Virtual reality applications in orthopaedics

Sir,

Virtual reality (VR) is a three-dimensional (3D) software-generated world, by which a person can see computer-generated reality, like the model creating a virtual world, through wearing specially designed glasses and pieces of equipment. This technology has potential to assist different procedures in the field of orthopaedics, where it can provide a collaborative development to improve the quality of health, treatment, and its reports.[1]

The meaning of Virtual (near) and Reality (experience of a human being) implies a "reality of anything." VR provides sensory information with a computer-generated virtual environment and helps to interact in a 3D world, with the help of digital display. It creates an immersive and believable experience to explore a virtual world or computer-generated world. Using scientific visualization, the human/audience can interact with these images or virtually created objects.[2] It is a fully immersive experience as it can convince the user to an artificial environment where they suspend their belief of real world and engage in the simulation. Different components of VR are head-mounted displays, immersive rooms, data gloves, and wands. It consists of different angled and multifunctional cameras, which creates a virtual environment or a second set of reality.

The components of VR interact with the virtual and real world to minimize the time of the treatment and orthopaedics surgery and thereby make it possible to experience it anywhere, anytime.[3] VR is an immersive type of reality to convince human brain like actual practice to perform the surgery. Working steps of VR in medical as well as in orthopaedics are as given below:

- The VR of surgery using glasses and cameras
- Learning, practice, and training machine learning involved
- Generation of an innovative concept
- Performing surgery.

First, VR helps to see the actual performance of surgery and helps the doctor to learn, practice, and generate new concepts and better methods. VR is an appropriate technique for the training of medical students in the operating room and helps to reduce errors and enhance their skills for surgery. VR combines real world using advanced display digital technique to provide preoperative planning information. This technology allows surgeons a proper visualization, which helps achieve correct alignment and placement of implants during orthopaedics surgery.

In orthopaedics, VR may be utilized effectively to perform clinical trials and may also provide useful feedback during orthopaedics, trauma, and knee replacement surgery and provides information at remote for virtual training.[2] Doctors and surgeon can solve different problems to improve the health of their patients through different applications of VR in orthopaedics [Table 1].

In orthopaedics, this digital technology is used to perform simulation of a complex fractured bone, which is helpful to perform better surgery. It also helps an orthopaedics surgeon to understand the complicated

Table 1: Major applications of virtual reality in orthopaedics

Applications	Description
Planning	Helps to plan the complicated procedure before performing an actual surgery
	Provides the best and innovative solution for the management of a traumatic fracture
Education and training	Provides a simulation model which upgrade the medical education and enhance training
	It can access any remote location and having the ability to simulate orthopaedics field
	The medical students can learn and study lesson in an effective way
Good-quality imaging	Image quality is reasonably good
	Provide a better image of patient hard tissue as compared to CT, MRI, ultrasound and other scanning technique
Digital 3D visualization and simulation	Creates an accurate digital simulation of anatomy and pathology of an individual patient
	Opens a new area of innovation to take challenges in orthopaedics
Treatment in rural areas	Helps perform treatment in rural/remote areas
	It is a cost-effective
Accurate information	Provides accurate information on patient health digitally
	Provides cost-effective communication between doctors, surgeon, and patient
Treatment of fractured bone	Anatomy of a fractured bone is seen clearly and is helpful in the treatment
	For stress management, it provides an effective solution to improves patient care
Keep record digitally	Used to record patient's bone defect, for research and development
	It is useful to keep a record as not keep by patient or families

3D=Three dimensional, CT=Computerized tomography, MRI=Magnetic resonance imaging

surgical procedure and treat the fractured bone. It is the principle of practice that allows the surgeon to see an actual patient pathology in real life.[4]

Martin *et al*., 2016 used VR for multiple instructional modules to facilitate training and education.[1] In another case, Li *et al*., 2017 used this technology in clinical medicine and this has exclusive use for pain management, surgical training, and treatment. The study shows that doctors and patients take full benefits of this technology.[5] Stirling *et al*., 2014 used VR to minimize risk in the safety of the patient, financial expenditure, and operating theater usage. It provides simulated prosthetic models and seems efficient 3D software tool.[6]

The main limitations of VR are in being cost (hardware and software) and are complex to use and train. Doctors need training before performing an actual VR-based surgery. Thus, to gain real-world experience, VR allows doctors and surgeons to take a virtual risk as it is based on interpersonal connections for individual communication. Sometimes, it does not offer that level of flexibility as the same program is repeated in a VR headset.[7]

It is hoped that VR will play a significant role for surgeons, doctors, trainees, and scientists. It will provide the most significant development for high precision surgery. Machine learning can also be implemented effectively for a higher degree of precision, analysis of previous surgery and record, providing with the details, on which doctors and surgeons can practice and learn the surgical procedure to performed better operations.[8] It develops a simulated environment to enhance the method of orthopaedics surgery. This technology will become cheaper and provide reality to communicate all procedure of orthopaedics and provides an experience of anything in anytime where required.[9]

VR is a modern tool which provides easy access, cost-effective, and safe technology and uses virtual information to create revolutionary innovation for various surgical procedures. In upcoming years, VR should create a positive impact in the field of orthopaedics.

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