Surgeon experience of mixed reality headset technology during the COVID-19 pandemic: a multicenter international case series in orthopedic surgery

INTRODUCTION

There is interest in using reality technologies within the medical sphere and specific focus within orthopedic surgery.[1]

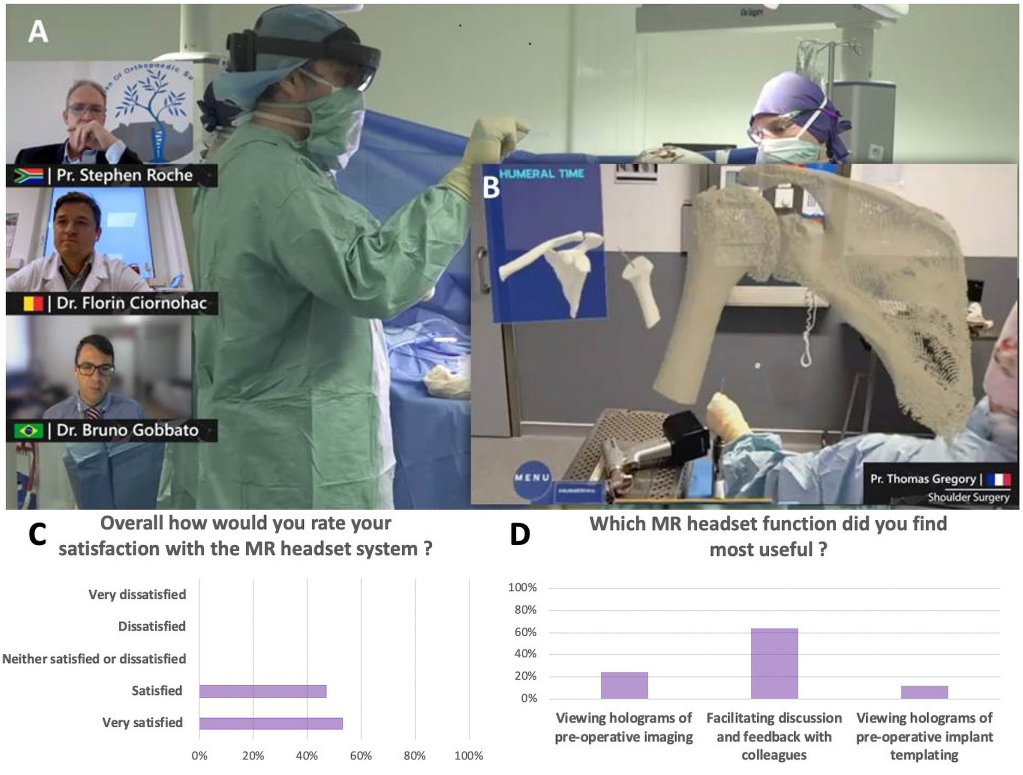
Mixed reality (MR) is a type of reality technology that allows for a digital image to be both superimposed and controlled by the user on top of their normal visual field. Using MR headsets, surgeons can access computer-based solutions in real time; manipulate three-dimensional (3D) holograms of patient anatomy, surgical planning, or implant systems; and remotely interact with colleagues. All these functions are achieved without compromising sterility and have been demonstrated successfully.[2–5]

Despite these successes, there has been no significant investigation into its impact on surgeon experience. Evaluating the surgeon experience of MR will be of importance in understanding how it can best be deployed and further optimized for the benefit of patients.

We report on surgeon experience following an international case series of orthopedic surgeries performed using MR headset technology during the COVID-19 pandemic.

METHODS

A consecutive case series of 13 orthopedic surgeries were performed between January and February 2021 during the COVID-19 pandemic. These were performed by different surgical teams across 13 different countries: Belgium, Brazil, Bolivia, France, Germany, India, Mexico, Morocco, South Africa, Ukraine, United Arab Emirates, the UK, and the USA. The procedure types performed were predominantly joint replacement surgeries (figure 1E). Surgical teams used the HoloLens MR headset system (Microsoft Corporation, Redmond, Washington, USA). Each team was able to use relevant computer-based solutions, and 3D holograms during the procedure, alongside communicating 'real time' with other surgical teams using a remote assist (RA) function (figure 1A,B). Audio-visual MR footage from each surgery was then edited and then shown to expert panels from multiple international centers over a 24-hour period. Detailed feedback was obtained from the surgical teams involved using an electronic questionnaire.



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Location of surgical team	Procedure
Belgium	Reverse Shoulder Replacement
Bolivia	Reverse Shoulder Replacement
Brazil	Shoulder arthroscopy
France	Anatomic Total Shoulder Replacement
Germany	Reverse Shoulder Replacement
India	Reverse Shoulder Replacement
Mexico	Anatomic Total Shoulder Replacement
Morocco	Total Hip Replacement & Total Knee Replacement
South Africa	Reverse Shoulder Replacement
Ukraine	Reverse Shoulder Replacement
United Arab Emirates	Reverse Shoulder Replacement
United Kingdom	Provided surgical assistance using MR headset
United States of America	Revision Lumbar Decompression and Fusion

Figure 1 Summary data, information, and images taken from the international mixed reality (MR) surgical case series. (A) The French surgical team based in Paris, performing an anatomic total shoulder replacement using MR headset technology with remote assistance from surgical teams based in Belgium, Brazil, and South Africa. (B) View seen by the operating surgeon showing a holographic representation of scapular anatomy, and relevant surgical planning. (C, D) A snapshot of surgeon electronic questionnaire results. (E) Geographic location of MR surgical team and procedure performed.

RESULTS

Seventeen surgeons from the 13 surgical teams were sent electronic questionnaires. The response rate was 100%. The overall surgeon satisfaction with the MR headset technology platform used was 52.9% (9 out of 17) reporting being very satisfied, and 47.1% satisfied (8 out of 17). Sixteen out of 17 (94.1%) surgeons reported that they would continue to use the MR headset technology in their future clinical practice (figure 1C,D).

Fourteen out of 17 (82.4%) surgeons reported importing preoperative holographic imaging, and 10 out of 17 (58.9%) reported holographic implant templating onto the MR platform for use during the case series. Eleven out of 17 (64.7%) surgeons found the RA functionality had been the most useful, followed by viewing of holograms of preoperative imaging (23.5%) and implant templating (11.8%). All surgeons reported that they would find the RA function a useful feature in the future.

DISCUSSION

This is, to our knowledge, the first published data in the literature on surgeon experience of MR technology. Our study used an innovative methodology designed to both demonstrate and evaluate the main functionalities of MR across an international cohort of surgeons. This was done during the global COVID-19 pandemic further adding to its novelty and relevance.

The overall surgeon satisfaction with the MR platform used was high, and nearly all stated that they would use the technology during their future clinical practice. Satisfaction rates within our cohort were equal to or higher than for other reality technologies.[6]

Focus and interest with MR technology to date has been the ability for 3D holographic viewing and manipulation. However, our results suggest it was the RA functionality and resulting enhancement to intraoperative communication with colleagues that surgeons found most useful. RA using MR technology should therefore be a point of focus for further research and development.

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