

Hologram opens new learning door for surgical residents- An academic view point

Introduction:

With the advent of newer technology and evolution of artificial intelligence, we can improve the expertise and decrease the errors in various medical fields. A hologram provides a non-contact three dimensional (3D) image that can be seen with the naked eye. These 3D images provide details of the human anatomy and activity of an internal organ of the body in high resolution. Holography is a two-step process. In the first step, it records a hologram in which a radiographic image is converted into a photographic record. The second step is to convert a hologram into a virtual image.

This provides better hands-on experience for medical and paramedical personnels. It can be employed in various fields of medicine ranging from laboratory investigations to complex surgical procedures.

A 3D hologram is a highly efficient simulation technique which could be effectively used for teaching and training for students in various aspects of the medical field at different levels.

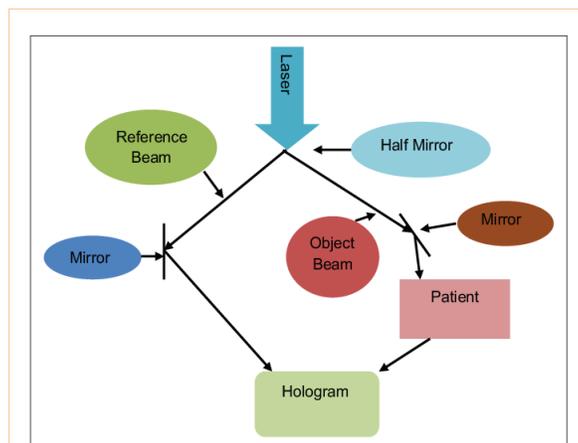


Figure 1: Process used in holography

As most of the residents doing specialization in surgical field (especially in orthopedics) in mid level tertiary care center, peripheral

center and post graduation in corporate hospitals where the access to anatomy dissection hall to learn in depth anatomy would be difficult which is required for better understanding for the students while doing surgeries and to learn the techniques real quick, hologram will make way easier for the students to achieve this lag. To err is human, but keeping our ethics in mind it is permissible and acceptable in a simulated environment rather than on actual patients. Creating a Simulated environment to learn reduces the damage to actual patient

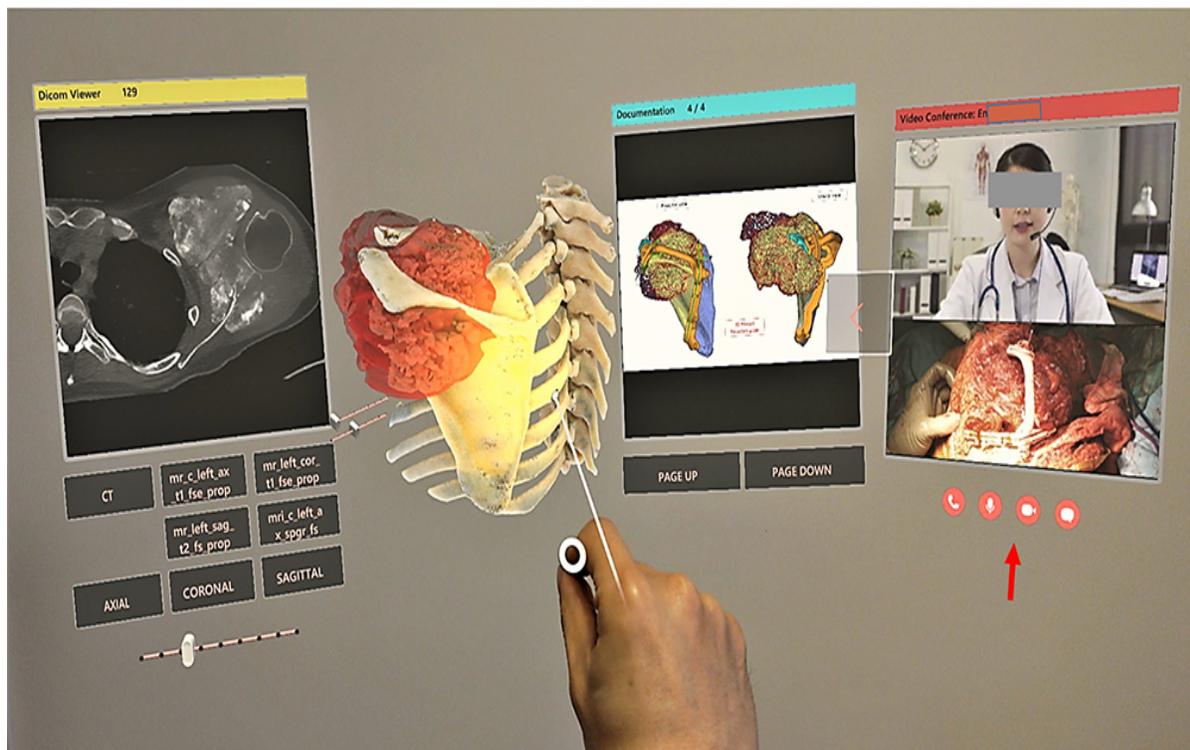
In this study we focus on how hologram helps in training orthopaedic residents in various surgical techniques and critical situations to handle the patients

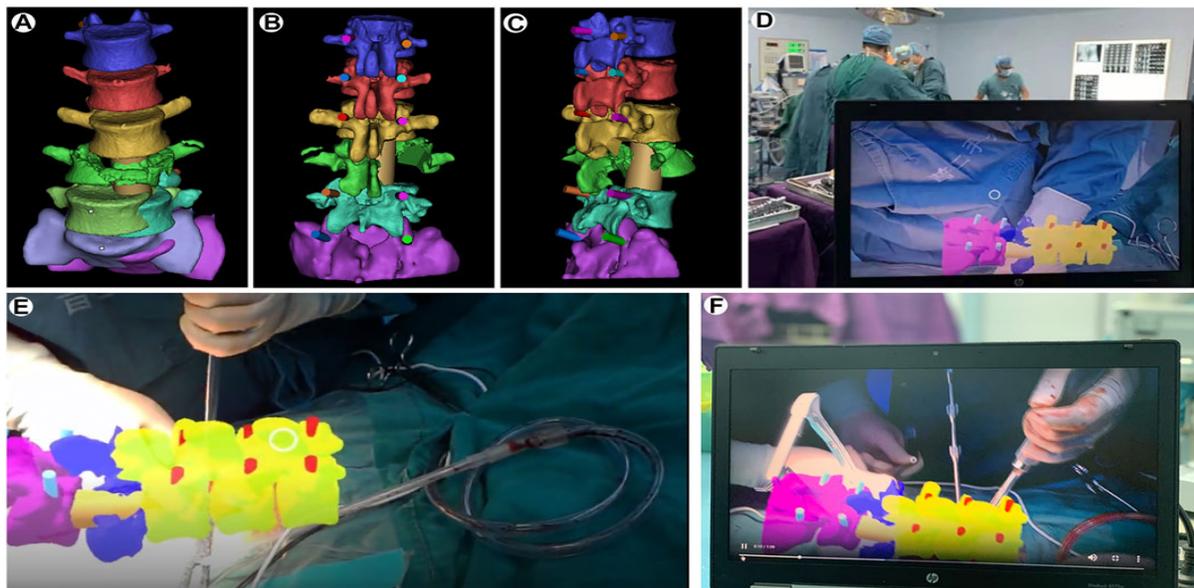
Methods:

Due to constraints in the time period during residency in orthopaedics, we are not able to get adequate hands-on experience for most of the surgical procedures. The reasons are mainly due to the confidence of the consultants towards the resident, as we need to operate on actual patients and there should be least chances for mistakes. The role of the hologram gets highlighted at this juncture, Using Microsoft's HoloLens glasses in combination with the Mixed reality system, it can project 3D holograms in real time under different clinical scenarios. The process of obtaining the surgical skills comes with practice which in turn boosts the confidence level of the resident and the consultant, which is the far fetched knowledge compared to that gained from books alone. Hereby holograms will provide different clinical, surgical and even emergency scenarios under simulation.

As the average total residency period for orthopaedic surgeons is 2 or 3 years in India, which is less when compared to the courses abroad. The students have inadequate operating experience on actual patients which may lead to lack of confidence during practice period. Using the hologram the residents can have a real time experience which

mimics a patient presenting with polytrauma along with appropriate feedback system, which enables proper learning of adequate resuscitative measures which could save the patient. This helps the students to deal with actual patients with better level of confidence and to minimize the human errors. In India due to non-uniformity of exposure of orthopaedic residents to various kinds of patients and surgical procedure hologram helps in bringing the learning exposure on par. It can help the consultants to sharpen their fine skills like soft tissue procedures (tendon suturing, nerve grafting, etc)with the appropriate simulation. Hologram can simulate a scenario and helps to do research that will be beneficial for the patients. It helps the consultant to superimpose the hologram image of the specific patients during surgery like spine, orthopaedic oncology etc., to predict the actual plane and degree of implant and screw placement, proper resection of tumor free margin.





Results:

This technology of using hologram that simulates various situations for the surgeons and physicians may be helpful for better training of residents. If this idea of using hologram to the residents is found beneficial, this can be extended even to undergraduates to develop knowledge about basics in every speciality which makes it easy to learn most of the things very early when they enter residency. It was found that surgeons who have started using hologram for a patient tailored pre-op and intra-op planning had a better outcome. Hence it will be more beneficial if this technology is extended for academic purpose.

Limitations:

Maybe thinking about extended reality won't be a better option for residents in certain scenarios, as it won't give tactile feedback like doing surgeries on actual patients, but it will enable them to learn better about the anatomy and dissection which is of utmost importance for the surgeons in their learning period.

In 1979, K. Piwernetz published an idea of “Holography in orthopaedics” as a part of the “springer series in optical sciences” book,

but it took many years since then to get a good knowledge about this and create a high resolution hologram for the medical professionals makes this technology really a difficult one to understand.

Conclusion:

Hologram will change the learning technique of the students by providing virtual imaging for better understanding of the subject. Simulation of some basic surgeries will help the residents to learn faster and decrease the incidence of errors in real time surgeries in future. Holograms can change the way of learning in future. But there are certain limitations concerning hologram use in academic purposes which includes the cost of manufacturing and maintenance and the source of funds to produce them. Hence it is still debatable about the feasibility of the advanced technology to the residents for which monetary benefits are required from the government to every teaching institute.

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