], 1985</td>
<td>Head and neck (33), trunks (20), limbs (16), pilonidal (21), perineal (47)</td>
<td>64</td>
<td>73</td>
<td>Time to healing, time off work, no. of hospital visits, recurrence rates</td>
<td>1</td>
</tr>
<tr>
<td>Visvanathan [18], 1988</td>
<td>Skeletal muscle (59)</td>
<td>23</td>
<td>36</td>
<td>Time to healing, length of hospital stay, recurrence rate</td>
<td>1</td>
</tr>
</tbody>
</table>

a Numbers in parentheses indicate number of abscesses in each specific anatomical site (when reported in the references).

**Table 2** Use of preoperative antibiotics, analgesia/anesthesia, and method of primary closure

<table>
<thead>
<tr>
<th>Study</th>
<th>Preoperative antibiotic</th>
<th>Analgesia/ anesthesia</th>
<th>Type of suture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abraham, 1997</td>
<td>IV flucloxacillin</td>
<td>NA</td>
<td>Nonabsorbable vertical mattress</td>
</tr>
<tr>
<td>Edino, 2001</td>
<td>IV ampicillin and cloxacillin</td>
<td>Ketamine anesthesia</td>
<td>Monofilament nylon vertical mattress</td>
</tr>
<tr>
<td>Macfie, 1977</td>
<td>IV lincomycin in half of the patients only</td>
<td>NA</td>
<td>Nylon mattress</td>
</tr>
<tr>
<td>Leaper, 1976</td>
<td>IV ampicillin and cloxacillin</td>
<td>General anesthesia</td>
<td>Monofilament vertical mattress</td>
</tr>
<tr>
<td>Simms, 1982</td>
<td>IV or IM clindamycin</td>
<td>General anesthesia</td>
<td>Monofilament nylon mattress</td>
</tr>
<tr>
<td>Stewart, 1985</td>
<td>Not given</td>
<td>General anesthesia</td>
<td>Chromic catgut mattress</td>
</tr>
<tr>
<td>Visvanathan, 1988</td>
<td>IV cloxacillin</td>
<td>NA</td>
<td>Chromic catgut mattress</td>
</tr>
</tbody>
</table>

IV indicates intravenous; IM, intramuscular; NA, not available.
In one study, a scar assessment was performed 3 months after drainage [8]. In patients whose abscess was treated with primary closure, 90% were considered to have “good” quality scars vs only 29.1% in the secondary closure group [8].

4. Discussion

The major finding of this meta-analysis is that primary closure of incised and drained skin abscesses results in faster healing than secondary closure. In addition, primary closure of incised and drained abscesses results in low rates of abscess recurrences that are comparable with those with the traditional method of secondary closure. Finally, primary closure was not associated with any significant adverse events such as sepsis or death. Of note, more than half of the patients had abscesses in the anogenital region that were treated by general or colorectal surgeons under general anesthesia.

The results of our study are further supported by multiple noncomparative studies evaluating the outcome of patients with skin abscesses managed by I&D followed by primary closure. In a retrospective series of 200 consecutive cases with perianal (109), ischiorectal (78), and perineal (13) abscesses, Ellis [6] reported a success rate of 77% after incision, drainage, and curettage followed by primary closure. Ellis emphasized the need to administer systemic antibiotics approximately 30 to 60 minutes preoperatively. He also noted that, after evacuating the pus, the lining of the abscess wall should be curetted to allow blood laden with antibiotic to penetrate. In contrast, Stewart et al [7] compared the outcomes of 64 patients randomized to I&D and primary closure without antibiotics to conventional management and concluded that routine antibiotic coverage was not necessary. Similarly, Edino et al [8] found comparable outcomes among 51 patients randomized to primary closure with or without antibiotics. Excellent healing rates have also been reported after closure of breast [9,10], axillary [11], gluteal [12], and a variety of other abscesses managed by primary closure [13,14].

The next logical question is whether the results reported in this study can be applied to I&D of skin abscesses by emergency physicians in the ED setting. In the majority of the reported studies, I&D was performed under general anesthesia by general or colorectal surgeons in the operating room. It may be more difficult to adequately drain the entire abscess cavity when general anesthesia is not performed, limiting any generalization to the ED setting. Furthermore, there are no reports of primary closure of incised and drained abscesses by emergency physicians under local, regional, or procedural sedation in North America. To answer this question, we are now conducting a randomized clinical trial of primary vs secondary closure of incised and drained abscesses in our ED. It is important to emphasize that successful primary closure of abscesses has only been reported after complete drainage of abscesses and curettage of its walls under general anesthesia. Whether drainage of abscesses in the ED under local anesthesia will be adequate to allow safe and effective primary closure remains to be determined. Because it has not been studied in the ED setting, we are currently excluding patients with significant cellulitis and signs of systemic infection (ie, fever or chills) as well as those with immunocompromising conditions. However, not all prior studies have excluded patients with these conditions [16]. In facts, of all 7 studies included in the meta-analysis, only one specifically noted excluding only patients with systemic signs of infection [14]. Also of paramount importance when considering primary closure for drained abscesses is the need for close patient monitoring and follow-up. Thus, all patients should be seen within 48 to 72 hours to determine whether there has been a recurrence or spread of the original infection. If and when a recurrent abscess occurs, the sutures

![Table 3](image)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Primary suture</th>
<th>Secondary closure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (95% CI) healing time, days</td>
<td>7.8 (7.3-8.3)</td>
<td>15.0 (14.3-15.7)</td>
</tr>
<tr>
<td>% Abscess recurrence (95% CI)</td>
<td>7.6 (4.6-10.6)</td>
<td>11.1 (7.5-14.7)</td>
</tr>
<tr>
<td>% Complications (95% CI)</td>
<td>8.1 (1.9-14.3)</td>
<td>11.0 (4.6-17.4)</td>
</tr>
<tr>
<td>Mean (95% CI) time until return to work, d</td>
<td>4.1 (2.3-5.9)</td>
<td>14.6 (11.7-17.5)</td>
</tr>
</tbody>
</table>

![Fig. 1](image)
should be removed and the abscess drained. This may require additional anesthesia and incision.

Another question is whether the recent increase in the number of abscesses caused by CA-MRSA should affect the use of primary closure for skin abscesses. A small study in children suggested that the addition of routine systemic antibiotics after I&D of large abscesses (>5 cm) managed by secondary closure improved outcome [22]. In contrast, a multicenter observational study, in which the majority of abscesses were caused by CA-MRSA, found favorable outcomes after I&D of skin abscesses followed by secondary closure regardless of whether antibiotics were administered or whether the appropriate antibiotics were given [2]. A recent randomized, double-blind trial of 166 outpatient subjects comparing placebo to cephalaxin at 500 mg orally 4 times for 7 days after I&D of skin and soft tissue abscesses found comparable cure rates (84.1% vs 90.5%, P = .25) [23]. In the latter study, S aureus was isolated from 70.4% of abscess cultures. Of the isolates tested, 87.8% were MRSA, 93% of which were positive for Panton-Valentine leucocidin genes. Of note, MRSA was not noted in any of the 7 studies included in this systematic review.

5. Limitations

Our study has several limitations worth noting. Although a large number of patients in prior studies have had perineal abscesses, these are the ones where most physicians would hesitate using primary closure because of their proximity to the anus and rectum. However, if it is safe to close these high-risk abscesses, it is probably at least as safe to close abscesses located away from the rectum, such as those on the trunk or extremities. The majority of studies were conducted before MRSA became prevalent. Thus, this limits generalizing the results to an era where MRSA is often the most common associated organism. However, a recent study of soft tissue infections indicated that, although MRSA was most common, healing after drainage of abscesses was not affected by whether any antibiotic was administered or whether the appropriate antibiotic (that covered MRSA) was used [2]. Therefore, it is possible that use of antibiotics may not be necessary even in today’s era.

Our meta-analysis was also potentially limited by clinical (not statistical) heterogeneity in view of the variation in the surgical procedures and abscess locations in the studies. In addition, in some cases, medians and IQRs were used to estimate means and standard deviations. This may have resulted in inaccurate estimates and results. Furthermore, few of the studies were considered of high quality based on their Jadad scores.

Our systematic review and meta-analysis investigated all randomized controlled clinical trials according to the inclusion criteria. The search strategy used in the present meta-analysis was broad and not limited to the English language to reduce any potential bias. Unpublished data or
those derived from searching proceedings’ databases were not specifically excluded. As always, the risk of publication bias existed, although the “funnel plot” of the studies in the meta-analysis implied minimal publication bias.

6. Conclusions

The overall quality of randomized trials comparing primary and secondary closure of incised and drained cutaneous is relatively poor and limited to literature from India, Australia, Britain, and Nigeria. In addition, many studies included patients with anogenital abscesses that were drained by surgeons under general anesthesia. However, based on these studies as well as multiple nonrandomized studies, it appears that primary closure of incised and drained abscesses results in faster healing and similar low abscess recurrence rates than after secondary closure. These studies provide a foundation for which clinical trials can be designed and conducted in the United States.

References