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# Objective Assessment of Arthroscopic Skills Using Novel Wireless Elbow-Worn Motion Sensors

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**Summary**:
A new objective and entirely wireless system for assessing surgical skills (WASP) has proved valid for assessing arthroscopic skills.The validation of an entirely objective method of assessing arthroscopic skill with wireless elbow-worn motion sensors introduces a feasible assessment system for use in live operating theatres with the potential to be applied to other surgical subspecialties.

**Abstract**:
BACKGROUND
Assessment of technical surgical skills is a key part of surgical training and judging competency for independent practice. Assessment is still predominantly subjective although more 'objective' subjective assessments such as Global Rating Scales are in use. The aim of this study was to validate the use of wearable, wireless, miniaturized motion sensors in assessing the technical skill of trainees and surgeons performing a number of defined arthroscopic procedures in a simulated environment. Validating cost effective elbow worn motion sensors offers huge potential to all surgical disciplines, allowing feasible transfer of truly objective training assessment to the live operating environment.

METHODS
30 participants were recruited and divided into 3 groups; novices (n=15); intermediates (n=10); and experts (n=5) by their level of arthroscopic experience. All participants performed 3 standardized tasks on a virtual reality simulator whilst wearing 2 wireless motion sensors on their wrists and 2 on their elbows. Video output from the simulator was recorded, allowing blinded performance assessment of all participants using a previously accepted and validated global rating scale (GRS). Dexterity output metrics were also recorded directly from the simulator. Finally live motion data was recorded via Bluetooth from the wireless wrist and elbow motion sensors and bespoke algorithms produced an Arthroscopic Performance Score (APS).
Results: Construct validity was shown for the 3 arthroscopic tasks with the GRS and the VR output metrics showing significant differences between novices, intermediates and experts (p-values<0.001). Correlation of the VR output metric of path-length to the number of hand movements calculated from the wireless motion data was very high (p-values<0.001). Comparison of the APS levels to the VR output also showed highly significant differences (p-values <0.01). Comparisons of the APS to the gold standard GRS showed strong and highly significantly correlations for both sensor locations (with elbow being stronger/more significant than wrist sensors).

CONCLUSION
A new objective and entirely wireless system for assessing surgical skills (WASP) has proved valid for assessing arthroscopic skills. The elbow-worn sensor was shown to achieve more accurate Arthroscopic Performance Scores

for the participants thereby offering great potential for objective assessment of dexterity and performance in the real operating room.

CLINICAL RELEVANCE
The validation of an entirely objective method of assessing arthroscopic skill with wireless elbow-worn motion sensors introduces a feasible assessment system for use in live operating theatres with the potential to be applied to other surgical and interventional subspecialties.