Review Article

# Orbital endoscopic surgery

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Minimally invasive "keyhole" surgery performed using endoscopic visualization is increasing in popularity and is being used by almost all surgical subspecialties. Within ophthalmology, however, endoscopic surgery is not commonly performed and there is little literature on the use of the endoscope in orbital surgery. Transorbital use of the endoscope can greatly aid in visualizing orbital roof lesions and minimizing the need for bone removal. The endoscope is also useful during decompression procedures and as a teaching aid to train orbital surgeons.

In this article, we review the history of endoscopic orbital surgery and provide an overview of the technique and describe situations where the endoscope can act as a useful adjunct to orbital surgery.

**Key words:** Endoscopic orbital surgery, endoscopic dacryocystorhinostomy, orbital fracture, transorbital

*Indian J Ophthalmol* 2008;56:5-8

In recent years, there has been a growing trend towards the use of minimally invasive techniques in surgery. This is a result of trying to achieve a better cosmetic outcome combined with reducing the morbidity of extensive tissue dissection. Endoscopic surgery exemplifies these attempts and has been enthusiastically adopted by general surgeons, gynecologists and ear nose throat (ENT) surgeons. Endoscopic orbital surgery, however, is in its infancy and is performed primarily via sinonasal approaches by ENT surgeons. Transnasal endoscopic approaches are well established for orbital decompression,[1] orbital medial wall fracture repair[2] and optic canal decompression.[3] The use of a transmaxillary or transnasal endoscopic approach has also been described for repair of orbital floor fractures.[2] The ophthalmologists are familiar with the endoscope primarily in the context of endoscopic dacryocystorhinostomy (DCR)[4] and endoscopic brow lift.[5] Nasal endoscopy has also been proven useful in the perioperative assessment for lacrimal surgery and probing of the nasolacrimal duct.[6,7] Additional applications in oculoplastic surgery include transcanalicular endoscopy[8] and endoscopic assistance in face-lifts[9] and in harvesting fascia lata.[10] The purpose of this article is to review the transorbital use of the endoscope. There are selected situations where the orbital surgeon can profitably use the endoscope and given the ready availability of endoscopic systems in most general hospitals and the relative ease of use, it is worthwhile for the orbital surgeon to familiarize him/herself with these applications.

## History

The widespread use of endoscopes in medicine followed the development of fiberoptic transmission of light by van der Heel, Harold Hopkins and Narinder Kapany (who coined the term fiberoptics). This allowed vastly superior illumination at the surgical site, thus overcoming the main limiting factor of endoscopes until that time. The first endoscope using fiberoptic transmission was a gastroscope built by Hirschowitz in 1958.[11] Rigid endoscopy became popular with the invention of rod lenses by Harold Hopkins in 1960.[11] They were first used in rigid cystoscopes and later in other endoscopes.

The use of endoscopes in orbital surgery was first described by Norris and Cleasby in 1981.[12] The initial reports by Norris *et al*. detailed the use of the endoscope in obtaining biopsy from orbital tumors[13] and in removing foreign bodies from the orbit. Isotonic saline was used to provide visualization while dissecting in the orbit. This, however, increased the pressure within the orbit and the tissues used to become rapidly edematous. Norris and Cleasby also found that using air to aid visualization was not successful.[12] Braunstein *et al*. have also described the experimental use of flexible endoscopes in the orbits of dogs using hyaluronate infusion through the endoscope tip to aid visualization.[14] However, the potential for compressive collateral damage during the creation of an optical cavity has limited the use of the endoscope within the orbital fat. Hence, due to the lack of a safely distensible space, intraorbital endoscopy[15] is not widely used. However, with the growing popularity of endoscopic surgery in otolaryngology, endoscopic approaches to the orbit began to be described, but these were mainly transnasal or transantral approaches. In 2004, Selva and Chen described the transorbital use of the endoscope during curettage of a cholesterol granuloma of the orbital roof.[16] Since then, there have been reports of endoscopic approach to lesions of the orbital roof and also on the use of the endoscope as a surgical teaching aid.[17,18]

## Instrumentation

Endoscopes may be flexible or rigid. In orbital surgery rigid endoscopes are primarily used. The endoscope consists of a steel tube enclosing the fiberoptic illumination system and the lens system. The optical system is similar to that of a periscope with objective and ocular lenses at the two ends of the scope. An inverted image is formed by the objective lens and the image is

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Manuscript received: 17.11.06; Revision accepted: 21.08.07

relayed along the length of the scope by means of 'rod' lenses, which are glass rods with intervening 'air lenses' [Fig. 1].

This system allows most of the light from the object to reach the eyepiece. Prisms are attached at the distal end to vary the angle of view, from zero degrees to 110 degrees. Light is usually provided by a 300W xenon light source. The image is captured on a charge couple device (CCD) camera located at the proximal end of the scope. A 3-chip CCD used in newer scopes provides better color reproduction. The image acquired by the CCD chip is processed and projected onto a video monitor. The images can be recorded and printed. Video endoscopes are available from several different manufacturers. Four-millimeter rigid endoscopes with 0, 30 and 70-degree tips are usually used in orbital surgery.

It is important to note that owing to the fragile glass components and adhesive agents within the endoscope, heat sterilization is usually not recommended. Endoscopes may be sterilized using ethylene oxide, but this entails at least a 24-h waiting period before the instrument can be used. Usually high-level disinfectants such as glutaraldehyde 2% and peracetic acid 0.2% are used.[19]

## Indications

One of the prerequisites for successful endoscopic surgery is the presence of a safely distensible cavity such as the bladder or stomach or a potential space that may be insufflated such as the peritoneal cavity.[15] As previously noted, the presence of orbital fat makes endoscopic surgery within the orbit very difficult. It is therefore necessary to either create a space to use the endoscope or, alternatively, use a potential cavity such as the sub-periosteal space.

The primary advantages of the use of the endoscope in the context of orbital surgery are: safe visualization of areas with difficult access which may otherwise require bone removal for adequate exposure, excellent illumination, magnification[20] and the potential for supervision of trainees. Thus, the two main indications for transorbital endoscopic surgery currently are lesions involving the orbital roof and the use of sub-periosteal endoscopy as a teaching aid.

**Use of endoscopy in orbital roof lesions:** Lesions such as cholesterol granulomas, orbital dermoids and Langerhans cell histiocytosis involving the anterior portion of the orbital roof and situated behind the superior orbital rim can be difficult to visualize during surgery [Figs. 2a and b]. Bone removal is often

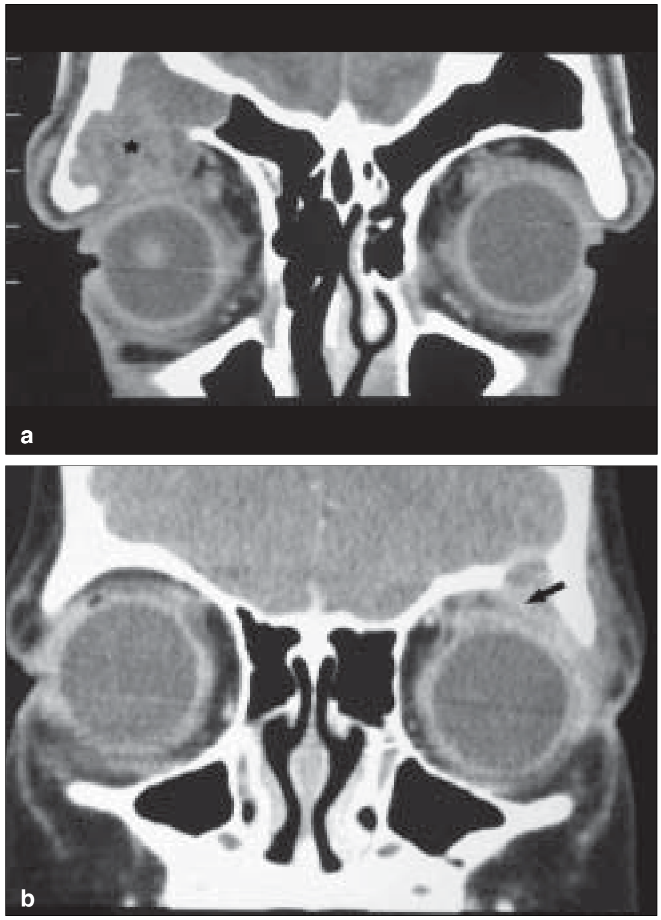


**Figure 2:** Computed tomographic images of selected orbital roof lesions where the intraoperative use of the video-endoscope is a useful adjunct, a) cholesterol granuloma involving the right superolateral orbital roof (asterisk) b) Langerhans cell histiocytosis (eosinophilic granuloma) involving the left superolateral orbital roof (arrow)

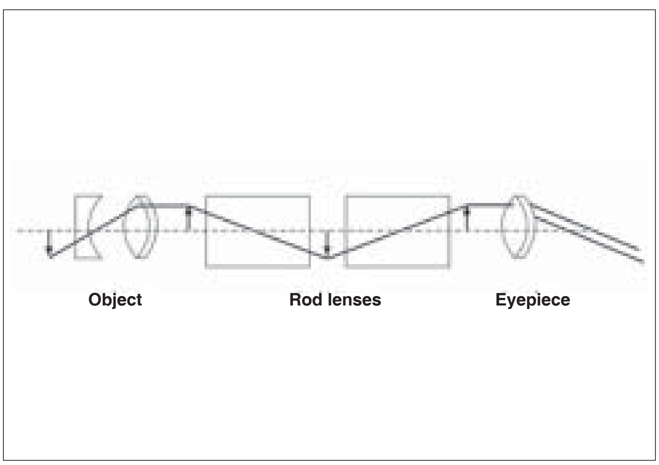


**Figure 1:** Optics of the rigid endoscope. The rod lenses within the endoscope tube help to minimize the scattering of light

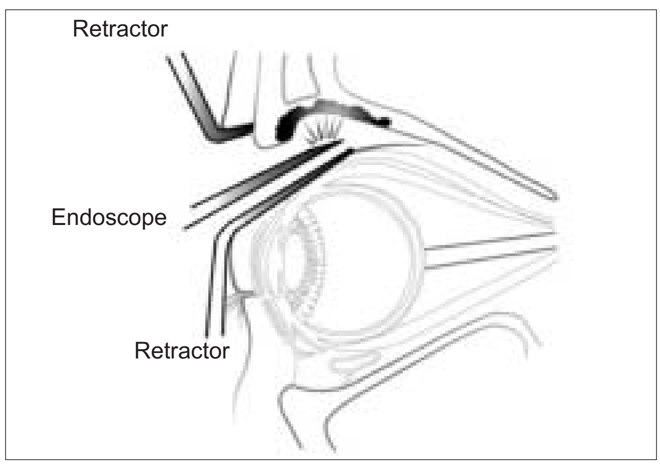


**Figure 3:** Line diagram illustrating the utility of a video-endoscope in visualization of orbital roof lesions

needed for adequate visualization in this situation. The use of a rigid video endoscope can provide excellent visualization behind the superior orbital rim and is an excellent aid during surgical removal of these lesions [Fig. 3].

The technique used is as follows: After induction of general anesthesia a skin incision is placed in the upper eyelid skin crease. A suborbicularis dissection is carried out to the superior orbital rim and the periosteum is incised 5 mm above the arcus marginale. The periorbita is then elevated off the orbital roof and orbital contents retracted inferiorly with malleable retractors. As much of the lesion as possible is removed under direct visualization [Fig. 4a]. A rigid video-endoscope with a 30 or 45-degree tip is then introduced posterior to the superior orbital rim [Fig. 4b]. Endoscopic survey reveals the extent of the lesion that can now be removed under visualization from areas that are not directly visible behind the orbital rim and any areas abutting the dura [Fig. 4c]. A 70-degree tip is on occasion required for a better view of the internal aspect of the superior orbital rim and the anterior wall of the frontal sinus for those lesions that abut these areas. The periosteum is reattached and the skin incision is closed.

**Use of the endoscope as a teaching aid:**[17] The small surgical field available when operating within the orbital confines makes it difficult for a supervising surgeon to view the trainee's surgery. The sub-periosteal space is a potential space that allows retraction of the orbital contents by placing a retractor against the orbital periosteum. The space thus created is ideally suited for placement of a video-endoscope which can be used to observe surgery within the orbit. The supervising surgeon usually holds the endoscope while the operating surgeon may either view the surgical field directly or observe it on the video monitor. The light from the endoscope and the magnification provided also aid in the dissection. In most cases the endoscope is rested on the orbital rim or, less frequently on a retractor to provide the required view and also to minimize fogging. Using agents such as cetrimide or FRED® (a defogging agent containing isopropyl alcohol and surfactant, Tyco Healthcare) to clean the endoscope tip can also help to reduce fogging. On occasion, a shorter and narrower endoscope such as a pediatric video-otoscope or a flexible endoscope may be used so as not to compromise the surgeon's access or view. This may be particularly useful in the transcaruncular approach to the medial orbital wall, where the

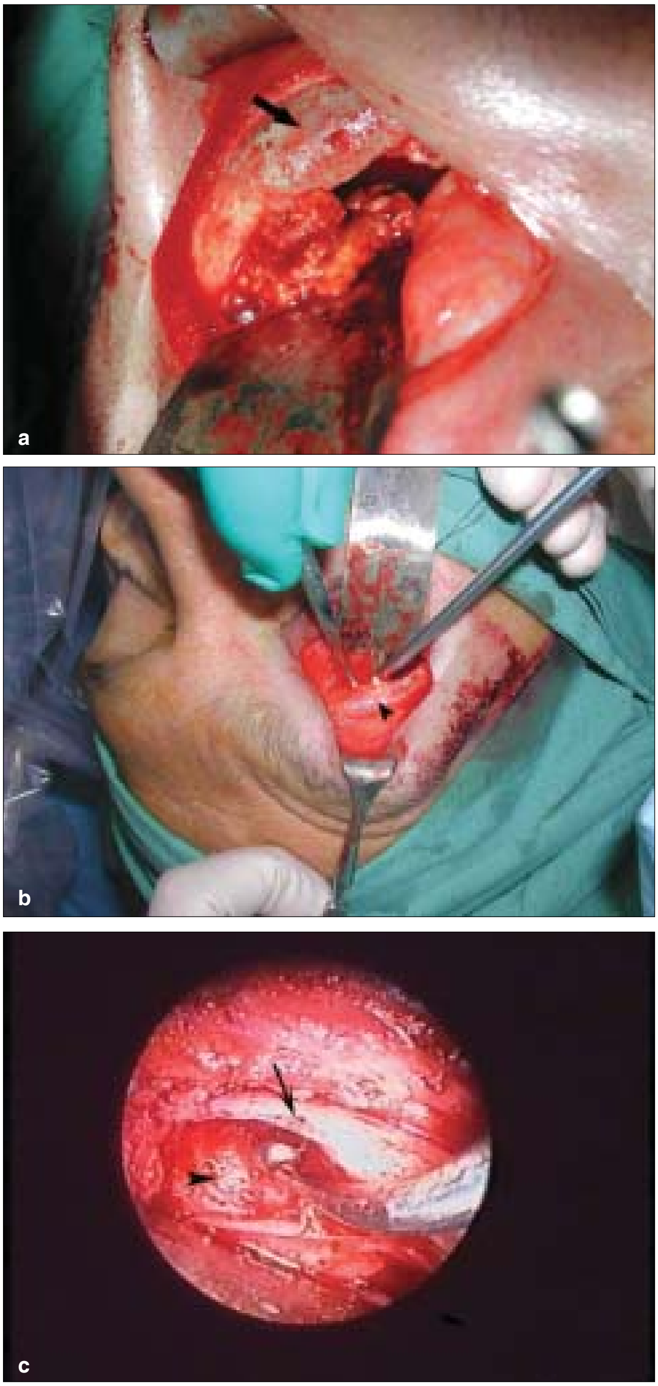


**Figure 4:** Intraoperative photographs demonstrating a) lid crease incision and retraction of orbital contents using a malleable retractor. The anterior portion of the lesion (cholesterol granuloma - arrow) can be removed under direct visualization. b) Introduction of endoscope beneath the superior orbital rim (arrowhead) and c) curettage of the lesion with endoscopic visualization. Endoscopic visualization of the dura (arrowhead) allows safe removal of the entire lesion (arrow-superior orbital rim)

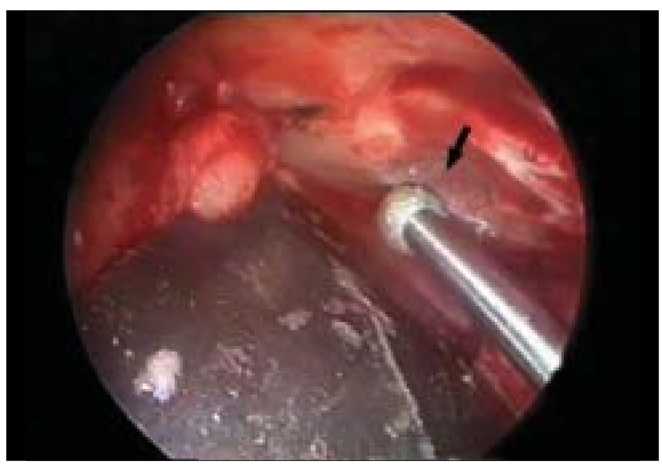

**Figure 5:** Still image from orbital decompression procedure showing the excellent visualization obtained with a video-endoscope during removal of the deep lateral wall (arrow)

larger endoscope may impede the surgeon's access through the small incision. Endoscopic supervision is most applicable to procedures such as deep lateral wall or medial wall orbital decompression, orbital fracture repair and lesions involving the orbital roof. Endoscopes used may vary from 0 to 70-degree tips depending on the location of the surgical field. In addition, the procedures may be recorded onto videotape and reviewed by both consultant and trainee [Fig. 5].

## Limitations and Complications

As previously mentioned, the presence of orbital fat interferes with intraorbital use of the endoscope. Thus, the utility of this accessory instrument is limited to procedures wherein a subperiosteal approach is possible. As with any procedure, there is a learning curve before the endoscope can be comfortably and effectively used, but this can be considerably shortened by observing and assisting with ENT endoscopic procedures. Complications from the use of the endoscope are extremely rare. Injury to orbital structures and dura with the instrument can be avoided by ensuring good visualization at all times and resting the instrument against a firm surface (such as the orbital rim) can help prevent sudden movement.

## Summary

An endoscope-assisted approach provides three distinct advantages to the surgeon: 1.increased light intensity at the operating site; 2. increased magnification and 3. excellent visualization of poorly accessible sites. The primary advantage of an endoscopic-assisted percutaneous approach to orbital roof lesions is avoidance of bone removal for adequate exposure. Furthermore, the utilization of a more minimally invasive technique may enable management as day surgery thus reducing length of hospitalization in comparison with the traditional postoperative management of a lateral orbitotomy or craniotomy. Also, as described, video-endoscopes can be an invaluable aid in teaching orbital surgery and allow the trainee to perform selected complex orbital surgeries under complete supervision. As the instrumentation is usually available in general surgical theaters orbital surgeons can request the help of their colleagues in other specialties to become comfortable in endoscopic techniques thus allowing them to take advantage of its potential in orbital surgery.

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**Source of Support:** Nil, **Conflict of Interest:** None declared.