PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Does robotic-assisted unicompartmental knee arthroplasty have lower complication and revision rates than the conventional procedure? A systematic review and meta-analysis
AUTHORS	Sun, Yifeng; Liu, Wei; Hou, Jian; Hu, Xiuhua; Zhang, Wenqiang

VERSION 1 – REVIEW

REVIEWER	Bagaria, Vaibhav Sir HN Reliance Foundation Hospital and Research Centre
REVIEW RETURNED	18-Nov-2020

GENERAL COMMENTS	The authors have conducted a met analysis to evaluate the complication rates and revisions with Unicompartmental Knee replacement. Robotic Assisted Knee Arthroplasty (RAKA) is gradually replacing the conventional Knee replacements. There are conflicting reports about its usefulness for Unicompartmental and Total Knee replacements. To clear the confusion and resolve the conflicting evidence such meta analysis are the need of the hour. The authors have done a good job of collating all relevant studies to come up with some robust conclusion. My specific comments regarding the manuscript are: 1. English and grammar needs to be copy edited thorouhhly. 2. Many confounding variables have not been studied or mentioned as limitation: In particular: type of Implant used/ the increase in surgical time and if the trial was industry sponsored? 3. Another important aspect is the duration of follow up: I believe that would not have been homogenous. The long term revision rates are dependant on the year of follow up. IT has to be explicit mentioned. IN order to reach meaningful conclusion - all the studies that have included should have minimum 5 year followup, preferably 10. Alternatively two groups can be created - Short term/ Long term 4. Discussion needs to be more focussed and better structured so that the readers can understand the perspective from which this study was conducted.

REVIEWER	Vermue, Hannes University Hospital Ghent, Orthopedic Surgery
REVIEW RETURNED	22-Feb-2021

GENERAL COMMENTS	Thank you very much for letting me review your manuscript. I appreciate the effort you have made performing this paper and submitting it to BMJ open.
	In this study, the authors assessed the current literature on revision and complication rates of robot-assisted unicompartmental knee arthroplasty compared to the conventional technique.
	This study was correctly conducted.
	Title:
	The title fits the proposed research. However, I would add 'compared to conventional unicompartmental knee arthroplasty' to make it totally clear.
	Abstract:
	Line 2: UKA should be written in full.
	Introduction:
	Try to explain in more detail what the current study adds to the literature. You stated several other, recent meta-analyses performed with a similar study design. For example, try to mention why the studies by Fu et al., and Zhang et al. are not appropriate enough.
	Methods:
	This part is written adequately. Most appropriate information is present.
	Unfortunately, no registration prior to conducting the systematic review and meta-analysis was performed.
	Please state which specific complications & which non-device specific complications you are aiming to include.
	Results:
	Good clear and short presentation of the results.
	Table 1: RCT and PCT should be declared.
	Please remove the capital letter at 'Knee ankylosis',
	Please rephrase 'and so on', this is no scientific wording.
	Page 10 - line 5: I do not comprehend your arguments to include this study in the meta-analysis. This does shift your results in the direction of this study, which is of course understandable with it's sample size. Please provide further reasoning. What happens with the results when this study is left out?
	Discussion:
	Page 11 - line 1: please provide reference
	Page 11 - line 8: 'better superiority' is a tautology.
	Page 11 - line 11: please provide reference.
	Try to refrain from using 'we' and 'and so on' throughout the article.
	What are your thoughts on the different follow-up times in the included studies? Do you think this influenced your results?

Was the following article found in the literature search & why was it excluded in the literature search?
"St Mart, J. P., de Steiger, R. N., Cuthbert, A., & Donnelly, W. (2020). The three-year survivorship of robotically assisted versus non-robotically assisted unicompartmental knee arthroplasty: a study from the Australian Orthopaedic Association National Joint Replacement Registry. The bone & joint journal, 102(3), 319-328."
It is a similar registry-based study, like Zakharia et al performed, and might influence your thoughts on possible complications in robot-assisted UKA, such as a possible increased infection rate.

Conclusion:
I think the conclusion of this article might be biased with the inclusion of study 14 in table 1 (Rushabh et al). Please find my comment in the results section.

References:
Please review referencing in the article. For example, the mentioned authors Rushabh et al used in the article is in fact Vakharia et al.
[numbers] and superscript numbers are both used, please correct them according to the journal guidelines.

Language:
Some minor contextual and spelling errors are still present. Please let a native English speaker review your manuscript for further finetuning.

REVIEWER	Held, Michael
	Columbia University Medical Center
REVIEW RETURNED	07-Mar-2021

GENERAL COMMENTS	Overall nice study. I would suggest to the editor an acceptance pending revisions.
	(1) need to discuss limitations better
	(2) need to somehow incorporate device related complications such as pin site fracture and infection. Stating that RA-UKA has fewer complications and revisions without including these is misleading. This either has to be included if possible or clearly stated in methods and limitations.
	(3) Need to state the types of RA-UKA that were used in each study and discuss the evolution of this and its possible impact on outcomes.
	Abstract:
	-State number of papers analyzed for this review
	-add limitation that different robotic systems used, not just 1 manufacturer
	Introduction:
	-Nice and brief and to the point. Need to add hypothesis of their study
	Methods:

State somewhere that all study types were included such as RCT, PCT, RCT, CC.
Was there a date inclusion or exclusion criteria?

Were all robotic systems included? Imageless and those with preoperative CT?

What do you mean by non-device specific complication? Did you include pin-site complications such as infection and fracture?

Results:
In table 1 please add column stating the specific robotic system used in each study.
Why did you not include device specific complications? The biggest down side of RA-UKA is time added, increased EBL due to this and pin site complications. This needs to be included.

Discussion: Nicely written. Should discuss the potential influence of newer generations of RA-UKA given that you included studies dating back to 2006. Robots in 2006 were very different then they are today so this needs to be mentioned and brought up in your discussion.

Also need to mention pin site complications and device specific complications as a limitations. Were revisions secondary to pin site fracture included?

Figures: Very strong. No edits requested.

REVIEWER	Cochrane, Lynda Clinical Statistics Consultants
REVIEW RETURNED	08-Mar-2021

GENERAL COMMENTS	This is a useful and interesting investigation. The methods are described clearly and were easy to follow. When events, such as complications, occur over a period of time that is not fixed, it is common to use the hazard ratio as the statistic of interest. Please could the authors explain why revision rates were chosen instead? The studies involve vastly different lengths of follow-up, from one month to 60 months. The nature of any complications experienced is likely to vary from short term (e.g. post-operative infection) to long-term (e.g. component failure). These have not been mentioned or investigated. Loss to follow-up, the reasons for it and the effects on the analysis, have not been mentioned or investigated. Revision surgery has been classed as one complication, whereas there are likely to be several types. The chosen tool for quality of study assessment (NOS) has a number of drawbacks, including poor inter-rather agreement. This

is especially true when raters are relatively inexperienced. It would be helpful to have some justification of this choice, particularly wrt authors' experience.

Did the authors consider the power of the studies included?

The random effects model is suitable when heterogeneity cannot be explained i.e. it is random. The observed heterogeneity could also be due to independent factors that could affect outcomes, as mentioned by the authors. Did they explore any of these? Or consider some method of dealing with the effects of them such as stratification or meta-regression?

The conclusion, in my view, overstates the findings. 'Obviously better superiority' is a particularly strong statement, in view of the weaknesses of the study.

Table 1: Keens should read Knees, 'stiffness' should read 'stiffness'.

P4, L47: The wording of this sentence is unclear. Perhaps it would be more simple to separate the criteria for using each model (random then fixed effects).

P8, L42: Statistical heterogeneity was noted but statistics imply it was not. Presumably this is a typographic error.

P11, L12: While there is no universally accepted tool for measuring post-operative function, many have been shown to be reliable, responsive and reproducible.

I would have found it useful to see the definition of non-device specific complications earlier in the manuscript, such as in Methods.

The spelling and grammar within the manuscript could be enhanced in places by careful editing.

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1
1. English and grammar needs to be copy edited thorouhhly
Re: We have reedited the english and grammar
2. Many confounding variables have not been studied or mentioned as limitation: In particular: type of Implant used/ the increase in surgical time and if the trial was industry sponsored?
Re: The surgical time in 7 studies was assessed. The chi-square and I-square test results showed statistical heterogeneity among the included studies (p<0.01; I2= 69.5%), and Galbraith plots showed that no studies were found to cause heterogeneity. The plotted points laid close to a sloped straight line on the quantile-quantile (Q-Q) plot (Fig. S7A, B), which showed that there was no significant deviation from the confidence interval in our studies. Therefore, a random-effects model was used for the analysis. We found that robotic arm-assisted UKA was found to significantly prolong the time of surgery compared to

conventional UKA (RR: 2.33, 95% CI: 1.68-3.23, p<0.01; Fig. S7C). We added these outcomes to the supplementary material and discuss it in our manuscript. (Page 12 - line 56 to Page 13 - line 6)

As to whether the trial was industry sponsored, we checked all articles included in the meta-analysis as to whether they contained a statement on the funding or interest of the work presented. When such a statement was given we categorized the information in the statement of industry-funded or had authors with financial conflict of interest. We found that the included articles were more likely to be industry funded or be written by authors with financial conflicts of interest (Fig. S8). Therefore, more attention should be paid to this issue and more large-scale studies with non-commercial supports for evaluating the efficacy of both treatments in this patient population are needed in the future. (Page 13 - line 6 to 20)

3. Another important aspect is the duration of follow up: I believe that would not have been homogenous. The long term revision rates are dependant on the year of follow up. It has to be explicit mentioned. In order to reach meaningful conclusion - all the studies that have included should have minimum 5 year followup, preferably 10. Alternatively two groups can be created - Short term/ Long term

Re: As you suggested that the long term revision rates are depended on the year of follow up. In our study, the follow-up time of revision rates were range from 3 months to 60 months (5-year), so it's difficult to creat the two group into short term and long term. This is a limitation of our study. (Page 13 - line 23 to 29)

4. Discussion needs to be more focussed and better structured so that the readers can understand the perspective from which this study was conducted.

Re: It has been modified as required

Reviewer: 2

1. The title fits the proposed research. However, I would add 'compared to conventional unicompartmental knee arthroplasty' to make it totally clear.

Re: According your and the Editor's comments, we change the title to "Does robotic- assisted unicompartmental knee arthroplasty have lower complication and revision rates than the conventional procedure? A Systematic Review and Meta-Analysis"

2. Line 2: UKA should be written in full.

Re: It has been corrected in the article

3. Try to explain in more detail what the current study adds to the literature. You stated several other, recent meta-analyses performed with a similar study design. For example, try to mention why the studies by Fu et al., and Zhang et al. are not appropriate enough.

Re: According your comments, we change it to "The previous meta-analyses compared the effects and safety of the robotic-assisted and conventional UKA. In a meta-analysis by Fu et al. it was reported that the robotic-assisted system in UKA showed no decrease in the rate of adverse events compared to the conventional UKA. However, few articles (only 7 studies) were included in the meta-analysis, and the difference in the revision rates between the two techniques was not compared6. Another meta-analysis by Zhang et al. contradicted the conclusion about the adverse events by Fu et al. and reported that robotic-assisted UKA could significantly reduce the rate of complications; however, the results were also subject to the sample size and follow-up duration, which might influence the assessment of the difference in outcomes between robotic-assisted and conventional UKA." (Page 4 - line 52 to (Page 5 - line 12)

4. Unfortunately, no registration prior to conducting the systematic review and meta-analysis was performed.

Re: We apply for registration on PROSPERO website on 06/04/2021. But it may take a long time.

5. Please state which specific complications & which non-device specific complications you are aiming to include.

Re: After rigorous contemplation and discussion, the "non-device specific complications" should be corrected to "non-implant specific complications"

Complications that lead to failure can occur following UKA including bearing dislocation, aseptic loosening, polyethylene wear, periprosthetic fracture, progression of the arthritis to the contralateral compartment, infection, bone-implant impingement, retaining of cement debris in the joint, knee ankylosis, wound complications, deep haematoma, infection, thrombosis, persistent pain pin-site infection and fracture, and other adverse events. (Page 10 - line 5 to 13)

Non-implant specific complications were recorded in a total of 10 studies, which mainly included infection, knee ankylosis, wound complications, deep haematoma, infection, thrombosis, persistent pain, pin-site infection and fracture in our meta-analysis. (Page 10 - line 50 to 54)

6. Table 1: RCT and PCT should be declared.

Re: RCT : Randomized Controlled Trial; PCT;Prospective cohort trial

7. Please remove the capital letter at 'Knee ankylosis',Please rephrase 'and so on', this is no scientific wording.

Re: It has been corrected in the article

8. Page 10 - line 5: I do not comprehend your arguments to include this study in the meta-analysis. This does shift your results in the direction of this study, which is of course understandable with it's sample size. Please provide further reasoning. What happens with the results when this study is left out?

Re:when this Study 14 (Vakharia,2019) is left out, The chi-square and I-square test results showed statistical heterogeneity among the included studies (p=0.12; I2= 19.1%), Therefore, a fixed-effects model was used for the analysis. We found that robotic-assisted UKA had less complications than conventional UKA (RR: 0.66, 95% CI: 0.46-0.94, P=0.02). This study does not shift the direction in our study,

9. Discussion:

Page 11 - line 1: please provide reference

Re: We've added the reference

Page 11 - line 8: 'better superiority' is a tautology.

Re: we change it to "This study showed that robotic-assisted UKA had fewer complications and lower revision rates than the conventional procedure."

Page 11 - line 11: please provide reference.

Re: We've added the reference

Try to refrain from using 'we' and 'and so on' throughout the article.

Re: ok, we try to refrain from using 'we' and 'and so on' throughout the article.

10. What are your thoughts on the different follow-up times in the included studies? Do you think this influenced your results?

Re: As you suggested that the long-term revision rates depend on the year of follow up; however, all the included studies had short-term follow up (3 months to 60 months). Hence, the results of revision rates are questionable. Hence, future studies with a longer follow-up duration, preferably 10 years, are necessary to assess the complications and revision rates. This is a limitation of our study. We need to discuss it in the limitations. (Page 13 - line 23 to 29)

11. Was the following article found in the literature search & why was it excluded in the literature search? "St Mart, J. P., de Steiger, R. N., Cuthbert, A., & Donnelly, W. (2020). The three-year survivorship of robotically assisted versus non-robotically assisted unicompartmental knee arthroplasty: a study from the Australian Orthopaedic Association National Joint Replacement Registry. The bone & joint journal, 102(3), 319-328."

It is a similar registry-based study, like Zakharia et al performed, and might influence your thoughts on possible complications in robot-assisted UKA, such as a possible increased infection rate.

Re: We've added the study to our meta-analysis.

12. Conclusion:

I think the conclusion of this article might be biased with the inclusion of study 14 in table 1 (Rushabh et al). Please find my comment in the results section.

Re: when this Study 14 (Rushabh,2019) is left out, The chi-square and I-square test results showed statistical heterogeneity among the included studies (p=0.12; I2= 19.1%), Therefore, a fixed-effects model was used for the analysis. We found that robotic-assisted UKA had less complications than conventional UKA (RR: 0.66, 95% CI: 0.46-0.94, P=0.02). This study does not shift the direction in our study,

12. References:

Please review referencing in the article. For example, the mentioned authors Rushabh et al used in the article is in fact Vakharia et al.

[numbers] and superscript numbers are both used, please correct them according to the journal guidelines.

Re: It has been modified as required

13. Language

Some minor contextual and spelling errors are still present. Please let a native English speaker review your manuscript for further finetuning.

Re: We have reedited the english and grammar

Reviewer: 3

1. need to discuss limitations better

There are several limitations to this meta-analysis. First, long-term revision rates depend on the year of follow up; however, all the included studies had short-term follow up (3 months to 60 months). Hence, the results of revision rates are questionable. Hence, future studies with a longer follow-up duration, preferably 10 years, are necessary to assess the complications and revision rates. Second, some studies were not RCTs and had small sample sizes, which increases the possibility of publication bias. Therefore, our results should be further confirmed by large-scale RCT studies. Thirdly, the types of RA-UKA performed in each study were different, as shown in Table 1. The different types used were Acrobot system, RIO™ System or Mako-assisted Restoris System, and Navio system. Rapid advances in robotic-assisted technology have led to the development of UKA over the past 10 years. Implant position, soft tissue balance, and radiographic components alignment appear to be gradually improved with the development of robotic-assisted systems. Considering the evolution of this technology and its possible impact on the outcomes, well-designed studies are necessary to advance our understanding of the impact of different robotic systems. Fourth, all the included studies were limited to the English literature; therefore, some related studies published in other languages that might have met the inclusion criteria could have been missed. Fifth, most of the studies in our meta-analysis have not reported the pin site complications and device-specific complications. Revisions secondary to pin site fracture were included in some studies; however, the sample size is small. Therefore, we did not conduct a systematic research on these specific complications and revisions. Although we attempted to identify and retrieve all additional unpublished information, some missing data were inevitable. In addition, our results were unadjusted for other factors that might influence complication outcomes such as patient age and weight, the anterior cruciate ligament, soft tissue balance, composition and thickness of the polyethylene component and others. Finally, given that there is no established functional scoring system to measure the postoperative function and due to the limited number of exact P-values, we did not evaluate the functional outcome in our meta-analysis (Table 1). However, many studies have reported shown that RA-UKA had a reliable, responsive, and reproducible postoperative function. Therefore, it is necessary to establish a universal system for assessing the postoperative function in patients with UKA. (Page 13 - line 23 to Page 14 - line 18)

2. need to somehow incorporate device related complications such as pin site fracture and infection. Stating that RA-UKA has fewer complications and revisions without including these is misleading. This either has to be included if possible or clearly stated in methods and limitations.

Re: The most of the studies in our meta-analysis has not proclaimed the pin site complications. Pin site fracture and infection were included in the "Complications" and "Non- implant specific complications".

3. Need to state the types of RA-UKA that were used in each study and discuss the evolution of this and its possible impact on outcomes

Re: The types of RA-UKA performed in each study were different, as shown in Table 1. The different types used were Acrobot system, RIO™ System or Mako-assisted Restoris System, and Navio system. Rapid advances in robotic-assisted technology have led to the development of UKA over the past 10 years. Implant position, soft tissue balance, and radiographic components alignment appear to be gradually improved with the development of robotic-assisted systems. Considering the evolution of this technology and its possible impact on the outcomes, well-designed studies are necessary to advance our understanding of the impact of different robotic systems. (Page 13 - line 35 to 47)

4. Abstract:

-State number of papers analyzed for this review

Re: In all, 16 studies involving 50024 patients were included in the final meta-analysis.

-add limitation that different robotic systems used, not just 1 manufacturer

Re: The types of RA-UKA performed in each study were different, as shown in Table 1. The different types used were Acrobot system, RIO™ System or Mako-assisted Restoris System, and Navio system. (Page 13 - line 35 to 47)

5. Introduction:

-Nice and brief and to the point. Need to add hypothesis of their study

Re: we add the hypothesis "Our hypothesis was that there would be no obvious differences in the complications and revision rates between the two groups.". (Page 5 - line 17 to 19)

6. Methods:

-State somewhere that all study types were included such as RCT, PCT, RCT, CC.

Was there a date inclusion or exclusion criteria?

Re: Studies that met the following criteria were eligible for inclusion in this study: (1) original studies about unicompartmental knee arthroplasty; (2) comparison of robotic-assisted and conventional UKA; and (3) providing controls and effective data (included RCT, PCT, CC, Retrospective comparative study); (4) publication in English. Exclusion criteria were as follows: (1) literatures published as a talk, review, digest, letter, commentary, digest or case report; (2) model-based or cadaver studies; (3) duplicate or overlapping data; and (4) not case-control studies. (Page 5 - line 41 to 51)

-Were all robotic systems included? Imageless and those with preoperative CT?

Re: Not all the robotic systems included. The robotic systems in the trials that met the inclusion and exclusion criteria were included in our meta-analysis. The types of robotic systems that were used in each study were showed in the table 1. We can see the often used types were Acrobot system, RIO™ System or Mako-assisted Restoris System, Navio system.

The Acrobot system, RIO™ System or Mako-assisted Restoris System The Mako system is a semi-active tactile robotic system that requires preoperative imaging,after which a preoperative planning is performed.This Navio system is an image-free semi-active robotic system and has the same characteristics as the aforementioned Mako system

What do you mean by non-device specific complication? Did you include pin-site complications such as infection and fracture?

Re: After rigorous contemplation and discussion, "non-device specific complication" should be be corrected to "non-implant specific complication", Pin site fracture and infection were included in the "Complications" and "Non- implant specific complications".

Complications that lead to failure can occur following UKA including component loosening, progression of disease, polyethylene wear, bearing dislocation, fracture, infection, persistent pain, bone-implant impingement, instability, malalignment, prosthesis dislocation, incorrect sizing, patellofemoral pain, bone Lysis, metal related pathology, osteonecrosis synovitis, retaining of cement debris in the joint, knee

ankylosis, knee ankylosis, wound complications, deep haematoma, infection, thrombosis, persistent pain pin-site infection and fracture, and other adverse events. (Page 10 - line 5 to 13)

Non-implant specific complications were recorded in a total of 10 studies, which mainly included infection, knee ankylosis, wound complications, deep haematoma, infection, thrombosis, persistent pain, pin-site infection and fracture in our meta-analysis. (Page 10 - line 50 to 54)

7. Results:

-In table 1 please add column stating the specific robotic system used in each study.

Re: The types of RA-UKA that were used in each study were showed in the table 1.

Why did you not include device specific complications? The biggest down side of RA-UKA is time added, increased EBL due to this and pin site complications. This needs to be included.

Re: The most of the studies in our meta-analysis has not proclaimed device specific complications. It is hard to distinguish the device specific complications.

The operative time in 7 studies was assessed. The chi-square and I-square test results showed statistical heterogeneity among the included studies (p<0.01; I2= 69.5%), and Galbraith plots showed that no studies were found to cause heterogeneity . The plotted points laid close to a sloped straight line on the quantile-quantile (Q-Q) plot (Fig. 2B), which showed that there was no significant deviation from the confidence interval in our studies. Therefore, a random-effects model was used for the analysis. We found that robotic arm-assisted UKA was found to significantly prolong the time of surgery compared to conventional UKA (RR: 2.33, 95% CI: 1.68-3.23, p<0.01; Figure S7). (Page 12 - line 56 to Page 13 - line 6)

8. Discussion: Nicely written. Should discuss the potential influence of newer generations of RA-UKA given that you included studies dating back to 2006. Robots in 2006 were very different then they are today so this needs to be mentioned and brought up in your discussion.

Re: Rapid advances in robotic-assisted technology have led to the development of UKA over the past 10 years. Implant position, soft tissue balance, and radiographic components alignment appear to be gradually improved with the development of robotic-assisted systems. Considering the evolution of this technology and its possible impact on the outcomes, well-designed studies are necessary to advance our understanding of the impact of different robotic systems. (Page 13 - line 35 to 47)

Also need to mention pin site complications and device specific complications as a limitations. Were revisions secondary to pin site fracture included?

Re: The most of the studies in our meta-analysis has not proclaimed the pin site complications and device specific complications. Revisions secondary to pin site fracture were included in some studies, but the sample size is small. Therefore, we had not made the systematic research on these special complications and revisions

Figures: Very strong. No edits requested.

Reviewer: 4

1. When events, such as complications, occur over a period of time that is not fixed, it is common to use the hazard ratio as the statistic of interest. Please could the authors explain why revision rates were chosen instead?

Re: As you mentioned, it is common to use the hazard ratio as the statistic of interest, the reason why revision rates were chosen RR instead. (1)In our study, All the analyses were performed using the 'metafor' packages of the R 3.6.2 software. the documentation of the metafor-package showed that the statistic of interest can be used in conjunction with any of the usual effect size or outcome measures used in meta-analyses (e.g., log risk ratios, log odds ratios, risk differences, mean differences, standardized

mean differences, raw correlation coefficients, correlation coefficients transformed with Fisher's r-to-z transformation, and so on). The 'metafor' packages has no function to use the hazard ratio as the statistic of interest;

(2) The relative risk was used as the common measure of association across studies. Hazard ratios and incidence density ratios were directly considered as relative risks.(Ronksley PE, Brien SE, Turner BJ, Mukamal KJ, Ghali WA. Association of alcohol consumption with selected cardiovascular disease outcomes: a systematic review and meta-analysis. BMJ. 2011;342:d671. Published 2011 Feb 22. doi:10.1136/bmj.d671);

2. The studies involve vastly different lengths of follow-up, from one month to 60 months. The nature of any complications experienced is likely to vary from short term (e.g. post-operative infection) to long-term (e.g. component failure). These have not been mentioned or investigated

Re: The most of the studies in our meta-analysis has not proclaimed the specific short term (e.g. post-operative infection) to long-term (e.g. component failure) complications, and the sample size is small. so it's difficult to creat the complications into Short term and Long term. This is a limitation of our study. We need to discuss limitations better. (Page 13 - line 23 to 29)

2. Loss to follow-up, the reasons for it and the effects on the analysis, have not been mentioned or investigated.

Re: By reviewing each of the papers, they did not mention the reasons for loss of follow-up. However, it may have the effects on the analysis. We will discuss it in the limitation.

3. Revision surgery has been classed as one complication, whereas there are likely to be several types.

Re: The revision reason mainly include the component loosening, progression of disease, polyethylene wear, bearing dislocation, fracture, infection, persistent pain, bone-implant impingement, instability, malalignment, prosthesis dislocation, incorrect sizing, patellofemoral pain, bone lysis, metal related pathology, osteonecrosis synovitis, retaining of cement debris in the joint, knee ankylosis, wound complications, pin-site infection and fracture.

Revision surgery involved the aboved types, but the sample size of each type is very small. Therefore, we had not made the systematic research on each type of revisions

4. The chosen tool for quality of study assessment (NOS) has a number of drawbacks, including poor inter-rather agreement. This is especially true when raters are relatively inexperienced. It would be helpful to have some justification of this choice, particularly wrt authors' experience.

Re: (1) There are some non-randomised studies in our meta-analysis. Cochrane Handbook recommended two kinds of methods for assessing the quality of non-randomised studies in meta-analyses: Downs and Black instrument and Newcastle-Ottawa Scale. The latter is to develop an instrument providing an easy and convenient tool for quality assessment of nonrandomised studies to be used in a systematic review.

(2) The Newcastle-Ottawa Scale (NOS) is an ongoing collaboration between the Universities of Newcastle, Australia and Ottawa, Canada. It was developed to assess the quality of nonrandomised studies with its design, content and ease of use directed to the task of incorporating the quality assessments in the interpretation of meta-analytic results.

(3) We have a lot of experience in this area. One more experienced reviewer has been added to use the Modified Newcastle-Ottawa Quality Assessment Scale (NOS) to evaluate the quality of the selected studies.

5. Did the authors consider the power of the studies included?

Re: In the "Outlier and influence analyses" part, Figure 5 shows the the hat values and weights values were used to assess the power of the studies

6. The random effects model is suitable when heterogeneity cannot be explained i.e. it is random. The observed heterogeneity could also be due to independent factors that could affect outcomes, as mentioned by the authors. Did they explore any of these? Or consider some method of dealing with the effects of them such as stratification or meta-regression?

Re: In the "Outlier and influence analyses" part, Figure 5 shows that Study 14 (Vakharia,2019) was identified as a potential outlier, which lead to the heterogeneity. when this Study 14 (Vakharia,2019) is left out, The chi-square and I-square test results showed statistical heterogeneity among the included studies (p=0.12; I2= 19.1%). However, due to the fact that the study had as advantages the large sample size (35,061 patients, Robot =13,617; CONV =21,444), which makes it suitable to study national trends, and that the hat values and weights values showed that this study occupied the largest proportion in the meta-analysis, this study was not be removed, but the outlier was included in the meta-analysis.

7. The conclusion, in my view, overstates the findings. 'Obviously better superiority' is a particularly strong statement, in view of the weaknesses of the study.

Re: This study showed that robotic-assisted UKA had fewer complications and lower revision rates than the conventional procedure.

Table 1: Keens should read Knees, 'stiffness' should read 'stiffness'.

Re: It has been modified as required

8. P4, L47: The wording of this sentence is unclear. Perhaps it would be more simple to separate the criteria for using each model (random then fixed effects).

Re: Fixed effect models were employed when there was no significant heterogeneity (I2≤50%, P>0.10); otherwise, a random-effects model was used to obtain the pooled effects among the included studies

9. P8, L42: Statistical heterogeneity was noted but statistics imply it was not. Presumably this is a typographic error.

Re: this is a typographic error. The chi-square and I-square test results indicated no statistical heterogeneity among the included studies (p=0.49; I2= 0.00%)

10. P11, L12: While there is no universally accepted tool for measuring post-operative function, many have been shown to be reliable, responsive and reproducible.

Re: Finally, given that there is no established functional scoring system to measure the postoperative function and due to the limited number of exact P-values, we did not evaluate the functional outcome in our meta-analysis (Table 1). However, many studies have reported shown that RA-UKA had a reliable, responsive, and reproducible postoperative function. Therefore, it is necessary to establish a universal system for assessing the postoperative function in patients with UKA.

11. I would have found it useful to see the definition of non-device specific complications earlier in the manuscript, such as in Methods.

Re: After rigorous contemplation and discussion, "non-device specific complication" should be be corrected to "non-implant specific complication". The definition of non-device specific complications earlier in the in Results.

12. The spelling and grammar within the manuscript could be enhanced in places by careful editing.

Re: We have reedited the english and grammar

VERSION 2 – REVIEW

REVIEWER	Bagaria, Vaibhav Sir HN Reliance Foundation Hospital and Research Centre
REVIEW RETURNED	28-May-2021

GENERAL COMMENTS	The authors have improved the manuscript as per the suggestions provided and can be accepted for publication. My specific comment for minor modification are:

	1. There are few grammatical errors and the manuscript needs to be further copy edited for the same. 2. If not already done, a help from statistical may help present the data regarding biases and outcomes in a comprehensive manner. With inclusions of new study and newer input data, there is scope of improvement in the way the data has been presented.

REVIEWER	Cochrane, Lynda Clinical Statistics Consultants
REVIEW RETURNED	18-May-2021

GENERAL COMMENTS	I am grateful to the authors for addressing the points I raised in my initial review. The responses provided are in most, but not all, cases satisfactory. 1. Relative risk (RR) is cumulative and is a measure of the risks over the whole of the study period. Hazard ratio is a measure of risk at any point during the study. Measured over small time intervals, these are similar but not the same. The fact that others have used this statistic is not a justification for continuing to do so. The use of RR is a limitation of the study and should be mentioned as such. As a matter of interest, packages that estimate HR in meta-analyses are available. 2. P2, P55-57: It is not only revision rates that are time-dependent: complications are too. The authors have acknowledged the fact that short- and medium-term complications cannot be differentiated is a limitation but then they appear to suggest that both 3 month and 60 month follow-up is 'short-term'. 2. Loss to follow-up and the reasons for it are important in any survival study. Patients who are lost to follow-up can have very different outcomes to those who do and studies with unidentified reasons for such loss are likely to have lower validity. This should be mentioned as a limitation of the study and in the discussion. 3. Lack of detail about revision surgery should be mentioned as a limitation and in the discussion. 4. I thank the authors for their response to the NOS comments. 5. I thank the authors for their response to the power comment. 6. The authors have addressed the issue of the effects of independent factors on outcomes. 7. The conclusion is still too strong, given the number of important limitations of the study. A more appropriate statement would be 'The study provides some evidence that UKA had fewer complications and lower revision rates but, due to the significant limitations, the results cannot be relied upon. More research is required'. 8. I thank the authors for their response.

	9. I thank the authors for clarifying the typographical error.
	10. The authors appear to have misunderstood that in this context the terms 'reliable, responsive and reproducible' apply to measuring tools (e.g. Knee Society Score) not surgical procedures.
	11. I thank the authors for making this change.
	12. The English and grammar are much improved.

VERSION 2 – AUTHOR RESPONSE

Reviewer: 1
Dr. Vaibhav Bagaria, Sir HN Reliance Foundation Hospital and Research Centre
Comments to the Author:
The authors have improved the manuscript as per the suggestions provided and can be accepted for publication. My specific comment for minor modification are:

1. There are few grammatical errors and the manuscript needs to be further copy edited for the same.
Re: we further improved the grammar and copy edited for the same.

2. If not already done, a help from statistical may help present the data regarding biases and outcomes in a comprehensive manner. With inclusions of new study and newer input data, there is scope of improvement in the way the data has been presented.
Re: The data regarding biases and outcomes had been updated. If there is a need for further improvement, please feel free to point out the details.

Reviewer: 4
Competing interests of Reviewer: There are no competing interests.

Reviewer: 1
Competing interests of Reviewer: None

Reviewer: 4

Dr. Lynda Cochrane, Clinical Statistics Consultants

Comments to the Author:

I am grateful to the authors for addressing the points I raised in my initial review. The responses provided are in most, but not all, cases satisfactory.

1. Relative risk (RR) is cumulative and is a measure of the risks over the whole of the study period. Hazard ratio is a measure of risk at any point during the study. Measured over small time intervals, these are similar but not the same. The fact that others have used this statistic is not a justification for

continuing to do so. The use of RR is a limitation of the study and should be mentioned as such. As a matter of interest, packages that estimate HR in meta-analyses are available.

Re: We went over the instructions carefully again, the 'metafor' and 'meta' packages of the R 3.6.2 software have no function to use the hazard ratio as the statistic of interest . This is a limitation of our study. We discuss it as follows.

when events such as complications and revisions occur over a non-fixed period, it is common to use hazard ratios as the statistic of interest. As the 'metafor' package has no function for using hazard ratios as the statistic of interest, we used RRs as the statistic of interest across all studies.

2. P2, P55-57: It is not only revision rates that are time-dependent: complications are too. The authors have acknowledged the fact that short- and medium-term complications cannot be differentiated is a limitation but then they appear to suggest that both 3 month and 60 month follow-up is 'short-term'.

Re: we added the complications to the sentence.

We suggest that both 3 month and 60 month follow-up is 'short-term is due to the comments of one of the reviewers:" The long term revision rates are dependant on the year of follow up. It has to be explicit mentioned. In order to reach meaningful conclusion - all the studies that have included should have minimum 5 year follow up, preferably 10."

"

2. Loss to follow-up and the reasons for it are important in any survival study. Patients who are lost to follow-up can have very different outcomes to those who do and studies with unidentified reasons for such loss are likely to have lower validity. This should be mentioned as a limitation of the study and in the discussion.

Re: we mentioned it as a limitation of the study and in the discussion.

3. Lack of detail about revision surgery should be mentioned as a limitation and in the discussion.

Re: we mentioned it as a limitation of the study and in the discussion.

4. I thank the authors for their response to the NOS comments.

5. I thank the authors for their response to the power comment.

6. The authors have addressed the issue of the effects of independent factors on outcomes.

7. The conclusion is still too strong, given the number of important limitations of the study. A more appropriate statement would be 'The study provides some evidence that UKA had fewer complications and lower revision rates but, due to the significant limitations, the results cannot be relied upon. More research is required'.

Re: I'll take your advice, thank you.

8. I thank the authors for their response.

9. I thank the authors for clarifying the typographical error.

10. The authors appear to have misunderstood that in this context the terms 'reliable, responsive and reproducible' apply to measuring tools (e.g. Knee Society Score) not surgical procedures.

Re: Forgive me for misunderstanding what you meant. Some measuring tool have been shown to be reliable, responsive and reproducible (e.g. KSS, AKSS). After rigorous contemplation and discussion, we will remove this part.

11. I thank the authors for making this change.

12. The English and grammar are much improved.

VERSION 3 – REVIEW

REVIEWER	Cochrane, Lynda Clinical Statistics Consultants
REVIEW RETURNED	12-Jul-2021

GENERAL COMMENTS	This is now an interesting contribution to knee arthroplasty research.