



Evaluating Basic Knee Arthroscopy Skills in Orthopaedic Trainees in a Limited Resource Setting

by

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This study is in partial fulfilment of the requirements for the degree

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University of Cape Town

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Acknowledgements, format and contributions

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Conflicts of interest

The authors have no conflicts of interest to declare pertaining to the content of this article.

Availability of data and material

The data supporting the findings of this study is stored in a secure office at the University of Cape Town, Orthopaedic Department officers in a marked file. Data is available upon reasonable request from the corresponding author with permission using a University of Cape Town third party account.

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Abstract

Background: Orthopaedic training in Southern Africa is largely focused on trauma, although elective procedures, such as knee arthroscopy are increasing. This is especially true in the private sector where most trainees will practice. The primary aim of this study was to assess the arthroscopic competency of orthopaedic trainees in a setting of limited resources.

Methods: A prospective observational cohort study was carried out. Orthopaedic trainees of a Southern African university hospital performed basic arthroscopy on a knee model. Their surgical competency was assessed by two surgeons proficient in arthroscopy using the modified Basic Knee Arthroscopy Skill Scoring System (mBAKSSS).

Results: A total of 16 trainees (12 male) were included (6 junior and 10 senior trainees). The median age of participants was 36 (34.8, 37). The median mBAKSSS was 28.0 (20.3, 32.5) but showed a large variability (12.0-42.5). The overall reliability was excellent with Cronbach's Alpha of 0.91 and interclass correlation of 0.91 [95% CI 0.75, 0.97].

Conclusions:

The average knee arthroscopy proficiency of our trainees is comparable to those of international training programs, but there was great variability with inconsistent skills amongst the trainees. This calls for improved and reproducible arthroscopy training and skills transfer, exposure to procedures and ongoing assessment.

Level of Evidence: II (Prospective observational cohort study)

List of tables

Table 1 shows demographic data, previous experience, scores assessed by two raters, and average score of participants. M = male; F = female; mBAKSSS = modified Basic Arthroscopic Knee Skill Scoring System

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Figure 1 shows a box and whisker plot depicting individual categories of the mBAKSSS for 16 trainees assessed. The average score for each component of the tool from the two raters was used in the analysis. A Likert scale rates these categories from one (worst) to five (best).

Abbreviations

CI – Confidence Interval

HREC – Human Research Ethics Committee

JBJS – The Journal of Bone and Joint Surgery

F - Female

M - Male

mBAKSSS - Basic Knee Arthroscopy Skill Scoring System (mBAKSSS)

MANUSCRIPT IN PUBLICATION FORMAT

Evaluating Basic Knee Arthroscopy Skills in Orthopaedic Trainees in a Limited Resource Setting

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Keywords: Arthroscopic training; Objective assessment; Simulation-based medical education; Proficiency; Surgical training

Abstract

Background: Orthopaedic training in Southern Africa is largely focused on trauma, although elective procedures, such as knee arthroscopy are increasing. This is especially true in the private sector where most trainees will practice. The primary aim of this study was to assess the arthroscopic competency of orthopaedic trainees in a setting of limited resources.

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Introduction

Orthopaedic training in Africa is focused on trauma surgery due to a large burden of injuries and limited resources.¹ Despite the negative effect on the exposure to elective surgery, procedures such as arthroscopy are increasing and competency assessment is needed. Due to limited employment opportunities in government hospitals, many surgeons in Southern Africa are forced into private practice.² Here the distribution of trauma and elective surgery often mirrors high resource settings, where arthroscopy of the knee and shoulder is ranked amongst the ten most common procedures for a general orthopaedic surgeon.³ For knee arthroscopy in this sector, an estimated 10 knee arthroscopies are performed per 10000 population annually.⁴ This creates a mismatch between training and preparation for surgical practice specifically in elective procedures. Deficiencies in surgical education may be due to increasing complexity of procedures or implants, reduced training time, diluted exposure to high-cost elective cases, shortage of trainers in the clinical academic environment and greater awareness of medico-legal implications and ethical issues.⁵ Therefore adequate training and assessment of skills, such as basic arthroscopy is key to train competent orthopaedic surgeons.

Traditionally, the surgical competency of trainees has been assessed by observations in the operating room, subjective end-of-rotation evaluations, and logbooks.⁶ (CME) But, there is a need for objective work-based assessment in order to implement teaching strategies that are effective in a resource limited setting. Learning curves in

surgical skills are variable and largely related to volume of procedures performed.⁷⁻

¹⁰ For arthroscopic surgery, training with the use of models can be used to improve technical skills prior to real-life surgery.

Unfortunately, there are no reports on arthroscopic training and assessment in limited resource settings in Southern Africa. This knowledge is key to improve competency and allow adequate preparation for future surgical practice. Therefore, the primary aim of this study was to assess the competency of orthopaedic trainees in our hospital. The secondary aim was to assess the interobserver reliability of the scoring system used.

Methods

A prospective observational cohort study was carried out to assess the competency of basic knee arthroscopy skills in postgraduate orthopaedic trainees at an urban Southern African university hospital. There is variability in the experience of elective orthopaedic surgery prior to entering the four year training program. Most trainees rotate through our secondary level hospitals for at least two years as orthopaedic medical officers prior to their specialist training. Here input is provided in form of courses, tutorials and supervised surgery with close interaction of academic staff from the tertiary care facility. Yet, not all future trainees will go through the same rotations at the secondary level hospitals and some are recruited from other provinces of the country without such preparatory pre-rotation. Our specialist training consists of 18 months of trauma orthopaedic surgery, six months of hand surgery, six months of paediatric orthopaedic surgery and 18 months of elective reconstructive surgery.

During this final rotation of training, eight to nine months are allocated for exposure to arthroscopic procedures of the knee (three months) and shoulder (six months).

The residency arthroscopy curriculum has not changed over the last four years, and senior trainees have been through the same rotations and training as the current junior trainees. Arthroscopic cadaver courses are held approximately four times a year throughout the course of the training.

All 21 trainees who were part of the orthopaedic department at the time of the study were approached to participate. Exclusion criteria were clinical duties and annual leave on the day of assessment. Participants completed a questionnaire providing demographic data, hand dominance, year of postgraduate study, training hours received in specific arthroscopy skills and number of knee arthroscopies performed up to this point. Averages were reported as median (25th percentile, 75th percentile). Trainees in the first two years of training were defined as junior trainees. Senior trainees were defined as being in their third year of training or later.

An information sheet was provided which described the standardised basic arthroscopy to be performed. This included a diagnostic knee arthroscopy on a dry silicon knee model (Sawbone, Washington, United States of America), a high-definition lens camera control unit and 4mm 30-degree video-arthroscope (Smith+Nephew, Watford, England) was provided with a standard arthroscopic instrument tray. This included a high flow arthroscopic sheath, obturator, probe and a variety of graspers and punches. The participants were then asked to locate and remove two foreign bodies within the knee during the assessment. They were blinded to one another and did not observe others performing the arthroscopy. During the

arthroscopy, participants were assessed by two raters using the modified Basic Arthroscopic Knee Skill Scoring System (mBAKSSS).⁸ The raters were qualified orthopaedic surgeons from the same department, experienced in performing and teaching arthroscopic surgery. Both surgeons simultaneously scored the performance but were blinded to each-others marks.

The mBAKSSS consists of nine questions, in the form of a global rating style questionnaire, including the parameters of instrument handling, depth perception, bimanual dexterity, flow of operation, knowledge of instruments, efficiency, knowledge of procedure, autonomy and the quality of the final product. Each skill is assessed on a Likert scale with a minimum score of one and maximum of five in each category.⁸ Construct validity, interrater reliability and internal consistence of the mBAKSSS has been shown in multiple studies.¹¹ The score has been validated for baseline skills and learning curves in various high-income countries with virtual simulators, cadavers and dry models but its translation into a clinical setting remains to be assessed.^{11,12} There are no validated cut-off points as pass-fail mark for the mBAKSSS. Previous studies have shown a median score of 20 in junior and 32 in senior trainees and have arbitrarily set a competency level at a score of 30.^{13,14}

Interrater reliability of the two raters was assessed using Cronbach's Alpha and interclass correlation with confidence interval (CI) set at 95%. For this no power analysis was done. Cronbach's Alpha of >0.9 is equivalent to excellent internal consistency; 0.8-0.9 good; 0.7-0.8 acceptable and <0.5 unacceptable. Interclass correlation closer to 1 shows higher interrater reliability. Full ethics approval was

obtained prior to the study from the institutional review board (HREC #231/2017).

No funding was received for this study.

Results

A total of 16 (12 male) of the possible 21 trainees were included in the study. Those who did not participate were either carrying out clinical duties (three) or on annual leave (two).

Detailed demographic data and scores for each participant are shown in Table 1. The median age of participants was 36 (34.8, 37) years. There were three participants from each of the first three years; and seven from the fourth year (Table 1). Prior to this assessment participants reported an estimated median of seven hours (2.8, 12.8) of exposure to arthroscopy training. Although the training program offers similar rotation and training opportunities, there was reported variability in pre-rotation experience as medical officers. This included performing diagnostic scopes prior to a procedure in the theatre, arthroscopy courses, use of simulated devices and previous cadaver workshops. The group reported a median of five (1.5, 10) arthroscopies performed on patients prior to the assessment.

Table 1 – Demographic and scores for each participant

The overall median mBAKSSS was 28.0 (20.3, 32.5) with large variability ranging from 12.0 to 42.5. Notably, the three lowest scores (12, 15.5, 18.5) were obtained by senior trainees in their third or fourth year (Table 1). The scores of the individual components of the mBAKSSS are shown in Figure 1.

Figure 1 – Assessment Scores

An assessment of the interrater reliability between the two raters can be seen in Table 2. The overall reliability was excellent with Cronbach's Alpha of 0.91 and interclass correlation of 0.91 [95% CI 0.75, 0.97]. There was good to excellent correlation for all the individual assessment points except for autonomy, knowledge of instruments and, flow of operation and forward planning.

Table 2 – Interrater reliability

Discussion

Our study assessed the competency of basic knee arthroscopy skills amongst trainees in a Southern African university hospital using the mBAKSSS with excellent interrater reliability. These scores were comparable to other international training programs. Large variability amongst scores of trainees was seen with poor scores for three of the nine senior trainees.

The overall mean mBAKSSS of our study was 28.0, which correlates with those of other training centres and confirms that our trainees have comparable skills to their international counterparts.⁸ However, there was large variability of reported training experience as well as test performance with no apparent correlation between the two. Olsen et al reported on a similar variability in a group of senior trainees with a score of 33 and range of 18 to 35. Their junior trainees mBAKSSS scored more

homogenous but lower with 20 and a range of 18 to 22. This suggests that there is inconsistency in how trainees access or experience the educational arthroscopy training offered.¹³ (CME) Following the specialist training, we offer fellowship opportunities when preparing for a subspecialist practice. Yet, the disparity of skills and poor performance in some senior trainees is concerning and their progression into general orthopaedic practice potentially unsafe. We currently have limited mechanisms to restrict the scope of practice for these individuals as our national orthopaedic specialist exam does not evaluate arthroscopy skills as pass-fail. Here, workplace-based assessment can provide an important checkpoint,¹³ which will be introduced into our training program in the near future as part of a national drive. These findings also highlight that our trainees acquire arthroscopy skills prior to their training program in peripheral hospitals where cases with lower complexity are managed. The environment at the tertiary level hospital, with more complex cases operated by subspecialists, might therefore be less amenable to acquire basic arthroscopy skills for trainees in the operating room. Most arthroscopy exposure is limited to the final months of our training program, thus repetition throughout the training is limited. Focused training of basic arthroscopy skills could be shifted to the peripheral hospitals to overcome some of these challenges.

To establish an adequate learning curve in knee arthroscopy a high volume of surgery is needed. One study suggested that 150 to 200 knee arthroscopies should be performed, which equates to a fellowship trained surgeon.⁸ Another study proposed 35 knee arthroscopies to achieve an acceptable level of competency.^{10,15} In diagnostic shoulder arthroscopy around 52 cases logged are needed which increases to 248 for more complex procedures such as Bankart repairs.¹⁶ The number of

previous arthroscopic procedures has been shown to significantly correlate with rating scores in both the knee and shoulder.¹⁷ In our study group, a large variability of self-reported arthroscopic procedures was provided. Here, simulation could become an important component for skills development, as reported in other studies in low-resource settings where clinical exposure to elective arthroscopic procedures is reduced.¹⁸⁻²⁰

This study has some limitations. The experience of the trainees was self-reported and could not be verified. A prospective study including objective recording of the trainees' exposure to both simulated and operating rooms environments would have provided a more accurate documentation of surgical experience. Other factors which can lead to improved three-dimensional hand-eye coordination, such as regular video gaming was not assessed in our study and could have influenced the mBAKSSS.²¹

Furthermore, the mBAKSSS only assesses technical skills of arthroscopy. Other non-technical skills that are essential for a safe and competent surgeon are excluded, such as surgical leadership, communication, problem solving and planning.¹¹ Using a dry model might not reflect true arthroscopy skill needed in patients, and must be interpreted cautiously, but it allows for a standardized and repeatable skills assessment as well as a 'hands-off' approach by assessors without risks to patients and medical legal implications. The study was carried out at a single centre and might not reflect other universities or hospitals with different resources or clinical setup. Although challenges might be similar, generalization of these results should be avoided. Also, the study was underpowered for subgroup analysis (i.e. junior versus senior trainees) due to the large variability of the scores. The trainees were not

assessed longitudinally and an individual's skills improvement could not be assessed over time.

Conclusion

Although the average basic arthroscopy skill competency of our trainees was adequate, there was great variability of skills. This calls for ongoing assessment and a re-evaluation of the exposure but especially of the actual experience in skills training. As our graduates are expected to perform basic knee arthroscopy, our program must define competency expectations for all and create a curriculum and evaluation program which matches those goals. Ultimately, this must also lead to greater educational consistency amongst trainees. Furthermore, the mBAKSSS proved to be reliable in our study but future work is required to confirm construct validity in a clinical setting.

References

1. Meara JG, Leather AJM, Hagander L, et al. Global Surgery 2030: Evidence and solutions for achieving health, welfare, and economic development. *The Lancet*. 2015;386(9993):569-624. doi:10.1016/S0140-6736(15)60160-X
2. Dell AJ, Gray S, Fraser R, Held M, Dunn R. Orthopaedic Surgeon Density in South Africa. *World J Surg*. 2018;42(12):3849-3855. doi:10.1007/s00268-018-4709-4
3. Kellam JF. The core competencies for general orthopaedic surgeons. *Journal of Bone and Joint Surgery - American Volume*. 2017;99(2):175-181. doi:10.2106/JBJS.16.00761

4. Jameson SS, Dowen D, James P, et al. The burden of arthroscopy of the knee. A contemporary analysis of data from the English NHS. *Journal of Bone and Joint Surgery Br.* 2011;93(10):93-1327. doi:10.1302/0301-620X.93B10
5. Marais L, Dunn R. Teaching and training in orthopaedics. *South African Orthopaedic Journal.* 2017;16(4). doi:10.17159/2309-8309/2017/v16n4a1
6. Swanepoel S, Dunn R, Klopper J, Held M. The FC Orth(SA) final examination: how effective is the written component? *SA Orthopaedic Journal.* 2018;17(3). doi:10.17159/2309-8309/2018/v17n3a2
7. Hodgins JL, Veillette C, Biau D, Sonnadara R. The knee arthroscopy learning curve: Quantitative assessment of surgical skills. *Arthroscopy - Journal of Arthroscopic and Related Surgery.* 2014;30(5):613-621. doi:10.1016/j.arthro.2014.02.021
8. Insel A, Carofino B, Leger R, Arciero R, Mazzocca AD. The development of an objective model to assess arthroscopic performance. *Journal of Bone and Joint Surgery - Series A.* 2009;91(9):2287-2295. doi:10.2106/JBJS.H.01762
9. Koehler RJ, Goldblatt JP, Maloney MD, Voloshin I, Nicandri GT. Assessing diagnostic arthroscopy performance in the operating room using the Arthroscopic Surgery Skill Evaluation Tool (ASSET). *Arthroscopy - Journal of Arthroscopic and Related Surgery.* 2015;31(12):2314-2319.e2. doi:10.1016/j.arthro.2015.06.011
10. Stunt JJ, Kerkhoffs G, van Ooij B, et al. The Suitability of Global Rating Scales to Monitor Arthroscopic Training Progress. *Int J Sports Exerc Med.* 2016;2(041).
11. Velazquez-Pimentel D, Stewart E, Trockels A, Achan P, Akhtar K, Vaghela KR. Global Rating Scales for the Assessment of Arthroscopic Surgical Skills: A Systematic Review. *Arthroscopy - Journal of Arthroscopic and Related Surgery.* 2020;36(4):1156-1173. doi:10.1016/j.arthro.2019.09.025

12. Alvand A, Auplish S, Gill H, Rees J. Innate arthroscopic skills in medical students and variation in learning curves. *Journal of Bone and Joint Surgery - Series A*. 2011;93(19):e115(1). doi:10.2106/JBJS.K.00199
13. Olson T, Koehler R, Butler A, Amsdell S, Nicandri G. Is there a valid and reliable assessment of diagnostic knee arthroscopy skill? *Knee. Clin Orthop Relat Res*. 2013;471(5):1670-1676. doi:10.1007/s11999-012-2744-2
14. Butler A, Olson T, Koehler R, Nicandri G. Topics in training: Do the skills acquired by novice surgeons using anatomic dry models transfer effectively to the task of diagnostic knee arthroscopy performed on cadaveric specimens? *Journal of Bone and Joint Surgery - Series A*. 2013;95(3). doi:10.2106/JBJS.L.00491
15. Koehler RJ, Amsdell S, Arendt EA, et al. The Arthroscopic Surgical Skill Evaluation Tool (ASSET). *American Journal of Sports Medicine*. 2013;41(6):1229-1237. doi:10.1177/0363546513483535
16. Middleton RM, Vo A, Ferguson J, et al. Can Surgical Trainees Achieve Arthroscopic Competence at the End of Training Programs? A Cross-sectional Study Highlighting the Impact of Working Time Directives. *Arthroscopy - Journal of Arthroscopic and Related Surgery*. 2017;33(6):1151-1158. doi:10.1016/j.arthro.2016.10.025
17. Middleton RM, Baldwin MJ, Akhtar K, Alvand A, Rees JL. Which global rating scale?: A comparison of the ASSET, BAKSSS, and IGARS for the assessment of simulated arthroscopic skills. *Journal of Bone and Joint Surgery - American Volume*. 2016;98(1):75-81. doi:10.2106/JBJS.O.00434
18. Boutefnouchet T, Laios T. Transfer of arthroscopic skills from computer simulation training to the operating theatre: A review of evidence from two randomised controlled studies. *SICOT J*. 2016;2. doi:10.1051/sicotj/2015039

19. Howells NR, Gill HS, Carr AJ, Price AJ, Rees JL. Transferring simulated arthroscopic skills to the operating theatre. A randomised blinded study. *J Bone Joint Surg.* 2008;90-B(4):494-499. doi:10.1302/0301-620X.90B4
20. Dunn C, Held M, Laubscher M, Nortje M, Roche S, Dunn R. Orthopaedic surgical training exposure at a South African academic hospital – is the experience diverse and in depth? *South African Orthopaedic Journal.* 2022;21(1):22-28. doi:10.17159/2309-8309/2022/v21n1a3
21. Gupta A, Lawendy B, Goldenberg MG, Grober E, Lee JY, Perlis N. Can video games enhance surgical skills acquisition for medical students? A systematic review. *Surgery (United States).* 2021;169(4):821-829. doi:10.1016/j.surg.2020.11.034

Figure Legend

Figure 1 shows a box and whisker plot depicting individual categories of the mBAKSSS for 16 trainees assessed. The average score for each component of the tool from the two raters was used in the analysis. A Likert scale rates these categories from one (worst) to five (best).

Table and Figures

Table 1 – Demographic and scores for each participant

	Age	Gender	Year of Training	Hand Dominance	Hours of training	Number of arthroscopies	Rater 1	Rater 2	Average mBAKSSS
1	36	M	4	Right	5	20	24	22	23.0
2	37	F	3	Right	4	0	26	29	27.5
3	37	M	4	Right	10	10	28	33	30.5
4	38	F	4	Right	3	2	18	19	18.5
5	35	F	1	Right	3	3	25	32	28.5
6	42	M	4	Right	20	5	13	11	12.0
7	35	M	3	Right	15	15	14	17	15.5
8	34	M	2	Right	2	0	25	29	27.0
9	33	F	2	Right	30	0	38	34	36.0
10	32	M	1	Right	2	10	18	23	20.5
11	37	M	4	Right	9	10	40	36	38.0
12	35	M	3	Right	1	32	30	35	32.5
13	31	M	1	Right	12	5	43	42	42.5
14	38	M	2	Right	10	10	34	27	30.5
15	37	M	4	Right	20	2	35	30	32.5
16	36	M	4	Left	0	0	17	24	20.5

Table 1 shows demographic data, previous experience, scores assessed by two raters, and average score of participants. M = male; F = female; mBAKSSS = modified Basic Arthroscopic Knee Skill Scoring System

Figure 1 – Assessment Scores

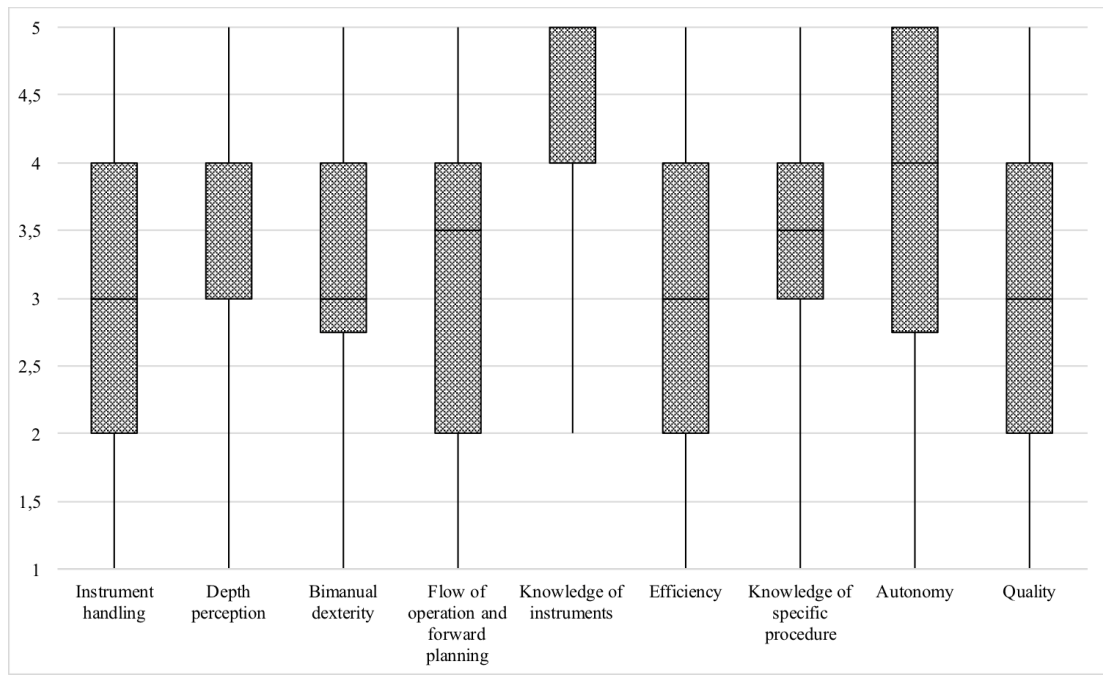


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Table 2 – Interrater reliability

Category of mBAKSSS	Cronbach's Alpha	Interclass correlation	95% CI*
Quality	0.803	0.802	0.488, 0.930
Autonomy	0.709	0.715	0.184, 0.900
Knowledge of specific procedure	0.923	0.914	0.752, 0.970
Efficiency	0.819	0.828	0.478, 0.943
Knowledge of instruments	0.309	0.319	-1.147, 0.776
Flow of operation and forward planning	0.756	0.754	0.291, 0.916
Bimanual dexterity	0.833	0.842	0.539, 0.945
Depth perception	0.863	0.863	0.619, 0.952
Instrument handling	0.950	0.953	0.865, 0.984
Total	0.910	0.914	0.750, 0.970

Table 2 shows excellent interrater reliability of the two raters with a Cronbach's

Alpha of >0.9 and good to excellent interclass correlation in the various areas of the score.

*CI = confidence interval for interclass correlation (upper and lower limit).

mBAKSSS= modified Basic Knee Arthroscopy Skill Scoring.

APPENDICES

The Journal of Bone and Joint Surgery Open Access Instructions to Authors

REVISED AUGUST 11, 2021

All manuscripts must be submitted online via Editorial Manager at:

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Assurance of Quality: All papers will be subjected to a **rigorous, double-blinded peer review**. At *JBJS OA*, this means reviews by:

- 2 or 3 outside experts in the article's subspecialty area*
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- a Co-Editor of *JBJS OA*

Introduction

JBJS Open Access (JBJS OA) is an open access, peer-reviewed journal that welcomes original articles that contribute to orthopaedic knowledge from all sources in all countries, with the goal of improving the quality of care of orthopaedic patients. By publishing in *JBJS OA*, authors enable readers around the globe to have free, perpetual, unrestricted online access to their article on the *JBJS OA* website immediately upon publication.

To cover the cost of copy-editing, production/layout, and hosting of the article, *JBJS OA* charges authors an article processing charge (APC) of \$2,250 USD upon acceptance. If the author originally submitted the paper to *The Journal of Bone & Joint Surgery* and has paid a submission fee, the author will receive a \$250 USD coupon code to use upon acceptance for publication in *JBJS OA*, making the total APC \$2,000 USD. For AOA Critical Issues in Education articles only, if the corresponding author is a member of the American Orthopaedic Association or an AOA program affiliate (including Emerging Leaders Program, Own the Bone institution, traveling fellow, APEX program, or CORD Affiliate), the author will receive a \$1,250 USD coupon code upon acceptance, making the total APC \$1,000 USD. There is no fee to submit an article for consideration. **All articles submitted to *JBJS OA* undergo our standard peer-review process and are accepted or rejected on the basis of their merit only.**

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Articles submitted or transferred to *JBJS OA* undergo double-blinded peer review, with the Editorial Office removing all author and institution identifiers before sending papers to reviewers.

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- Articles are accepted for exclusive publication in *JBJS OA*. Previous presentation at a scientific meeting, and/or publication of the abstract in conjunction with the meeting, does not preclude publication of the article; however, this information must be disclosed in a cover letter at the time of submission. Previously published articles, including those published in non-English-language journals, are not accepted. *JBJS OA* does not accept manuscript submissions involving human subjects (or their medical records) that have been previously posted to preprint servers.
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- All manuscripts dealing with the study of human subjects must include a statement that the subjects gave informed consent to participate and that the study was approved by an institutional review board or a similar committee. All studies should be carried out in accordance with the World Medical Association Declaration of Helsinki (*JBJS* 79-A:1089-98, 1997). Patient confidentiality must be protected according to the U.S. Health Insurance Portability and Accountability Act (HIPAA). See our complete [Ethics Policy](#) for additional information.
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- If requested by the Editor-in-Chief or either of the Co-Editors of *JBJS OA*, authors must make the tabulated raw data that form the basis of their work available for examination in a timely fashion.

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Authors should, in general, follow the ICMJE's "[Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals](#)."

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- **AOA Critical Issues in Education** manuscripts address the education of medical students, residents, fellows, and faculty; Board/in-training examinations; and other testing/assessment topics.

*Note: Clinical studies reporting on three or fewer patients are classified as case reports and are not considered for publication in *JBJS OA*. These should be submitted to [JBJS Case Connector](#) instead.

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The following items must be submitted:

1. **Title Page:** The title page must include (1) article title, (2) authors' names, in the order in which they should appear, and academic degrees, (3) institution(s) at which work was performed, (4) institution (and city and state or country) with which each author is affiliated, (5) corresponding author and his/her e-mail address.
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- **Word count:** Maximum, 3,000 words (including the Abstract but excluding references and figure legends)
- **Line spacing:** Double-spaced
- **Font:** Times New Roman (size 12)
- **Page layout:** Manuscript title included at the beginning of the first page with continuous line numbering down left side of page

Clinical Research and **Basic-Science Research articles** should consist of:

1. A **Structured Abstract** consisting of 5 paragraphs, totaling no more than 325 words, with the headings: Background (stating the primary research question), Methods, Results, Conclusions, and Level of Evidence (for Clinical Research articles) or Clinical Relevance (for Basic-Science Research articles). The Level of Evidence should be assigned according to the definitions in the [Level of Evidence](#) table. This rating will be reviewed by a JBJS Deputy Editor, who will make the final determination.
2. The **body** should consist of:
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 - **Materials and Methods:** Describe the study design in detail using standard methodological terms.
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Refer to our detailed guidelines for writing a [Materials and Methods](#) section for additional guidelines.

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- **Discussion:** Be succinct. What does your study show? Is your hypothesis affirmed or refuted? Discuss the importance of this article with regard to the relevant world

literature; however, a complete literature review is unnecessary. Analyze your data and discuss their strengths, their weaknesses, and the limitations of the study.

3. A **reference section**, in PubMed/Index Medicus format, must be included after the manuscript text. Number the references according to the order of citation in the text (not alphabetically), and cite all references in the text. Papers posted on preprint servers may not be used as references. Refer to our [Reference Formatting Guidelines](#) for additional guidance. Notice that journal citations must include all authors (not "et al.") and complete page numbers (not just the first page), per journal style.
4. **Figure legends** must be included at the end of the manuscript text file, after the References section, for all images. Explain what each figure shows. Identify machine settings for magnetic resonance images, and give the magnification of all photomicrographs. Define all arrows and other such indicators appearing on the figure.
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AOA Critical Issues in Education articles should be topically centered on orthopaedic education pertaining to undergraduate medical education, resident training and education (graduate medical education), fellowship training, and new techniques/technology for those in orthopaedic practice. Please see the [editorial](#) by Shepard R. Hurwitz, MD, FACHE, FAOA, and Michelle A. James, MD, FAOA, which offers general guidance for authors and discusses the role of surveys and questionnaires in studies, with suggested reading for more information:

- American Association for Public Opinion Research. Best practices for survey research. <https://www.aapor.org/Standards-Ethics/Best-Practices.aspx>
- Phillips AW, Artino AR Jr. Lies, damned lies, and surveys. J Grad Med Educ. 2017 Dec;9(6):677-9.
- Annals of Emergency Medicine. Guidelines and preferences for specific research study designs. www.annemergmed.com/content/designs
- Krosnick JA, Fabrigar LR. Designing good questionnaires. New York: Oxford University Press; 1998.

Regarding abstracts in manuscripts for the AOA Critical Issues in Education channel, authors may include a summary abstract if appropriate. The summary abstract should be less than 325 words and is included in the overall word count limit for the paper.

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JBJS Open Access Editorial Decision

First review

Apr 26 2022 07:23AM

Kirsty Berry

RE: "Evaluating Basic Knee Arthroscopy Skills in Orthopaedic Trainees in a Limited Resource Setting," number JBJSOA-D-22-00020

Dear Dr. Berry:

Thank you for your submission to The Journal of Bone and Joint Surgery. Your manuscript entitled, "Evaluating Basic Knee Arthroscopy Skills in Orthopaedic Trainees in a Limited Resource Setting," number JBJSOA-D-22-00020, has been evaluated by Consultant Reviewers to The Journal. They recommend that your manuscript not be accepted in its current form. Their comments are below.

Please consider these comments and, if you feel they can be addressed in a major revision of the manuscript, please submit your revised manuscript along with a cover letter with a point-by-point response to the comments. Additionally, all corresponding changes to the text should be in bold. The due date for revision will be May 24 2022 11:59PM. However, we are sensitive to the disruptions caused by COVID-19, so please let us know if you require additional time.

Please note that revised manuscripts should not exceed 3000 words, including the abstract section and excluding references and figure legends.

To submit a revision, go to <https://www.editorialmanager.com/jbjsoa/> and log in as an Author. Please go to the "Submissions Needing Revision" folder to view a copy of this letter, access the Reviewers' comments and download your submission files. To begin the revision process, click on 'Revise Submission'.

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The APC is charged on acceptance of the article and must be paid within 48 hours by the author, funding agency or institution. Payment must be received in full for the article to be published.

Thank you for submitting your manuscript to The Journal of Bone and Joint Surgery.

Sincerely,

Michelle A. James, MD
Deputy Editor for Hand, Upper Extremity, The Journal of Bone and Joint Surgery
Associate AOA Deputy Editor for Critical Issues in Education, JBJSOA

Reviewers Comments with Response in bold:

Dear Reviewers

We appreciate the time and effort you have spent on our publication. Your comments were constructive and very well thought through. It was a privilege to have received this feedback from you, and we have incorporated your points as below.

Kind regards the authors

Reviewer #1:

Summary: This is a relatively simple study that will be of interest to a subset of readers. I like that it is looking at development of arthroscopic skills in the developing world, and the associated challenges.

Comments: The authors could add a bit more detail and address a few important questions per my review.

1. The authors conclude that there was no difference in measured skills between junior and senior trainees. This could be explained by inadequate power of study, or use of a poor assessment tool, or, actually, no improvement in skills. The first option should definitely be addressed. Although a preliminary power analysis was done, there was a huge variability of outcome scores, especially in the year 4 group. I suspect that this variability would actually make the power of the study very low. Did they do a post-hoc power analysis?

This is a very valid point and we realized with your comments that this should be one of our main findings: our trainees are not homogenous in their skills!

We opted against post-hoc power analysis but have included a passage into the limitation section which talks to power of comparing junior to senior trainees. We are one of the largest orthopaedic programs in Southern Africa and have recruited 80% of all trainees for the study. We believe that this cohort is as large as we can make it for a study on single centre arthroscopy training in our region.

L213: We noted an increase in variability in our cohort, which might have led to reduced power, although we matched numbers with the original studies of the mBAKSSS. However, it is this variability in the scores of our trainees that is one of our main findings.

In terms of actual skill improvement, the authors recognize that they don't know how the scores in the models correlate with clinical performance in patients. So why wasn't the assessment done in patients? I can imagine the answer(s) to this question, but it is worth explaining in the manuscript.

This was added into the limitation and discussion sections (L191 and L207).

2. L35: Is this arthroscopy rate per lifetime, per year, etc in the population?

This an annual rate that is quoted from the study referenced in this passage. This has been added to the text (L38).

3. L58: This is a good aims statement. The conclusions should be limited to these goals. They really didn't examine the impact of training on a benchtop simulator.

We have removed superfluous assumptions and limited the conclusion to only speak to these aims.

4. L69: It looks like arthroscopy experience falls mainly in the last year of residency. But some of the year four residents reported very low educational and case experience. How can that be? From my look at the data, there appears to be a very wide disparity in educational experience in arthroscopy. If the goal is to train surgeons who can go out and do basic arthroscopy (and I don't know for sure that this is the goal, but worth discussion in the paper), then one of the conclusions might be that there is a need for greater educational consistency across residents.

This is very true and an important point to highlight. We have done so in the discussion as well as conclusion (L189 and L225).

5. L81: What model? Wet or dry arthroscopy?

It was a dry knee model. This was added to the text (L91).

6. L104: As noted above, what was the actual measured variability compared to the pre-hoc analysis?

This point has been addressed above in question 1.

7. L126: Since there are such low case numbers, why expect a change in skills?

Very true, this is a challenge for most low resource training hospitals. We are currently augmenting our training with cadaver workshops, but virtual simulation and especially training of 3D hand eye coordination will become very important here. We have touched on this in our discussion (L199).

8. L148: I would disagree that the scores are acceptable. Mean scores might be, however the huge variability of performance in the year 4 residents is very concerning. In order to do arthroscopy in practice, do graduates go on to fellowship training?

This is a valid point which we have highlighted in the discussion (L165).

9. L163: It is not clear how the peripheral hospitals work in this training program. When and how do they come into play?

This was further explained in the methods section (L67).

10. L174: "This transfer validity" suggests that transfer validity was measured in this study. But it wasn't. I don't think the authors intended to infer this, but probably should be reworded for clarity.

We have removed this term in here to avoid confusion.

11. L189: I think one of the key questions is whether all graduates from this program are expected to be able to go out and perform arthroscopy. If so, the program needs to define competency expectations for all graduates and create a curriculum and evaluation program that matches those goals. The variability of case numbers and training experience in arthroscopy that are presented in this study can't possibly meet minimum educational goals. However, if the system is designed to train some surgeons who have no intention of doing arthroscopy in the future, the current design might be just fine. My bias is toward training consistency across residents if at all possible.

Well stated. It provides a very important next step for our program: define expectations and a curriculum. We have therefore included this in the conclusion (L224).

Reviewer #2:

Comments: An integral part of orthopaedic surgical training is teaching technical skills. While this does not account for clinical knowledge or the ability to take care of a patient it is nonetheless pivotal to outcomes. Arthroscopic skills require performing tasks in a 3-dimensional space. While one can learn the fundamentals by reading and watching most of the skills are acquired through doing. Hands-on practice and repetition is necessary. Some trainees have exceptional innate arthroscopic skills while others need more practice. While this study provides valuable information particularly when assessing baseline arthroscopic skills there are some variables that need to be addressed.

1. Video game play has been correlated with 3-d hand-eye coordination. A trainee's experience with videogames prior to testing would be interesting. This information may not be possible for this study cohort but for future studies it would be interesting to ask and could be considered in the discussion.

We have included this in our limitation section (L205-209). It does make for an interesting follow up study.

2. The types of pre-test training would also be valuable. The junior residents averaged 9.9 hours of training pre-test while the senior residents averaged 8.7 hours of training pre-test. Was this training didactic or hands-on and did it differ between levels of training? What was the formal residency/intern training prior to the orthopaedic training and could this have influenced the testing? Laparoscopic skills can translate to arthroscopic skills so while an orthopaedic surgery trainee in internship may not have had orthopaedic training during internship if they had exposure to laparoscopic training in general surgery, even if only on a simulator, this could improve their arthroscopic abilities even as a junior trainee.

The training is varied prior to our residency program. Most interns are not exposed to laparoscopic surgery, but rather open procedures, but a valid point in the cross over of skills. We have included the different types of exposure in the results section (L133-136).

3. Did the residency curriculum change between the current juniors and when the current seniors were juniors? It would be valuable to longitudinally assess the juniors in the study and reassess them as seniors to see if the knee simulator curriculum in addition to more focus on actual knee arthroscopy cases, would improve their skills over time. Since this test took place on one day for all trainees the conclusions are misleading. The variables above need to be addressed prior to concluding that the

seniors did not improve since comparing the juniors to seniors may be like comparing apples and oranges.

Agreed, even though the study compared the senior to junior trainee cohort who went through the same arthroscopic training program, the residents were not assessed longitudinally and an individual's skills improvement could not be assessed over time.

We have added this to the limitations section (L216-218).

4. L64-5: Please expand on the experience prior to starting the 4th year orthopaedic surgery training. How long is the training prior to orthopaedics? Please comment on the types of exposures that a trainee may experience.

This was further explained in the methods section (L67-73).

5. L121-2: Consider rewording "There were three participants (each) from year one, two, and three..."

This was been reworded in the text (L130-131).

6. L131-2: Figure 1 is difficult to read if printed in black and white since the colors that define Junior vs Senior are similar. Please consider having one cross-hatched to differentiate.

Figure 1 has been updated, the colors have been removed and cross-hatch/grey scale used instead (L146; Attachment Figure 1).

7. L154-6: Four of the 5 lowest scores were in Senior level residents. Resident #16 was a 4th year trainee and had zero hours of training and zero arthroscopies prior to the modified Basic Knee Arthroscopy Skills Scoring System (mBAKSSS) testing. Another 4th year trainee #6 seemed to have adequate pre-test training but only scored a 12. Another 4th year scored 18.5 (#4) and a 3rd year scored a 15.5 (# 7). These results could certainly skew the outcomes for the senior level trainees. Did anything change in the curriculum from junior to senior year? Just being scrubbed in a knee arthroscopy does not mean that you are performing the arthroscopy if the senior or attending surgeon does the majority of the surgery. Was there a change in the residency's teaching philosophy that may have influenced the resident's education? Looking critically at these 4 lowest scores in seniors and evaluating their arthroscopic training would be valuable.

These are good questions. The curriculum did not change during this time, which we have added to the methodology section (L77-79). We have added possible reasons for these findings in the discussion section (L189-194).

8. L179-182: Understanding that the hours of training prior to the testing was self-reported, it would be valuable to know what the hours of training included. Sitting in a lecture or watching a course on arthroscopy is distinctly different than a hands-on cadaver or simulator arthroscopy course.

Arthroscopic training is variable, including performing surgery under supervision, assisting, courses, cadaver workshops and simulated devices. A large portion of this was prior to entering the four-year program. We have included this in the results section (L133-136).

JBJS Open Access Editorial Decision

Second review

Aug 26 2022 11:50AM

Dr Kirsty Berry

RE: "Evaluating Basic Knee Arthroscopy Skills in Orthopaedic Trainees in a Limited Resource Setting," number JBJSOA-D-22-00020R1

Dear Dr Berry:

Your revised manuscript entitled, "Evaluating Basic Knee Arthroscopy Skills in Orthopaedic Trainees in a Limited Resource Setting," number JBJSOA-D-22-00020R1, has been reviewed by 2 Consultant Reviewers who previously reviewed your original submission, and by the Statistics Editor, and me. We are interested in your manuscript, but we have questions and concerns that need to be addressed before we give it further consideration. These are listed below.

I hope that you are able to address these concerns in a revised manuscript accompanied by a response letter. In your response letter, each reviewer concern should be reiterated followed by a specific response. The due date for revision will be Sep 09 2022 11:59PM. Please note that the revised paper may undergo a review by a statistics/methodology editor that may lengthen the time to a decision.

At the time of resubmission please submit one or two questions that could be included in our quarterly and/or subspecialty CME examinations. As the content expert on your article, you are best qualified to identify the major "take home" finding(s) of your study. Please access this link http://www2.ejbjs.org/misc/cme_author_guidelines.pdf for a detailed description of the required format for the CME questions. Please cite where the answer to the question is located by inserting the indicator "(CME)" at the appropriate place in the text.

Sincerely,

Michelle A. James, MD
Deputy Editor for Hand and Upper Extremity, The Journal of Bone and Joint Surgery
Associate Deputy Editor for Critical Issues in Education, JBJS OA

Dear Reviewers

We appreciate your effort to make this manuscript better and can see that you have spent a lot of time on this. Thank you very much! We have addressed all of your concerns and have adjusted the main message of our article to avoid comparison between junior and senior residents. Please find our detailed responses to your comments below.

Kind regards

The Authors

Associate Deputy Editor (R1):

Comments:

1. Your Introduction sets the stage for your study by establishing the need for training in knee arthroscopy in your country. However, you mention the importance of training with the use of models (L50), but you apparently only studied testing on a knee model among trainees with variable experience with simulation (L132-135). Please revise L45-51 accordingly.

We revised to ‘For arthroscopic surgery, ~~simulator~~ training with the use of models can be used to improve technical skills prior to real-life surgery.

2. Table 1 indicates that none of the factors you studied (age, gender, year of training, hand dominance, reported hours of training, and number of arthroscopies appear to be associated with mBAKSSS. Figure 1 and the text indicate that you found no differences between junior and senior residents – but your study was not powered to discern this. Also, your study was cross-sectional (you did not study “progression” (L20) or “improvement” (L160) or “change” (L168) or “increase in variability” (L212. L222-223) of individual residents, as you state in L216-217). Please revise.

Basically, your findings are that the mBKASSS has good interrater reliability for your purposes, arthroscopy training at your program is inconsistent, many of your residents are not proficient at performing knee arthroscopy according to the mBKASSS scores, and you can’t discern an association of proficiency with training because your study was not sufficiently powered to find this. You state in multiple places (L19-20, L159

Please define an acceptable mBKASSS score or range according to the literature in Methods (L102-111).

Please revise Results, Discussion and Conclusions accordingly throughout, including the Abstract.

We removed all sections comparing junior to senior trainees according to your advice. The main message is now: ‘The mBAKSSS showed large variability with inconsistent skills proficiency amongst the trainees.’ We have therefore also taken out the section on the power analysis in Methods as well as the limitations section in the discussion. We felt it was important to highlight that ‘the study was underpowered for subgroup analysis (i.e. junior to senior trainees) due to the large variability of the scores.’ This was left in the limitation section. (L209)

The acceptable mBAKSSS ranges has been included (L108-110): ‘There are no validated cut-off points as pass-fail mark for the mBAKSSS. Previous studies have shown a median score of 20 in junior and 32 in senior trainees and have arbitrarily set a competency level at a score of 30.’

3. L110-111. What is the point of “an objective tool...to be developed”? Are you planning to call for this in the Discussion? Why? I don’t think your study supports mentioning this, and it distracts from your actual findings.

Agreed. We have deleted this.

4. L165. “Inhomogenous skill transfer” – this is an understatement. According to Table 1, 4 of your trainees had performed 0 arthroscopies (and one of these was a 4th year resident). While you didn’t study whether this was the cause of disparity (it may not be, since some of the residents who reported limited or no experience performed better than those with more experience according to the mBAKSSS) you can’t surmise any other potential reasons for skill disparity until you equalize exposure to this procedure. Please revise throughout, accordingly.

We agree, there is a disconnect between how we think our training opportunities are offered and how our trainees experience this or can take advantage of it. We added this to the text (160-165):

‘However, there was large variability of reported training experience as well as test performance with no apparent correlation between the two. Olsen et al reported on a similar variability in a group senior trainees with a score of 33 and range of 18 to 35. Their junior trainees mBAKSSS were more homogenous but lower with 20 and a range of 18 to 22. This suggests that there is inconstancy in how trainees access or experience the educational arthroscopy training offered.’

5. L170-17173. You did not study whether current training methods improve skills, or where/whether your trainees acquired skills. See 2 above and revise accordingly.

This has been amended in point number 2. We have deleted the comparison made in L170-171.

6. L190-193. You did not correlate mBAKSSS performance with reported exposure. See 2 above and revise accordingly.

As suggested by a previous reviewer, we wanted to highlight simulation as a solution to the lack of exposure to real-life arthroscopy. We have changed this passage to ensure it is not seen as a conclusion we drew from our results.

7. L224-229. These are appropriate conclusions.

Statistics Editor (R1):

Comments:

1. The manuscript is generally well written, but the statistics are often oddly reported.

a. Please be consistent in the number of significant digits reported. The mBKMSSS scores need only be reported either as whole numbers or with one significant digit.

We have changed this, except for the initial total Likert scoring scale (as this can only be a whole number) for the individual ratings.

b. IQR should be reported as such "Median (25th percentile, 75th percentile)." This avoids nonsensical reporting such as a median previous arthroscopy case experience of 5 with an IQR of 8.5

We changed the reporting of median accordingly and added an explanation in Methods: 'Averages were reported as median (25th percentile, 75th percentile)'.

c. For 95% CIs, report the upper and lower limits. It's not at all clear what you're reporting. Is that the upper bound only? The lower bound is also needed.

We changed the reporting of 95% CI with upper and lower limited both in the text and tables.

2. Please assess whether there is statistical significance in the individual parts of the score displayed in Figure 1. It appears some differences may exist. Also, Figure 1 should be re-imagined, displaying the responses as a box plot. It could currently be interpreted as many subjects scoring zero on some of the items when you're actually trying to display a mean or median value for each group.

Figure 1 has been amended in line with the changes to the manuscript, and is no longer comparing the junior to senior trainees. Figure 1 is now a box plot showing the variability of the individual components of the mBAKSS.

Reviewer #1 (R1):

Comments: This manuscript is improved, and I think there is still a good message for the study. However there still is a major flaw in the methodology and presentation.

1. In their response, the authors indicate that they chose not to perform a post-hoc power analysis because they were able to recruit about 80% of the residents for the study. One thing has nothing to do with the other. Even if 100% of the residents were included, if the performance variability of junior and senior residents was extremely high, there would simply be no way of drawing valid conclusions comparing performance between the two groups. Maybe there IS improvement in senior residents, but it was washed out by a couple of outliers in the senior resident group? One way to deal with this would have been to decide, in advance, to drop subjects who are more than two or three standard deviations below the mean performance. This is a common problem when EXPERT surgeons are evaluated in simulation studies. Sometimes a "world expert" performs terribly. So we've learned that the best way to handle that situation is a pre-determined plan for management of outliers. Back to this study: Perhaps there really is NO improvement in the senior resident cohort because clinical case numbers are so low in this specific training environment? Bottom Line: The authors need to revise the paper to explain that while the intent of the study was to compare these groups, it was impossible given the observed variability.

Thank you for this detailed explanation and insight and have adjusted the manuscript accordingly changed it. We agree, it does not take away from our overall message that our trainees have a large variety of arthroscopy skills.

2. L159: Revise to: These MEAN scores were acceptable overall... (From an educational perspective, I would personally say that super low scores for a few trainees are not acceptable for a training program, unless there are mechanisms to restrict the scope of practice for those individuals after completion of residency. Why give an incompetent surgeon free reign upon graduation? How does that protect patients?)

We have expanded on this and adjusted this section (L160-173):

However, there was large variability of reported training experience as well as test performance with no apparent correlation between the two. Olsen et al reported on a similar variability in a group of senior trainees with a score of 33 and range of 18 to 35. Their junior trainees mBAKSSS scored more homogenous but lower with 20 and a range of 18 to 22. This suggests that there

is inconstancy in how trainees access or experience the educational arthroscopy training offered.¹³ Following the specialist training, we offer fellowship opportunities when preparing for a subspecialist practice. Yet, the disparity of skills and poor performance in some senior trainees is concerning and their progression into general orthopaedic practice potentially unsafe. We currently have limited mechanisms to restrict the scope of practice for these individuals as our national orthopaedic specialist exam does not evaluate arthroscopy skills as pass-fail. Here, workplace-based assessment can provide an important checkpoint which will be introduced into our training program in the near future as part of a national drive.

3. L163: Please drop the word "equivalent" and find another way to express the idea that the observed scores on average fall within the range(s) reported in other studies. Was similar performance variability observed in other studies? If so, please provide those specific references.

We have changed the wording from ‘equivalent’ to ‘comparable’. Also, There are no validated cut-off points as pass-fail mark for the mBAKSSS. Previous studies have shown a median score of 20 in junior and 32 in senior trainees and have arbitrarily set a competency level at a score of 30.’ This we have included in the methods section and referenced previous studies. (L108-110)

Reviewer #2 (R1):

Comments: Thank you to the authors for their manuscript revision and for incorporating the reviewer's questions/comments. The revised manuscript is well-presented and I believe of value, especially highlighting the variability in training experiences in residents and the need for more standard curricula. I have just a few minor questions.

1. L90: The authors mention the manufacturer of the arthroscope but who is the manufacturer or the name of the silicone knee model simulator?

This has been included (L88)

2. L102-111: It may be helpful for a point of reference of give the range of possible low to high score for anyone being tested with the modified BAKSSS.

We added:

There are no validated cut-off points as pass-fail mark for the mBAKSSS. Previous studies have shown a median score of 20 in junior and 32 in senior trainees and have arbitrarily set a competency level at a score of 30. (L108-110)

JBJS Open Access Editorial Decision
(JBJSOA-D-22-00020R2) - [EMID:4e231518c9c76433]

Oct 23 2022 08:10PM

Kirsty Berry

RE: "Evaluating Basic Knee Arthroscopy Skills in Orthopaedic Trainees in a Limited Resource Setting", number JBJSOA-D-22-00020R2
Article Type: AOA Critical Issues in Education

Dear Dr. Berry:

Thank you for submitting your manuscript entitled, "Evaluating Basic Knee Arthroscopy Skills in Orthopaedic Trainees in a Limited Resource Setting," number JBJSOA-D-22-00020R2, to *JBJS Open Access*.

We are pleased to inform you that no further questions have arisen. Therefore, the manuscript is now in the hands of the Copy Editors for preparation for online publication. You will, of course, receive a galley for your approval prior to publication of your manuscript.

If you have not already done so, please ensure that the License to Publish agreement has been completed and each author has completed and submitted a Conflict of Interest form. We will not be able to proceed with publication until all forms have been received.

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We wish to thank you and your co-authors for preparing this material for *JBJS Open Access*, and for your cooperation during the editorial process.

Sincerely,

Eng Hin Lee, MD | Co-Editor

Robin R. Richards, MD | Co-Editor

JBJS Open Access

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HREC approval letter



UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee



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Email: nosi.tsama@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

19 April 2017

HREC REF: 231/2017

Dr M Held
Orthopaedics Surgery
H49, Old Main Building

Dear Dr Held

PROJECT TITLE: EVALUATING KNEE ARTHROSCOPY SKILLS IN ORTHOPAEDIC TRAINEES

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30th April 2018.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.

(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval before the research may occur.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE
Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical

HREC 231/2017

HREC Extension (Most recent)

HUMAN RESEARCH ETHICS COMMITTEE

18 FEB 2022



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Human Research Ethics Committee



FHS016: Annual Progress Report / Renewal

HREC office use only (FWA00001637; IRB00001938)			
This serves as notification of annual approval, including any documentation described below.			
<input checked="" type="checkbox"/> Approved	Annual progress report	Approved until/next renewal date	30.03.23
<input type="checkbox"/> Not approved	See attached comments		
Signature Chairperson of the HREC/ Designee			Date Signed
			19/2/2022

Note: Please email this form and supporting documents (if applicable) in a combined pdf-file to hrec-enquiries@uct.ac.za.

Please clarify your plan for research-related activities during COVID-19 lockdown.

Please use the latest form found on our website:

<http://www.health.uct.ac.za/fhs/research/humanethics/forms>

Comments to PI from the HREC

Principal Investigator to complete the following:

1. Protocol Information

Date (when submitting this form)	15/02/2022		
HREC REF Number	231/2017	Current Ethics Approval was granted until	30/03/2022
Protocol title	Evaluating knee arthroscopy skills in orthopaedic trainees		
Protocol number (if applicable)			
Are there any sub-studies linked to this study?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If yes, could you please provide the HREC Reference number for all sub-studies? Note: A separate FHS016 must be submitted for each sub-study.			
Principal Investigator	Michael Held		