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Cataract surgery assisted by anterior endoscopy

K Al Sabti,1 S Raizada,2 T Al AbdulJalil2

ABSTRACT

Aim: The aim of the present study is to evaluate the feasibility of endoscopy-assisted phacoemulsification, intraocular lens (IOL) implantation and anterior segment manoeuvres like synechiotomy where conventional surgery through a microscope view was not possible due to corneal opacification.

Methods: This is a prospective, non-comparative, case report series of nine consecutive patients who underwent endoscopy-assisted anterior segment surgery in Al Bahar Eye Center in Kuwait. A fused fibre-optic type of endoscope was used to aid in performing phacoemulsification, to identify the position of haptics of IOL and synechiotomy.

Results: Out of a total of nine patients, seven patients underwent endoscopy-assisted phacoemulsification. In case 7, the endoscope was used to sever irido-corneal synechiae. In case 8, the endoscope was used to identify the position of the haptics of IOL in a partially dilated pupil. In case 9, endocyclophotocoagulation (ECP) was done after phacoemulsification. Vision improvement occurred in all cases. No intraoperative or postoperative complications related to either the surgery or the use of the endoscope were observed.

Conclusion: The ophthalmic microendoscope appears to be safe and effective in simultaneously providing illumination, video recording and a clear endoscopic view of the anterior chamber. This study demonstrates that in selected cases, anterior segment endoscopy is a useful adjuvant to cataract surgery.

The majority of the uses of the endoscope in ophthalmology have been limited to vitreoretinal surgery.1–9 Recently, the ophthalmic micro-endoscope has been used in performing phacoemulsification in a case with corneal opacity;10 as an educational tool to teach cataract surgery;11 in assisting with continuous curvilinear capsulorrhexis;12 to visualise the posterior surface of the cornea during deep anterior lamellar keratoplasty (DALK);13 in assessing the position of intraocular lens implants;14 for glaucoma surgery in a case with hazy cornea;15 and for photo-ablation of ciliary processes under direct visualisation in refractory glaucoma.16 17 In the present study, we report our experience using an ophthalmic endoscope for surgical procedures in the anterior segment of the eye in cases with corneal opacification in which conventional microscopic visualisation was not adequate.

METHODS AND MATERIAL

This is a prospective, non-comparative, case report series consisting of nine consecutive cases in which the endoscope (E-4 Microprobe, manufactured by Endo-optiks, Little Silver, New Jersey) was used to assist in anterior segment surgical procedures. The study was conducted in Al-Bahar Eye Center in Kuwait. Nine cases over a period of 14 months (from December 2006 to February 2008) were enrolled in this study. The procedure was explained in detail to all patients, and informed consent was obtained. This study was approved by the local ethics committee and the Ophthalmic Council of Kuwait.

We used a fused fibre-optic type of endoscope, a 0.88 mm/20G probe. The fused fibre-optic technology makes it more flexible, provides a larger field of view and is focused only once before starting the surgery. The compact endoscopy cabinet houses a 175 W xenon light source and a 10 MP CCD camera. A high-resolution monitor (Sony PVM-14M2MDU, Tokyo) is placed near the surgeon for video-display. This compact unit also creates the opportunity to simultaneously image and to do endolaser.

Cases with corneal opacities, either booked for cataract surgery or waiting for corneal transplant preceding cataract surgery, were included in the study. In these cases, complete phacoemulsification through conventional microscopic visualisation was judged not to be possible, due to corneal opacification. Other indications to use endoscopy were, in one case, to release irido-corneal adhesions, in another, to ascertain haptic position in a patient with poorly dilating pupils and in a third case to perform photo-ablation of ciliary processes in a patient with refractory glaucoma.

All patients underwent complete ocular examinations and needed to have a minimum follow-up of 4 months after the procedure to be included in the study. The details of the endoscopic surgery and operative complications were noted. Postoperative findings of visual acuity, intraocular pressure, posterior segment status and ultrasound findings were recorded.

All cases were done under peribulbar anaesthesia. A 2 mm clear corneal incision was made for endoscope entry. Another 2.8 mm limbal incision was made to insert the phaco probe. Both the incisions are at 90° to each other, to facilitate manoeuvring of both probes in the anterior chamber. Trypan Blue (0.5 ml 0.1%, Vision blue, DORC International, Zuidland, The Netherlands) was used to stain the anterior capsule because the colour contrast makes it easier to see through the endoscope. After washing the dye, viscoelastic (Viscoat Alcon-Couvreur, Puurs, Belgium) was injected in the anterior chamber to deepen it. After that, the video image was sharpened by focusing the endoscope on any object (we used a 2 ml syringe) and to see the orientation of Number 2, which should be upright and clear. The endoscope probe was then inserted into the anterior chamber. Capsulorrhexis was done with the help of the video image.
of rhesis forceps via the image seen on the monitor through the endoscope. Endoscope was used to identify the edge of the capsulorhexis so that the hydro-dissection cannula could be inserted between the capsule and the cortex. Phacoemulsification was partly done using the view from the endoscope and partly by using the operating microscope through the less opaque cornea. The technique used was trench, divide and conquer. Endoscopic visualisation was used to sculpt a central trench. Trench-making is difficult because depth perception is not present in two-dimensional views on the monitor. This lack of stereopsis was overcome by keeping the depth of the trench at a one-and-a-half phaco probe diameter. Bimanual nucleus fracture was done through microscopic visualisation. Transcorneal illumination with an endo-illuminator also helps when working under a microscope through a less opaque cornea. Removal of nucleus fragments, as well as irrigation and aspiration (I&A), was done through endoscopic visualisation. IOL implantation was done through microscopic visualisation. The endoscope was inserted again at the end of the surgery to check for residual cortex and to assess the position of the haptics. Viscoelastic was injected into the anterior chamber and also under the iris. The endoscope was directed towards the periphery to see the capsular bag and the relative position of IOL haptics. The corneal entry wounds were closed with 10 zero sutures at the end of surgery. In one case of refractory glaucoma, photocoagulation of ciliary processes was done through an endoscope probe. In this case, after phacoemulsification and irrigation-aspiration, viscoelastic was injected in the anterior chamber of eye to inflate the capsule in order to gain access to ciliary processes from the anterior approach. Then, the endoscope was inserted through the corneal entry wound, and the ciliary processes were visualised on the endoscope monitor. Two hundred and seventy degrees of ciliary processes were treated, the end point being a whitening and shrinkage of processes.

RESULTS
Nine eyes of nine patients were included in this study. Concise results are tabulated in table 1.

In case 1, slit-lamp examination showed thick fibrotic pterygium arising from the inferior fornix and reaching up to the centre of the cornea. Phacoemulsification was done using the endoscope except for the cracking of nucleus and IOL insertion. Pterygium was removed after endoscope-assisted phacoemulsification because pterygium excision and scraping it off the cornea would have made the cornea hazier and more distorted. Moreover, conjunctival bleeding would make the surgery difficult. Mitomycin C (0.02%) was applied to the bare sclera for 5 min. Even, after the removal of pterygium, the view of the anterior chamber was not clear. In case 2, in the bag position the IOL was confirmed by endoscopy at the end of surgery. No residual cortex was seen. In case 3, only capsulorhexis and assessment of the IOL position were done under endoscopic visualisation: the rest of the steps were done under an operating microscope through the less opaque areas in the cornea. Case 4 was a patient with macular grade corneal opacity and a mature cataract in the right eye. Capsulorhexis, trench-sculpting, removal of nuclear fragments, and irrigation and aspiration were done under endoscopic visualisation. At the end of the surgery, endoscopy revealed that one haptic was in sulcus. It was dialled in the bag under endoscopic visualisation. In case 5, phacoemulsification under endoscopic visualisation was done. At the end of surgery, endoscopy revealed one haptic in sulcus, which was dialled in the capsular bag. Cases 6 was a patient with cataract and diffuse corneal opacity. Due to the dense corneal haze in the left eye, the patient underwent phototherapeutic keratotomy (PTK) to remove 100–150 μm of anterior corneal haze, 4 weeks before cataract surgery. Even after PTK, the view was not conducive enough for phacoemulsification through a microscope view, so the patient underwent endoscope-assisted phacoemulsification. At the end of the surgery, endoscopy revealed that the IOL was not in the bag. The haptics were dialled in the bag under endoscopic visualisation. Case 7 was a patient with post-traumatic central corneal opacity with irregular pupil and dense cataract in the right eye (fig 1A). The pupil was irregular, due to iridocorneal synchia. Before starting phacoemulsification in this patient, synchietomy was done, with the help of endoscopic visualisation. After a corneal stab wound, the anterior chamber was deepened with viscoelastic injection. This stretched the synchia (fig 1B). Intraocular scissors were used to cut the synchia (fig 1C). The anterior segment was formed and regular, after synchietomy (fig 1D). After this, endoscopy-assisted phacoemulsification was done. Case 8 was a patient with a history of recurrent uveitis. The pupil in the right eye was rigid and fixed at a mid-dilated position. The patient underwent phacoemulsification in the right eye under microscopic visualisation. Endoscopic visualisation revealed that the inferior haptic was out of the capsular bag. The IOL was dialled in the bag, using a Sinskey hook. Case 9 was a 71-year-old man who had presented with nebulomacular corneal opacity, cataract and intractable glaucoma in the left eye. His IOP remained high in the left eye even after three antiglaucoma topical medications. In the left eye, endoscopy-assisted phacoemulsification was done. Prior to insertion of IOL, the endoscope was inserted in the eye through the corneal entry wound to visualise the ciliary processes (fig 2). Endophacoemulication to the ciliary processes was done. At the 4-month follow-up, IOP was stabilised at 12 mm of Hg without any antiglaucoma medication.

DISCUSSION
Moore et al.² first reported the use of endoscopy in phacoemulsification. They used cadaver eyes and succeeded in making CCC in one out of four eyes. The first reported endoscope-assisted cataract surgery on a patient was performed by Junko et al.¹⁰ under general anaesthesia, while we performed all our cases under local anaesthesia. The first case series of phacoemulsification with PCIOL implantation was reported by Henderson et al.¹¹ Interestingly, only one out of four eyes had corneal scar. These authors inserted the endoscope through a 2 mm paracentesis, and the endoscope was controlled by the surgical assistant. In our cases, the endoscope was controlled by the surgeon. Bimanual phacoemulsification steps, like cracking of the nucleus, were performed using a microscopic view through a less opaque cornea. Henderson et al.¹¹ used the endoscope to reveal a hidden nuclear fragment under the iris, in one case, and to replace the misplaced haptic inside the capsular bag. They found the endoscope especially useful in gauging the depth of the groove to aid in better cracking of the nucleus, and also in the correct placement of the haptics in the bag. In our series we kept the groove depth at a one-and-a-half phaco probe depth for easy cracking.

The logic regarding the use and the utility of the endoscope for phacoemulsification can be argued. Endoscope-assisted phacoemulsification is not an alternative to PKP. All our patients are listed in the waiting list for PKP. Our technique is merely an interim procedure to make patients ambulatory while they are waiting for their turn for PKP, because some patients...
with nebulomacular corneal opacity may regain ambulatory vision after the removal of cataract alone. We agree that penetrating keratoplasty (PKP), followed by phacoemulsification or a one-stage triple procedure (PKP + ECCE + IOL), could have been done to the same effect. The advantage with endoscope-assisted phacoemulsification is that we are able to perform closed chamber phacoemulsification in cases with corneal opacity. As a result, we were able to avoid the risk of

Table 1  Endoscopic-assisted phacoemulsification

<table>
<thead>
<tr>
<th>Case</th>
<th>Age/sex</th>
<th>Eye</th>
<th>Preop VA</th>
<th>Anterior segment</th>
<th>Procedure done</th>
<th>Follow-up (months)</th>
<th>Postop VA</th>
<th>Complications</th>
<th>End-result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60/M</td>
<td>OD</td>
<td>20/800</td>
<td>Fibrotic pterygium</td>
<td>Endophaco</td>
<td>12</td>
<td>20/100</td>
<td>PCO</td>
<td>Vision improved</td>
</tr>
<tr>
<td>2</td>
<td>64/M</td>
<td>OD</td>
<td>20/1000</td>
<td>Postulcer corneal opacity</td>
<td>Endophaco</td>
<td>10</td>
<td>20/200</td>
<td>PCO</td>
<td>Vision improved</td>
</tr>
<tr>
<td>3</td>
<td>69/F</td>
<td>OD</td>
<td>20/400</td>
<td>Corneal opacity</td>
<td>CCC, assessment of haptic position</td>
<td>7</td>
<td>20/200</td>
<td>None</td>
<td>Vision improved</td>
</tr>
<tr>
<td>4</td>
<td>58/M</td>
<td>OD</td>
<td>20/800</td>
<td>Corneal opacity</td>
<td>Endophaco</td>
<td>8</td>
<td>20/300</td>
<td>Haptic in sulcus</td>
<td>IOL dialled in bag with endoscope view; vision improved</td>
</tr>
<tr>
<td>5</td>
<td>61/F</td>
<td>OD</td>
<td>LP</td>
<td>Corneal opacity</td>
<td>Endophaco</td>
<td>6</td>
<td>20/400</td>
<td>Haptic in sulcus</td>
<td>IOL dialled in bag with endoscope view; vision improved</td>
</tr>
<tr>
<td>6</td>
<td>62/F</td>
<td>OS</td>
<td>20/400</td>
<td>Corneal opacity</td>
<td>Endophaco</td>
<td>6</td>
<td>20/80</td>
<td>Haptic in sulcus</td>
<td>IOL dialled in bag with endoscope view; vision improved</td>
</tr>
<tr>
<td>7</td>
<td>67/F</td>
<td>OD</td>
<td>20/800</td>
<td>Traumatic corneal opacity, iridocorneal synechiae</td>
<td>Endophaco, endosynechiotomy</td>
<td>8</td>
<td>20/50</td>
<td>None</td>
<td>Vision improved</td>
</tr>
<tr>
<td>8</td>
<td>54/F</td>
<td>OD</td>
<td>20/100</td>
<td>Chronic uveitis, small pupil</td>
<td>Assessment of haptic position</td>
<td>7</td>
<td>20/30</td>
<td>Haptic in sulcus</td>
<td>IOL dialled in bag with endoscope view; vision improved</td>
</tr>
<tr>
<td>9</td>
<td>71/M</td>
<td>OS</td>
<td>20/400</td>
<td>Corneal opacity, intractable glaucoma</td>
<td>Endophaco, ECP</td>
<td>7</td>
<td>20/100</td>
<td>None</td>
<td>Vision improved, IOP controlled</td>
</tr>
</tbody>
</table>

CCC, continuous curvilinear capsulorhexis; ECP, endoscopic cyclophotocoagulation; Endophaco, endoscope-assisted phacoemulsification; IOP, intraocular pressure; LP, perception of light; OD, right eye; OS, left eye; PCO, posterior capsular opacification; VA, visual acuity.

Figure 1  Case 7. Central corneal opacity with irregular pupil and dense cataract in right eye (A). Anterior chamber was deepened with viscoelastic injection. This stretched the synechia (B). Intraocular scissor was used to cut the synechia (C). Anterior chamber well formed and deep after synechiotomy (D).
expulsive haemorrhage which can occur during the open sky technique. Another problem with PKP is the lack of availability of donor corneas. Due to the shortage of suitable donor tissue, the waiting lists for this type of ocular surgery are increasing, in countries like Kuwait. We performed all cases under local anaesthesia, which is particularly useful in old or debilitated patients for whom general anaesthesia (for PKP) is difficult or contraindicated. So, in comparison with PKP, endoscopy-assisted phacoemulsification decreases the time and effort needed to provide functional vision.

We did not encounter any major intraoperative complications. Rhexis was continuous and curvilinear in all cases. No posterior capsule rent or significant residual cortex occurred in any case. Late posterior capsular opacification occurred in two cases. In all cases of endoscope-assisted phacoemulsification, vision improved from the preoperative status (although, in case 1, the visual improvement was in part due to removal of a fibrotic pterygium). In case 7, we used the endoscope to sever an irido-corneal synchia. By cutting it under endoscopic visualisation, we had minimal tissue loss, maintained anatomical integrity and also avoided endothelial touch. In cases 4, 5, 6 and 8, an endoscopic view was used to dial the haptics of the IOL in the capsular bag. Despite a poorly dilated pupil, the use of iris hooks was avoided in case 8. In case 9, endocyclophotocoagulation was done in a case of refractory glaucoma. Valmaggia and De Smet used the endoscope through pars plana to cyclophotoablate the ciliary processes in six eyes of five patients with refractory glaucoma. We used an anterior approach, combined with phacoemulsification, hence avoiding pars plana vitrectomy. Our patient's IOP remained under control without any medications for a period of 7 months, avoiding the need for any additional glaucoma surgical procedure. Barkana et al. reported successful use of endoscopic photocoagulation in a 3.5-year-old child after the repeated failure of trans-scleral diode cyclophotocoagulation. The endoscopy showed many misplaced laser burns in the pars plana area, done earlier by the trans-scleral route. Multicentre, randomised trials are needed to assess this combination of phacoemulsification with ECP as a viable alternative to combined phacoemulsification and trabeculectomy procedure.

Endoscopy facilitates the view of areas not visible through an operating microscope, like the anterior chamber angle, the retroiridial space, the inside of the capsular bag, and the sulcus and ciliary processes. The disadvantages of endoscopy are that it is expensive, is difficult and has a steep learning curve. The surgeon has to get used to the image on the monitor, in terms of focus and depth perception. We are using a semidisposable endoscope probe that can be used for approximately 10 cases after resterilisation. We use the endoscope in posterior-segment procedures also especially in trauma cases which makes it more cost-effective.

We have found endoscope-assisted phacoemulsification to be safe and feasible, both as a primary therapeutic option in cases where penetrating keratoplasty is not possible and as an interim procedure in patients awaiting keratoplasty, conferring early visual rehabilitation.

Competing interests: None.

Ethics approval: Ethics approval was provided by the local ethics committee and the Ophthalmic Council of Kuwait.

Patient consent: Obtained.

REFERENCES