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Does temporary external fixation and staged protocol for closed fractures lead to bacterial contamination of the surgical site and associated complications? – A prospective trial

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ABSTRACT

Introduction: Temporary external fixation is a viable option for numerous conditions and fixations in orthopaedic and trauma surgery. If the external fixator is left in place it is necessary to disinfect it prior to surgery, yet the subsequent risk for bacterial contamination of the surgical site originating from the external fixator remains unknown.
Material and methods: In a prospective study, samples were taken at the time of definitive osteosynthesis to assess bacterial contamination of the surgical site and the external fixator in twenty consecutive patients treated with temporary external fixation for closed fractures from October 2016 until March 2017.
Results: Twenty external fixators of twenty patients with complete sampling and a mean follow-up of seven months (range: 3–14) were available for analysis. Ten out of 120 cultures of the surgical site (8.3%) were positive for bacterial growth in a total of seven patients (35%). Pathogen's detected were *Propionibacterium acnes* (60%) and *Staphylococcus epidermidis* (30%). No contamination of the external fixator was detected.
Conclusion: We conclude that the presented perioperative management to decontaminate external fixators allows for a safe definitive osteosynthesis in a staged protocol without increasing bacterial contamination of the surgical site. It is safe to leave the external fixator in place for definitive osteosynthesis.

Introduction

Temporary external fixation is a viable option for numerous conditions and fixations in orthopaedic and trauma surgery. It is often used in damage control orthopaedics, in polytraumatised patients or in staged procedures until soft tissue allows for definitive osteosynthesis. Usage of a temporary external fixation and a staged protocol for complicated intraarticular fracture patterns is described in previous studies [1–3]. If the external fixator is left in place to maintain reduction in complex fractures, it has to be disinfected prior to surgery. Several authors described a contamination of the external fixator and there exist various regimes of perioperative management in order to prevent associated complications [4–9]. However, surgical site contamination and the possible risk of an implant-associated infection remains unknown and has not been studied yet. A recent international survey underlines the lack of evidence in the perioperative management of external fixators in staged protocols. Despite the common use of a temporary external fixation in daily practice, there is no written evidence concerning the potential contamination of the surgical site [9].

We hypothesised, that bacterial contamination of the external fixator leads to a contamination of the surgical site and therefore the same bacteria should be detected on the external fixator and at the surgical site.

Material and methods

This article was written in accordance with the STROBE-statement [10].

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Twenty-five consecutive patients with closed fractures treated primarily with temporary external fixation were prospectively enrolled at a Level I trauma centre from October 2016 until March 2017 and assessed for eligibility. Inclusion criteria were: treatment of a closed fracture with temporary external fixation and staged definitive osteosynthesis and a minimum follow-up three months postoperative.

Exclusion criteria were: Incomplete sampling, long-term (>7 d) antibiotic therapy fourteen days prior to the index surgery, polytraumatised patients (Injury severity score (ISS) >16)), open fracture, insufficient language skills or declination to participate (see Fig. 1) [11].

Data collected

Basic patient demographic data was collected and the time between injury and external fixation placement and the duration of surgery were analysed. Patients were evaluated for signs of a pin site infection (according to Checketts-Otterburn Scale) at the time of the definitive osteosynthesis and whether there was an overlap of a pin site with the definitive implant [12].

Standardised management of external fixation in staged protocol

All patients received a single-shot of Cefazolin 2 g intravenous thirty minutes prior to the application of the external fixation and prior to the definitive osteosynthesis. Standardised disinfection of the external fixator was done with an alcohol-based povidone-iodine (1%) spray (Braunoderm ©) prior to draping. The underlying skin was prepared with the same disinfectant three times. The extremity was draped in a usual sterile fashion. Parts that were not used for manipulation of the external fixator were draped with an additional tape to prevent possible contamination (see Fig. 2).

For external fixation a modular rod system was used from Depuy Synthes © (Zuchwil, Switzerland). Pins were pre-drilled bicortical with a drill sleeve under continuous saline irrigation. Careful pin placement was performed to avoid any soft-tissue tension. Self-tapping pins were placed manually. The modular clamp-rod design provides optimal stability [13].

If manipulation of the external fixator was necessary, the surgeon changed the superficial gloves and the newly exposed part of the pin-clamp or tube-clamp interface was re-disinfected with Braunoderm ©.

Sampling of the surgical site and external fixator

Intraoperative sampling of the surgical site and swabs of the external fixator at the time of definitive open reduction and internal fixation (ORIF) was performed in a standardised manner:

- Two samples were taken from the fracture site and the subcutaneous tissue prior to the ORIF.
- Two samples were taken from the fracture site and the subcutaneous tissue after completion of the ORIF.
- Two swabs were taken from the fracture site and of the rinsing solution after completion of the ORIF.
- Two swabs of the external fixator were taken from all tube-clamp and pin-clamp interfaces after sequential removal of the external fixator parts intraoperatively. If any swab came in contact with the skin, it was rejected and a new swab was performed.

All biopsies and swabs were analysed for bacterial growth within 24 h in the microbiological laboratory of the hospital. The swabs (SwabaX ©) and tissue samples were incubated on sheep blood cell agar and chocolate agar for 48 h at 37° C in atmospheric CO2 pressure. The samples were cultured for a total of fourteen days. If positive bacterial colonisation was present bacterial species was determined.

Postoperative pin care

Postoperative pin care included daily inspection of the pin sites, rinsing with Ringerfundin © and disinfection with Betadine ©, followed by a dry gaze drape performed by the nursing staff. If any signs of infection occurred a picture was taken for documentation.

Follow-up

Follow-up was conducted at six weeks, twelve weeks, 6 months and 1 year postoperative during regular outpatients' clinic visits. Postoperative signs for superficial, deep surgical site infection, antibiotic treatment and revision surgery were recorded. Postoperative surgical site infections were classified according to centre for disease control (CDC) [13,14].

Statistics

The sample size was a result of consecutive external fixation for closed fractures performed at the author's institute within six months. The number of patients was limited to 20 due to financial resources for the project. Prior to analysis of data, demographics and outcomes were evaluated for normal distribution and assessed by histograms. Binomial data are presented as the number and percentage. Continuous data are presented as mean or median ± standard deviation. Subgroup analysis for numeric values was performed with the Mann-Whitney *U* test for skewed data. Categorical data were compared using the Chi-square test and Fisher's exact test. All data were analysed using SPSS software (version 22; IBM ©). A two-sided p-value of <0.05 was considered significant.

Ethics

All procedures performed in this study involving human participants was in accordance with the ethical standards of the

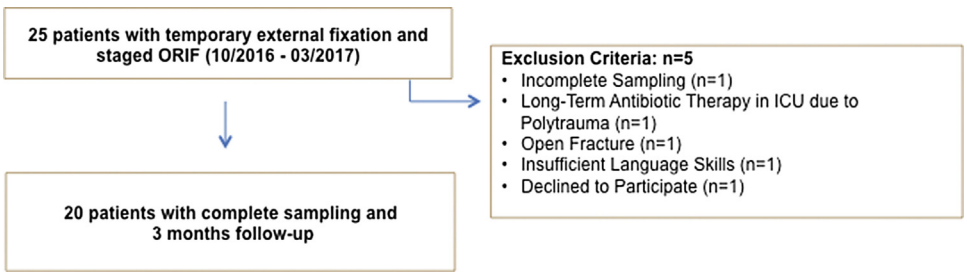

Fig. 1. Patients Flowchart.

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