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Original article

EARLY WOUND INFECTIONS FOLLOWING REMOVAL OF POSITIONING SCREW FROM THE DISTAL TIBIO-FIBULAR SYNDESMOSIS

РАНИ ИНФЕКЦИИ НА РАНАТА ПО ВАДЕЊЕ НА ПОЗИЦИОНИОТ ШРАФ ОД ДИСТАЛНАТА ТИБИО-ФИБУЛАРНА СИНДЕЗМОЗА

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Abstract

Introduction. The routine removal of the positioning screw from the syndesmosis in a period of 8-12 weeks from the index surgery is under debate. The aim of the present study was to examine the incidence of early surgical wound infection after removal of the positioning screw.

Methods. A total of 114 patients that had undergone a screw removal from the distal tibio-fibular syndesmosis in the period between January 2011 and June 2016 were examined. No antibiotic prophylaxis was given during the procedure. The patients' follow-up was one week, two weeks, one month and three months following the surgery. The occurrence of an infection was statistically examined in correlation with the sex, age, body mass index, diabetes, smoking and the American Society of Anaesthesiology score.

Results. An infection of the surgical wound following removal of the distal tibio-fibular syndesmosis screw was registered in 8 patients (7%). Five of them had *S. aureus* isolated from their surgical wound, one had *Pseudomonas aeruginosa* and one had *Enterococcus faecalis*. One patient had a negative microbiological finding. One patient needed hospitalization, parenteral antibiotic therapy and a surgical treatment of the wound. Statistically significant risk factors were: diabetes, body mass index, and smoking.

Conclusion. Our results support prophylactic use of antibiotics during the removal of the positioning screw from the distal tibio-fibular syndesmosis.

Keywords: syndesmosis, ankle, screw, extraction, infection

Апстракт

Вовед. Рутинското вадење на позициониот шраф за

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фиксација на синдезмозата 8-12 седмици по иницијалната операција е предмет на дебати. Целта на оваа студија е да се испита инциденцата на рана инфекција на раната по вадење на позициониот шраф од синдезмозата.

Методи. Во студијата учествуваа вкупно 114 пациенти лекувани во периодот јануари 2012-јуни 2016 година. При вадењето на позициониот шраф не беше давана антибиотска профилакса. Следењето се спроведуваше една и две седмици, како и еден и три месеци по операцијата. Појавата на инфекција статистички се испитуваше во корелација со полот, возраста, Индексот на телесна маса, дијабетот, пушењето и Скорот на Американската асоцијација за анестезиологија.

Резултати. Инфекција на хируршката рана беше регистрирана кај 8 испитаници (7%). Кај петмина беше изолиран *S. Aureus*, а кај по еден *Pseudomonas aeruginosa* и *Enterococcus faecalis*. Кај еден испитаник микробиолошкиот наод беше негативен. Кај еден испитаник беше потребна хоспитализација, парентерална антибиотска терапија и хируршки третман на раната. Статистички сигнификантни ризик фактори беа дијабет, Индекс на телесна маса и пушење.

Заклучок. Резултатите од ова истражување ја поддржуваат профилактичката употреба на антибиотици при вадење на позициониот шраф од синдезмозата.

Клучни зборови: синдезмоза, скочен зглоб, шраф, вадење, инфекција

Introduction

The ankle fractures are the most common injury of the lower extremity [1], and their incidence has increased in the past decades [2]. Simultaneously, they are the most common injury of a weight-bearing joint. The articular surface have specific morphology, and the distal tibio-fibular syndesmosis has a very important role in the biomechanics of the joint; thus the challenge during the reduction of the joint, which makes the absolute stability and the healing of the ligaments that form the

distal tibio-fibular syndesmosis is difficult to be achieved [3]. The ankle fractures are considered to be accompanied by a disruption of the syndesmosis in 15-23% of the cases [4]. The disruption of the distal tibio-fibular syndesmosis completely disturbs the delicate biomechanics of the joint [5-7]. Syndesmotic reconstruction is widely regarded as the cornerstone in the treatment of these injuries [8-10]. Even though transfixation with the positioning screw is still a "gold standard" [11], there are opposing opinions about the technical details of the procedure itself. There is no consensus regarding the number and calibre of the screws, the level at which they should be placed, the number of cortices that should be engaged, and the duration of the transfixion of the syndesmosis. In the past few years, several cadaveric biomechanical studies confirmed the importance of the syndesmosis during the movements of the ankle, so the question for the duration of the syndesmotic transfixion has been raised [12-14]. On the other hand, the results from many studies have questioned the need for removal of the positioning screws in terms of the functional outcome following this injury, stating that the routine screw removal has no effect when it comes to achieving pre-injury activity level [15-17]. In the meantime, these authors believe that another surgery to remove the screws increases the risk of postoperative complications, which may affect the patient's overall satisfaction from the treatment. We were motivated to analyze the occurrence of infection of the surgical wound following removal of the positioning screws, which is another element in the scientific discussion focused on the need of removal of the positioning screws.

Materials and methods

A prospective study was conducted at the University Clinic of Traumatology at the Medical Faculty in Skopje, in the period from January 2011 to June 2016. The study was focused on patients with ankle fracture, who had their positioning screw removed 8-12 weeks after the initial surgery. The need for removal of the positioning screw was determined by the surgeon. Patients who had a serious wound infection after the initial surgery, another fracture which was surgically treated, visceral or cranio-cerebral injury which was surgically treated and was acquired during the incident that also caused ankle fracture, patients who had an ASA score ≥ 3 during the initial procedure and patients who were on corticosteroid therapy, were excluded from the study. The procedure of screw removal was performed by infiltrating a local anesthetic at the place of the planned incision, making a skin incision no longer than one centimeter, identifying and removing of the positioning screw. The wound was closed with prolene suture and a sterile dressing was applied. A prophylactic antibiotic was not given. The follow-up of the wound was on the first postoperative day, seven days, fourteen days, one month and three months after the screw removal. Following the wound check on the first postoperative day, the dressing was changed and remained in place till the next wound check (a week following surgery) when the stitch was removed. The dressing was applied again and the patient was advised to remove it the next morning. The patients were discharged from the hospital during the first postoperative day. The presence of an

Table 1. Criteria for wound infection diagnosis

<i>Presence of at least one of the following factors:</i>	
	purulent discharge
	positive microbiological finding from a sample taken aseptically
	opening of the wound by the surgeon
<i>Presence of one of the signs/symptoms:</i>	
	pain
	swelling
	redness
	high temperature at the site of the wound
	the surgeon believes there is a wound infection

infection was diagnosed based on the generally accepted recommendations by the Centre for Disease Control and Prevention (Table 1) [18].

A swab was taken from the wound of the patients that had positive findings, and an oral antibiotic treatment was ordinated depending on the microbiological results. The patients that needed another hospitalization, a wound revision and parenteral antibiotic treatment, were considered to have a serious wound infection. It was considered that the patient did not have an early wound infection related to the positioning screws removal, if there were no signs of an infection during all four check-ups.

Other factors that were registered, besides the status of the surgical wound, were the demographic characteristics of the patients, the mechanism of the injury, the BMI (Body Mass Index) [19], the American Society of Anesthesiology (ASA) score [20], diabetes and smoking. All data were entered in an electronic data base (Microsoft Excel, Microsoft, Redmond, Washington), and after finishing the study, the data were transferred to SPSS (SPSS for Windows 22.0, Chicago IL). The qualitative variables were described as absolute and relative numbers, and the quantitative variables were described as an average value and standard deviation. The t-test for

independent samples and the Fisher's exact two-tailed test were used for variable analysis.

Results

Enrolment in the study, demographics, type of fracture

In the stated period, 563 patients underwent an ankle fracture surgery at the University Clinic of Traumatology.

Among them, 186 (32.9%) had a syndesmotic fixation, and 131 (69%) had their positioning screw/screws removed within 8-12 weeks from the initial procedure. The decision for the removal was made by the surgeon. Of these 131 patients, 114 (87%) were involved in the study (6 patients did not want to participate, and 11 did not satisfy the inclusion and exclusion criteria). The demographics of the patients are shown in Table 2.

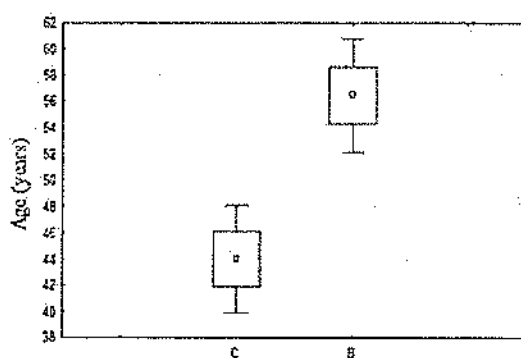
Table 2. Demographic characteristics of patients

Sex	Number (%)	Mean (age)	SD (age)	SE (age)	Min	Max
Men	73 (64%)	49.6	14.2	1.66	21	75
Women	41 (36%)	54.3	13.3	2.07	23	78
Total	114 (100%)	51.3	14	1.31		

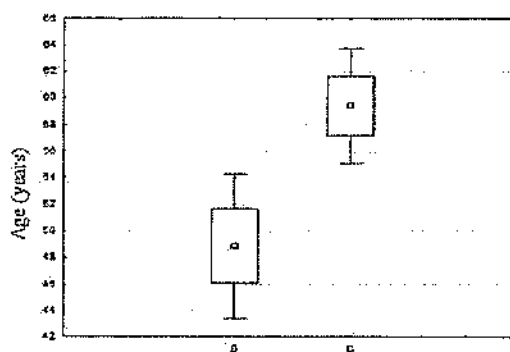
SD-standard deviation; SE-standard error; Min-minimal value (age); Max-maximal value (age)

The participants were mostly male, and the average age of acquiring the ankle fracture was higher among women. The average screw removal period after the

initial procedure was 81.3 ± 14.7 days. The analysis of the type of the fracture related to age and sex of the patients is shown in Figure 1.



Males - Type of fracture, Weber/AO Classification



Females - Type of fracture, Weber/AO Classification

Fig. 1. Analysis of type of fracture by age and gender

Wound infection, causes and treatment

Early wound infection was diagnosed in eight patients (7%) during the control check-up, which was implemented with the previously described methodology. In four (50% of those in whom the infection was diagnosed) patients, the infection was diagnosed one week after the surgery and in three (37.5% of those in whom the infection was diagnosed) patients it was diagnosed during the control check-up two weeks after the performed procedure. In one (12.5% of those in whom infection was diagnosed) patient, the infection was diagnosed one month after the surgery. The eight patients, in which the infection was diagnosed, were represented as group B, and the rest of 106 patients were represented as group A. The microbiological finding was positive in seven (87.5% of group B) patients. In five of them, *Staphylococcus aureus* was isolated, in one *Enterococcus faecalis* and one of the patients had *Pseudomonas aeruginosa*. The patient who was infected with *Pseudomonas aeruginosa* had the wound opened by the surgeon and parenteral antibiotic therapy was adminis-

tered. The antibiogram of this patient showed Imipenem, Meropenem, Cefazidin and Colistin sensitivity. In this case, Cefazidin was administered parenterally for 7 days, which resulted in reduced local inflammation and the patient was treated with dressings for the next 2 weeks. Patients with *Staphylococcus aureus* and the one with *Enterococcus faecalis* were given oral antibiotic therapy with amoxicillin-clavulanic acid for 7-10 days. The symptoms and clinical signs subsided without any further complications. There were no signs of spreading of the infection in the deeper structures nor did any other complication occur in the osteosynthetic material. The patient with the negative microbiological finding was administered amoxicillin-clavulanic acid for 7 days, after which the patient was symptom-free.

Risk factors for surgical infections

Besides the characteristics stated previously, we calculated BMI, checked the presence of diabetes, asked patients about their habit of smoking cigarettes and calculated the ASA score.

As shown in Table 3, we found no statistical association between the infection and the ASA score (Fisher's exact test: $p=1.00$). Also, we found that both smokers and non-smokers equally got infection (Fisher's exact test: $p=0.448$).

There was a significant difference between the two

groups related to the level of BMI in favor of higher value in the group with infection (t -test=4.7; $df=112$; $p<0.001$) (Table 3). Our analysis showed significant association between the infection and the presence of diabetes (Fisher's exact test: $p=0.025$) (Table 3).

Table 3. Results of the analysis of risk factors

Parameter		group A	group B
ASA score	score 1	71 e. (66.9)	5 e. (62.5)
<i>Fisher exact, two tailed $p=1.00$</i>	score 2	35 e. (33.02)	3 e. (37.5)
Body Mass Index	mean value	25.68	29.75
<i>t-value=4.77, df=112, $p<0.001$</i>			
Diabetes	No DM	82 e. (77.36)	3 e. (37.5)
<i>Fisher exact, two tailed $p=0.025$</i>	DM	24 e. (22.64)	5 e. (62.5)
Smoking	smoker	36 e. (33.9)	4 e. (50)
<i>Fisher exact, two tailed $p=0.448$</i>	non-smoker	70 e. (66.1)	4 e. (50)

e-examinees; df-degree of freedom; the numbers in the parentheses show the percentage of group A and group B

Discussion

The results of the present study showed that the wound infection occurred in 7% of the patients after the positioning screw was removed from the syndesmosis. The authors have a strong opinion that it is a significant percentage, especially having in mind the technical simplicity of the positioning screw removal procedure. In addition, the study of Bonneville *et al.*, which included 1617 examinees, reported significantly less cases of wound infection after skeletal trauma procedures for osteosynthesis and arthroplasty [21]. Similar results were presented by Astagneau *et al.*; wound infection occurred in 1.5% following surgery for skeletal trauma [22]. On the other hand, the study of Andersen found wound infection in 5% of patients following positioning screw removal from the syndesmosis [23%]. Yet, another study reported up to 9% following the procedure discussed [24]. Theoretically, it is hard to address the cause of the high rate of wound infection following this simple procedure; however, it is common for our study and the other studies describing this complication that no antibiotic prophylaxis was given during the procedure. The microbiological findings showed that up to 62.5% of patients had *Staphylococcus aureus*. Most of the studies that have analyzed this issue have stated that the number one cause of surgical wound infection in skeletal surgery is the abovementioned microorganism [25,26].

It is not surprising that smoking, diabetes and high BMI were significantly more present in patients with wound infection [25,27-30]. However, we found intriguing that the study of Andersen did not confirm the significance of the smoking and BMI in the occurrence of the wound infection following this procedure, although the study group was quite similar to ours [23]. It is also very important to be stated that BMI in this study was significantly higher compared to the Andersen's study. Nonetheless, it may be noteworthy that the mean

BMI in the present study was much higher compared to the study of Andersen.

Even though the present study was not focused on the need of syndesmotomic screw removal, the high rate of wound infections we found, gave us a reason to briefly address the subject abovementioned. The removal of the positioning screw is the second surgical procedure that patients experience and it comes with its own risks, which can lead to prolonged hospital stay and higher health expenses. Huber's cadaveric study focused on the syndesmosis movement the restrictions in the joint movement in presence of positioning screw that went through the tibia and fibula [31]. Similar anatomical and radiological studies have discussed the same issue [32-34]. However, the clinical significance of the prolonged fixation of the syndesmosis is still uncertain. Most of the clinical studies that have discussed this issue failed to prove the impact of the prolonged fixation on the functional outcome [35-39]. At least two studies demonstrated the best functional results in patients in whom the positioning screw was found to be broken [40,41].

Having in mind all these notions, the high percentage of postoperative infection following removal of the positioning screw should be regarded as yet another risk factor while deciding whether or not the syndesmotomic screw should be removed.

The limitations of the present study were its small number of patients that were treated in a single institution, the lack of a control group and the strict inclusion/exclusion criteria. Also, we did not analyze the functional result with regard to the occurrence of wound infection and costs of the treatment. On the other hand, the risk factors did give useful information though this procedure is recognized by many surgeons as a minor one, it might be the cause of serious complications and therefore they should be modified before the procedure is undertaken. Complications following partial or total implant removal have already been re-

ported. Namely, the study of Sanderson (1992) described an infection following implant removal in 15% of patients [42]. The authors of the present study believe that prophylactic antibiotic use will reduce the rate of wound infection following syndesmotic screw removal.

Conclusion

The need of routine syndesmotic screw removal remains controversial. Our results demonstrated a high percentage of wound infection following the procedure. The postoperative wound infection carries risks of spreading in the deeper structures and it may lead to preterm implant removal, which will render uncertain functional result. The routine use of the antibiotic prophylaxis while performing this procedure might reduce the rate of wound infections. Our results do not support routine syndesmotic screw removal.

Conflict of interest statement. None declared.

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