



# Prioritising of hip and knee arthroplasty procedures during the COVID-19 pandemic: the European Hip Society and the European Knee Associates Survey of Members

Martin Thaler<sup>1</sup> · Nanne Kort<sup>2</sup> · Luigi Zagra<sup>3</sup> · Michael T. Hirschmann<sup>4</sup> · Ismail Khosravi<sup>1</sup>  · Michael Liebensteiner<sup>1</sup> · Theofilos Karachalios<sup>5</sup> · Reha N. Tandogan<sup>6</sup>

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## Abstract

**Purpose** During the COVID-19 pandemic there has been a massive reduction of arthroplasty services due to reallocation of hospital resources. The unique challenge for clinicians has been to define which arthroplasty patients most urgently require surgery. The present study aimed to investigate priority arthroplasty procedures during the pandemic and in the reinstatement period from the surgeon's perspective.

**Material and methods** An online survey was conducted among members of the European Hip Society (EHS), European Knee Associates (EKA) and other invited orthopaedic arthroplasty surgeons (experts) from across the world. The survey consisted of 17 different arthroplasty procedures/indications of which participants were asked to choose and rank the most important 10.

**Results** Four hundred and thirty-nine arthroplasty surgeons from 44 countries responded. The EHS and EKA had a 43% response rate of members. In weighted average points, the majority of respondents (67.5 points) ranked 'acute fractures requiring arthroplasty (Periprosthetic fractures, THA/hemi-arthroplasty for femoral neck fractures)' as priority indication number one, followed by 'first-stage explantations for acute PJI (periprosthetic joint infection)' in second place and priority indication (45.9 points) three as 'one-stage revision for acute PJI' (39.7 points).

**Conclusions** There was agreement that femoral neck fractures, periprosthetic fractures, and acute infections should be prioritised and cannot be postponed in the setting of the COVID-19 pandemic. As arthroplasty procedures are being resumed in most countries now, there has also been a relaxation of lockdown rules in most countries, which might cause a so-called second wave of the pandemic. Therefore, the results of the current study present a proposal by experts as to which operations should be prioritised in the setting of a second wave of the pandemic.

**Keywords** SARS-CoV-2 · Survey · Prioritisation of procedures · Arthroplasty · Fracture · Infection

✉ Ismail Khosravi  
ismail.khosravi@tirol-kliniken.at

<sup>1</sup> Department for Orthopaedic Surgery and Traumatology, Medical University Innsbruck, Innsbruck, Austria

<sup>2</sup> CortoClinics, Schijndel, The Netherlands

<sup>3</sup> Hip Department, IRCCS Istituto Ortopedico Galeazzi, Milan, Italy

<sup>4</sup> Department of Orthopaedic Surgery and Traumatology, Kantonsspital Baselland, (Bruderholz, Liestal, Laufen), University of Basel, 4101 Bruderholz, Basel, Switzerland

<sup>5</sup> Orthopaedic Department, Faculty of Medicine, School of Health Sciences, University General Hospital of Larissa, University of Thessalia, Thessalia, Greece

<sup>6</sup> Ortoklinik and Cankaya Orthopaedics, Ankara, Turkey

## Introduction

The COVID-19 pandemic poses unprecedented challenges for patients, clinicians and healthcare systems. During the pandemic clinicians of every discipline have been forced to modify patient care, to minimise exposure for patients and health care workers, and to preserve and reallocate resources to COVID-19 patients [16]. There has been a drastic cut-back of arthroplasty services [3] and other orthopaedic procedures [8] due to COVID-19, with procedures being cancelled or postponed not only in Europe [14], but all over the world [2]. Surgeons have been forced to triage arthroplasty patients during the COVID-19 pandemic using their expertise because of a lack of guidelines or published data. Therefore, the risks of disease progression and compromised

outcomes for patients had to be weighed against viral exposure of patients and staff [5, 15], taking into consideration each individual's comorbidities and age to predict the risk of mortality from COVID-19. As arthroplasty procedures have now resumed to some extent worldwide, increased demand for hip and knee arthroplasty, coupled with limited hospital resources [11], will force surgeons to select which patients will receive hip and knee arthroplasties sooner than others [6, 10]. This will entail employing objective, transparent criteria in prioritising patient selection [7] to identify those patients most in need, who also have lower risk factors for disease transmission and post-operative complications. Unfortunately, these factors frequently conflict with high-risk patients who may need major surgery such as revision arthroplasty, implant removal or reimplantation due to infection. Some guidelines are available for prioritising patients undergoing elective surgery. The MeNTS Score (Medically Necessary Time-Sensitive Procedures Score) [13] is a scoring system that takes procedural factors, disease factors and patient factors into account. The final score ranges from 21 to 105, and higher scores represent poorer patient outcomes and increased risk of SARS-CoV-2 transmission. The MeNTS Score is not widely available and is not specific to arthroplasty patients. The International Consensus Meeting and the AAHKS (American Association of Hip and Knee Surgeons (AAHKS) Research Committee recommend priority surgery for impending fracture and exposed implants, hip dislocation, knee dislocation, periprosthetic fracture, and acute pain exacerbation [12]. However, no exact ranking of such procedures was provided. The spread of the COVID-19 infection is still increasing, and many healthcare systems fear a second wave.

The objective of this survey was to prioritise patient scenarios by the urgency of treatment and to make treatment recommendations based on these priorities. These recommendations can be used by those countries which are still in a reinstatement period following an acute outbreak of COVID-19, for countries facing a COVID-19s-wave, and in the case of a further, future pandemic.

## Material and methods

The study design was a prospective online survey sent to orthopaedic surgeons (expert opinion). All participants were members of the European Hip Society (EHS), of the European Knee Associates (EKA) or affiliated surgeons by invitation. Approval of an institutional review board was deemed unnecessary because no patient data were involved.

The survey was created with LimeSurvey (<http://www.limesurvey.org/Hamburg/Germany>), an online data collection program. The survey included 17 indications for arthroplasty surgeries. The indications were selected based on the

findings of Thaler et al. and Liebensteiner et al. [8, 14]. Tables 1 and 2 show the indications, which were selected by the participants. Participants were asked to rank their top ten priority indications for adult hip and knee arthroplasty.

A link to the survey was then sent out on the 23rd of May 2020, and the survey was finally closed on 6th of June. Participants had to choose ten indications out of 17, and the ranks 1 to 10 were given to the 10 selected indications. Those indications which were not ranked by the individual were finally summarised as “not applicable”.

In the ranking calculation we set the given points in descending order, rank one equalled 10 points, and rank 10 equalled 1 point. For the evaluation of the statistics, the weighted average and the weighted standard deviation of the relative points were calculated. The corresponding points included the summarised “not applicable” data. Weighted average takes into account the varying degrees of importance of the indication. Therefore, each rank in our data set was multiplied by the rank number and divided by its sum to make the final calculation. The weighted standard deviation showed the relative significance to each value in our number of responses. To summarise the overall ranks we also calculated the absolute percentages by excluding the value for “not applicable”. Some indications might be ranked twice in absolute percentages because the surgeons ranked them differently.

## Results

439 arthroplasty surgeons participated in the online survey. The geographical spread of this survey included surgeons from 44 different countries on six continents (Fig. 1). The EHS and EKA had a 43% response rate of members, respectively. The mean ‘time in practice’ for all participants was 20 years (min 1 year–max 46 years). The calculated weighted average shows the averaged ranks from 1 to 10 (Table 2).

In absolute percentages ‘acute fractures requiring arthroplasty (Periprosthetic fractures, THA/Hemi-arthroplasty for femoral neck fractures)’ ranked as number 1 (83.3%). The other indications were listed differently by individuals and therefore appeared on different ranks in absolute percentages (Table 2).

## Discussion

The most important finding of our survey is that the majority of survey respondents prioritised fractures (periprosthetic fractures, THA/Hemi-arthroplasty for femoral neck fractures) and surgery for acute PJI (periprosthetic joint infection), like first-stage explantations and one-stage revisions.

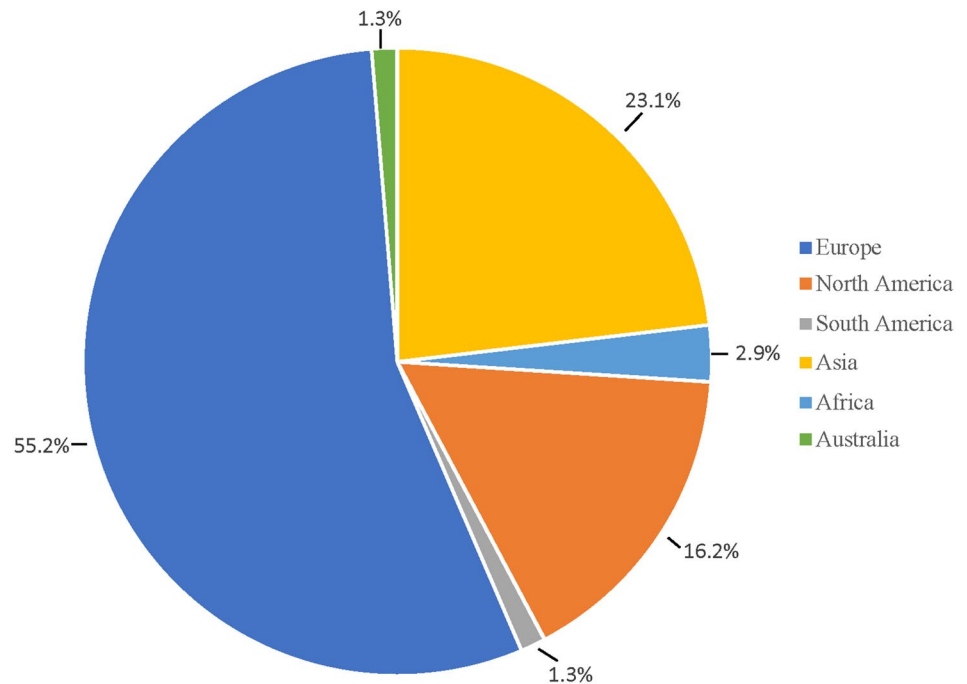
**Table 1** List of procedures in relative percentages with weighted average and weighted standard deviation

Procedures	Weighted average	Weighted standard deviation
Acute fractures requiring arthroplasty (Periprosthetic fractures, THA/Hemi-arthroplasty for femoral neck fractures)	67.5	115.6
First-stage explantations for acute PJI (periprosthetic joint infection)	45.9	40.1
One-stage revision for acute PJI	39.7	35.0
Revision surgery required for massively failed arthroplasty: imminent fracture, massive osteolysis at risk of implant migration, implant breakage, impending fractures because of osteolysis or instability, severe adverse reaction to metal debris (ALTR or ARMD)	36.7	23.2
First-stage explantations for chronic PJI (periprosthetic joint infection)	20.6	13.9
Osteonecrosis with joint collapse, Avascular head necrosis (AVN)	18.4	9.5
Total joint arthroplasty reconstruction after bone sarcoma resection	18.2	8.1
Patient with severe arthritic condition and/or pain forced to stop working (Rapid progressive Osteoarthritis)	15.3	9.5
Patient with severe functional impairment compromising autonomy and ability to walk	14.3	13.1
One-stage revision for chronic PJI	13.0	10.3
Patient with inability to walk and requiring important technical aid (wheelchair, home care, human assistance)	12.8	9.9
Amputation in cases of failed arthroplasty	12.1	5.4
Surgeries required because prolonged delay could prevent the appropriate surgery to be performed adequately	11.6	10.5
Second stage for treatment of an infected joint replacement	10.7	9.5
Patient with chronic severe arthritic pain requiring opioid use	9.0	8.5
Patient with severe articular deformity and/or instability	8.9	6.3
Conversion from osteosynthesis to total joint arthroplasty	6.0	5.5
Not applicable	78.4	37.4

**Table 2** List of ranked procedures in absolute percentages (explanation for repeats in the text)

Rank	Surgery	%
1	Acute fractures requiring arthroplasty (periprosthetic fractures, THA/Hemi-arthroplasty for femoral neck fractures) (A1)	83.3
2	First-stage explantations for acute PJI (periprosthetic joint infection)	33.4
3	One-stage revision for acute PJI	21.0
4	Revision surgery required for massively failed arthroplasty: imminent fracture, massive osteolysis at risk of implant migration, implant breakage, pending fractures because of osteolysis or instability, severe adverse reaction to metal debris (ALTR or ARMD) (A5)	18.1
5	Revision surgery required for massively failed arthroplasty: imminent fracture, massive osteolysis at risk of implant migration, implant breakage, pending fractures because of osteolysis or instability, severe adverse reaction to metal debris (ALTR or ARMD) (A5)	11.6
5	One-stage revision for chronic PJI	8.3
7	First-stage explantations for chronic PJI (periprosthetic joint infection) (A8)	10.2
7	Patient with severe functional impairment compromising autonomy and ability to walk	10.2
9	Patient with severe functional impairment compromising autonomy and ability to walk	11.0
9	Second stage for treatment of an infected joint replacement	9.1
11	Patient with severe functional impairment compromising autonomy and ability to walk (A15)	11.1
11	Patient with inability to walk and requiring important technical aid (wheelchair, home care, human assistance) (A16)	11.1
13	Patient with severe functional impairment compromising autonomy and ability to walk (A15)	12.4
13	Patient with inability to walk and requiring important technical aid (wheelchair, home care, human assistance) (A16)	12.0
13	Patient with chronic severe arthritic pain requiring opioid use	12.0
16	Patient with chronic severe arthritic pain requiring opioid use	17.0
16	Patient with severe functional impairment compromising autonomy and ability to walk	12.1
16	Patient with inability to walk and requiring important technical aid (wheelchair, home care, human assistance) (A16)	10.3
16	Second stage for treatment of an infected joint replacement	8.9
16	Surgeries required because prolonged delay could prevent the appropriate surgery to be performed adequately (A14)	8.5

**Fig. 1** Participants from 6 different continents



Most of these cases were never completely halted even during the peak of the outbreak due to the recognised emergency features of such cases [14, 16]. The historic cutback of arthroplasty service worldwide has forced surgeons to triage arthroplasty patients according to their indications, in particular in the early reinstatement period. Protection of patients, surgical staff, limited availability of beds in intensive care units and hospital wards, and COVID-19 restrictions by the authorities, have created the need for an evidence-based prioritization of the patient undergoing arthroplasty. Many patients requiring arthroplasty are older and may have associated comorbidities, and therefore a higher risk of morbidity and mortality following COVID-19 transmission [4, 17]. On the other hand, these ‘more fragile’ patients may require revision for implant failure for any reason or suffer from rapidly disruptive osteoarthritis. Pain and walking capability can quickly be compromised, with various consequences on general health status in such cases when autonomy is lost. Pain control may require opioids with the risk of developing subsequent dependency. All these factors, as well as ethical implications [7], have to be considered in the decision-making process of patient prioritisation. The American College of Surgeons has published a guideline for elective surgical procedures and recommended as priority indications for hip and knee arthroplasty surgery the following; hip dislocation, knee dislocation, periprosthetic fracture, acute pain exacerbation in prior joint arthroplasty, inability to bear weight on the extremity, wound drainage, fever and concern about periprosthetic infection [1]. However, this guideline is very general and

hence challenging to apply in daily clinical routine, when surgeons have to decide whether to treat a patient suffering from a periprosthetic fracture or a patient with fever and a TJA [9]. Our results provide a more detailed prioritisation list with different indications. Our prioritisation ranking can easily be applied to most arthroplasty cases in daily clinical routine. They can also form the basis for discussion with patients and relatives for shared decision-making and well informed consent for the procedure.

The present study has several limitations. First, the findings from the participants ( $n=439$  arthroplasty surgeons) cannot be fully extrapolated to all surgeons and all health care systems. Nevertheless, surgeons from 44 countries and six continents participated, and to the best of our knowledge, this is the most extensive survey on this topic as well as the most recent one initiated by two important scientific societies. Other limitations are related to the fact that it was an Internet-based survey with a response rate of 21%. However, those who responded had an average of 20 years experience in arthroplasty practice. Therefore the survey can be considered to state an expert recommendation that covers multiple healthcare systems on patient prioritisation in a pandemic. In addition, we were not able to discriminate among prioritisation surgery in COVID-19 negative, positive or post-positive cases. Nevertheless, it can be a useful tool for surgeons when a decision about prioritisation must be taken for patients with no signs of COVID-19 and negative tests.

The results of this survey could be used to organise a process of structured decision-making for the care of patients undergoing arthroplasty surgery during reinstatement or a

possible second wave of the COVID-19 pandemic or another pandemic. However, as the current pandemic is still rapidly evolving, we are increasingly learning about the disease and its impact on the arthroplasty service; thus, our prioritisation recommendations may change over time and place.

## Conclusions

There is an agreement that femoral neck fractures, periprosthetic fractures and acute infections should be prioritised in the setting of the COVID-19 pandemic and cannot be postponed. As arthroplasty surgery is now being resumed, there has also been a relaxation of the lockdown rules in most countries, which may lead to a second wave of the pandemic. The results of the current study represent a proposal by experts as to which arthroplasty procedures should be prioritised in all phases of a pandemic.

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## Compliance with ethical standards

**Conflict of interest** The authors declare that no conflicts of interests.

**Ethical approval** The subject was not submitted for ethical committee approval due to the fact that neither clinical data nor patients were involved.

## References

- American College of Surgeons (2020) COVID 19: elective case triage guidelines for surgical care. <https://www.facs.org/covid-19/clinical-guidance/elective-case/orthopaedics> Accessed on 25 May 2020
- Athey AG, Cao L, Okazaki K, Zagra L, Castelli CC, Kendoff DO et al (2020) Survey of AAHKS International Members on the Impact of COVID-19 on Hip and Knee Arthroplasty Practices. *J Arthroplasty* 35:S89–S94
- D’Apolito R, Faraldi M, Ottaiano I, Zagra L (2020) Disruption of Arthroplasty Practice in an Orthopedic Center in Northern Italy during the coronavirus disease 2019 pandemic. *J Arthroplasty* 35:S6–S9
- Donell ST, Thaler M, Budhiparama NC, Buttaro MA, Chen AF, Diaz-Ledezma C et al (2020) Preparation for the next COVID-19 wave: The European Hip Society and European Knee Associates recommendations. *Knee Surg Sport TraumatolArthrosc* 28:2747–2755
- Hirschmann MT, Hart A, Henckel J, Sadoghi P, Seil R, Mouton C (2020) COVID-19 coronavirus: recommended personal protective equipment for the orthopaedic and trauma surgeon. *Knee Surg Sport TraumatolArthrosc* 28:1690–1698
- Kort NP, Gomez-Barrena E, Bedard M, Donell S, Epinette JA, Gomberg B et al (2020) Resuming elective hip and knee arthroplasty in the setting of the SARS-CoV-2 pandemic: the European Hip Society and European Knee Associates recommendations. *Knee Surg Sport TraumatolArthrosc* 28:2723–2729
- Kort NP, Zagra L, Barrena EG, Tandogan RN, Thaler M, Berstock JR et al (2020) Resuming hip and knee arthroplasty after COVID-19: ethical implications for wellbeing, safety and the economy. *Hip Int J ClinExp Res Hip PatholTher* 5:492–499
- Liebensteiner MC, Khosravi I, Hirschmann MT, Heuberger PR, Thaler M (2020) Massive cutback in orthopaedic healthcare services due to the COVID-19 pandemic. *Knee Surg Sports TraumatolArthrosc* 28:1705–1711
- Malik AT, Alexander JH, Li DD, Li M, Khan SN, Scharschmidt TJ (2020) What are the costs of hip osteoarthritis in the year prior to a total hip arthroplasty? *J Arthroplasty U S* 35:313–317.e1
- Mouton C, Hirschmann MT, Ollivier M, Seil R, Menetrey J (2020) COVID-19—ESSKA guidelines and recommendations for resuming elective surgery. *J ExpOrthop* 7:28
- Oussedik S, Zagra L, Shin GY, D’Apolito R, Haddad FS (2020) Reinstating elective orthopaedic surgery in the age of COVID-19. *Bone Jt J Engl* 102-B:807–810
- Parvizi J, Gehrke T, Krueger CA, Chisari E, Citak M, Van Onsem S et al (2020) Resuming elective orthopaedic surgery during the COVID-19 pandemic: guidelines developed by the International Consensus Group (ICM). *J Bone JtSurg Am U S* 102:1205–1212
- Prachand VN, Milner R, Angelos P, Posner MC, Fung JJ, Agrawal N et al (2020) Medically necessary, time-sensitive procedures: scoring system to ethically and efficiently manage resource scarcity and provider risk during the COVID-19 pandemic. *J Am CollSurg* 231:281–288
- Thaler M, Khosravi I, Hirschmann MT, Kort NP, Zagra L, Epinette JA et al (2020) Disruption of joint arthroplasty services in Europe during the COVID-19 pandemic: an online survey within the European Hip Society (EHS) and the European Knee Associates (EKA). *Knee Surg Sports TraumatolArthrosc* 28:1712–1719
- Wang Y, Zeng L, Yao S, Zhu F, Liu C, Di Laura A et al (2020) Recommendations of protective measures for orthopedic surgeons during COVID-19 pandemic. *Knee Surg Sport TraumatolArthrosc* 28:2027–2035
- Zagra L, Faraldi M, Pregliasco F, Vinci A, Lombardi G, Ottaiano I et al (2020) Changes of clinical activities in an orthopaedic institute in North Italy during the spread of COVID-19 pandemic: a seven-week observational analysis. *IntOrthop* 44:1591–1598
- Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z et al (2020) Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet* 395:1054–1062

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