

# The Treatment of *Staphylococcus Aureus* Infected Sore Nipples: A Randomized Comparative Study

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## Abstract

Sore, cracked nipples are commonly experienced by breastfeeding mothers. We have previously reported a strong correlation between sore, cracked nipples and *S. aureus* colonization. A prospective, randomized clinical trial was performed to compare four treatment regimes for *S. aureus* infected sore nipples. Eighty-four breastfeeding mothers were enrolled in the study. After 5 days to 7 days of treatment, only 8% of mothers showed improvement in the “optimal breastfeeding technique alone” group, 16% improved with topical mupiricin, 29% improved with topical fusidic acid, yet 79% improved with oral antibiotics ( $p < .0001$ ). Optimal breastfeeding techniques and topical antibiotics ointment failed to heal most infected, sore, cracked nipples. Mastitis developed in 12% to 35% of mothers not treated with systemic antibiotics compared to 5% of mothers treated with systemic antibiotics ( $p < .005$ ). In conclusion, *S. aureus* infected sore, cracked nipples should be diagnosed as a potentially widespread impetigo vulgaris and treated aggressively with systemic antibiotics in order to improve healing and decrease the risk of developing mastitis due to an ascending lactiferous duct bacterial infection. J Hum Lact 1999; 15:241—246.

**Keywords:** breastfeeding, treatment of sore nipples, *Staphylococcus aureus* nipple infections

## Introduction

Sore nipples, particularly during the first few days of breastfeeding, are a common symptom experienced by approximately 80% of breastfeeding mothers.<sup>1</sup> Transitory nipple soreness is generally accepted as within normal limits.<sup>2</sup> Factors such as nipple preparation, and frequency or duration of breastfeeding do not seem to make a difference in preventing this soreness,<sup>3,4</sup> nor are maternal skin or hair color predictive.<sup>5-7</sup>

The current recommendations for sore, cracked nipples focus on optimizing maternal breastfeeding technique, including correct positioning and latching.<sup>8-11</sup> In some cases, nipple pain and ulceration continue despite these interventions. Little emphasis has been put on identifying or eradicating the underlying cause(s).

As in other clinical situations, when there is a break in the skin surface, there is a predisposition to bacterial and fungal colonization. Contaminated wounds are often slow to heal, and can lead to widespread infections.<sup>12,13</sup> *Staphylococcus aureus* is a pathogen that is a common causative agent for impetigo of the skin, cellulitis, ascending lactiferous duct infections, mastitis, and breast abscess.<sup>14,15</sup>

Based on unpublished data by the author, approximately 85% of mothers in Vancouver initiate breastfeeding, but the majority terminate breastfeeding within 3 months due to difficulties that include sore, cracked nipples. Based on our previous study, about 100 new mothers are referred to the Vancouver Breastfeeding Center each month and 51% complain of sore, cracked nipples. Mothers with infants younger than 1 month who complain of moderate to severe nipple pain with cracks, fissures, ulcers, or exudates have a 64% chance of having a positive bacterial skin culture and a 54% chance of having *S.*

*aureus* impetigo vulgaris colonization.<sup>16</sup> It was our clinical impression that sore, cracked nipples colonized with *S. aureus* were slow to heal despite careful attention to optimal breastfeeding technique.

The purpose of this study was to test the hypothesis that optimal breastfeeding technique alone does not cure *S. aureus* infected, sore cracked nipples, and to compare 4 treatment regimes for *S. aureus* infected sore, cracked nipples.

## **Methodology**

### *Setting and Demographics*

The Vancouver Breastfeeding Center is a community-based clinic that specializes in diagnosing and managing breastfeeding problems. Most patients attending the center are Caucasian or Asian, have completed high school, and live in urban or suburban areas.

### *Study Design and Selection Criteria*

Mothers attending the breastfeeding clinic complaining of sore nipples, with objective evidence of a break in the nipple skin integument including cracks, fissures, or ulceration, were considered potentially eligible for the study. According to routine practice, a standard clinical breastfeeding assessment was performed. Symptoms and signs of sore nipples were recorded, followed by an observation of breastfeeding to assess positioning, latch, and infant sucking dynamics. All mothers received one-on-one instruction about basic breastfeeding techniques, including positioning and latching, given by a lactation consultant. They also received an instructional video to review at home about breastfeeding techniques.<sup>17</sup> A nipple culture was obtained from an unwashed, cracked nipple before breastfeeding, using a cotton-tipped culturette. According to routine office procedure, the swab was sent to the local laboratory. "Normal skin flora" was reported for coagulase-negative staphylococci, diphtheroids, alpha-streptococci, and non-betahemolytic streptococci. For all other organisms isolated and identified, sensitivities were given for three or fewer organisms. Specific fungal swabs were not routinely obtained.

During the study period, only mothers with sore, cracked nipples and a *S. aureus* positive culture were eligible to enter. Mothers with evidence of local or systemic spread of infection such as cellulitis, ascending lactiferous duct infection, or mastitis were excluded. Eligible mothers were invited to participate and informed consent was obtained.

### *Intervention*

Each case was randomly assigned to 1 of 4 treatment groups: (1) review of basic breastfeeding technique alone;<sup>18</sup> (2) topical treatment with 2% mupirocin ointment applied to nipples after each breastfeed;<sup>9,20</sup> (3) topical fusidic acid ointment applied to nipples after each feed; or (4) oral cloxacillin/erythromycin 500 mg every 6 hours for 10 days.<sup>21-23</sup> One hundred tags were alternatively labeled A, B, C, or D and placed in an envelope. Every case was randomly assigned by drawing a tag from the envelope. The target sample size of 25 per group was set to be able to detect a medium-to-large effect size with 80% power (at 5% significance level) using either a one-way analysis of variance to compare means, or a Fisher's Exact test to compare proportions. An operational definition of a medium-to-large effect size is that the standard deviation of the population means is one-quarter to one-third as large as the standard deviation of the observations within the populations.

### *Outcome Measurement*

All mothers were assessed by a physician at 7 days of treatment or sooner if requested. Mothers were instructed to return early if their sore nipples worsened or if they developed fever, chills, deep breast pain, or erythema, as these symptoms and signs are clinically suggestive of spreading cellulitis, ascending infections, and mastitis.

At the time of reassessment, mothers ranked their symptoms of nipple pain as mild, moderate, or severe. Symptoms and signs of wound healing were ranked by the physician as: (1) better/resolved if the pain was absent and skin surface was intact; (2) the same or no obvious change if the pain persisted or the skin surface was still broken and there were no signs of wound healing; or (3) worse if the pain persisted and skin surface was broken with purulent exudates and signs of extension of lesions. If, at any stage, there were clinical symptoms or signs of a spreading infection including cellulitis, mastitis or fever, systemic oral

antibiotics were added immediately and this was considered a treatment failure. If the sore nipples remained the same or worse at the end of the assessment period, additional oral antibiotics were prescribed at the physician's and mother's discretion.

This was an open study and outcome measures could be subjected to bias. The assessment of improved versus no change or worse was categorized conservatively, that is, if the clinical findings were ambiguous this finding was recorded as no obvious change. This is in keeping with clinical practice.

## Results

Eighty-four mothers with *S. aureus* impetigo were enrolled and all mothers completed the study. They were a highly motivated population of breastfeeding mothers. Seventy-four percent had infants less than 1 month old. At the time of initial presentation 7% (6) had mild nipple pain, 63% (53) had moderate nipple pain, and 30% (25) had severe nipple pain. On examination, they all had cracked, fissured, or ulcerated lesions on their nipples with or without purulent exudates (Table 1). Nipple culture results revealed that 31% (26) had scant growth of *S. aureus*, 18% (15) had moderate growth, and 51% (43) had heavy growth. Eighty-six percent of the *S. aureus* were penicillin resistant and one was methicillin resistant.

Table 1. Clinical findings (n=84).

Subjective Findings		
Mild nipple pain	7%	(6)
Moderate pain	63%	(53)
Severe pain	30%	(25)
Objective Findings		
Nipple skin with scabs	12%	(10)
Cracks/fissures with exudates	88%	(74)
Other Material Findings		
Sore, cracked nipples in hospital or previous mastitis	43%	(36)
	17%	(14)
Poorly graspable nipples Other Infant Findings		
Tongue tie	10%	(9)
Retrognathia	12%	(11)

Each mother was assessed within 5 days to 7 days. Thirty-one percent of the total group had complete resolution of the problem or clinical dermatological evidence of good wound healing, including absence of exudate, lack of surrounding erythema, re-epithelialization, or a dry scab. Forty-three percent had no clinical evidence of wound healing and 26% had clinical dermatological evidence of spreading skin infection. Systemic antibiotics were added in 46 of the 58 cases that had not improved.

Out of 23 mothers who received advice about basic breastfeeding techniques alone, 9% were considered improved or resolved, 56% remained the same or showed no obvious change, 5% were worse without having mastitis, and 30% developed systemic symptoms and signs of mastitis. Twenty-five mothers received basic breastfeeding advice combined with topical 2% mupirocin ointment. Only 16% were considerably improved or resolved, 56% remained the same or demonstrated no obvious change, 16% were worse, and 12% developed mastitis. Seventeen mothers received basic breastfeeding advice combined with topical fusidic acid ointment. Thirty-six percent were considerably improved or resolved, 43% remained the same or showed no obvious change, and 21% developed mastitis. Nineteen mothers received basic breastfeeding advice combined with oral antibiotics. Seventy-nine percent improved or resolved, 16% remained the same or showed no obvious change, and only 5% developed mastitis (Table 2).

Table 2. Treatment groups.

Clinical Outcome	Optimal Technique <i>n</i> =23	Topical Mupirocin <i>n</i> =25	Topical Fusidic Acid <i>n</i> =17	Oral Antibiotics <i>n</i> =19
Improved	9% (2)	16% (4)	36% (5)	79% (15)
Same	56% (13)	56% (14)	43% (6)	16% (3)
Worse	35% (8)	28% (7)	21% (3)	5% (1)

Note. Chi-square test of independence: chi-square stat = 28.20; *p* value = .0001.

A chart review was performed to identify cofactors that might affect outcome. Forty-three percent (36) of subjects had a history of sore, cracked nipples during their postpartum stay in the hospital, or recently experienced mastitis. Cross-tabulations comparing clinical history of possible *S. aureus* infections with outcome failed to reveal a correlation.

Maternal or infant factors that interfere with effective positioning, latch, or suckling can cause repetitive trauma to the nipple, resulting in abrasions and a break in the skin integument. It was hypothesized that repetitive trauma causing ongoing breakage of skin and hence a portal of entry for pathogens might be related to *S. aureus* infection. Seventeen percent (14) of mothers had poorly graspable nipples, 10% (9) of infants had a short frenulum, and 12% (11) of infants had significant retrognathia. Cross-tabulations comparing these variables with outcome failed to find a correlation.

The risk of developing mastitis within 7 days of presentation to the clinic was 25% among mothers who were not treated systemically compared to 5% for mothers who received oral antibiotics. The study was stopped early due to a clinical and ethical concern about an apparent high incidence of treatment failure, as evidenced by persistent nipple pain and poor wound healing and the high risk of developing mastitis amongst the groups not receiving systemic antibiotics (Table 3).

Table 3. Risk of developing mastitis.

	Non Systemic Treatment ( <i>n</i> =65)	Systemic Treatment ( <i>n</i> =19)
No mastitis within 7 days of presentation	75% (49)	95% (18)
Clinical symptoms and signs of mastitis within 7 days of presentation	25% (16)	5% (1)

Note. Chi-square test of independence: chi-square stat = 3.41; *p* value = .065.

When comparing severity of sore nipples to outcome, a small number of mothers improved regardless of therapy, but it appears that oral antibiotics were the only effective treatment in mothers with severe sore nipples (Table 4).

Table 4. Clinical outcome by treatment group and initial soreness status.<sup>1</sup>

Treatment Group	Optimal Technique ( <i>n</i> =23)			Topical Mupirocin ( <i>n</i> =25)			Topical Fusidic ( <i>n</i> =17)			Oral Antibiotics ( <i>n</i> =19)		
	Mild <sup>2</sup>	Mod	Sev	Mild	Mod	Sev	Mild	Mod	Sev	Mild	Mod	Sev
Initial Soreness												
Clinical Outcomes												
Improved	0	2	0	0	3	1	1	4	0	1	8	6
Same	3	9	1	0	9	5	1	3	2	0	0	3
Worse	0	6	2	0	5	2	0	4	2	0	0	1

<sup>1</sup>Overall difference in outcome between treatment groups, *p* < .0001 by Fisher's Exact test.

<sup>2</sup>Difference in outcome by initial soreness, not significant for any treatment group.

Since recruitment of subjects was terminated early, with unequal group sizes, a postrandomization comparison of the 4 groups with respect to demographic and medical history variables was done to ensure compatibility. There was no significant difference with respect to infant or maternal cause, milk production, nipple trauma, presenting subjective complaints, or objective findings. The control and fucidin groups had significantly younger infants ( $p=.03$ ), while the control and oral antibiotic groups had significantly more instances of previous possible *S. aureus* infections ( $p=.02$ ). Although the sample size was smaller than originally planned, it was still large enough to show a significant difference between treatment groups.

## Discussion

Elucidating the cause of sore nipples usually requires a detailed maternal and infant history and physical examination, followed by observation of breastfeeding. Increasing or persistent nipple pain, excoriations, dermatitis, or ulceration are pathological and require careful dermatological evaluation.<sup>24</sup>

Natural barriers, such as the stratum corneum, skin dryness, rapid cell turnover, and acid pH of 5 to 6 of the intact skin, usually prevent infection. When there is a break in the integument, there is a predisposition to a secondary infection due to bacterial or fungal contamination, which may lead to a delay in wound healing.<sup>25</sup> Sore nipples associated with skin breakage including cracks, fissures, and ulceration have a high chance of contamination by microorganisms.

Humans are a natural reservoir of *S. aureus*. Thirty percent to 50% of adults are colonized and are at increased risk of becoming infected.<sup>26,27</sup> Strains of *S. aureus* can penetrate the superficial layers of the epidermis at sites of minor trauma to the skin. They produce numerous toxins causing inflammation, epidermal separation, and the appearance of blisters or bullae. The bullae break down causing erosions, which are covered by a yellow, crusted exudate, the hallmark of impetigo. The findings on the nipple and areola of local erythema, excoriations, ulcers or purulent exudates, and tenderness are clinically suggestive of impetigo vulgaris due to coagulase-positive *Staphylococcus aureus*, or group-A beta-hemolytic *Streptococcus*.

Many cases of breast cellulitis, puerpual mastitis, and breast abscess are a complication of an ascending lactiferous duct infection, not a blood-borne infection, and are probably secondary to impetigo on the nipple.<sup>28,29</sup> This route of infection is similar to acute pyelonephritis of the kidney that results from an ascending lower urinary tract infection. They both warrant aggressive management.

During the study period, there were other clusters of breast problems that appeared to be related to *S. aureus* infections. Five study mothers complained of severe sore nipples with deep, radiating, burning breast pain and episodic vasospasms of their nipples unrelated to immediate suckling. Blanching or vasospasms of a peripheral appendage induced by cold exposure or repetitive trauma is termed Raynauds phenomenon. In these cases, there appeared to be a clinical correlation between vasospasms of the nipple associated with repetitive gumming of the nipple and *S. aureus* infection.<sup>30</sup> Eradicating the infection with cloxacillin, minimizing the repetitive trauma, and avoiding nipple exposure to cold were effective measures in resolving the vasospasms of the nipple.

Most mothers reported they avoided washing their nipples with soap and water based on advice given by health professionals or gleaned from written educational materials. Yet careful bathing and hygiene are important adjunct measures in the management of impetigo of the skin.

## Recommended Management

Sore, cracked nipples, with or without a crusty, yellow exudate, should be diagnosed clinically as impetigo vulgaris, and treated according to the standard medical recommendations for impetigo. Nipple cultures can confirm the diagnosis, but treatment should be based on clinical judgment and commenced early. Management for impetigo vulgaris includes the principles of moist wound healing.<sup>31</sup> Careful washing of the nipples with soap and water to remove crusting and exudates and the application of topical antibiotic ointments such as 2% mupirocin may be effective in the early stages of superficial impetigo.<sup>32</sup> But the findings in this study suggest that impetigo of the nipple is, or can lead to, a widespread or deep infection. Therefore, the treatment of choice among these study patients was systemic penicillinase resistant antibiotics such as dicloxacillin, cephalosporin, or erythromycin.<sup>33</sup>

Continuous treatment for 10 days or until the skin is fully healed is recommended in order to eradicate the infection and prevent relapse. Repetitive friction or trauma on the nipple should be avoided because it may cause a break in the skin integrity, predisposing it to reinfection at any time. The source of the infection is often transmitted from the mother's or infant's oropharyngeal or ophthalmic flora. In persistent or recurrent infections, the authors have found it necessary to treat the infant as well. Nasal mupirocin ointment may help reduce the carrier state.<sup>34,35</sup>

The risks and benefits of systemic antibiotics must always be considered and weighed against the risk of early termination of breastfeeding due to persistent sore nipples and the morbidity associated with puerperal mastitis. Inappropriately treated sore, cracked nipples may result in persistent soreness and a 25% chance of developing mastitis due to an ascending lactiferous duct infection.

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Tratamiento de pezones agrietados e infectados por *staphylococcus aureus*: estudio de sondeo aleatorio comparativo (The Treatment of *staphylococcus aureus* Infected Sore Nipples: A Randomized Comparative Study)

## Resumen

Pezones agrietados y adoloridos son experiencias relativamente comunes entre madres lactantes. En estudios anteriores nosotros reportamos una estrecha relación entre pezones agrietados y adoloridos y colonización por *S. aureus*. Este es un estudio prospectivo, muestra aleatoria clínica para comparar cuatro regímenes de tratamiento en pezones agrietados con infección por *S. aureus*. En este estudio se reclutaron 84 madres lactantes. Luego de 5—7 días de tratamiento, solo el 8% de madres mostraron mejoría en el grupo “técnica de lactancia óptima solamente,” 16% mejoría con uso de mupirocin tópico, 29% de mejoría con aplicación tópica de ácido fusídico, y 79% de mejoría con antibióticos orales ( $p < 0.0001$ ). La técnica de lactancia óptima y antibióticos tópicos fracasaron en la curación en la mayoría de los pezones agrietados y adoloridos infectados. Se desarrolló mastitis en 12—35% de las madres sin tratamiento con antibióticos sistémicos comparado con el 5% tratadas con antibióticos sistémicos ( $p < 0.005$ ). En conclusión, la infección de pezones agrietados, adoloridos debida a *S. aureus* se debe diagnosticar como un posible impétigo vulgaris y se debe tratar agresivamente con antibióticos sistémicos, para su curación y disminución del riesgo de desarrollar una mastitis debida a una propagación de la infección bacteriana por los conductos galactóforos.

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