



Assessment of periprosthetic joint infection prevention methods amongst Turkish orthopedic surgeons in total joint replacement: A survey

Oğuzhan Çimen, MD¹, Nesrullah Azboy, MD², Bilgehan Çatal, MD³, İbrahim Azboy, MD³

¹Department of Orthopedics and Traumatology, Istanbul Medipol Hospital, Istanbul, Turkey

²Department of Public Health, Mustafa Kemal University, Faculty of Medicine, Hatay, Turkey

³Department of Orthopedics and Traumatology, Medipol University, Faculty of Medicine, Istanbul, Turkey

Periprosthetic joint infection (PJI) remains a challenging complication and is a leading reason for failure following total joint arthroplasty (TJA). There is a significant economic burden to the treatment of PJI.^[1] In addition to the economic burden, elderly patients with comorbid conditions are at increased risk of postoperative morbidity and mortality when undergoing treatment of PJI.^[2]

Currently, many different strategies are used to mitigate the risk of PJI after TJA and newer approaches are constantly in development. Several organizations have subsequently recommended evidence-based guidelines for the prevention of PJI and surgical site infections (SSIs). The most notable are the International Consensus Meeting (ICM),^[3] World Health Organization (WHO),^[4] and the Center for Disease Control and Prevention (CDC)^[5] guidelines.

In parallel to new scientific developments, these guidelines sometimes change their recommendations. However, the alignment of orthopedic surgeons with these guidelines may differ due to their experiences

ABSTRACT

Objectives: This study aims to assess the methods employed by Turkish orthopedic surgeons to prevent periprosthetic joint infection (PJI) in total joint arthroplasty (TJA).

Patients and methods: The data obtained for this study, conducted between January 2019 and February 2019, were gathered by sending out an online survey to Turkish Society of Orthopedics and Traumatology members (n=2,267). A total of 354 orthopedic surgeons responded and completed survey. The survey had 23 questions which include the experience, academic position, hospital where the physician works, monthly arthroplasty numbers, and infection prevention methods employed before, during, and after surgery.

Results: The period for antibiotics prophylaxis showed variability, with about 63% of surgeons using prophylaxis longer than 24 hours. In terms of academic position, 52.4% of professors and 52.8% of associate professors used prophylaxis for the first 24 hours whereas this rate was 31.3% in operators (p=0.01). Of surgeons, 50.7% who perform more than 10 arthroplasties per month and 33.6% of surgeons who perform less than 11 arthroplasties per month used 24-hour antibiotic prophylaxis (p=0.006). Blood glucose level assessment prior to surgery was performed by the majority of surgeons (94%). A total of 118 orthopedic surgeons (33.3%) performed methicillin-resistant *Staphylococcus aureus* (MRSA) decolonization with 54.7% of associate professors, 59.5% of professors, and 24.7% of operators (p=0.001). Only 60 surgeons (16.9%) checked vitamin D levels.

Conclusion: Our study results demonstrated that the majority of orthopedic surgeons in Turkey do not follow the antibiotic prophylaxis recommendations and they use antibiotic prophylaxis for longer periods. Professors and associate professors, and surgeons with higher monthly arthroplasty numbers than surgeons with lower monthly arthroplasty numbers follow the recommended periods more than their counterparts. Most surgeons assess blood glucose levels whereas a small number of surgeons perform MRSA decolonization and check vitamin D levels.

Keywords: Antibiotic prophylaxis, periprosthetic joint infection, prevention, total joint arthroplasty, Turkey.

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Correspondence: Oğuzhan Çimen, MD. Koşuyolu İstanbul Medipol Hastanesi Ortopedi ve Travmatoloji Bölümü, 34718 Kadıköy, İstanbul, Türkiye.

E-mail: o.cimen@hotmail.com

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and the facilities of the hospitals they work. Therefore, in this study, we aimed to assess the methods employed by Turkish orthopedic surgeons to prevent PJI in TJA.

PATIENTS AND METHODS

This study was conducted at Medipol University, Faculty of Medicine between January 2019 and February 2019. Data of the study were obtained through an online survey from 354 orthopedic surgeons registered in Turkish Orthopedics and Traumatology Association database (n=2,267) in 2019 and currently performing knee and hip arthroplasty. For this purpose, a draft survey was prepared containing questions about precautions employed by surgeons to reduce PJI risk following primary total knee arthroplasty (TKA) and total hip arthroplasty (THA). Five experienced surgeons operating more than 100 arthroplasties per year were consulted to evaluate the survey. The survey was finalized according to their suggestions. The final survey consisted of 23 questions investigating the demographics of surgeons, their work experience, monthly arthroplasty numbers, and PJI prevention methods employed before, during, and after surgery (Table I). The study protocol was approved by the

Medipol University, Faculty of Medicine Ethics Committee. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical analysis

All data were entered into the IBM SPSS version 22.0 software (IBM Corp., Armonk, NY, USA). Descriptive statistics and chi-square analysis were used for statistical assessment of data. Significance level was set as $p < 0.05$.

RESULTS

Seventy-three percent of participants were orthopedic surgeons in this survey. The demographic data of the 354 participating surgeons were listed in Table II.

A total of 257 participants (73%) started antibiotic prophylaxis one hour before surgery in operating room, whereas 92 (26%) started in the inpatient ward. The antibiotic prophylaxis period showed a great deal of variability. Only 116 orthopedic surgeons (33%) used prophylaxis in the first 24 hours. Seventy-two surgeons (20%) used prophylaxis for three days and 39 surgeons (11%) continued prophylaxis for seven days or longer. Totally, 223 surgeons (64%) in total performed prophylaxis longer than 24 hours.

TABLE I
Survey questions

1. How many years have you been a specialist?
2. Please indicate your academic position.
3. Specify the institution you are working in.
4. How many primary arthroplasty cases do you perform per month?
5. What is your preference for antibiotic prophylaxis?
6. What is your preferred duration of antibiotic prophylaxis?
7. What is your drain preference?
8. What do you use when you need hair removal in patients you plan arthroplasty?
9. What is your approach to patients with diabetes that you plan arthroplasty?
10. What is your approach to alcohol and smoking before surgery?
11. Do you screen patients that you plan elective arthroplasty for urinary infection?
12. Do you perform methicillin-resistant *Staphylococcus aureus* decolonization before surgery?
13. What is your preference if you are performing methicillin-resistant *Staphylococcus aureus* decolonization?
14. What are you doing at home for skin cleansing before surgery?
15. When do you operate on arthroplasty cases?
16. What is your routine of using gloves during surgery?
17. What is your preference for the use of iodophor-impregnated drape?
18. Do you use disposable surgical covers?
19. What do you use as a surgical field irrigation solution?
20. What is your preference for using tranexamic acid?
21. Do you use antibiotic cement in cases of primary arthroplasty?
22. What is your preference for vitamin D levels?
23. Would you recommend antibiotic use for patients before dental surgery?

TABLE II
Demographic data

	n	%
Workplace		
District state hospital	87	24.6
Research and training hospital	81	22.9
Private hospital	119	33.6
University hospital	67	18.9
Academic position		
Orthopedic surgeon	259	73
Associate professor	53	15
Professor	42	12
Expertise time (year)		
0-5	55	15.5
6-10	112	31.6
11-20	110	31.1
21-30	52	14.7
>30	25	7.1
Number of primary arthroplasties per month		
1-5	153	43.2
6-10	130	36.7
11-20	38	10.7
>20	33	9.4

Fifteen surgeons (4%) used a single-dose preoperative antibiotic prophylaxis.

In terms of academic position, 52% of professors and 53% of associate professors used antibiotic prophylaxis for the first 24 hours whereas this rate was 31% in orthopedic surgeons ($p=0.001$) (Table III). Of surgeons, 50.7% performing more than 10 arthroplasties per month preferred 24-hour antibiotic prophylaxis whereas only 31% of surgeons performing less than 11 arthroplasties per month preferred this method ($p=0.006$) (Table III).

Sixty-one participants (17%) performed methicillin-resistant *Staphylococcus aureus* (MRSA) decolonization in all patients whereas 57 (16%) preferred in selected patients. Fifty-five percent of associate professors, 60% of professors, and only 25% of orthopedic surgeons performed MRSA decolonization ($p=0.001$). Surgeons working in university hospitals preferred MRSA decolonization more compared to surgeons working in research and training hospitals and state hospitals (48%, 36%, and 22%, respectively) ($p=0.002$). The rate of performing MRSA decolonization was 26% in the participants whose duration of expertise was less than 10 years, whereas it was 40% in those whose duration of expertise was more than 10 years ($p=0.012$) (Table IV).

Preoperative blood glucose assessment was performed by the majority (94%) of surgeons. A total of 102 surgeons (29%) emphasized that the blood glucose levels should be below 200 mg/dL whereas 211 surgeons (60%) requested blood glucose levels to be below 200 mg/dL as well as hemoglobin A1c levels to be below 7%. No statistical significance was found in terms of blood glucose level assessments between academic positions, institution worked or the length of expertise ($p>0.05$).

A total of 217 surgeons (61%) did not make any recommendations to stop alcohol intake and smoking prior to surgery whereas 96 (27%) recommended these one month prior to surgery and 41 (12%) recommended these three months prior to surgery. Orthopedic surgeons were less likely to recommend quitting alcohol intake and smoking compared to associate professors and professors ($p=0.001$) (Table V).

Totally, 294 participants (83%) did not check vitamin D levels. Associate professors and professors were significantly more likely to check and regulate vitamin D levels compared to orthopedic surgeons ($p=0.02$).

TABLE III
Comparison of antibiotic prophylaxis duration preference in terms of academic career and number of monthly arthroplasties

	First 24 hours after surgery		Longer than 24 hours		Total		p
	n	%	n	%	n	%	
Academic career							
Orthopedic surgeon	81	31.3	178	68.7	259	100	0.001
Associate professor	28	52.8	25	47.2	53	100	
Professor	22	52.4	20	47.6	42	100	
Number of arthroplasties per month							
1-10	95	33.6	188	66.4	283	100	0.006
>10	36	50.7	35	49.3	71	100	

TABLE IV
Methicillin-resistant *Staphylococcus aureus* decolonization preferences

	Selected patients		In all patients		In no patient		p
	n	%	n	%	n	%	
Academic career							
Orthopedic surgeon	36	13.9	28	10.8	195	75.3	0.001
Associate professor	11	20.8	18	34	24	45.3	
Professor	10	23.8	15	35.7	17	40.5	
Workplace							
District State Hospital	13	14.9	6	6.9	68	78.2	0.002
Research and Training Hospital	12	14.8	17	21.0	52	64.2	
Private Hospital	22	18.5	16	13.4	81	68.1	
University Hospital	10	14.9	22	32.8	35	52.2	
Expertise time (year)							
1-10 years	25	15.0	19	11.4	123	73.7	0.012
>10	32	17.1	42	22.5	113	60.4	

A total of 121 participants (34%) did not use tranexamic acid (TXA). Fifty-seven (16%) used only local, 87 (25%) used only intravenous (IV) TXA, while 89 (25%) used both IV and local TXA. Sixty percent of orthopedic surgeons used TXA whereas this rate was 83% in associate professors and 81% in professors (p=0.002). While 78% of participants in research and training hospitals used TXA, this rate was 46% in those in state hospitals (p=0.001) (Table VI).

Fifty-four participants (15%) recommended a complete body bath using chlorhexidine, 136 (38%) recommended taking a normal bath, and 74 (21%) recommended cleaning the surgical field using chlorhexidine or antiseptic soap, while 90 surgeons (25%) did not have any recommendations.

A total of 172 participants (49%) recommended antibiotic prophylaxis before dental procedures for

TABLE V
Comparison of demographic data with smoking and alcohol use

	I don't recommend stopping smoking and alcohol		I recommend stopping smoking and alcohol 1 month before surgery		I recommend stopping smoking and alcohol 3 months before surgery		p
	n	%	n	%	n	%	
Academic career							
Orthopedic surgeon	169	66.5	61	24.0	24	9.4	0.001
Associate professor	24	45.3	16	30.2	13	24.5	
Professor	16	36.4	19	43.2	9	20.5	
Workplace							
District State Hospital	59	70.2	16	19.0	9	10.7	0.063
Research and Training Hospital	41	50.6	24	29.6	16	19.8	
Private Hospital	74	62.2	35	29.4	10	8.4	
University Hospital	35	52.2	21	31.3	11	16.4	
Expertise time (year)							
1-5	39	73.6	10	18.9	4	7.5	0.152
6-10	71	65.1	24	22.0	14	12.8	
11-20	62	56.4	33	30.0	15	13.6	
21-30	25	46.3	20	37.0	9	16.7	
>30	12	48.0	9	36.0	4	16.0	

TABLE VI
Comparison of demographic data with tranexamic acid use

	I don't use		IV only		Local only		Both IV and locally		p
	n	%	n	%	n	%	n	%	
Academic career									
Orthopedic surgeon	104	40.2	61	23.6	42	16.2	52	20.1	0.002
Associate professor	9	17.0	15	28.3	9	17.0	20	37.7	
Professor	8	19.0	11	26.2	6	14.3	17	40.5	
Workplace									
District State Hospital	47	54.0	18	20.7	11	12.6	11	12.6	0.001
Research and Training Hospital	18	22.2	26	32.1	17	21.0	20	24.7	
Private Hospital	38	31.9	22	18.5	20	16.8	39	32.8	
University Hospital	18	26.9	21	31.3	9	13.4	19	28.4	
Expertise time (year)									
1-10 years	63	37.7	42	25.1	28	16.8	34	20.4	0.224
>10	58	31.0	45	24.1	29	15.5	55	29.4	

IV: Intravenous.

lifetime, whereas 42 (12%) recommended for one year following surgery, 42 (12%) recommended for three years, and 98 (28%) did not recommend at all.

A total of 208 participants (59%) ordered urinary screening in all patients prior to surgery whereas 103 (29%) ordered in selected patients with 43 (12%) not ordering at all. Totally 276 participants (78%) used electric razors whereas 69 (20%) used razorblades, and three (0.8%) did not perform epilation. A total of 276 orthopedic surgeons (78%) used iodophor-impregnated drape in all patients, whereas 68 (19%) used in selected cases. Totally 313 surgeons (88%) used double-layered surgical gloves, with 152 (42.9%) changing them every hour. A total of 201 (57%) surgeons used saline solution for irrigation of surgical area following surgery without any antiseptic solutions or antibiotics. Totally 219 participants (62%) used hemovac drain routinely following surgery with 75 (21%) using them in selected patients with 17 (5%) not using it at all.

DISCUSSION

The most important result of our study was that the majority of the orthopedic surgeons in Turkey did not follow antibiotic prophylaxis recommendations proposed by guidelines following TJA and they used antibiotics for longer periods.^[6]

International Consensus Meeting suggests that the antibiotic prophylaxis period should not exceed 24 hours whereas WHO and CDC strongly recommend ending prophylactic antibiotic usage right

after closing wound, even in cases where surgical drains are used. There is evidence that antibiotic prophylaxis lasting longer than 24 hours is deemed as unnecessary and might possibly increase bacterial resistance.^[7] Furthermore, a recent study reported that a single-dose antibiotic prophylaxis was effective in TJA.^[8] Compliance with the recommended 24-hour antibiotic prophylaxis was reported to be 70.2% in a study in Italy.^[9] In our study, 131 orthopedic surgeons (37%) used 24-hour prophylaxis whereas 223 (63%) used prophylaxis longer than 24 hours. Although the majority of orthopedic surgeons were using antibiotic prophylaxis more than 24 hours, associate professors and professors were in line with current antibiotic prophylaxis recommendations in comparison with operators as well as with surgeons with monthly arthroplasty numbers higher than 10 compared to their counterparts. Future studies may investigate the reasons behind this prolonged antibiotic usage amongst orthopedic surgeons in Turkey.

Staphylococcus aureus (*S. aureus*) accounts for about 30% of SSIs.^[9] Nasal colonization rate of *S. aureus* is about 25%, with increasing MRSA rates^[10] and SSI risk is known to be higher in nasal MRSA carriers.^[11] Although preoperative routine MRSA screening is still debated, decolonization in MRSA carrier patients was shown to decrease SSI risk.^[12] World Health Organization strongly recommends the nasal carriers to use 2% mupirocin.^[4] In our study, 236 orthopedic surgeons (67%) did not decolonize MRSA whereas 61 (17%) decolonized MRSA in all patients. The MRSA decolonization rates were significantly higher among

associate professors and professors compared with operators. We did not question the screening and decolonization methods in this survey. A future study may investigate this issue in detail.

Although skin is a remarkable barrier against microbes, it does host the majority of pathogens which can cause PJI and SSI. Preoperative skin cleansing was shown to decrease bacterial load and SSI rates.^[13] According to current evidence, ICM, WHO, and CDC recommend skin cleansing prior to surgery. The cleansing can be performed using antibacterial or antiseptic soaps or antibacterial liquids. Chlorhexidine is probably the most effective agent in such cases due to its effectiveness against most of the pathogens, including MRSA.^[14] In this study, 54 orthopedic surgeons (15%) recommended a complete body bath using chlorhexidine and 136 (38%) recommended just normal bathing, while the remaining 164 (46%) did not recommend body cleanse at all. This study demonstrates that about half of the orthopedic surgeons in Turkey did not follow the recommendations about preoperative skin cleansing.

About 8-22% of TJA patients were diagnosed with diabetes,^[15] with one-third of those patients with undiagnosed hyperglycemia.^[16] Diabetes, particularly uncontrolled diabetes, is an important risk factor for developing PJI.^[17] Both WHO and CDC underline the importance of close glycemic control, regardless of diabetes diagnosis before surgery. CDC recommends the fasting blood sugar levels in surgical patients to be below 200 mg/dL. In our study, the majority of the participating surgeons (94%) performed glycemic monitoring.

Smoking and alcohol consumption increase PJI risk following arthroplasty.^[18] A recent meta-analysis showed that PJI risk following TJA increases by double with alcohol consumption.^[19] Similarly, PJI risk after TJA increases by 3.5 times with smoking.^[19] It is recommended to stop smoking and alcohol consumption four-eight weeks before surgery.^[20,21] In our study, 209 orthopedic surgeons (59%) did not make any recommendations to stop smoking or alcohol consumption prior to surgery. However, professors and associate professors were more likely to recommend stopping smoking and alcohol consumption. It is remarkable that more than half of the orthopedic surgeons in Turkey did not make any recommendations about quitting smoking and alcohol consumption prior to arthroplasty. It is essential to emphasize the importance of recommending cessation of smoking and alcohol consumption prior to surgery in educational meetings

and congress. Preparation of informative brochures targeted to patients might also be beneficial in increasing the awareness about the subject.

Total joint arthroplasty is a major surgery. Blood loss is inevitable and blood transfusion may be required in TJA. Using TXA decreases blood transfusion rates by decreasing intra- and postoperative blood loss.^[22] It also decreases the risk of revision for acute and delayed PJI after total knee replacement.^[23] In our study, we found that 119 participants (34%) did not use TXA, with operators with the lowest usage rates. Although TXA is recommended for routine use, it is not routinely used for 62% in the UK^[24] and 73.1% in Australia.^[25] Compared to other countries, TXA usage is higher among orthopedic surgeons in Turkey.

Immune system enhancing strategies to decrease PJI risk have gained popularity in recent years.^[26] Vitamin D supplementation may decrease PJI risk by boosting the immune system. Maier et al.'s^[27] study reported vitamin D levels to be lower in patients who develop PJI following arthroplasty compared to others ($p < 0.001$). Zajonz et al.'s^[28] prospective study reported that vitamin D levels were lower in patients who develop acute PJI following TKA and THA, compared to patients who develop chronic PJI ($p = 0.002$). On the other hand, Signori et al.^[29] reported that patients who develop PJI have higher vitamin D levels compared to aseptic loosening. In our study, we found out that the majority of the participants did not (83%) measure preoperative vitamin D levels. Further studies are required to reach a consensus on this subject.

Symptomatic urinary tract infections are risk factors for PJI and must be treated before TJA.^[30] However, asymptomatic bacteriuria (ASB) is frequently seen in TJA patients and should not be considered as a risk factor for PJI. Hence preoperative urine culture and antibiotic treatment are not indicated in patients with ASB.^[31] In our study, 59% of surgeons performed urinary screening routinely whereas 29% performed it on selected patients, and 12% did not perform it at all. Routine screening might cause unnecessary treatments and increase costs.

This study has several limitations. Geographical distribution of the orthopedic surgeons participated in the study was not questioned. However, proper distribution of academic positions and institutions can be used to remedy this limitation. Moreover, we did not include the method of choice used for MRSA screening and decolonization. Also, we could not include other risk factors such as history of septic arthritis, immunosuppressive treatment,

operating room traffic, length of hospital stay, obesity, malnutrition, and chronic diseases since we tried to keep the number of our survey questions limited to evaluate and discuss them properly in limited space for a paper. Future studies are required to assess all other factors in detail.

In conclusion, the present study demonstrated that the majority of orthopedic surgeons in Turkey did not follow antibiotic prophylaxis recommendations proposed by guidelines and they used antibiotics for longer periods. The participants performed blood glucose assessments and urinary screening in higher rates. The majority of the participants did not question the usage of tobacco and alcohol, which was recommended to be questioned by guidelines. Educational documents outlining standard protocols for PJI prevention and discussing those subjects in educational meetings and congresses in detail might be beneficial in raising awareness.

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