Advantages of 3D Visualization Systems for Teaching in Ophthalmology

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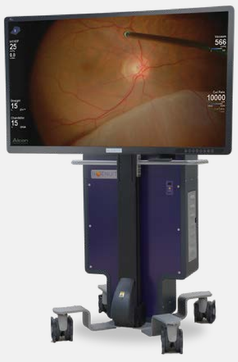
BACKGROUND

- Ophthalmic surgeons in training are often hindered by the difficulty in obtaining the best operative view[1]
- Visualization and depth perception are critical in learning, but with conventional microscopes (CMs) the surgeon looks through binoculars of the scope, while trainees observe through a secondary monitor, which lacks the same resolution or light output[1]



The NGENUITY® Visualization System, an example of a 3D visualization system

OBJECTIVE

- A literature review was conducted to understand benefits of 3D visualization systems for teaching and education in ophthalmic surgery

METHODS

- A targeted search was performed and screened using the following strategy and criteria:

Database:	• MEDLINE
Date range:	• January 1, 2001 – May 26, 2022
Search terms:	• "ophthalmic", "cataract", "eye surgery", "3D visualization", "heads-up", "digitally-assisted", "education", "teaching", "learning curve"
Key inclusion criteria (screening):	• Reported errors and a digital technology or digital solution used in ophthalmology • English language

- Reference lists from relevant articles were also scanned

RESULTS

- Of 508 sources identified, fourteen studies evaluating the impact of 3D visualization systems for education in ophthalmology were identified.
  - ➢ All identified studies noted a benefit for surgical training with the use of a 3D display[1-14]
- Six surveys comparing surgeon preferences for 3D displays versus CMs reported that the majority of surgeons expressed greater preference and higher satisfaction scores for 3D visualization, with educational advantages noted as a key benefit:

➢In surveys in the US and Japan, surgeons have reported greater preference for 3D displays than for CMs, with **teaching benefits being one of the most common reasons provided**[2,3]

➢In a questionnaire from Saudi Arabia, 68.1% of the 3D display users found it a valuable educational tool, and 83.3% of users recommended its use in surgical training[5]

➢In a satisfaction questionnaire administered to surgeons alternating between a 3D visualization system and a CM, 100% of surgeons expressed **highest satisfaction scores** when considering visibility, image quality, and **teaching potential**[6, 13, 14]

➢Two questionnaires administered to medical interns and residents observing surgeries in randomized controlled trials found that the **3D groups had significantly higher ratings of satisfaction** than the CM groups (P<0.001) across several parameters, including educational value[1,4]

In an evaluation of macular hole surgeries by trainee surgeons, closure rate was significantly higher (P<0.004) when trainees used 3D displays than with CMs, with viewing technique being the only significant variable between the groups[7]

Benefits of 3D visualization have been observed during scleral buckling and in vitreoretinal surgeries for enhanced trainee and staff viewing, and it has been noted that the 3D display augments the educational impact and enhances surgical communication[8,9]

3D visualization has been used with high satisfaction for telementoring, with three Canadian surgeons proctored by a surgeon in Israel in the implantation of a keratoprosthetic device[10]

CONCLUSION

- The current evidence demonstrates that 3D visualization displays, such as the NGENUITY® 3D Visualization System, can provide considerable advantages for teaching and education
- By allowing the attending surgeon and trainees to share a view of the operating site, 3D displays allow surgeons to provide feedback using the screen's surgical view. Moreover, trainees can discuss difficult surgical steps and complications in a 3D view using the video recording, providing learning experiences and opportunities to reduce the duration of subsequent surgeries[7]
- Future studies assessing trainee experience would strengthen these observed trends

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