Evidence for skeletal pin site care

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Summary
This article explores the management of skeletal pin sites focusing on the research that underpins current practice. The effectiveness of pin site care depends on assessment and delivery of appropriate care. Because pin site management varies greatly between clinical areas, it is important that clinicians are aware of the evidence base on which their current practice is founded.

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Pin site complications
Pin site infections are one of the most common and most feared complications associated with the use of skeletal pins, wires and external fixation (W-Dahl and Toksvig-Larsen 2004). The presence of the pin prevents total healing of the soft tissues and it is essential to maintain an environment that minimises the risk of infection (Davies et al 2005). On this basis, it is clear that pin site care and management techniques should be evidence-based, rather than founded on anecdotal evidence or personal preference (Temple and Santy 2004). The presence of infection at the pin site is painful and delays patient mobilisation. Infection may also cause severe complications (Davis 2003, W-Dahl et al 2003) including osteomyelitis, delayed fracture healing, non-union, loss of fracture alignment and systemic infection (McKenzie 1999, Temple and Santy 2004), which may ultimately result in ‘failed’ orthopaedic surgery or long-term pain and disability (Davis 2003). Equally, failure to treat pin site infection promptly may lead to the development of deeper infection, loosening of the pin, loss of fixation and/or stability of the external fixator (Figure 1) and osteomyelitis.
Despite the risks associated with the use of skeletal pins and wires, there are numerous advantages, including:

- Early ambulation, which reduces periods of prolonged bed rest and its associated complications (Sisk 1983).
- Axial loading of the fracture to promote healing.
- Easier observation of the skin for compartment syndrome—compromise of circulation and function of tissue within a closed space as a result of increased pressure.
- Easier access to the skin for wound care (Temple and Santy 2004).

Earlier mobilisation has financial benefits regarding shorter periods of hospitalisation and individuals may benefit psychosocially by being able to return to near normal activity (Patterson 2005).

**Pin site infection** There is currently no uniformly accepted definition of pin site infection that standardises its description and reporting (Temple and Santy 2004). This contributes to the difficulty in comparing infection rates and treatment outcomes. One of the key areas in pin site management is the ability to distinguish between an adverse tissue response to the presence of skeletal pins during the 72 hours following insertion, and the development of an infection (Davis 2003). The differences between pin site reaction, colonisation and infection have been outlined by Lee-Smith et al. (2001) in an attempt to clarify and standardise the terms used in clinical practice (Box 1).

Copious serous drainage is common during the 72 hours following the placement of skeletal pins as a result of tissue reaction to the metallic foreign body, however, this is expected to subside (Santy 2000, Patterson 2005). It is therefore essential for clinicians to be able to differentiate between the normal healing process and the signs of infection (Holmes et al. 2005).

Definitions of pin site infection remain varied in the literature, with opinions divided regarding the value of classification systems to define infection because of their lack of established validity and reliability (Holmes et al. 2005). Their use does, however, assist in the reliable assessment and monitoring of pin sites by all healthcare professionals, thus making it easier to compare treatment strategies. One of the most frequently used grading tools is shown in Table 1 (Checketts 2000). Pin site infections are graded from one to six, with minor infections being classed as grades one to three, and major infections rating grades four to six. Minor infections are usually benign and easily treatable with antibiotics, whereas major infections may require the removal of one or more pins before the infection can be resolved (Bernardo 2001, Holmes et al. 2005).

Pin site infection commonly occurs in the presence of *Staphylococcus aureus* and often responds readily to oral antibiotics. Deeper infection, however, may persist despite the use of parenteral antibiotics and may subsequently affect the stability of the fixation (Davis et al. 2005, Patterson 2005). W-Dahl et al. (2003) found that positive cultures were 50% higher in proximal pin sites than in distal pin sites. Similarly, pin sites nearer joints are noted as being particularly prone to infection because they are subject to greater movement (Davis et al. 2005). Furthermore, several authors have...
identified correlations between rate of infection and age, smoking, muscle pathologies, low serum protein, patient personal hygiene and patient concordance (Sproles 1985, Wallis 1991, Sims and Saleh 1996, Ward 1998). Bernardo (2001) noted that excess pin site motion may also be associated with an increased risk of infection.

**Cleansing**

Only two randomised controlled trials of good methodological standard regarding pin site care are available (Temple and Santy 2004). However, these address different aspects of care: cleansing solutions (Henry 1996) and frequency of site care (W-Dahl et al 2003). The studies’ populations were diverse, as were the types of conditions being managed and the external fixation devices used. Similarly, pin sites associated with external fixators used to manage multiple trauma, hip fractures and halo jackets were not among the study populations, indicating that the current research available may not be representative of all patients and pin sites (Temple and Santy 2004).

Hydrogen peroxide was previously a common cleaning agent for pin sites (Wood 2001), and may still be used for irrigating infected and dirty wounds (Henley et al 2004). However, air embolisms have been noted with the use of hydrogen peroxide during orthopaedic procedures (Morikawa et al 1995, Neff et al 1996, Henley et al 2004). Despite hydrogen peroxide being described by McKenzie (1999) as a useful debriding agent when removing crusts from around pin sites, its use is currently discouraged because it may subsequently cause damage to the healthy tissue surrounding the pin (Trigueiro 1983). Olson (1996) also associated the use of hydrogen peroxide with increased infection rates and the disruption of the skin’s normal flora.

**Evidence base for cleansing method** W-Dahl and Toksvig-Larsen (2004) conducted two prospective consecutive case series comparisons on 49 patients operated on for knee deformity. Thirty patients’ wounds were cleansed with chlorhexidine 2mg/ml once weekly and 19 were cleansed with normal saline once weekly. The study reported 0.5% grade 2 infections in the chlorhexidine group compared with 3% in the normal saline group. Similarly, the chlorhexidine group also required significantly fewer antibiotics during the course of the study and reported less pain at weeks six and ten of the trial.

In contrast to this, Henry (1996) conducted a randomised controlled trial on 30 patients aged between 11 and 18 years undergoing limb lengthening of the tibia or femur. Patients in group one had their pin sites cleansed with 0.9% sodium chloride. Pin sites in group two were cleansed with 70% alcohol and the pin sites in group three were not cleansed but did have crusts removed with dry gauze. All groups had crusts removed and received povidone-iodine dry spray to the skin and a dry gauze dressing. Infection occurred in 25% of participants in the 0.9% sodium chloride (group one), 18% in group two, and 8% in group three, with 92% of all positive cultures being Staphylococcus aureus. However, using a Chi-square test of independence calculated on the data provided in the report, the differences presented may be attributable to chance variation instead of a cleansing solution (Chi square = 4.44, degrees of freedom (df) = 2, P = 0.11) (Holmes et al 2005). Olson (1996) noted that povidone-iodine, hydrogen peroxide and chlorhexidine have all been associated with increased infection rates, disruption of the healing process and disruption of the normal skin flora (McKenzie 1999). Celeste et al (1984) observed that povidone-iodine has a corrosive effect on stainless steel skeletal pins. Its use has also been reported to cause skin staining and allergic reactions (Bernardo 2001, Patterson 2005).

In an earlier study, Sproles (1985) compared the use of soap and water to cleanse pin sites followed by the application of alcohol twice daily (group one) with no specific treatment where

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(Checketts 2000)
crusts were left on to form a protective barrier (control group). Infection was reported at 13% in group one and 27% in the control group. Despite these differences the findings were not reported as statistically significant. **Current guidance** Following a review of current literature and review of current practice by a British consensus group of orthopaedic nurse experts, Lee-Smith *et al* (2001) recommend that pin sites are not cleansed except with the use of sterile normal saline or water to remove exudate from the area surrounding the pins. However, the National Association for Orthopaedic Nurses (NAON) advocate the use of chlorhexidine 2mg/ml to cleanse pin sites (Holmes *et al* 2005). The use of showering has also been discussed in some articles (Gordon *et al* 2000, Sims and Saleh 2000), however, because this method of cleansing has not been compared with other cleansing methods in a controlled trial, comparisons cannot be made. A prospective consecutive case series studied 27 children with tibial circular external fixators who received daily showers from the fifth post-operative day and who had a total of 178 pin site infections. The NAON offer no recommendations about the use of a towel to dry external fixators, however, the British consensus group recommends that patients should be permitted to dry the fixators with a clean towel only after 48 hours (Lee-Smith *et al* 2001). A hairdryer may also be used for drying pins as an alternative to a towel (Holmes *et al* 2005). While there are arguments for and against the use of showering with pins exposed to water flow, those in favour of such cleansing suggest that this may be an effective ‘normalising’ activity (Holmes *et al* 2005).

**Dressings**

The use of dressings in the management of pin sites is another poorly researched area and is associated with great variation in clinical practice. The use of dressings on pin sites can be divided into two categories: those which are used during the initial post-operative period when serous and haemoserous drainage may be evident; and those which are used when the drainage has stopped. While there is a disparity of opinion about whether pin sites should be dressed or left exposed to air once the initial drainage has subsided, there is also a difference of opinion regarding the most suitable type of dressings. This has been reflected in a survey of current practice in skeletal pin site management (Santry and Newton-Triggs 2006).

The use of dressings may decrease the incidence of air-borne infection and ‘finger’ contamination around the skeletal pins (Trigueiro 1983). Some authors claim that dressings provide a protective barrier (Celeste *et al* 1984, Grant *et al* 1992). Those opposed to this view suggest that dressings may potentially block the drainage of exudate, thus increasing the risk of infection at pin sites (Olson 1996). Sims and Saleh (1996) advocate the use of dressings only if there is excessive movement around the pin or if there is associated soft tissue injuries. In studies that advocate the use of dressings, dressing choice and technique are also varied: W-Dahl *et al* (2003) suggest a non-stick absorbent dressing held in place with a soft roll dressing; while Sims and Saleh (2000) suggest rolled gauze dressings when there is exudate, typically in the first 48 hours. The NAON offer no recommendations on the use of dressings, however, they indicate that most panel members use a non-stick absorbent dressing and gauze wrap for the initial 48 hours, and thereafter a loose cover or no dressing (Holmes *et al* 2005). In contrast to this, the British consensus group advocates the use of a small dressing that applies a minimum amount of pressure to prevent tenting of the skin along the pin. It also recommends that these dressings are removed only as required to prevent cross-infection (Lee-Smith *et al* 2001).

Because there is currently a dearth of research on the use of dressings comparing infection rates in pins that are exposed to air or dressed, there is no evidence on which to base care other than clinicians’ preference or clinical use. Similarly, no definitive evidence exists if the choice of dressing should contain an antimicrobial to further reduce the risk of infection.

**Pin site crusting**

The removal of crusts at the pin-skin interface is again a debated issue with no research directly comparing infection rates in patients who have crusts left *in situ* or removed. Two study protocols specified that crusts were removed (Henry 1996, W-Dahl *et al* 2003). However, W-Dahl and Toksvig-Larsen (2004) specified that crusts were not to be removed unless signs of infection were present. The argument for leaving crusts in place is that they form a normal protective barrier and their removal may disturb the surrounding healthy tissue and subsequently make it more vulnerable to infection. The counter-argument is that crust removal will allow exudate to drain and prevent contamination of the tissues and formation of abscesses. Some literature suggests that leaving the crusts in place could prevent drainage from the pin sites and result in infection (McKenzie 1999, Holmes *et al* 2005, Patterson 2003). The British consensus group currently advocates the removal of crusts to allow observation of the...
wound (Lee-Smith et al. 2001) and to encourage free drainage of exudate which may otherwise cause infection (Davis 2003). The NAON does not offer any recommendations on the removal of crusts (Holmes et al. 2005).

Conclusion

It is vital that a standardised method or tool is used to define and categorise pin site infection to enable reliable assessment and monitoring of pin sites by healthcare professionals. Without the acceptance of a standardised method of reporting pin site infections, future research will not be easily comparable with other studies, thereby restricting comparison of interventions.

In the absence of adequately powered and valid randomised controlled trials to inform the management of pin sites, there is no apparent direction to inform practice other than to identify the need for appropriate controlled trials in this field. It is evident from the literature examined that there is great disparity between the sparse research available and between ‘consensus groups’ and ‘expert panels’. Therefore, it is recommended that controlled trials of homogenous samples be conducted to compare the use of cleaning methods and solutions on skeletal pins in relation to infection. The question of whether to remove crusts or leave them also needs to be investigated in relation to infection rates. Controlled trials are necessary to compare the effect of dressing pin sites with leaving them exposed to air in relation to the incidence of infection. Further studies should then be focused on which method of dressing pin sites is the most effective to develop definitive practice guidelines. Without apparent evidence to guide practice, pin site care may continue to be based on clinician preference and clinical practice and care standards will continue to be diverse in nature and inconsistent in delivery.

References


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