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Does the Use of Clean or Sterile Dressing Technique Affect the Incidence of Wound Infection?

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ABSTRACT

PURPOSE: The purpose of this article is to examine the evidence and provide recommendations for the use of clean or sterile dressing technique with dressing application to prevent wound infection.

QUESTION: In all persons with acute or chronic wounds, does the use of clean or sterile dressing technique affect incidence of wound infection?

SEARCH STRATEGY: A search of the literature was performed by a trained university librarian, which resulted in 473 articles that examined any age group that dealt with application of a wound dressing using either sterile or nonsterile technique. A systematic approach was used to review titles, abstracts, and text, yielding 4 studies that met inclusion criteria. Strength of the evidence was rated using rating methodology from Essential Evidence Plus: Levels of Evidence and Oxford Center for Evidence-Based Medicine, adapted by Gray and colleagues. Johns Hopkins Nursing Evidence-Based Practice Nursing Research Appraisal Tool was used to rate the quality of the evidence.

FINDINGS: All 4 studies reported no significant difference in the rate of wound infection when using either clean or sterile technique with dressing application. The strength of the evidence for the identified studies was identified as level 2 (1 level A, 3 level B). The study sizes were variable, and the wounds included do not represent the continuum of wounds clinically encountered across the board.

CONCLUSION/RECOMMENDATION: Evidence indicates that the use of clean technique for acute wound care is a clinically effective intervention that does not affect the incidence of infection. There is no recommendation that can be made regarding type of dressing technique for a chronic wound due to the lack of evidence in the literature.

KEY WORDS: Acute wound, Bandage, Chronic wound, Clean, Dressing, Incision, Infection, Sterile, Surgical site, Wound.

INTRODUCTION

Clinical practice varies widely, and there is little research to guide the clinician in determining whether clean or sterile technique is more effective in preventing wound infection.

A wound is defined as a disruption of the normal function and structure of the skin and underlying tissue. Acute wounds usually have an identifiable cause such as trauma or surgery. They proceed through the healing phases in an orderly, organized fashion. Some references use a 4-week time frame on healing for acute wounds, although there is no consensus.[1] Chronic wounds can begin as an acute wound or result from breakdown of previously intact skin. They are often associated with physiologic conditions such as diabetes and peripheral vascular disease that impair healing. These wounds often stall in one of the healing phases and fail to progress.[1]

Infection occurs when the presence of bacteria or other microorganisms that are present in sufficient quantity damage tissue or impair healing. Common signs and symptoms of infection include purulent exudate, foul odor, erythema, warmth, tenderness, edema, pain, fever, and elevated white blood cell count. When chronic wounds become infected, they may present with subtle signs and symptoms such as increase in pain, change in exudate or presence of necrotic tissue, delayed healing, poor quality of granulation tissue, unusual odor, or new areas of breakdown. Infection inhibits wound healing.[2]

Clean dressing technique involves use of a clean procedure field, clean gloves with sterile supplies, and avoidance of direct contamination of materials and supplies. Sterile technique involves use of a sterile procedure field, sterile gloves, sterile supplies/dressing, and sterile instruments. Meticulous hand hygiene is required for both.[3]

The purpose of this Evidence-Based Report Card (EBRC) is to examine the evidence and provide recommendations related to the use of clean or sterile dressing technique during dressing application to prevent wound infection. We developed our search questions and key words using the PICO model, where P = population, I = intervention, C = comparison, and O = outcome.[4]

P: Persons with acute or chronic wound

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I: Clean dressing technique
C: Sterile dressing technique
O: Infection

Question

In all persons with acute or chronic wounds, does the use of clean or sterile dressing technique affect incidence of wound infection?

METHODS/SEARCH STRATEGY

An experienced reference librarian searched 3 multidisciplinary medical databases on September 21, 2017, to find literature related to clean and sterile dressing technique. The databases searched were CINAHL, PubMed, and EMBASE, which were selected for their robust, international scope of available literature. Search filters for all databases were English language; article types included were Articles, Articles in Press, and Reviews for EMBASE. Medical Subject Heading (MESH) terms identified for this search included (dressing* OR bandage*) AND (wound* OR incision* OR "surgical site*") AND (clean OR sterile) AND infection. No date restrictions were made in order to capture all relevant literature.

Following these limiters, 107 results were retrieved from CINAHL, 339 results were found in EMBASE, and 258 results were retrieved from PubMed. A total of 704 article citations were transferred to a proprietary citation management software. After removing duplicate articles across databases, 473 citations remained for further review. Inclusion criteria for the final review were original research studies that were English articles on any age group that dealt with application of a wound dressing using either sterile or nonsterile technique. An initial review of these abstracts removed 457 citations. Of the remaining 16, four articles were identified that met all of the inclusion criteria (Figure).

FINDINGS

Four studies were identified that met the inclusion criteria. Three randomized controlled trials (RCTs) were identified.[5-7] One study was quasi-experimental.[8] In one RCT, the incidence of wound infection was compared with uncomplicated lacerations repaired with clean or sterile gloves.[5] Another RCT examined wound-healing rates in open surgical wounds when using sterile or clean technique for dressings.[6] The third RCT analyzed infection rates in Mohs Micrographic Surgery (MMS) when using clean or sterile gloves during the procedure.[7] The quasi-experimental study considered differences in infection rates when using clean or sterile dressing technique with surgical wounds.[8] In 3 of 4 studies, there were small sample sizes. The studies were completed in settings of varying sizes. The studies each had different measures to determine indicators of infection, and there were many types of acute wounds, including lacerations, MMS procedural wound, and a variety of surgical wounds. Studies of clean versus sterile dressing techniques for chronic wound infection rates were not located.

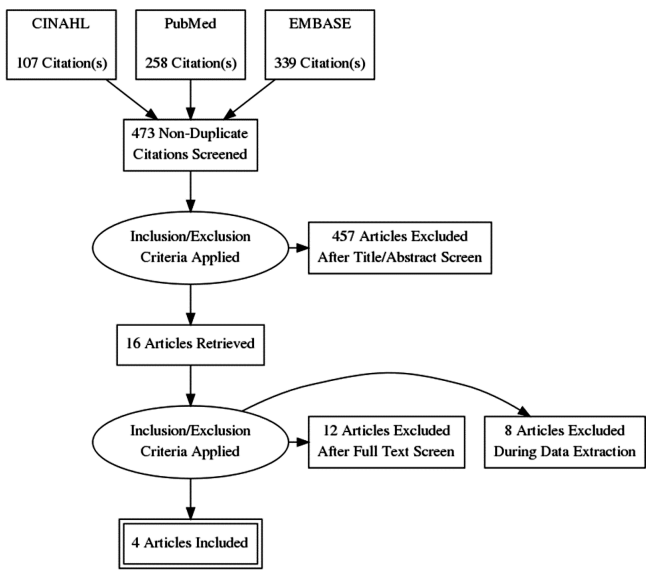

Figure. PRISMA diagram.

Using methods described previously,[9,10] studies were appraised and rated for strength (Table 1). Additionally, each study was assessed for level of recommendation quality using the Johns Hopkins Nursing Evidence-Based Practice Nursing Research Appraisal Tool (Table 2).[11] One study was graded as level A[5] and 3 studies as level B.[6-8] See Table 3 for a summary of each study.

Summary of Findings

Four studies were identified that met the criteria to answer the question we posed, and the primary outcome was incidence of infection of acute and chronic wounds. One RCT by Stotts and colleagues[6] examined the difference between dressing change technique (clean vs sterile) in open abdominal surgical wounds and studied 2 groups of patients for 3 to 9 days postoperatively (n = 30). The 2 groups were randomized into receiving dressing changes 3 times per day, with either clean or sterile technique application, depending upon their group assignment. This small study operated on the premise that a heavy bacterial burden would delay healing and a light bacterial burden stimulates healing. These data showed no significant difference ($P > .5$) between the 2 groups on the rate of wound healing. However, this was a small sample and type II error (confirms an idea that should have been rejected) could not be ruled out.

Another multicenter RCT by Perelman and colleagues[5] studied infection rates in 816 people who had noncomplicated traumatic lacerations with surgical repair using sterile (n = 408) versus nonsterile (n = 408) gloves. There was no significant difference in the incidence of laceration infection between these 2 groups ($P = .295$). The infection rate for the group that received laceration repair with sterile gloves was 6.1% (95% CI, 3.8-8.4), and the rate in the group that received laceration repair with nonsterile gloves was 4.4% (95% CI, 2.4-6.4). The relative risk of infection was 1.37 (95% CI, 0.75-2.52). Limitations for this study include that an unknown number of providers performed the laceration repairs, and the skill levels of the laceration repair provider could have influenced the outcome (student vs licensed physician, for example).

The third RCT study by Xia and colleagues[7] evaluated whether there was a difference in infection rates of patient who underwent MMS in all steps of the procedure with the providers using either sterile or clean gloves, with 30 subjects in each group (n = 60). In this study in a single center, a total of 12 wound infections were identified. Two infections occurred in the sterile glove group, and 1 infection occurred in the

TABLE 1.
Method for Rating the Strength of the Evidence[a]

Evidence Level	Description
A	Evidence based on consistent results of RCTs, other experimental designs, or systematic reviews supported by meta-analysis.
B	Evidence based on inconsistent findings from RCTs or evidence based on findings from nonrandomized studies with a control group and/or well-designed observation (cohort or case-control) studies
C	Evidence based on single-group studies, expert consensus or opinion, current or best practice, physiological theory or principles, case series, or case studies

Abbreviation: RCT, randomized controlled trial.
[a]From Gray and colleagues.[9] Used with permission.

clean glove group; however, this difference was not statistically significant ($P = .99$). Limitations for this study include a small sample size.

In wounds that heal by secondary intention, a quasi-experimental study done by Lawson and colleagues[8] compared surgical site infection rates in surgical patients (n = 2033) in their facility. After implementation of nonsterile wound care for all patients with open surgical wounds, data were collected for 3 months. Baseline data were also collected for the 3 months prior to the intervention. In the 3 months prior to the intervention, the infection rate for surgical wounds was 0.84% (n = 1070). After the intervention, the infection rate for surgical wounds was 0.83% (n = 963). The infection rates in surgical wounds compared pre- and postintervention were not statistically significant. This study has several limitations in that the infection presence was based on the documentation of a positive wound culture. However, it is possible that not all wounds were cultured and it is also possible that not all wounds were captured or identified. The number of wounds counted versus the number of individual patients counted to produce some discrepancy cannot be ruled out.

One important study by Creamer and colleagues[12] did not meet the inclusion criteria but is important to mention as the investigators studied bacterial load of gloves. This excluded study compared the bacterial load of gloves in the 3 groups of volunteers (n = 25) who (1) donned clean gloves independently, (2) donned sterile gloves independently, and (3) donned sterile gloves again with technician assistance. The palmar surface of each glove was cultured. While there was a significant difference in bacterial load on clean gloves versus sterile gloves ($P < .001$), there was a clinically irrelevant statistical difference when comparing the bacterial contamination on clean gloves with the bacterial load that would be expected to cause an infection. Findings from this small study provide preliminary data on clean versus sterile technique and incidence of infection. While gloves are not the only potential contaminant for an infection, this study suggests that glove types (clean vs sterile) are not a strong factor in the outcome of wound infection incidence.[12]

TABLE 2.
Level of Recommendation[a]

Level of Recommendation	Description
Level 1	Based on consistent findings from 2 or more studies with level A evidence
Level 2	Based on result of one level A study or inconsistent (mixed) findings from 2 or more level A studies
Level 3	Based on studies whose highest level of evidence is B
Level 4	Based on level C evidence (expert opinion, case series/case studies, etc)

[a]From Ebell and colleagues[13] and Gray and colleagues.[9] Used with permission.

SORT Statement

The Strength of Recommendation Taxonomy (SORT), developed by Ebell and colleagues,[13] addresses the quality, quantity, and consistency of evidence and allows the rating of bodies of evidence using a systematic and structured method. Using an adapted version of the SORT methodology described by Gray and Doughty,[14] we accorded the body of evidence related to this recommendation as a level 2 to address acute wounds (see Tables 2 and 3). SORT level 2 is based on results of 1 level A study or on inconsistent (mixed) findings from 2 or more level A studies. We deem level 2 to be acceptable to determine our evidence-based recommendation.

Recommendation for Practice

The use of clean technique for acute wound care is a clinically effective intervention that does not affect the incidence of infection (SORT level 2). However, there are multiple wound types, and this statement is a recommendation based on scant literature that does not cover all wound types and clinical scenarios. Due to the paucity of scientific evidence available, no recommendation for technique type for dressings of chronic wounds is made in this EBRC. The literature that is currently available does not support or refute either technique; therefore, each clinician and setting must establish their own procedure recommendations for chronic wound care.[14]

Clinical Implications

Incidence of wound infection in persons with acute or chronic wounds can be affected by 1 or more variables. For this EBRC, the evidence for the use of clean versus sterile technique continues to be controversial in many settings of care. A previous *JWOCN* EBRC of clean versus sterile technique when applying dressings[14] reported a lack of evidence to support the use of either method for wound care, and only limited progress has been made to establish firm and broad recommendations for acute wounds. The literature is largely silent on chronic wound infection incidence associated with sterile or clean dressing technique. Evidence-based practice is defined as a problem-solving approach to clinical decision-making within a health care organization that integrates best available scientific evidence and best available experiential (patient and practitioner) evidence, considers internal and external influences on practice, and encourages critical

TABLE 3.
Literature Summary Table

	Level of Evidence	Sample/Setting	Purpose	Findings	Limitations
Lawson and colleagues[8] *Design: Nonrandomized, longitudinal study*	B	*Participants* *N = 2033 surgical wounds in total* *Setting:* Acute surgical units at a major medical center in the United State	To determine differences in infection rates and costs of using sterile vs clean dressing technique in the management of surgical wounds	Surgical wounds with sterile dressing technique prior to intervention had a 0.84% infection rate Surgical wounds postintervention (clean technique only) had a 0.83% infection rate, which was not significant	Wound cultures may not have been performed on all patients Sample size is small May not have had exact number of all surgical wounds
Perelman and colleagues[5] *Design: Prospective, randomized, double-armed, multicenter study*	A	*Participants* *N = 816 patients* *Setting:* 3 large community hospitals in North America	To determine whether difference in the incidence of wound infections in uncomplicated lacerations varied between use of clean vs sterile gloves	There was no significant difference in observed infection rate in uncomplicated lacerations between patients who received repair with clean vs sterile gloves	Sample size in both arms limited equivalency Packaging of different gloves allowed for only partial blinding to medical personnel Ensuing care was not "absolutely" standardized Some repairs were completed by medical students
Stotts and colleagues[6] *Design: 2-group randomized study*	B	*Participants* *N = 30* *Setting:* A hospital in the United States	To determine if there was a difference in the rate of wound healing and costs of supplies between sterile vs clean dressing technique for open surgical wounds	No difference in the wound-healing rate between use of sterile vs clean technique in open surgical wounds Clean technique is less expensive	Small sample size Did not use any empirical measure for infection Type II error may exist
Xia and colleagues[7] *Design: Prospective, 2-arm randomized study*	B	*Participants* *N = 60* *Setting:* An outpatient clinic in the United States	To evaluate whether there is a significant difference in infection rates in patients undergoing MMS when using clean vs sterile gloves during tumor removal/wound repair phases of the procedure	No difference in infection rates when using clean gloves vs sterile gloves during MMS wound repairs	Small sample size

Abbreviation: MMS, Mohs Micrographic Surgery.

thinking in the judicious application of such evidence to care of the individual patient, patient population, or system.[15] Therefore, since no scientific evidence was found on dressing technique related to chronic wounds, the clinician and the organization, using available experiential evidence and considering internal and external influences on practice, must encourage critical thinking and establish dressing technique guidelines for wound care.[14]

Sterile versus nonsterile glove use is only one of the many variables that can affect the incidence of infection, including but not limited to the setting wound care is to be provided (ie, hospital, home, long-term care, outpatient clinics), type of wound (ie, surgical, venous, gynecological), patient overall status (ie, immunocompromised, comorbidities, history of infection), and level of staff or care provider training and or education. Good-quality multisite RCTs with clean versus sterile technique as the controlling variable for best evidence-based practice of wound care and wound infection prevention are urgently needed. To reduce the risk for infection when performing wound care, clinicians must critically analyze the technique to be used based on patient overall status, wound type and location, and topical care to be provided and perform care consistent with agency policies and procedures.

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