

Robotic surgery

Robotic surgery in ophthalmology: reality or fantasy?

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Advantages of robotic surgery

During the past 5 years, robotic surgery has gained increasing acceptance in mainstream clinical care owing to dramatic improvements in technology and ergonomics. Robotic surgery offers several advantages compared with other minimally invasive laparoscopic surgical techniques, including a three-dimensional view, superior instrument manoeuvrability, greater magnification and reduced tremor. Minimally invasive laparoscopic surgery has been poorly implemented despite a clear improvement in morbidity compared with open surgical techniques. Despite similar cost barriers, robotic surgery offers several important advantages and opens a new frontier for minimally invasive surgery, but will it have a role in ophthalmology?

Robotic surgery as performed by the da Vinci robot allows the surgeon to remain seated when viewing a three-dimensional image. Here, the robot translates complex hand and wrist movements in a coordinated manner and maintains hand-eye coordination. Currently, no tactile feedback is available; however, this is immaterial to the ophthalmic surgeon.

The overwhelming advantage of minimally invasive, robotic surgery is its elegant access to critical surgical sites without collateral tissue damage secondary to direct visualisation and instrumentation. For example, robotics has gained considerable attention in cardiac surgery, especially valve replacement, paediatric abdominal surgery and urology.¹⁻⁵ In each case, maximum implementation has been achieved when open access to the surgical site would require pronounced collateral tissue trauma. In addition, even when

open techniques are possible, robotics provides superior precision.

Ophthalmic surgery is unique, as the surgeon has direct visualisation of the surgical site and ocular structures via the cornea. Direct, non-invasive visualisation via the transparent cornea and microscopic techniques has promoted the development of elegant, minimally invasive surgical instrumentation for intraocular surgery. In fact, the development of ophthalmic instrumentation formed the foundation for robotic instrumentation. Thus, one of the foremost advantages of robotic surgery—direct visual access and microsurgical manipulation in a confined surgical site—is not relevant to ophthalmic surgery.

Robotic surgery may provide other distinct advantages for ophthalmic surgery, including improved technical precision and improved patient access to subspecialty surgery. Ophthalmic surgery requires precise manipulation of microsurgical instrumentation. Robotics, as shown in Trisbas *et al*,⁶ can provide the level of precision necessary to perform ophthalmic surgery with a short learning curve, improved speed and without mechanical tremor (*see page 18*). At present, robotic instrumentation is precise to within 1 mm, but as technology continues to develop, precision within microns will be required for successful implementation in ophthalmology.

Utilisation of robotic surgery and telemedicine may provide access to ophthalmic subspecialty surgery in geographically isolated areas. Robotic surgery has been effectively implemented in geographically isolated regions, such as Alaska, and in remote sites by the

military. In these circumstances, robotic devices facilitate subspecialty surgery that would otherwise be unavailable.

Robotic ophthalmic surgery may potentially provide outstanding subspecialty surgical training for new and experienced surgeons without requiring extensive travel.⁷ It is often difficult to communicate the art of ophthalmic surgery without direct “hands on” training. Although surgical training as a sole purpose for implementation would be cost prohibitive, this technology offers the potential to substantially improve surgical training and, as a result, patient care.

Several hurdles face broad implementation of robotic surgery, including direct robotic costs and ancillary staff training, but these considerations are common during the introduction of novel subspecialty instrumentation. Robotic ophthalmic surgery offers several advantages, but it will probably face major technical and financial challenges before widespread implementation is achieved.

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