Original Article

Micro Incision Cataract Surgery (MICS)/ Bimanual Phacoemuslsification. Initial Problems and the Solutions

Khawaja Khalid Shoaib

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See end of article for authors affiliations

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Correspondence to:
Khawaja Khalid Shoaib
Head of Eye Department
CMH Kharian Cantt

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Purpose: To describe the difficulties faced by a phacoemulsification (phaco) surgeon switching to Micro incision cataract surgery (MICS) - bimanual phaco so that others are better prepared when starting the procedure.

Material and Method: Initial fifty cases of MICS -bimanual phaco were analyzed to find out the problems encountered peculiar to the new procedure. All the complications that occur during the conventional co-axial phaco were excluded. Operation time of twenty cases of MICS was compared to operation time of twenty cases of coaxial phaco in various categories of cataract hardness. Average effective phaco time (EPT) of grade 2 cataract for MICS and coaxial phaco were compared.

Results: Spray of liquid emitting through wound, anterior chamber (A/C) collapse, increased operation time, increased size of irrigating chopper causing difficulty in manipulation and its sharpness resulting in rupture of posterior capsule, were encountered. Operation times of MICS were greater than coaxial group from 3.12 to 8.04 minutes for various categories of cataract hardness. EPT of grade 2 cataract for MICS was 3.92±2.07sec and coaxial phaco was 5.67±3.7sec. It means more operation time but less phaco for MICS as compared to coaxial phaco.

Conclusion: In spite of enormous advantages of MICS - bimanual phaco, it has some problems which are unique to the procedure and phaco surgeon should be

Micro incision cataract surgery (MICS)/ bimanual phaco is the latest technique[1] for cataract surgery, in which infusion is shifted from phaco tip to chopper so that both the incisions sizes are less than 2 mm. First operation was done by Amar Agarwal[2] with 0.9 mm incision on 15th August 1998. Later her sister, Sunita Agarwal joined her. They termed it PHAKONIT (Phaco Needle Incision Tip). It has been found safe[3-,7] as far as endothelial cell loss[8-12] during the operation or anterior chamber flare[9] after the operation is concerned by majority of surgeons. A few have reported central corneal endothelial cell loss[13].

In coaxial phaco, ultrasound (US) probe the sleeve around the metallic tip has two important functions:

1. It introduces BSS.
2. It cools the tip so that corneal burns are avoided.

In Micro incision cataract surgery (MICS)/ bimanual phaco, there is no sleeve.

Special features of the bimanual phaco are related to:

1. Ultrasound (US) Emission

To prevent corneal burns phaco power is introduced in PULSE/BURST mode which enables discontinuous US emission or different systems are provided in the probe e.g. thermal protection (as in Microflow). Regarding increased incision temperature, the major contributors identified are: incision size, US power, duty cycle, aspiration flow rate, vacuum setting, tip design, and presence of an ophthalmic viscosurgical device (OVD). Minor contributors included pulse frequency, bottle height and temperature of the infusate.[13]

2. Fluidics

High vacuum and high flow levels are necessary. As gravity alone can not maintain increased flow through smaller diameter instruments in some machines, air pump (Fig.1) is required.

3. Instruments

Knives 1.2-1.5 mm, irrigating choppers (Nagahara, Braga-Mele, Chang, Fine, Olson, Aggarwal, Walker, Packard, El-Kasaby, DK, Farmer, Rosen, Nucleus claw, Universal, Kazuno, Tsunoeka, Ohki etc), fine capsulorhexis forceps and 20 G irrigation/aspiration canulas are required.

Advantages of MICS due to decreased incision size (as compared to coaxial phaco) are:

1. Astigmatism is reduced[14-16].
2. Strength of wound is better.
3. Healing of the wound is rapid.

MATERIAL AND METHOD

This study was carried out in eye department, CMH Kharian from Oct 2007 to March 2008. Phaco machines Admiral (A), Pulsar II (P) and Oertli (O) were used.

All the operations (MICS - bimanual phaco) were performed by the author. Initial fifty cases were analyzed to find out the problems encountered peculiar to the new procedure. The patients included 40 males and 10 females. Age ranged from 29 years to 80 years with mean of 61.1 years $\pm$10.47 (SD). All the complications which occur during the conventional co-axial phaco e.g. posterior capsular rupture during aspiration of viscoelastic or insertion/dialing of intraocular lens (IOL) or trauma to iris by phaco tip etc, were excluded.

Anesthesia: Having done about 1200 phaco under topical anesthesia (TA) in the last two years, author started MICS under TA. 0.5% Proparacaine (Alcaine) one drop repeated four times at half minute intervals before making the first incision, was the only anesthetic used in all the cases.

Incision: Clear corneal tunnel incision at the limbus was made. In the initial five cases when 1.5 mm keratome was not available, partial entry with 3.2 mm keratome was done. The rest of the cases were done with 1.5 mm keratome. After filling anterior chamber with sodium hyaluronate (Visco Supreme), second incision was made again with 1.5 mm kera-tome at about sixty degrees away from the first one.

Capsulorhexis: It was done with the bent needle of insulin syringe.

Infusion Bottle: It was kept at maximum height (approximately 120 cm).

Phaco tip: 20 gauge thick tip which could be used with high vacuum, was used in all MICS cases (Fig. 1).

Choppers: Different irrigating choppers were used (Fig. 2,3). Each time irrigating chopper was introduced first which snugly fitted in the incision and phaco tip was introduced through the other incision.

Phaco: In the first twenty five cases, nucleus was divided into four pieces by "Divide and Conquer technique" keeping the vacuum low (20-40 mm of Hg). In the second step each piece was phacoemulsified with high vacuum (200-250 mm of Hg). It required less experience with the chopper but used considerable phaco power. Later on the rest of the cases were done with the "Stop-and-Chop technique" in which a single tunnel was made and the nucleus divided in two halves. Each half was engaged by the phaco tip with high vacuum (200-250 mm of Hg) and chopper made pieces just like making pieces of a cake. It required more experience with the chopper but used less phaco power. To prevent corneal burn intermittent use of phaco power was achieved by pressing the foot pedal to phaco position for brief intervals. Later on Phaco power was converted to pulse mode with increased interval between pulses.

IOL insertion: After the phaco was completed with two 1.5 mm incisions and irrigation /aspiration done, incision was enlarged to allow IOL insertion. In most of the cases thin IOL through 1.8 mm incision was inserted. Viscoelastic was aspirated. Injection of 0.1 ml of intracameral Moxifloxacin (Vigamox /Megamox) and hydration of the wounds was done in every case. Post operatively patient was advised Moxifloxacin (Vigamox /Megamox) eye drops QID and Fortipred / Predforte eye drops QID for two weeks.

Cataract density was divided in five grades depending upon the density of cortical and nuclear opacities. Grade 1 for minimum density and grade 5 for most dense cataracts. On every operation list a few cases of MICS were randomly mixed with coaxial cases. All the coaxial cases were done with 19 G tip through 2.75 mm incision. Forty patients were randomly selected for the two groups, last twenty cases out of the first fifty MICS (Group A) and coaxial phaco (Group B) twenty cases. Each group was subdivided according to grade of cataract (Table 1).

Table 1: Problems encountered and their solutions in the first fifty cases of MICS - bimanual phaco

Cases n (%)	**Problems**	**Solutions**
2(4)	Spray of liquid droplets emitted through wound	Decrease the phaco power
5 (10)	Anterior chamber (A/C) collapse/ shallowing / depth fluctuations	• Infusion Bottle height maximum (max) • Irrigating chopper with max flow • Inflated BP cuff around infusion bottle • Air pump connected to infusion bottle • Incision size 1.5 mm
5 (10)	Difficulty in irrigating chopper manipulation	Experience required
1(2)	Sharpness of chopper	choppers having blunt edges
50(100)	Increased operation time	-High vacuum (250-300 mm of Hg) -Experience required

Total operating time: It was the time from the moment keratome touched the cornea to end of irrigation /aspiration of lens matter. Average operation times (minutes) of the two Groups (A and B) were compared for each grade of cataract.

Effective phaco time (EPT): It is equivalent time to 100% of phaco power. It is calculated by multiplying total phacoemulsification time in seconds by the average power percent used. Average EPT of grade 2 cataract was compared for MICS and coaxial phaco.

RESULTS

The problems encountered in the first fifty cases of MICS - bimanual phaco were (Table 2):

1. Spray of liquid droplets emitted through wound in the first two cases.
2. Anterior chamber (A/C) collapse/ shallowing / depth fluctuations. In the first five cases, partial collapse A/C shallowing /fluctuations in its depth, occurred.
3. Difficulty in irrigating chopper manipulation. It was noted, in first five cases.
4. Sharpness of chopper. It resulted in rupture of posterior capsule in one case.
5. Increased operation time. Average operation times of MICS were greater than coaxial group

from 3.12 to 8.04 minutes for various categories of cataract density (Table 3).

Table 2: Distribution of cases

Density of Cataract (grade)	No. of cases MICS 20G	No. of cases Coaxial Phaco 19G
1	1	
2	12	9
3	4	4
4	2	2
5	1	5

Table 3: Average Operation time

Density of Cataract (grade)	**A= minutes ± SD, MICS 20G**	**B= minutes ± SD, Coaxial Phaco 19G**	**Difference between A & B (minutes)**
1	8.52		
2	10.51±2.23	7.39± 0.7	3.12
3	14.82±3.4	8.9± 1.2	5.92
4	16.37±1.4	9.1± 1.6	7.27
5	18.44	10.4± 3.98	8.04

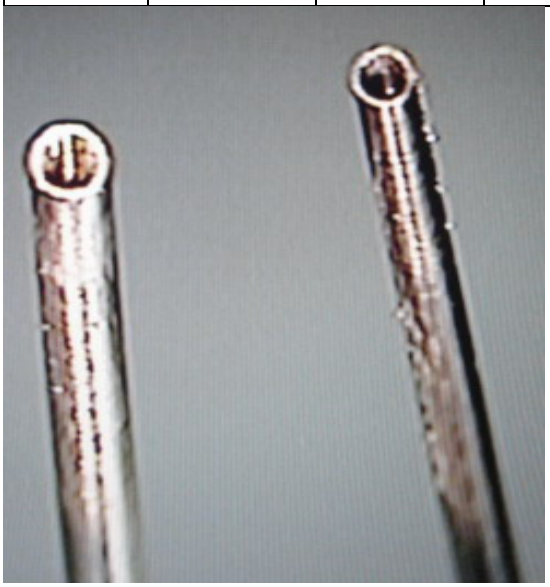

Fig. 1. Diameter of phaco tips: (Left) Coaxial Phaco 19G, (Right) MICS 20G

Fig. 2. Different irrigating choppers

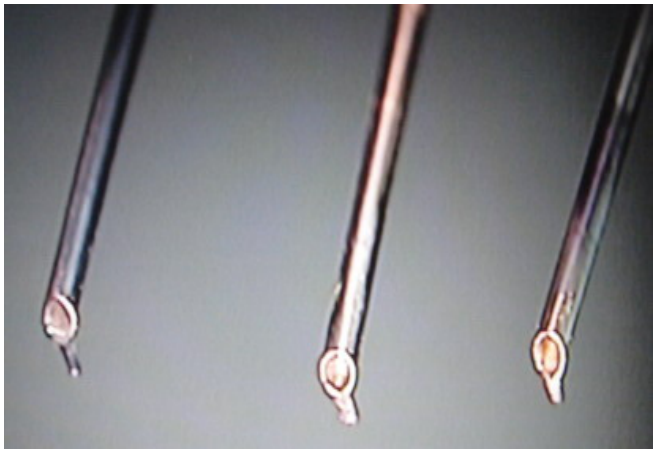

Fig. 3. Magnified view of irrigating choppers tips

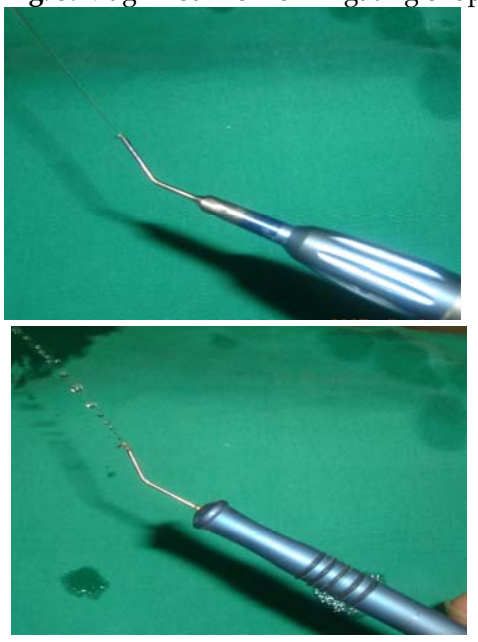

Fig. 4. (Left)Irrigation chopper with fast flow, (Right) Irrigation chopper with slow flow

Fig. 5. Air pump attached to infusion bottle having height 120 cm

Fig. 6. Flow less without air pump(Left) and increasing with air pump on (Right).

EPT

Average EPT of grade 2 cataract for MICS was 3.92 ± 2.07 sec and coaxial phaco was 5.67 ± 3.7 sec (Table 4)

Table 4: Average EPT

Density of Cataract(grade)	Sec ± SD MICS 20G	Sec ± SD Coaxial Phaco 19G
2	3.92±2.07	5.67±3.7

DISCUSSION

The problems

1. Spray of liquid droplets emitted through wound. It was because of the turbulence created by the vibrating phaco tip which was not covered by the sleeve. It was controlled by further decreasing the phaco power. For A and P this happened at phaco power above 20 % so we had to bring the phaco power to 15 %.
2. Anterior chamber (A/C) collapse/ shallowing / depth fluctuations. Initially this was thought to be due to decreased flow in the A/C. Irrigating choppers were found to have different flow rates and the one which provided maximum flow was used (Fig. 4). We used different techniques to increase the infusion pressure. At first inflated sphygmomanometer (BP) cuff was tried around the infusion bottle which gave good flow but an assistant was required to keep the pressure constant. Later on the air pump (Fig. 5, 6) was connected to infusion bottle to increase the flow. Finally it was observed that (after the availability of 1.5 mm keratome) if the incision size is kept strictly under control (which allows the instruments to pass through incisions with slight difficulty), the A/C could be maintained with very little assistance from air pump.
3. Difficulty in irrigating chopper manipulation. As it was larger in size, it took time to master its handling
4. Sharpness of chopper. It was replaced with choppers having blunt edges.
5. Operation time. Increased operation time might be because of different reasons. Firstly it might be due to smaller inner diameter of 20 G phaco tip and suction canula. Secondly it might be partly because of learning curve of MICS and partly due to the extra care when costly IOL was involved. With increasing experience it was possible to increase the vacuum to 300 mm of Hg which decreased the operation time but it still remained more than the coaxial phacoemulsification group. The difference was more marked for dense cataracts. Others have also found prolonged phaco time in the dense cataracts.[8] The mean operating time was found to be 11 min and 20 s when the nuclear hardness was of grade 3 or above (in a scale of 5)[5]. Some have found operation time to be less in MICS when compared with coaxial.[17,18] Surgical time of coaxial MICS have also been found to be significantly higher than with conventional coaxial phaco[19].

EPT

Decreased EPT means less phaco for MICS as compared to coaxial phaco and it has been noted by others also.[12,17] In a study, the mean EPT found was 4.3 sec with an average ultrasound of 5.7% when the nuclear hardness was of grade 3 or above (in a scale of

5).[5] Less phaco most probably is due to increased mechanical work by the chopper.

CONCLUSION

MICS - Bimanual phaco has enormous advantages including reduced astigmatism and rapid wound healing. At the same time it has some problems which are unique to the procedure and phaco surgeon should be ready to handle them.

Author's affiliation

Lt. Col. Khawaja Khalid Shoaib
Head of Eye Department
CMH Kharian Cantt

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