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ORIGINAL PAPER

Complications of transcutaneous metal devices

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Abstract A high incidence of associated infection with the use of transcutaneous metal devices has been widely reported. The aims of this study were: (1) to record the incidence of pin site infection in a Plastic Surgery department, (2) to compare the infection rate in our department with published literature and (3) to identify factors that contribute to infection. A prospective cohort study was performed including all patients presenting to the plastic surgery unit with any type of transcutaneous metal in situ over a 3-month period. Patients and staff were questioned on wound hygiene and whether they had been provided with specific protocols. Our study revealed an infection rate of 24%. Patients and staff were not aware of preventive protocols. From this study, the following conclusions are made: (1) pin site infection is a major problem, and no consensus has been reached on the best way to manage pin sites, (2) there is variable knowledge of pin-site care, (3) there is a need for a clearer definition of pin-site infection and a standardised system of assessment, classification and treatment and (4) there is a need for more innovative technology in pin-site manufacture as studies reveal that the type of material used in the pins does affect infection rates.

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The utilisation of transcutaneous metal devices is common practice in orthopaedic practice, and with increasing involvement of plastic surgeons in hand trauma and combined management of lower limb injuries, many of these patients are managed for variable periods by plastic surgeons. Transcutaneous devices of various types are used on a short- or longer-term basis to stabilise fractures or to correct deformity. Kirschner wires, known as K-wires, are most commonly used on a short-term basis as a simple and cost-effective way to provide stability to small bone fractures [1]. The Hoffman external fixator or the Ilizarov circular frame, used for long bone fractures, may be applied for periods extending to several months with an increasing incidence with time. Essentially, a pin tract is a chronic wound containing a foreign body providing an ideal focus for bacterial colonisation. Although pin-tract infection is often not considered to be a serious complication in the short term, it has the potential to decrease the stability of the bone–pin interface, which can cause pin loosening, osteomyelitis and poor functional outcome [2, 3]. The problem has heretofore been widely reported in orthopaedic literature, but as pin-site infection impacts the care of plastic surgery patients also, it is important for plastic surgeons to understand the scale of the problem and strategies for prevention.

The aims of this study were:

1. To record the incidence of pin-site infection in a Plastic Surgery department in comparison with published reports;

2. To review literature on comparative trials of pin site management to determine from the literature what method of wound care best prevents pin-site infection;
3. To establish current nursing practices in pin-site care and patient-initiated practices;
4. To determine the need for more innovative technology in prevention.

Methods

A prospective, cohort study was conducted on patients presenting to the Plastic Surgery ward or clinic with any type of transcutaneous metal device. Patients presenting between November 1, 2010 and February 1, 2011 were included. Episodes of subjective or objective complications were recorded. Objective data comprised of demographic information, the reason for the transcutaneous metal insertion, details of the type of fixator used, any reported complication, the results of microbiology swabs sent to the laboratory, antibiotic use and relevant radiological findings. Infection was defined by clinical symptoms such as redness, pain, prolonged discharge and functional loss. Subjective data were obtained by interviewing the patient, asking about skin problems, discharge, functional loss associated with the metal device and any discomfort (Figs. 1, 2, 3, 4, 5).

Fig. 1 K-wiring of the little finger

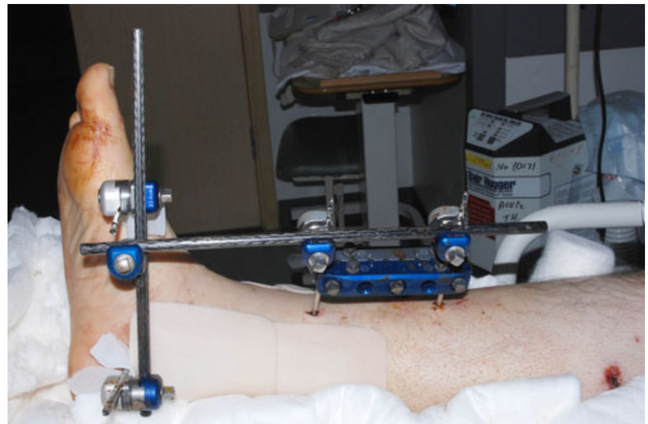

Fig. 2 Hoffman external fixator

Results

Thirty-five consecutive patients with transcutaneous metal devices were seen in our specialised outpatient clinic from November 1, 2010 to February 1, 2011. Of these, 25 individuals were suitable for inclusion in the study. Seven patients were excluded as their K-wires were buried, and three were not compliant with follow-up. Of the 25 cases, 9 patients had an external fixator (51 pin sites) and 16 had K-wires (27 pin sites) in situ. In Table 1, you find the patients' characteristics and recorded complications. The duration of treatment varied between 14 and 78 days for K-wires and between 21 and 78 days for external fixators. The duration of follow-up varied between 7 and 89 days.

Of the 25 patients with transcutaneous metal devices, nine developed complications (36%). In three cases, slight migration of K-wires occurred (12%). Six patients suffered from pin-tract infection (24%, with a 95% confidence interval (CI) of 12% to 43%). In three patients, the swab taken from the pin site was positive for *Staphylococcus aureus*. The external fixator had to be prematurely removed from one patient due to an infection. This patient developed recurrent infections at the site of his previous pin tracts even after pin removal. Of the patients surveyed, 80% had

Fig. 3 Insertion of external fixator pins

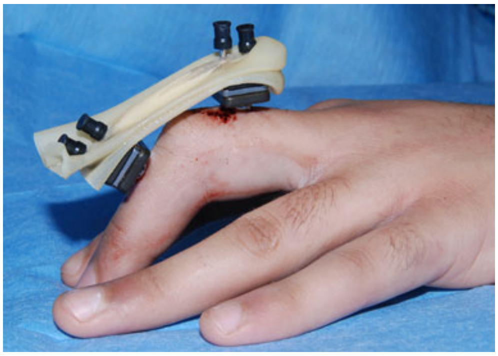

Fig. 4 Pennig orthofix

not been provided with instructions on wound management. Only one of the patients had the benefit of a district nurse assessment with pin-site care. The patients did not receive instructions on either washing the pin sites or on cleaning them.

In our study, we found that pin-site care was not consistent. Mostly, the pins were cleaned daily with normal saline and a new dressing was applied. The pin sites were not washed. In some cases, betadine or chloramphenicol 1% ointment was applied to the pin sites.

In our study, there was no standard protocol on the prescription of antibiotics in patients with transcutaneous metal. Fifty percent received a preoperative antibiotic dose. Others received a single dose or multiple postoperative doses of co-amoxiclav or flucloxacillin.

Discussion

Our data show six infections from 25 patients, which is 24%, with a 95% CI of 12% to 43%. Thus, the true infection rate in the whole patient population is between 12% and 43%.

Our key limitation is the small number of patients. We calculated that if we would have entered more patients, or if we would repeat the study, we could expect an infection rate in the same range (for 95 out of 100 projects). Assuming the same infection rate of 24%, with 12 infections from 50 patients, the 95% CI is 14% to 37%, and with 24 infections from 100 patients, the 95% CI is 17% to 33%. As these numbers would not have made a great difference, we decided to keep our number of patients to 25.

Fig. 5 Infected threaded pin

The reported rate of pin-tract infection in the literature is high, ranging from 4.5% to 71%. Although diagnostic criteria vary (Santy [20]), and this may be a factor in the wide range of these quoted figures, certain factors however seem to be important. In Table 2, you find the reported infection rates in the literature, with the prevention and management measures listed. Table 3 explains the several classification systems which are used to diagnose a pin-tract infection.

K-wires and external fixators in the hand and wrist In a retrospective study by Stahl and Schwartz [1], which considers the use of K-wires in wrists, the authors reported an infection rate of 5.5%; 13 out of 236 patients developed infection around the pin. Margic [4] observed 100 patients in a prospective study of small external fixators used on metacarpal and phalangeal fractures, and found an infection rate of 7%. Studies on external fixator use for fractures of the distal radius report a higher recurrent infection rate of between 10.1% and 43% [5, 9, 10]. Egol et al. [6] performed a randomized controlled trial on such fixators and recorded an infection rate of 10.1%.

The role of skin movement Hove et al. [7], who investigated the differences between static and dynamic fixation of the wrist, found that 15 of their patients (43%) in the dynamic fixator group and 4 (11%) of the static group had a superficial pin-tract infection (p<0.01). They attributed this difference to the motion allowed by the dynamic fixator which seemed to increase skin irritation around the wrist.

Fixators applied to the elbow must also contend with motion. Cheung et al. [8] looked at the hinged external fixator .The pin-tract infection rate was found to be 25%.

External fixators in areas prone to infection The pelvic external fixator is another device associated with a high rate of infection; Mason et al. [9] reported a complication rate of 62% for definitive pelvic fixators (mean duration of treatment is 60 days) and an infection rate of 21% for temporary fixators (mean duration of treatment is 8 days). This resulted in the premature removal of seven devices, the reinsertion of one pin and the drainage of two abscesses.

Lower limb external fixator devices The lower limb is an area where wound healing is notoriously difficult.

Table 1 Characteristics and recorded complications of patients with transcutaneous metal devices seen between November 1, 2010 and February 1, 2011

	Injury	Fracture	Device	Type and size	Duration (days)	Complications	Infection	Swabs	Antibiotics	Duration
1	Dupuytren	No	External fixator	Pennig Orthofix (Mini) 4×wires, hand	28	None	None	NA	Co-amoxiclav	2×tabs for 7 days
2	Dupuytren	No	External fixator	Pennig Orthofix (Mini) 8×wires, hand.	21	Infection	Yes	NA	Co-amoxiclav	1×IV for 1 day
3	Traumatic	Yes	External fixator	Hoffman external frame 3×4 mm Pins 1×5 mm Pins, leg.	22	None	No	NBG	None	None
4	Degloving	No	K-wire	1×0.9 mm, hand.	16	None	None	NA	Co-amoxiclav	1×IV for 3 days, 1×tabs for 5 days
5	Traumatic	No	External fixator	Mini Hoffman II 3 and 2 mm pins[a], hand.	74	Infection technical error[a]	Twice, two admissions	*S. aureus* +++	Co-amoxiclav and flucoxacillin	4× IV for 1 day, 1×IV for 7 days, 1× tabs for 7 days
6	Blunt	Yes	K-wire	1×0.9 mm K-wire, hand	28	None	None	NA	None	NA
7	Traction	No	K-wire	1× K-wire, hand	14	None	None	NA	Co-amoxiclav	1× IV, 1×tabs for 5 days
8	Mallet	Yes	K-wire	1×0.9/1×1.1 mm, hand.	30	Migration K-wire	None	NA	None	NA
9	Occupational	No	K-wire	1×0.9 mm K-wire, hand	31	None	None	NA	Co-amoxiclav	1× IV 1.2 g
10	Industrial	Yes	External fixator	Pennig Orthofix, hand.	28	None yet	None	NA	None	Not applicable
11	Crush	Yes	K-wire	6×0.9 mm, hand	21	Infection	Twice	*S. aureus* +	Co-amoxiclav	IV 7, tab 10
12	Enchondroma	No	K-wire	2×0.7 mm, hand	30	None	None	NA	None	NA
13	Unstable	Yes	K-wire	2×1.1 mm, hand	30	Slight migration	None	NA	Co-amoxiclav	1× 7 days
14	Crush	Yes	K-wire	2×1.1 mm Orthofix mini, hand	28	None	None	NA	Co-amoxiclav	IV, 3 days; Tab, 5 days
15	Traumatic	Yes	K-wire	2×1.1 mm, hand	78	None	None	NA	Co-amoxiclav	1×IV 1.2 g
16	Dog bite	Yes	K-wire	1×0.9 mm, hand	27	None	Yes	MCS	Co-amoxiclav	IV, 3 days; tabs, 7 days
17	Dupuytren	No	Ext. fixation	Pennig Orthofix, hand	26	Technical error	Yes	NA	Flucloxacilline Co-amoxiclav	Tabs 7 days
18	Traumatic	Yes	Circular frame	7× wires, 3× pins, lower leg	60	Infection and nerve injury	Many	*S. aureus* +++	None	NA
19	Traumatic	Yes	K-wire	2×1.1 mm, hand	33	Infection	Once	NA	Co-amoxiclav	1×IV 1.2 g
20	Traumatic	Yes	K-wire	1×1.2 mm, hand	35	None	None	NA	None	None
21	Circular saw	Yes	K-wire	1×1.1 mm, hand	44	None	None	NA	Co-amoxiclav	IV, 3 days; Tabs, 7 days
22	Sports injury	Yes	Needle	Hollow needle, hand	14	Slight migration	None	NA	Co-amoxiclav	Tabs, 5 days
23	Deglovement	Yes	External fixator	Hoffman II 2×4 mm 2×5 mm pins, hand	27	None	None	NA	Co-amoxiclav Gentamicin	IV, 3 days
24	Assault Axe injury	Yes	K-wire	1×0.9 mm, hand	21	None	None	NA	Co-amoxiclav	IV 6 days; Tabs, 7 days
25	Occupational	Yes	External fixator	Pennig Orthofix, hand	27	None	None	NA	None	NA

NBG no bacterial growth, *NA* not applicable

[a] Pins were changed due to insertion of wrong-sized pins

Table 2 Reported infection rates in the literature; diagnosis, prevention and management of pin-tract infection

	Device	*n*	Population	Mean duration Rx (days)	Mean FU	Study design	Complication rate	Infection rate	Diagnosis of PTI[a]	Prevention: antibiotics	Prevention: wound care	Management of PTI
Ahlborg and Josefson 1999 [5]	Hoffman small-frame external fixator	314	Adults, unstable distal radius #	7–122 (39)	3.5 years	Retrospective	27%	21%	Requiring oral antibiotics	No	Not mentioned	9 premature removals
Battle and Carmichael 2007 [26]	Kirschner wires	202	Children/upper limp #	18–102 (30.7)	NA	Retrospective	NA	7.9%	Green	No	Not mentioned	5 operations, 1 pin removal and IV AB
Blasier et al. 1997 [10]	External fixator	132	Children/femur #	80	14 months	Retrospective	53.4%	40.5%	Superficial (36%) or significant (4.5%)	No	Instructions, twice daily cleaning using nonsterile cotton swabs, hydrogen peroxide and povidone–iodine 10%	4×IV antibiotics, 2×debridement
Botte et al. 1992 [27]	Unthreaded pins	137	Hand or wrist dislocations and #	2–168 (45.5)	43 days–47 months (4 months)	Retrospective	18%	7%	Clinical symptoms + bacteriology	IV Cephalosporin antibiotics	Dressed with antibiotic ointment + dressing	Superficial: povidone–iodone/removal of pins/removal, incision and drainage
Cavusoglu et al. 2009 [12]	Ilizarov external fixator.	39	Tibial #	Not mentioned	150 days	Prospective randomized	NM	(1.) 54.2%, (2.) 47.3%	Dahl classification	Pre- and postop IV cephazolin open # IV gentamicin and ornidazole TBS	Daily showering and - group 1: brushing the pin sites with soap and a soft toothbrush; group 2: cleaning the crusts using sterile gauze impregnated with 10% polyvinylpyrrolidone iodine (Polyod)	1 parenteral AB, two premature fixator removals
Checketts et al. 1995 [28]	Dynamic axial fixator.	134	Adult, tibial shaft #	105	3.5 months	Retrospective	NM	39%	Minor or major	Prophylactic, third-generation cephalosporin	Not mentioned	Repositioning in 1 patient, removal in 1 patient
Cheung et al. 2008 [8]	Hinged external fixators of the elbow	100	Fractures of the elbow	8–94 (31)	NM	Retrospective	25%	25%	Minor or major	75% received a course of postoperative prophylactic oral antibiotics	Patients were educated on pin care and were instructed to clean the pin sites with peroxide solution daily.	4× early removal
Davies et al. 2005 [15]	External fixation	120	Fractures or limb reconstructions	24–92	NM	Prospective	NM	A, 89.1%; B, 64.9%	Episode of pain/ inflammation at pin site, + discharge + on bacterial culture or responded to antibiotics	NM	Group A: care of the pin site according to local custom; group B: the Russian Ilizarov Scientific Centre technique[a]	Oral AB, removal of the pin or IV AB (numbers not mentioned)
Egol et al. 2006 [6]	External fixation devices	118	Unstable or displace fractures of the distal radius	Average 41.3	>6 months	Prospective, randomized	19%	10.1%	Requiring oral antibiotics	Three doses of IV cephalosporin	(1) Weekly dry dressing changes without pin-site care, (2) daily pin-site care with a solution of 1/2 normal saline and 1/2 hydrogen peroxide, (3) placement of a weekly changed chlorhexidine-impregnated disc (Biopatch) around the pins	Oral antibiotics 10.1%
Hove et al. 2010 [29]	Dynamic (Dynawrist) and static external fixation (Hoffman II Compact)	70	Unstable fractures of the distal radius	Mean 42	12 months	Prospective, randomized	NM	43% dynamic 11% static ($p<0.01$)	NM	NM	NM	Local wound cleaning or treatment with antibiotics. No pins removed prematurely

Table 2 (continued)

	Device	*n*	Population	Mean duration Rx (days)	Mean FU	Study design	Complication rate	Infection rate	Diagnosis of PTI[a]	Prevention: antibiotics	Prevention: wound care	Management of PTI
Hutson and Zych 1998 [30]	Illizarov system	135	Periarticular fractures of the tibia and femur	168 (tibial and femur) 189 (pilon fractures)	>2 years	Prospective	NM	13%	Infection that did not respond to pin care and oral antibiotics	IV antibiotics 2 days postop	Instructions, daily cleaning with soap and water, removal of crusts, Bactroban ointment and frame covers	Oral cephalexin, injecting and incision 'tenting' wounds. Loose wires retensioned. Removal.
Margcic 2006 [4]	The "simply" external fixator	100	Closed metacarpal and phalangeal #	28	19 Months (4–42)	Prospective	7%	7%	Sims and Saleh classification	NM	Instructions; antiseptic spray, antibiotic cream.	NM
Mason et al. 2005 [9]	Pelvic external fixator	100	Pelvic ring injuries	1–20 (8) tempory, 17–113 (60) definitive		Retrospective	21% temporary, 62% definitive	13% temporary, 50% definitive	Positive microbial culture and antibiotics used for treatment	NM	NM	22 antibiotics, 1 pin reinserted, 7 fixators removed, 1 osteomyelitis, 2 abscess drainage
Parameswaran et al. 2003 [2]	Ring, unilateral and hybrid fixators	285	Fractures, dislocations or tendon rupture	44.1–180 (mean, 61)	5.4–11.1 months (mean, 6.3)	Retrospective	11.2% Infection	3.9% Ring, 12.9% unilat., 20% hybrid	Signs and symptoms around the pin site that required a change of AB. Superficial or deep infection	99 received oral AB, continuously during duration Rx	Gauze packing, cleansing twice a day with half strength peroxide + antiseptic solution	9 pin removal, 1 osteomyelitis
Patterson 2005 [31]	External fixation	92	Fractures	Not mentioned	NA	Prospective randomized multicenter	NA	34%	Sims and Saleh 1996	NA	A. 1/2 strength peroxide + gauze, B. 1/2 strength peroxide + Xenoform dressing, C. saline + gauze, D. saline + Xenoform dressing, E. antibacterial soap and water + gauze, F. antibacterial soap and water + Xeroform dressing, G. no cleansing + gauze	2 patients required IV AB
Pieske et al. 2008 [32]	Titanium alloy pins (TA) versus stainless steel pins (SS) at the Wrist	80	Unstable distal radial fractures	3–17 days	3 months	Prospective	21%	SS 5% TA 0%	Clinical signs of infection	Only applied if a pin-tract infection occurred	Pins cleaned with saline after procedure + dry dressing with gauze. Instructions: treatment twice a week + dry dressing.	2 external fixators removed in stainless steel group+1 debridement + one persistent pin-tract infection with osteomyeltis.
Schroder et al. 1986 [13]	Hoffman external fixation	86	Compound or unstable tibial shaft fractures.	120–532 (mean, 300)	NM	Retrospective	87.5%	36%	Not mentioned	Not mentioned	Not mentioned	17× Removal of the fixator and curretage of the pin tract. 7× osteomyelitis+4× surgical treatment
Sharma et al. 2007 [33]	K-wires	103	Paediatric f ractures	21–42 (31.5)	2–24 months (10.2)	Retrospective	32.3%	5.8%	Documentation of seropurulent discharge/erythema around the pin stem with or without bacteriological evidence of infection	Not mentioned	The pins were protected with sterile cast padding	1×osteomyelitis, 17× removal of pins >4 weeks, 16× operations.
Sims and Saleh 2000 [11]	Orthofix llizarov Sheffield hybrid system	248	Fractures and elective reconstructions.	333 days (43–1125)	NM	Prospective	71%	71%	Saleh and Scott 1992	Not mentioned	Massage around the pin sites, cottonbuds with sterile or cooked water, scab removal, dressings removed if there is exudate.	44 on long-term antibiotics, 3× removal 8× curretage

Table 2 (continued)

	Device	*n*	Population	Mean duration Rx (days)	Mean FU	Study design	Complication rate	Infection rate	Diagnosis of PTI[a]	Prevention: antibiotics	Prevention: wound care	Management of PTI
Stahl and Schwartz 2001 [1]	K-wires	236	Fractures and dislocations in the hand and wrist	21–56	6–52 weeks	Retrospective	15.2%	5.5%	Clinical signs of infection	Not mentioned	Not mentioned	Local cleaning, oral antibiotics and pin removal. 3× parenteral antibiotics
W-Dahl and Toksvig-Larsen 2009 [34]	Orthofix T-garche	106	Knee deformities	71.4–101.8	10 weeks	Prospective	NM	NM	Checketts–Otterburn	No prophylactic antibiotics were used	Cleaning by chlorhexidine alcohol	6× replacement of pins and difficulties of correction
W-Dahl and Toksvig-Larsen 2006 [21]	Orthofix T-garche	101	Knee deformities	77–91	NA	Prospective	NM	Group 1, 81.8%; group 2, 3.3%	Checketts–Otterburn	Group 1, 3× IV AB; group 2, single dose IV AB	Sterile compresses moistened by chlorhexidine in alcohol + dressed, left for 1 week. After that, cleaned with chlorhexidine alcohol + sterile compress.	4× additional surgery

NA not applicable, *NM* not mentioned, *PTI* pin-tract infection

[a] In Table 3 you find the different classification systems

Blasier et al. [10] investigated 132 children with fractures of the femur who were treated with external fixators. They found an infection rate of 40.5%; a rate of superficial infection of 36% and a rate of 4.5% for cases requiring intravenous antibiotics. Sims and Saleh [11] reported a higher pin-tract infection rate of 86% associated with external fixation of the femur. These authors related the high infection rate to the bulk of tissue in the upper leg and its associated movement.

External fixation devices for tibial shaft fractures have been widely investigated. The Ilizarov circular, external frame is one of the transcutaneous devices often used to treat tibial fractures. The pin-tract infection rate varies from 36% to 54.2% [12, 13]

Pin-site wound care Lethaby et al. showed in 2008, in a systemic review, that there is insufficient evidence available on any one best way to care for pin sites [14]. Recently, the Russian Protocol of pin-site care has become more popular. This Russian Protocol was developed by the "Ilizarov Scientific Centre" for Restorative Orthopaedics in Russia. The system advises non-touch techniques when using the wires and pins, the utilisation of pulsed drilling, the removal of bone swarf and immediate coverage of the pin-site with dressings soaked in Chlorhexidine 1% ointment. The pins should be cleaned daily for 3 days with 70% alcohol, after which an occlusive dressing should be applied. This ritual is repeated every 7 days while the transcutaneous metal device is in place. Davies et al. [15] showed that infection rates are higher by 37% in cases where the Russian Protocol is not utilised ($p<0.001$). The Cochrane review dismissed the findings of Davies et al. as it questioned their methods of randomizing their sample, even though, Timms and Pugh [16] advocate the following of this prescription.

Grant et al. [17] concluded that there is a role for the application of a bactericidal solution, such as 10% povidone–iodone solution, to the skin surrounding the pin sites. The problematic aspect of this treatment is the difficulty in securing an occlusive dressing.

The pin insertion technique When inserting Ilizarov or K-wires, it has been shown that several important issues should be addressed to keep the infection rate down; adequate cooling during drilling is vital to prevent thermal damage, and (as recommended in the Russian Protocol) drilling should be conducted using the pulsed technique. The ends of transcutaneous wires should be bent to avoid migration [18] (in our study, three wires migrated; one of which had not been bent).

Pre-drilling was thought to be necessary for certain pins in certain bones, and unnecessary for other situations. If the pins have sharp-cutting trocar points, pre-drilling may be

Table 3 Different classification systems of pin-tract infection

Green classification 1983: A major pin-tract infection produces sufficient redness, pain or drainage to require hospital admission for either parenteral antibiotic therapy, pin removal or removal of the entire fixator. A chronic pin-tract infection or persistent drainage after pin removal is also considered a major infection. Any other pin reaction is defined as minor, even those with purulent discharge	
Modified Moore and Dahl classification 2009	
0	Normal appearance
1	Inflamed
2	Serous discharge
3	Purulent discharge
4	Osteolysis
5	Ring sequestrum
Sims and Saleh classification 1996	
1	Copious serous drainage
2	Superficial cellulitis
3	Deep infection
4	Osteomyelitis
Saleh and Scott Classification 1992	
0	No problems
1	Responds to local care, for example increased cleaning and massage
2	Responds to oral antibiotics
3	Responds to intravenous antibiotics or pin site releases
4	Responds to removal of the pin
5	Responds to local curettage
6	Chronic osteomyelitis
Checketts–Otterburn Classification (2000)	
1	Slight redness, little discharge
2	Redness of skin, discharge, pain and tenderness in the soft tissue
3	Grade 2 but not improved with antibiotics
4	Severe soft tissue infection involving several pins, sometimes with associated loosening of the pin
5	Grade 4 but also involvement of the bone; also visible on radiographs
6	This infection occurs after fixator removal. The pin track heals initially but will break down and discharge at intervals. Radiograph shows new bone formation and sometimes sequestra

unnecessary. In a study by Hutchinson et al. [19], soft tissue inflammation around the pins was almost twice as common in pre-drilled pin sites, which could be attributable to the increased soft tissue trauma associated with two passages of the wire across the tract. It has been suggested that with the use of sharp trocar points, the skin does not need pre-incision, but the skin should be incised if tenting appears at the pin site, as otherwise a fluid reservoir could develop and attract bacteria [20].

Antibiotics There is evidence that the presence of transcutaneous metal leads to the development of a biofilm between the skin and metal which allows bacterial growth. As transcutaneous metal is a foreign material, prophylactic antibiotics may be considered. Yet, according to W-Dahl and Toksvig-Larsen [21], antibiotics should be used as little as possible, and only those with a specific spectrum should be employed. These authors showed that prolonged antibiotic use has no benefit in eradicating infection. As you see in Table 2, good wound management and optimal insertion techniques do not eradicate this problem. The quickest answer to pin-site infection is often pin removal.

Technological solutions Various technological solutions have been tried in the hope of preventing pin-tract infection. Coated pins create an extra defence barrier between the pin and bacteria. In a recent systematic review of the influence of hydroxyapatite coating on pin loosening and pin-tract infection by Saithna [22], he concluded that there was less loosening with coated pins, but unfortunately not less infection.

Titanium is frequently used in Dentistry and in Orthopaedics for intraoral or intraosseous prostheses. [23]. This material produces a reduced susceptibility to bacterial adhesion. In a study by Pieske et al. [24], titanium alloy pins were compared with stainless pins in 80 patients.

There was no difference in the incidence of pin-tract infection. Masse et al. [25] found, in a randomized study, that silver pins resulted in a lower rate (30%) of positive microbiology cultures than uncoated pins (42%), but this difference was not statistically significant, and there was a raised serum silver in the patients with silver-coated pins. Much money is spent each year on improving technology, yet such attractive possibilities should not distract staff from executing the simple, basic but effective methods of wound and pin-site care.

Implications for practice

1. Our study found an infection rate of 24% associated with transcutaneous metal.
2. Plastic surgery departments need to develop clear protocols for prevention of pin-site infection, and randomized controlled trials are necessary to establish the best practice.
3. Patients need clearer instructions on how best to care for their pin sites.
4. There is a need to consider new technological solutions for this problem. Long-term implantation in dental practice has been established, but it is less successful in skin than oral mucosa.

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Conflict of interest None

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