

# Yemeni experience with phacoemulsification

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## ABSTRACT

**لأهداف:** دراسة وتقييم نتائج ومضاعفات أول تجربة سحب المياه البيضاء بواسطة جهاز موجات فوق صوتية (الفاكو). في اليمن لفترة من عام 2000م وحتى 2007م.

**الطريقة:** أجريت دراسة شملت 258 عيناً لـ 182 مريض مصاب بالمياه البيضاء خلال الـ 96. خض جميع المرضى لعملية سحب المياه البيضاء مع زراعة داخلية، وذلك باستخدام جهاز موجات فوق الصوتية (الفاكو). تم تدوين النتائج وتحليلها بشكل إحصائي.

**النتائج:** كان معدل الذكور للإناث (1:1) مع متوسط العمر 52 عاماً، أجريت لهم عملية سحب المياه البيضاء بواسطة جهاز موجات فوق صوتية (الفاكو) عن طريق الصلبة في (14) عيناً وعن طريق القرنية في (244) عين. تم تسجيل قوة الإبصار ومعدل وضيفة المضاعفات.

**خاتمة:** كانت نتائج عمليات سحب المياه البيضاء عن طريق الموجات فوق الصوتية (الفاكو) مشجعة جداً، وأهم المضاعفات التي حدثت أثناء العملية هي تمزق غلاف العدسة الخلفي.

**Objectives:** To evaluate the first experience of phacoemulsification in Yemen from 2000-2007 regarding the visual results, and complications.

**Methods:** Two hundred and fifty-eight eyes of 182 adult patients with significant cataract were included during the last 96 months. All eyes underwent phacoemulsification with implantation of intraocular lenses. The results were recorded and statistically analyzed.

**Results:** The male:female ratio was 1:1, with an average age of 52 years. Phacoemulsification was carried out by scleral approach in 14 eyes, and by clear corneal approach in 244 eyes. A visual acuity of  $\geq 6/18$  was achieved in 85.3%, and the most common serious complication was intraoperative posterior capsule rupture, which was reported in approximately 10.1%.

**Conclusion:** The results of phacoemulsification are very impressive, and the most common intraoperative complication was ruptured posterior capsule.

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The most exciting innovation in cataract surgery in the 20th century was the technique of phacoemulsification, introduced by Kelman in 1967,<sup>1</sup> which is considered a sophisticated form of extracapsular cataract surgery as it allows the surgeon to have greater control over intraocular structures during the surgery. This novel approach revolutionized cataract surgery by permitting cataract extraction through smaller incisions, thereby minimizing surgical trauma to the eye. Small incision cataract surgery provides optimal wound integrity, allowing rapid visual recovery while minimizing iatrogenically induced astigmatism.<sup>2</sup> Also, the sutureless incision has predictable, and minimal effects on corneal topography.<sup>3</sup> Thus, the preference for phacoemulsification over planned extracapsular cataract extraction (ECCE) has steadily increased, as phacoemulsification was preferred in 12% of cataract extraction in 1985. This percentage increased to 86% in 1994.<sup>4</sup> Understanding the surgical techniques unique to the procedure, as phacoemulsification comprises a series of steps, each of which is critically dependent on the former, like building a house from the foundation up.<sup>5</sup> The aim of this article is to evaluate the first experience of phacoemulsification in Yemen regarding the visual results, postoperative rehabilitation, and rate and nature of complications.

**Methods.** A total of 182 patients (258 eyes) with cataracts, who attended the outpatient clinic of the Ophthalmic Department of Al-Thawra Teaching Hospital, Sana'a, Yemen, were enrolled in this study from 2000-2007 with an average age of  $52.2 \pm 11.54$  years. Ethical clearance was obtained from the Research and Ethical committee in the Faculty of Medicine & Health Sciences, Sana'a University and all patients signed a consent for surgery. Cases with hypermature cataract, traumatic cataract with ruptured capsule, vitrectomized eye, glaucoma, congenital cataract, subluxated lens, and corneal dystrophies or compromised cornea due to other factors were excluded from the study. All eligible patients were subjected to systemic medical and ophthalmic evaluation. In addition, ultrasonography A- and B- scan was carried out to evaluate the posterior segment, and posterior chamber intraocular lens (PCIOL) calculation. The PCIOL calculation is determined through keratometer reading and A-scan ultrasonography axial length measurement, and then SRK-II, SRK-T, Holladay or Binkhorst softwares were installed in the computer to calculate the intraocular lens implantation. Pre-operatively, tropicamide 1%, phenylephrine 2.5%, and diclofenac eye drops caused pupil dilatation. Iris retractors were used for miotic pupils that did not respond to mydriatics. All patients underwent surgery under local anesthesia using peribulbar, and facial block with lidocaine 2%.

**Operative procedures.** In the scleral approach, a scleral tunnel incision was prepared either as frown 3.2 mm or straight 6.5 mm half thickness scleral incision. Then, a paracentesis was carried out, 2 hours from the phaco incision, through which the aqueous humor was replaced by viscoelastic material (methylcellulose 2%). After that, a phaco incision was carried out by entering the anterior chamber with a 3 mm microkeratome. In the clear corneal approach, after performing paracentesis, and replacing the aqueous by methylcellulose 2%, a temporal 3.2 mm clear corneal incision was prepared by a 3.2 mm microkeratome, or diamond knife. A continuous curvilinear capsulorhexis (CCC) was carried out. Can-opener capsulotomy was performed in white cataract, and if capsulorhexis was interrupted. Anterior capsule staining was carried out using trypan blue stain in some cases of white cataract. Hydrodissection and cortical cleaving hydrodissection were carried in all cases. Hydrodelineation was carried out in some cases. Phacoemulsification was carried out using the guider megatron system with 30 degree phaco mega tip. The nucleus of the soft cataract was removed by the bowel technique, while hard cataract, were removed by either the divide and conquer technique, as described by Gimbel,<sup>6</sup> or the stop and chop technique, as described by Koch.<sup>7</sup> In the case of posterior capsule

rupture, anterior vitrectomy was carried out followed by injection of viscoelastic material, and then removal of the remaining lens materials. The parameters used were 50-60% ultrasound power throughout the procedure, except the cortical removal step, flow rate was 16 ml/min during sculpting, 26 ml/min during nuclear quadrant removal, chopping, and cortical removal, and the vacuum was 10 mm Hg during sculpting, 150-200 mm Hg during quadrant removal and chopping, and 450 mm Hg during cortical removal. Methylcellulose 2% was injected into the anterior chamber to inflate the capsular bag. The phaco incision was not enlarged in eyes with foldable intraocular lens (IOL), but enlarged to 6.5 mm to allow implantation of rigid polymethylmethacrylate (PMMA) PCIOL with 6 mm optic. The lenses were implanted into the capsular bag, and if the posterior capsule ruptured, implantation was carried out in the ciliary sulcus. The enlarged incision was sutured with 2 radial sutures or a single transverse one. Corneal stromal hydration of the edges of the phaco incision and paracentesis was carried out. Closure of the conjunctival peritomy was by either cautery or suture in case of scleral tunnel incision. Subconjunctival injection of dexamethasone, and gentamicin and eye patch for 24 hours were carried out. Postoperative follow up ranged from 6 months to 5 years. Oral systemic antibiotics (ampiclox, 500 mg, bd) were given for the first 3 postoperative days as prophylaxis. Topical antibiotic-steroid eye drops were applied 4 times daily for 3 weeks and extended for a longer period if needed. The patients were examined on the first postoperative day, after 3 days, one week, one month, and then every 3 months for one year, then every 6 months for the rest of the follow up period. On each visit, visual acuity was tested, IOP measurement, slitlamp examination, and fundus evaluation. Autorefractor-keratometry was carried out after one month postoperatively, and every subsequent visit to evaluate the visual outcome and its stability with wound healing. Corneal sutures were removed 2 months postoperatively.

The results were recorded and statistically analyzed using SPSS version 10.0 (SPSS Inc. Chicago, IL). The p value of less 0.05 was considered statistically significant.

**Results.** This study included 258 eyes (182 patients). Male to female ratio was 1:1 and mean age was  $52.2 \pm 11.54$  years. The demographic characteristics of the patients are shown in Table 1. Senile cataract was found to have a significantly better postoperative visual acuity ( $p=0.018$ ). Scleral tunnel incision was carried out in 14 eyes during the first 14 cases and was not carried out after that, while temporal clear corneal incision was carried out in 244 eyes. The incision location was found

to have no significant effect on postoperative spherical, and cylindrical errors ( $p=0.274$ ). The CCC was carried out in 198 eyes, and it was sometimes difficult due to escape of methylcellulose through phaco wound, but with experience, this difficulty was overcome as healon was not available. Can-opener capsulotomy was carried out in 60 eyes. The bowel technique was carried out in 30 eyes, nucleofractis (divide and conquer) in 168 cases, and stop and chop in 60 eyes. Foldable lenses were implanted in 17 (13.2%) eyes and in the remaining eyes, a rigid PMMA PCIOL were implanted, while anterior chamber intraocular lenses were implanted in 10 eyes. Pre-operative visual acuity ranged from hand motion to 6/60 while post-operative best-corrected visual acuity was 6/12 or better in 70.5% of the cases and 6/18 or better was achieved in 85.2% of the cases as shown in Table 2. Intraoperative complications, included iris trauma, which was common during the first cases with a variable degree of iris damage and was found in 52 (20.2%) eyes, capsulorrhexis with extended tear to the periphery out of control was found in 60 eyes, which dictated conversion to the can-opener technique. Also, too small capsulorrhexis was found in 4 eyes, which made removal of the epinucleus difficult with subsequent injury to the posterior capsule during

using nucleus manipulator to support the epinucleus while being sucked, small hyphema was found in 8 eyes due to iris trauma in the scleral tunnel incision techniques, but they were of no surgical significance, rupture of the posterior capsule was seen in 26 (10.1%) eyes. Sixteen during emulsification, and 8 during irrigation/aspiration and 2 during intraocular lens implantation. The majority of these ruptures occurred in the early cases. Posterior capsule rupture occurred in 16 eyes of CCC and in 10 eyes of can-opener capsulotomy, and these showed no significant difference ( $p=0.171$ ). Also, posterior capsule rupture occurred in 22 eyes that underwent the divide and conquer technique, 4 eyes that underwent the chopping technique, and it did not occur in the bowel technique. However, the phaco technique was found to have no significant influence on the posterior capsule rupture ( $p=0.233$ ). Conversion to ECCE was carried out in 12 eyes, 8 of which with very hard nucleus, that needs long phaco time and 4 eyes with repeated shallowing of the anterior chamber. This conversion had no significant relation to the type of capsulotomy ( $p=0.696$ ), or to posterior capsule rupture, the odd ratio for posterior capsule rupture was 11.3 with 95% confidence interval. Postoperative complications, including mild uveitis were found in 78 (30.2%) eyes, which resolved during the first postoperative week, increased intraocular pressure was found in the early postoperative period in 24 (9.3%) eyes, who suffered rupture of the posterior capsule, that was controlled medically except in one eye that underwent glaucoma surgery. However, this intraocular pressure elevation was found to have no significant relation to the type of phaco technique ( $p=0.672$ ) or to the type of cataract ( $p=0.367$ ). Mild hyphema was seen in 4 eyes but they were of no clinical significance, early corneal edema occurred in 64/258 eyes (24.8%) and has significant relation to the type of phaco technique ( $p=0.013$ ) as it was more common in divide and conquer in 40 eyes, in 24 eyes of chopping, and none in the bowel technique. Mild to moderate edema associated with striate keratopathy was seen in 50 eyes, and this completely resolved within 1-2

**Table 1 -** Demographic characteristics of patients.

Variable	n	(%)
Age (years), mean ( $\pm$ SD)	52.2 $\pm$ 11.54	
<b>Gender</b>		
Male	128	(49.6)
Female	130	(50.4)
<b>Cataract type</b>		
Senile	212	(82.2)
Complicated	32	(12.4)
Traumatic	14	(5.4)

**Table 2 -** Pre- and post- operative visual acuity (VA).

Pre-operative VA	Postoperative VA		
	<6/18 n=38	6/18 n=38	>6/18 n=68
Hand motion (n=86)	26	22	38
Counting finger (n=88)	6	6	76
Visual acuity of 6/18 (n=84)	6	10	68
Data are expressed as number and (%), $p=0.00$			

weeks postoperatively, Severe corneal edema was seen in 14 eyes, which gradually cleared over a period of one month, especially after control of associated increased IOP, scleral burn was noted in 4 eyes (1.6%) and corneal burn in 4 (1.6%) eyes, subluxated PCIOL was found in one eye where the PCIOL was not implanted in the intact posterior capsule but in the sulcus and the inferior haptic slipped between the zonules, which was corrected 2 months postoperatively by redialing of the PCIOL. Residual lens matter of the subincisional cortex was seen in 4 eyes, which required no further interference, posterior dislocation of PCIOL occurred in one case that exposed, intraoperatively, to posterior capsule rupture with anterior vitrectomy and the dislocated lens was removed by vitrectomy with the use of perfluorocarbon liquid, and no endophthalmitis was reported. The incidence of posterior capsule opacification, which required neodymium-doped yttrium aluminium garnet capsulotomy, was significantly common in the bowel technique because it may be performed in soft cataract when the lens fibres are stickier to the posterior capsule ( $p=0.00$ ), and it occurred in 26 eyes (86.7%) of bowel technique.

**Discussion.** As phacoemulsification was not popular in Yemen until recently, and it is now becoming increasingly performed by more surgeons, we reviewed in this work our results with phacoemulsification over the last 8 years (from 2000 – 2007). The mean age of patients was  $52.2 \pm 11.54$ , and this age is relatively younger than those cataract patients who are subjected to the old type of surgery (ECCE). The relatively younger age group is likely to have a better outcome and less complications than that expected in elder patients.

In general, phacoemulsification, as compared to ECCE, was found in this study to be less time consuming, having a very short postoperative visual rehabilitation with less postoperative discomfort ability and was considered as the surgical procedure of choice for cataract extraction. The same was reported by Steinert et al<sup>8</sup> and Watson and Sunderraj.<sup>9</sup>

The scleral tunnel incision was carried out in this work in the first early 14 eyes, then all the remaining eyes underwent temporal clear corneal incision as temporal clear corneal incision was easier, less time consuming, with no need for cautery, which contributes to surgically induced astigmatism, or conjunctival incision, with less iris trauma, or hyphema. In addition, no oarlocking of the phaco handpiece as that occurs in the long scleral tunnel, and creates striae in the cornea, that compromises visualization of intraocular structures during the surgical procedure. Also, the temoral approach has further distance from the corneal center than the superior approach, and the incision is in line

with lid blink, and thus has a less effect on the incision, which subsequently has less astigmatic effect, and no need for superior rectus muscle suture. These are, what Fine<sup>10</sup> described when he introduced a clear corneal tunnel incision with temporal approach to avoid the disadvantages of scleral tunnel incision.

Neuhann<sup>11</sup> reported that capsulorrhexis was found easier through temporal clear corneal incision and it should be carried out through a separate corneal paracentesis. Also, creation of a CCC was found in this study to be crucial for safety of cataract extraction as it provides a smooth circular opening with a strong rim that resists tearing even when it is stretched during lens material removal or intraocular lens implantation. This is the same as reported by Werner et al.<sup>11</sup> Despite this, it was found in this study that phacoemulsification can be carried out uneventfully using can-opener capsulotomy with caution. This is in agreement with a report by Buratto,<sup>13</sup> who wrote that can-opener anterior capsulotomy can be used in phacoemulsification.

In this study, the bowel technique was performed only for soft cataract, otherwise, crater or through divide and conquer and stop and chop, were carried out for other types of cataract. Also, it was found in the present study that phacoemulsification through a temporal clear corneal incision was more convenient with no distortion of the globe and no obstruction by the brow. This is similar to that found by Fikry and Nasr.<sup>14</sup>

Insertion of rigid PMMA PCIOL was easier through temporal clear corneal incision, which is in accordance with the description of Koch.<sup>15</sup> Despite the small number of implanted foldable lenses, which were hardly available due to high cost of these lenses, in this study, the visual results of the enlarged phaco incision with rigid PMMA PCIOL were very impressive. This is because the enlarged incision to 6.5 mm is still smaller than that of ECCE. This is similar to a report by Buratto<sup>16</sup> who wrote that, in phacoemulsification, the visual results with the techniques that necessitate a wide incision are the same as that of the small incision at the end of the healing processes and the stabilization of the suture, but the visual rehabilitation in small incision technique is shorter. Also, Kamel<sup>17</sup> found that, after phacoemulsification, the visual results of PMMA through a 5.2 mm incision are comparable to those of foldable lenses with a 3.2 mm incision. In this study, the postoperative best-corrected visual acuity was improved to 6/12 or better in 70.6% of cases and to 6/18 in 85.2% of cases. This is less than that reported by Kamel<sup>16</sup> who, comparing small incision (3.2 mm) phacoemulsification and foldable lenses with enlarged incision (5.2 mm) phacoemulsification and 5 mm rigid PMMA PCIOL and ECCE with PCIOL, demonstrated

that the visual acuity of  $\geq 6/18$  found in 80% of eyes that underwent small incision phaco, 93% of eyes that underwent enlarged incision phaco, and 35% of eyes that underwent ECCE. The low results in this study may be due to the difference in the experience in phaco procedure. It was noted in this study that complications occurred mostly in the early cases and became less in the later cases. This points clearly to the importance of experience with this demanding technique. This is in accordance with the opinion of Jaffe et al<sup>18</sup> who reported that phacoemulsification is the most difficult operation for the ophthalmologist to master as it requires a high degree of mental discipline and cannot be taken casually. Iris trauma was found in this work in 20.2% of eyes. A similar result was reported by Thomas et al<sup>19</sup> and Fikry and Naser<sup>20</sup> who reported iris trauma in 22% of eyes after phacoemulsification. Trauma to the iris can be very inconvenient during surgery. As once the iris is aspirated by the phaco tip, it develops a tendency for repeated aspirations, which can be avoided by keeping the iris away from the phaco tip by using a second instrument. Also repeated iris aspiration may lead to miotic pupil where a second instrument was used to push the iris to the periphery to show the lens materials and to avoid iris aspiration. Miotic pupil occurred in 3 of the early 20 cases in this work, where conversion to ECCE was carried out, whereas in the late cases, none of the eyes with intraoperative miosis was converted to ECCE but phacoemulsification continued with the help of the second instrument. This is similar to a report by Shingleton.<sup>21</sup> The overall incidence of posterior capsule rupture in this work was 10.1%. It was on 31.8% in the early cases (14 early cases). This rate was much higher than the results of Noecker et al<sup>21</sup> who had a posterior capsule rupture incidence of 4.5%, but comparable to the results of Thomas et al<sup>19</sup> who reported an incidence of 40% in their early cases and 7% in later ones, while Fikry and Naser<sup>20</sup> reported an incidence of 9%.

Thermal scleral burn was found in 4 cases and thermal corneal burn in 4 eyes due to phaco needle overheating in prolonged procedures. The same percentage was reported by Fikry and Nasr<sup>14</sup> who demonstrated 3 of 32 cases had corneal burn, but no scleral burn was found. In the present study, thermal burn was found more in scleral tunnel incision because of an excessively long tunnel leading to a constriction of the phaco sleeve with phaco probe movements, and a consequent decrease of the infusion. A complication, which can be prevented by a temporal clear corneal incision. In addition, scleral tunnel incision procedure had prolonged time. The incidence of clinically significant corneal edema in this work was 24.8% mild to moderate, and no persistent merging into bullous keratopathy. Noecker et al<sup>22</sup> reported 14% transient, and 2% persistent corneal

edema while Fikry and Naser<sup>20</sup> reported 2.1% transient and 1.05% persistent corneal edema. Also, Kamel<sup>17</sup> found mild striate keratitis in 5 of 15 (33%) eyes that underwent small incision phaco and in 23 of 85 (27%) eyes that underwent enlarged phaco incision. While Steinert<sup>23</sup> found the overall incidence of corneal edema is less than 1%. The higher incidence of corneal edema may be explained by including striate keratopathy in this study. The most impressive observation, as compared to ECCE, was the postoperative visual rehabilitation; the patients gained good visual acuity, they were happy and satisfied with a short postoperative period as they came back and insisted to undergo the same procedure for the other eye in cases of bilateral cataracts. Also, the advantages of temporal clear corneal approach were remarkable.

This study concluded that, when properly carried out, phacoemulsification yields very impressive visual results, a very short visual rehabilitation period, and is less time consuming. Clear corneal temporal tunnel incision is more advantageous than scleral tunnel incision. Phacoemulsification is a very demanding technique and needs experience to avoid complications, and the most common complication was posterior capsule rupture.

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## Statistics

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Describe statistical methods with enough detail to enable a knowledgeable reader with access to the original data to verify the reported results. When possible, quantify findings and present them with appropriate indicators of measurement error or uncertainty (such as confidence intervals). Avoid relying solely on statistical hypothesis testing, such as the use of *P* values, which fails to convey important information about effect size. References for the design of the study and statistical methods should be to standard works when possible (with pages stated). Define statistical terms, abbreviations, and most symbols. Specify the computer software used.