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WRIST & HAND

Efficacy of perioperative antibiotic prophylaxis in elective soft-tissue-only wrist arthroscopy

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Aims

Wrist arthroscopy is a standard procedure in hand surgery for diagnosis and treatment of wrist injuries. Even though not generally recommended for similar procedures, general administration of perioperative antibiotic prophylaxis (PAP) is still widely used in wrist arthroscopy.

Methods

A clinical ambispective dual-centre study was performed to determine whether PAP reduces postoperative infection rates after soft tissue-only wrist arthroscopies. Retrospective and prospective data was collected at two hospitals with departments specialized in hand surgery. During the study period, 464 wrist arthroscopies were performed, of these 178 soft-tissue-only interventions met the study criteria and were included. Signs of postoperative infection and possible adverse drug effects (ADEs) of PAP were monitored. Additionally, risk factors for surgical site infection (SSIs), such as diabetes mellitus and BMI, were obtained.

Results

The overall infection rate of SSI was zero. Neither in the PAP group (n = 69) nor in the control group (n = 109) were signs of postoperative infection observed. Observed symptoms of ADEs were three-times higher in the PAP group when compared to the control-group (16.3 vs 5.5%; p = 0.043). No major ADEs were observed, but one in ten patients in the PAP group reported mild to severe intestinal or hypersensitivity symptoms.

Conclusion

We demonstrate that the number needed to treat (NNT) with PAP to prevent one postoperative infection in soft-tissue arthroscopies of the wrist is > 109. Conversely, symptoms of ADEs were reported by one out of ten patients given PAP. Considering the high NNT to prevent postoperative infection and the large number of ADEs caused by PAP, we recommend not to use PAP routinely in soft-tissue arthroscopies of the wrist. Subsequent large-scale studies should be conducted to substantiate these results.

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Keywords: Arthroscopy, Hand Surgery, Wrist Arthroscopy, Antibiotic Prophylaxis, PAP, Plastic Surgery

Introduction

Since wrist arthroscopy was first described in the 1970's, great advances,[1,2] in particular the introduction of smaller and better scopes and instruments, and its indications, have widened. Today, this technique has evolved from a purely diagnostic tool to an essential therapeutic procedure.[3,4] It constitutes the reference standard for staging of wrist pathologies like injuries of the carpal cartilage or the triangular fibrocartilage complex (TFCC), as well as the stability of the carpal ligaments.[4,5] Indications for arthroscopic treatment of the wrist cover soft-tissue-only interventions include excision of ganglion cysts, synovectomy, debridement of degenerative cartilage, and TFCC tears, as well as capsular refixation of traumatic TFCC tears.[3,4,6] In addition, there are numerous indications involving bone surgery like foveal refixation of TFCC lesions, reconstruction of scapholunate ligament with free tendon

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Table I. Signs of postoperative infection and adverse drug effects.[34]

Signs of postoperative infection (up to 30 days after intervention)	ADEs (up to 14 days after intervention)
Secretion of pus	Intestinal disorders
Detection of pathogens. microbiological swab positive for bacteria	Meteorism
Signs of infection at surgical site (pain, swelling, redness, warmth)	Abdominal pain
Fever	Nausea/vomiting
Unusual, infection-related, behaviour	Diarrhoea
	Hypersensitivity reactions
	Skin eczema
	Pruritus
	Anaphylactic reaction

ADE, adverse drug effect.

graft, resection of the distal ulna (Wafer-Procedure), or arthroscopic assisted reduction of intraarticular radius fractures.[3,7-9]

All surgical procedures damage skin and underlying soft-tissue. Through the break in the skin barrier bacteria can colonize the wound hereby increase the risk of wound infection.[10,11] To reduce the risk of surgical site infections (SSIs), perioperative antibiotic prophylaxis (PAP) may be administered, considering patient- and surgery-related risk factors.[12-15] For most interventions, a cephalosporine antibiotic is the recommended PAP. In case of contraindications, clindamycin, vancomycin, or fluoroquinolones may be administered.[12]

In most arthroscopies, PAP is given routinely, cephalosporines (e.g. cefuroxime) being the predominant antibiotic used.[16–18] Investigating the efficacy of prophylactic antibiotics in knee arthroscopies, Wyatt et al[19] could demonstrate an inverse correlation between administration of PAP and the occurrence of deep joint infections. These findings were backed by a meta analysis of Carney et al;[20] however, when bony interventions were excluded from the study this advantageous effect of PAP could no longer be detected. Studies of postoperative infection rates in knee and wrist arthroscopies performed with and without preoperative antibiotic treatment showed no difference in SSI rates.[21,22]

Complications after arthroscopy, with septic arthritis being the worst possible SSI, are very rare, with a reported overall frequency of less than 1%.[23] There are risks and complications related to unnecessary use of antibiotic prophylaxis. The incidence of adverse effects in patients given PAP is low; nevertheless, they can range from allergic reactions to diarrhoea with possible secondary *C. difficile* infection, toxic epidermal necrolysis, arthralgia, or phototoxicity, depending of the antibiotic given.[13,24]

For clean, elective soft-tissue hand surgery in non-immune compromised patients with operative duration of less than two hours, a prophylactic antibiotic treatment is not recommended.[13,24–26] Elective soft-tissue-only wrist arthroscopy fulfils these criteria. Indeed, several studies could not find a significant risk reduction of SSIs after general administration of PAP in surgical interventions of the hand.[21,25,27–31] Nevertheless, several procedures in elective hand surgery, such as wrist arthroscopies, registered an increase in the use of PAP since 2009.[32] This study therefore aims to evaluate whether PAP in elective soft-tissue-only wrist arthroscopies is recommendable.

Methods

Study design. This study was designed as a clinical, ambispective, dual-centre study using a retrospective and prospective patient recruitment. Study centres were the LMU Hospital and Schön Clinic, both located in Munich, Germany. Ethical approval for this study was obtained from the ethics committee of the medical faculty of LMU Munich, Germany (approval no. 19 to 530).

Retrospective cases of patients who already received arthroscopy of the wrist were included over a period of one year, from March 2019 to February 2020. The patients were identified by the code for wrist arthroscopy of the German Operation and Procedure Classification System (OPS).[33] The prospective cases were recruited between February and September 2020. The arthroscopies were performed by seven surgeons in the LMU Hospital and 12 surgeons in the Schön Clinic. Included in this study were only cases of elective arthroscopies without involvement or treatment of bony structures (soft-tissue-only) and without complex side procedures. Exclusion criteria were preoperative infection and preoperative antibiotic treatment for other reasons, reoperation within the study period, pregnancy, and insuperable language barrier. According to the national reference centre for surveillance of nosocomial infections, the observation period for post-interventional infections in arthroscopies is set to 30 days.[34] Patients that had a follow-up period of less than 30 days were therefore excluded from the study.

Data collection. In case of PAP administration, a single-shot dose of Cefuroxime 1.5 g iv (second-generation cephalosporin) was given. In cases of known or presumed allergy to penicillin,[35] a single shot of Clindamycin 600 mg iv (lincosamid antibiotic) was administered.

To evaluate the risk-benefit profile of PAP, the rates of postoperative infections and adverse drug reactions were assessed. Postoperative infections were defined according to the criteria of the national reference centre for surveillance of nosocomial infections and thus only diagnosed if a certain combination of clinical and/or microbiological and pathological criteria respectively occurred within 30 days after arthroscopy.[34] The occurrence of these infection criteria (i.e. pus, detection of pathogens, signs of infection, fever, and unusual behaviour) was identified by review of the patient's file and by examination and

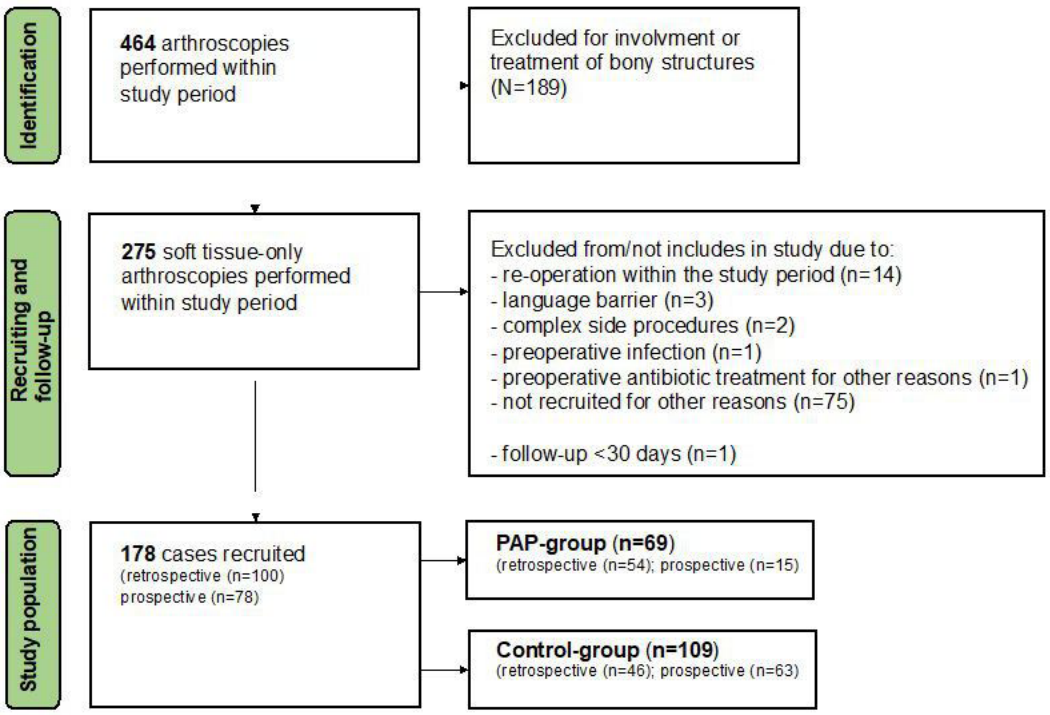

Fig. 1
Study population.

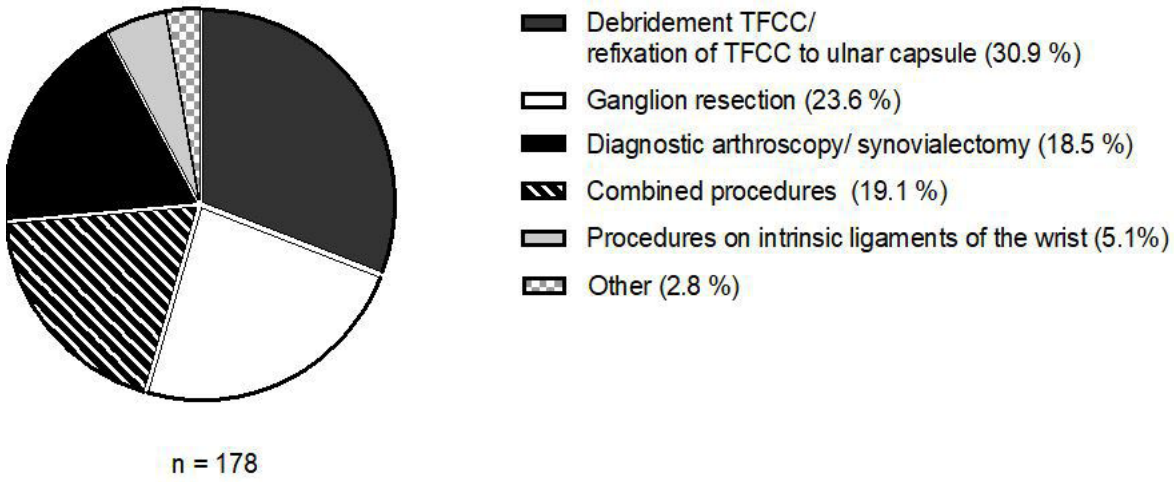

Fig. 2
Distribution of arthroscopic procedures included in the study.

inquiry during follow-up (Table I). The number of infections in the PAP-group and in the control-group were compared and the number needed to treat (NNT) calculated.[36] NNT represents the necessary number of patients who need to receive PAP to prevent one postoperative infection.

To identify cases of adverse drug reactions, patients were asked during follow-up about perception of ADEs. Reactions could be ranked by the patients as mild or severe. Additionally, the patients files were assessed for reports of ADEs. An ADE due to PAP was defined as an event within 14 days after arthroscopy. The following ADEs were gathered: intestinal disorders (meteorism, abdominal pain, nausea/vomiting, diarrhoea), and hypersensitivity reactions (skin eczema, pruritus, anaphylactic reaction) (Table I). Due to the design of this study, blood examinations were not examined. Therefore, ADEs that need laboratory diagnostic to be detected, such

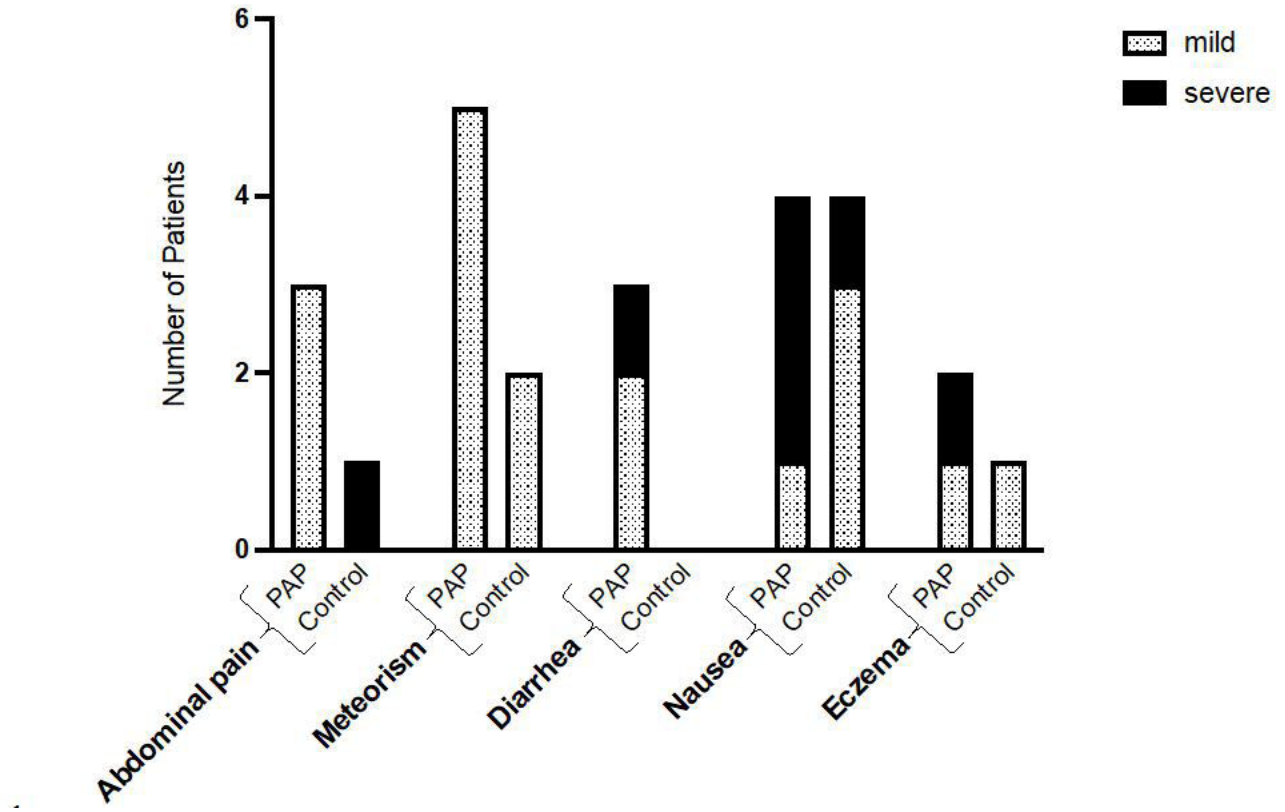

Fig. 3
Type of adverse effects and distribution across groups.

temporary eosinophilia and temporary elevation of transaminases of creatinine, were not examined.

ADEs in the PAP group and control group were compared, and the number needed to cause an ADE was calculated.[36] This number represents the number of patients who need to receive PAP to statistically cause one event of ADE.

The duration and type of arthroscopic procedure were assessed, and procedures were assessed and categorized into groups. Additionally, patients characteristics were assessed, including age and sex, as well as clinical factors possibly favoring or related to development of postoperative infections (i.e. diagnosis of diabetes mellitus, BMI, American Society of Anesthesiologists (ASA) score, smoking, alcohol consumption, immunosuppressive therapy, and prior history of SSI).

Statistical analysis. For statistical evaluation the GraphPad Prism (ersion 8.0.2; GraphPad Software, USA) was used. Groups being matched were checked for normal distribution by D'Agostino-Pearson tests. To compare the different groups, paired *t*-test was used for normally distributed and the Wilcoxon signed rank test for was used for non-parametric samples. Nominal or ordinal scaled values were checked for significant differences by Fisher's exact test. For more than two variables, chi-squared test was used. A p-value < 0.05 was considered statistically significant.

Results

Within the study period, 464 arthroscopies in total and 275 soft-tissue-only arthroscopies were conducted in both hospitals, Out of these, 178 patients met the inclusion criteria. Overall, 78 cases (43.8%) were recruited prospectively and 100 cases (56.2%) were recruited retrospectively. In 69 arthroscopies (38.8%), PAP was given, and in 109 arthroscopies (61.2%) no antibiotic was administered (Figure 1).

Of the 178 patients that were included, 102 (57.3%) were female and 76 (42.7%) were male. The mean age was 38.1 years, evenly distributed between PAP group and control group (38.6 years vs 37.8 years). The majority of arthroscopies that were performed involved a pathology of the TFCC (30.9 %), the rest of the procedures included arthroscopic ganglion resection, purely diagnostic arthroscopies with or without synovialectomy, combined procedures (e.g. transcapsular TFFC refixation in combination with ganglion resection), procedures involving pathologies on the intrinsic ligaments (predominantly the scapholunate ligament), and others (e.g. removal of free joint bodies) (Figure 2).

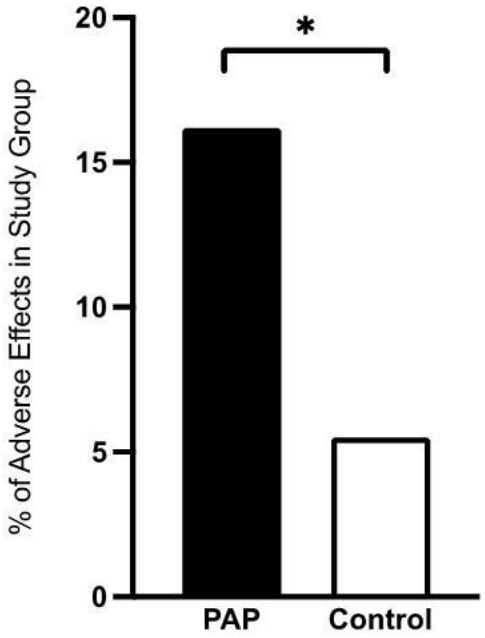

Fig. 4

Adverse drug effects (ADEs) in the two groups. The perioperative antibiotic prophylaxis (PAP) group showed significantly higher ADE when compared to controls. Consequently, approximately one out of ten patients with PAP shows an ADE (attributable risk of 9.37).

The mean duration of arthroscopic interventions was 40.4 minutes (standard deviati0n (SD) 18.1; incision-to-suture time), and the mean time between PAP administration and incision was 29.5 minutes (SD 16.3). Cefuroxime was given in 67 cases (97.1 %) and Clindamycin (in cases of known or presumed allergy to penicillin) was given to two patients (2.9 %). Postoperative infections or SSIs (according to the study criteria within 30 days of the arthroscopy) were observed neither in the PAP or control groups. Consequently, to prevent one postoperative infection, the number needed to treat is > 109.

Across both groups symptoms that could be linked to ADE of PAP were low. With the exception of nausea in the PAP group, most symptoms were mild (Figure 3). Moreover, no major ADE, such as anaphylactic shock or verified infection with *C. difficile*, were observed.

The patients in the PAP group showed significantly more intestinal disorders or hypersensitivity reactions linked to PAP administration than patients of the control group. Consequently, we observed significantly higher overall ADE in the PAP group (16.2% vs 5.5%; p = 0.029, chi-squared test) (Figure 4).

This results in an attributable risk for ADE when routinely administering PAP of 10.7%. The number needed to cause an ADE is therefore 9.37, which corresponds to approximately one out of ten patients.

Regarding potential risk factors, we observed no correlation with the development of a SSI (Table II).[37–39] Similarly, a positive history of adverse reaction to antibiotics was no risk factor for a new ADE.

Discussion

This study is the first partially prospectively executed study to research the efficacy of PAP in elective soft-tissue wrist arthroscopy. In the 178 soft-tissue-only wrist arthroscopies that were included, we observed no difference in the overall postoperative infection rate between both groups (PAP and control). SSI occurred in neither the PAP or control groups. Based on these findings, more than 109 patients have to receive PAP to prevent one SSI for elective soft-tissue wrist arthroscopy (NNT > 109). Moreover, ADEs were three-times higher in the PAP group (Figure 4). Consequently, the number needed to cause one ADE by administration of PAP is 9.37. Even though no severe ADEs were observed, one out of ten patients given PAP suffered mild to severe intestinal side-effects or hypersensitivity symptoms.

As the incidence of SSI after arthroscopy is very low, the prophylactic use of antibiotics remains controversial.[22,40] However, no clear advisory statement against the routine use of PAP in elective soft-tissue wrist arthroscopy by a major hand surgery, orthopaedic, or arthroscopic society has been published up to date. However, the Clinical Practice Guidelines for Antimicrobial Prophylaxis in Surgery of the American Society of Health-System Pharmacists (ASHP) does not recommend PAP for patients undergoing clean orthopaedic procedures, including arthroscopy, without implantation of foreign materials.[41] Likewise, the guidelines on prophylaxis of infection in arthroscopic surgery of the German Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften (AWMF) see no justification of routine administration of PAP in arthroscopies unless there are patient- or surgery-related risk factors.[42]

In knee arthroscopy, PAP used to be administered routinely.[43] Conversely, in the last decade, several large case series and retrospective analyses demonstrated no benefit of PAP in knee arthroscopies.[19,43,44] Very few studies regarding the use of PAP are available for arthroscopy of the wrist. A retrospective single-centre analysis of the rate of SSI after PAP in wrist arthroscopy was conducted by Hoel et al[21] in 2019. The authors showed a low overall rate of SSI of 0.6%, with no benefit of prophylactic administration of antibiotics. Moreover, several studies demonstrated that use of PAP in clean elective soft-tissue surgery of the hand offers no benefit with regard to SSI.[13,25] In clean elective operative procedures of the hand, lasting less than two hours, PAP is therefore not recommended.[24,26] In the current study, we observed an mean duration of arthroscopies of 40.4 minutes, which is well below the two-hour mark. Regarding these findings, as well as our results, a routine administration of PAP in elective soft-tissue wrist arthroscopy cannot

Table II. Potential risk factors and their relationship to the development of surgical site infections or adverse drug reactions.

Risk factor	Study population, n (%)	PAP group, n (%)	Control group, n (%)	p-value*
Diabetes mellitus	3 (1.7)	0 (0.0)	3 (2.8)	0.284
BMI, kg/m²	24.9 (4.7)	25.4 (4.4)	24.7 (5.0)	0.340
Smoker at time of surgery	44 (24.7)	19 (27.5)	25 (22.9)	0.593
Alcohol consumption				0.725
Never/less than 1 to 2 per year	41 (23.3)	14 (20.3)	27 (25.2)	
Rare (max. 1 to 2 per month)	42 (23.9)	17 (24.6)	25 (23.4)	
Occasional (max. 1 per week)	61 (34.7)	23 (33.3)	38 (35.5)	
Frequent (> 1 per week)	32 (18.2)	15 (21.7)	17 (15.9)	
ASA score				0.486
1	69 (38.8)	26 (37.7)	43 (39.5)	
2	103 (57.9)	42 (60.9)	61 (56.0)	
3	6 (3.4)	1 (1.4)	5 (4.6)	
≥ 4	0 (0.0)	0 (0.0)	0 (0.0)	
Immunosuppressive therapy prior SSI	10 (5.6)	4 (5.8)	6 (5.5)	> 0.999
Prior SSI	4 (2.2)	2 (2.9)	2 (1.8)	0.646
History of adverse reaction to antibiotics	53 (30.3)	21 (30.9)	32 (29.9)	> 0.999

*Chi-squared test.
ASA, American Society of Anesthesiologists; SSI, surgical site infection.

be recommended, in particular, when considering the current data on cause and prevalence of the rapidly growing resistance of bacteria against antibiotics.[45]

Interestingly, we observed no correlation between known and potential risk factors and the development of postoperative infections or a positive history of adverse reaction to antibiotics and the prevalence of an ADE (Table II). Here, the relatively small patient population may be a confounding factor. A larger study population would have probably identified known risk factors for SSI, such as BMI or ASA score.[46–48] Indeed, a major limitation of this study is the relatively small number of cases compared to the very low incidence of the observed SSI. Thus, we observed no SSI in the PAP or control group. Consequently, the NNT found in the present study is only an approximation, as it is defined by the number of patients that underwent arthroscopy without PAP (109 patients). In a study with a substantially greater number of cases, the NNT would be expected to be considerably higher.

Nevertheless, considering the high NNT of at least 109 to prevent one SSI in soft-tissue arthroscopies and the large number of ADEs caused by PAP (one out of ten), we feel safe to recommend not using PAP routinely in soft-tissue-only wrist arthroscopies, hereby confirming the current prevailing opinion in the literature.

Take home message

- Perioperative antibiotic prophylaxis (PAP) in wrist arthroscopies is still widely given. This study demonstrates that PAP does not provide a benefit regarding surgical site infections in soft-tissue-only arthroscopies, but causes significant adverse effects in patients.
- Regarding the growing rate of antibiotic resistances and the rising cost pressure in healthcare systems, the default administration of single-shot antibiotics in soft-tissue-only arthroscopies should be omitted.

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