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Cool phaco – new option in cataract surgery

„Cool phaco" – nowa opcja w chirurgii zaćmy

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Summary: Purpose: The aim of this paper is to present an alternative method of phacoemulsification.
Material and methods: Bimanual phacoemulsification through two paracenteses was performed in 15 eyes. After cataract removal intraocular lenses were implanted into the capsular bag through a small paracentesis (less than 2 mm).
Results: Anatomical and functional results were good in all cases. After comparison with conventional phacoemulsification we concluded, that the bimanual technique shortens the time of ultrasounds usage and reduces postoperative astigmatism.
Conclusions: Phacoemulsification performed through two paracenteses can be the next step in cataract surgery development.
Słowa kluczowe: zimna fakoemulsyfikacja, fakoemulsyfikacja przez małe nacięcie.
Key words: small incision phacoemulsification, cool phaco.

Purpose

Phacoemulsification with the use of crystalline lens is currently the method of choice in cataract surgery.

Development has been toward less traumatic surgery which leads itself to more rapid visual recovery. The pursuit of perfection in surgical techniques led to the creation of laser-based lens extraction systems, which enable lens extraction through a 1 mm incision (1,2). This method did not become widely accepted until recently, perhaps due to the difficulties involved in attempting to remove very hard nuclei with this technique (3).

In the last few years ultrasound phacoemulsification also enabled lens extraction through an incision of less than 2.00 mm (4). As a result of the changes in phacoemulsification parameters it became possible to emulsify the nucleus with a sleeveless phaco tip without causing wound burn. The introduction of foldable intraocular lenses that fit into such small incisions are a significant component of this method.

The purpose of this paper is to present our technique and our preliminary results on phacoemulsification performed through two 19 gauge paracenteses.

Material and methods

This prospective study comprised 15 consecutive patients (ten women, 5 men) treated by one surgeon. Cataracts were diagnosed in 15 eyes. Bimanual phacoemulsification through two paracenteses was performed in each of the 15 eyes. The surgical technique was similar to that described by Tsuneoka et al. (4). Local anesthesia was used in all cases. At the beginning of the surgery two paracenteses were made with a 19 gauge microvitreoretinal karatome. Then the anterior chamber was filled with viscoelastic substance and continuous curvilinear capsulorhexis was created with a bent-tip needle, through one of the paracenteses. This was followed by hydrodissection and hydrodelineation. Next bimanual cataract phacoemulsification was performed. A sleeveless phacoemulsification cutter was inserted though one paracenteses, and a „chopper" with infusion was inserted through the second. All surgeries were performed with OS 3 produced by Oertli.

The following parameters were employed: ultrasound power: 40%, maximum aspiration pressure: 250 mmHg, flow rate: 18-24 ml/min, length of ultrasound pulse: 12 ms (pulse rate 8/sec, US-pulse-ratio 10%).

After successful phacoemulsification of the nucleus, bimanual aspiration of residual cortex was performed. Subsequently the anterior chamber was filled with viscoelastic material and a foldable soft acrylic lens („Acri-Smart") with an optic diameter of 5.5 mm was injected into the capsular bag. The injector was pressed against the incision, but was not introduced into the anterior chamber. Just before loading of the soft acrylic lens, the ultra-small incision was enlarged to 1.8 mm. The maneuver used when introducing the lens is shown in figure 1.

Finally, viscoelastic substance was removed from the anterior chamber by stromal hydration of the incision. The total time of ultrasound use was calculated for each patient.

Follow-up lasted at least 3 months. All patients were monitored one day after surgery, then one week later, and after one, three and

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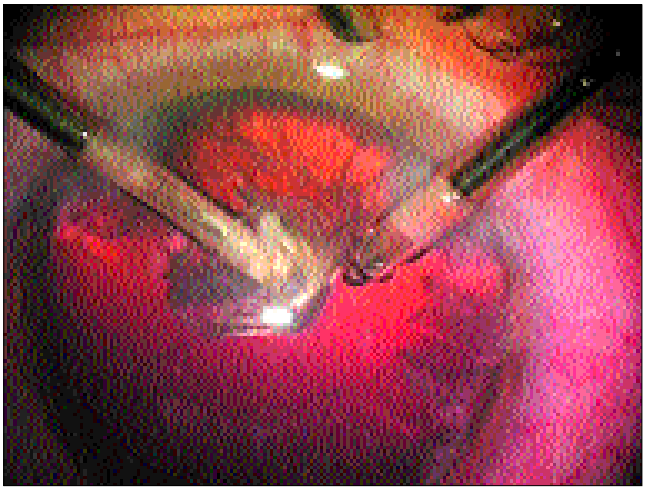
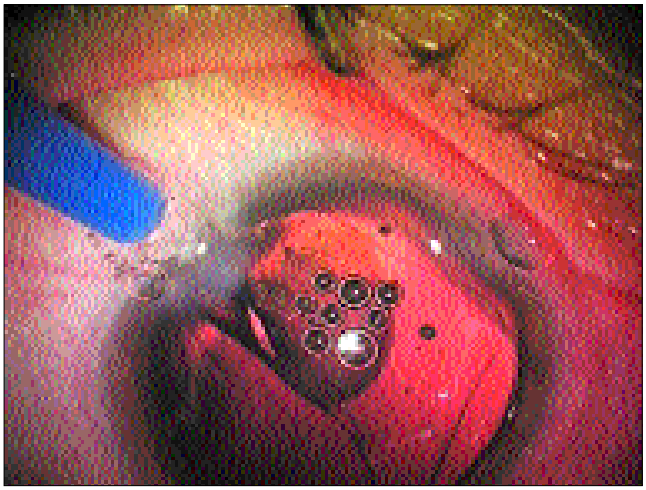


Ryc. 1. Usuwanie soczewki poprzez fakoemulsyfikację przez dwa wejścia do oka.
Fig. 1. Phacoemulsification through two paracentesis.



Ryc. 2. Wprowadzenie zwijalnej soczewki wewnątrzgałkowej przez cięcie o szerokości 1,8 mm.
Fig. 2. Implantation of foldable intraocular lens through a 1.8 mm incision.

six months. The inflammation rate, corneal edema and best corrected visual acuity were recorded.

For comparison a group of 25 consecutive patients (17 women, 8 men) was created. These patients were treated with conventional phacoemulsification through a clear corneal incision 2.5-4.00 mm wide. The intraocular lens was either injected into the eye (12/25 eyes) or introduced with the help of a pincette.

All patients had corneal astigmatism measured before surgery, then one week and three months after surgery. The measurements were performed with keratometer KM 500 produced by Nidek. The induced astigmatism analysis was based on sinus and cosinus law described by Naylor and by decomposition law described by Naesser and modified by Olson.

Results

The mean age in the treated group was 63 years (range 45 to 89 years) and in the control group 64 years (range from 49 to 92 years).

No serious complications appeared. The best corrected visual acuity measured one week after surgery was 0.88 (0.6-1.0). In the control group the best corrected visual acuity was 0.66 (0.4-1.0).

The induced astigmatism one week after surgery was 0.39 Dpt (0.17-0.57 Dpt) and 0.28 Dpt three months after surgery by patients by whom bimanual phacoemulsification was performed. In the control group the induced astigmatism one week after surgery was 0.76 Dpt (0.12-1.6 Dpt) and three months after surgery 0.68 in the group with intraocular lens introduced with an injector and 1.29 Dpt (0.01-2.37 Dpt) in the group with intraocular lens introduced with pincers and three months after surgery 0.88 Dpt.

No statistically significant changes in corneal curvature were observed during the 3 months period in the treated group.

The analysis of total ultrasound usage time was in the treated group 3.7 sec (0.6-9.5 sec) and 31.4 sec (13-62 sec) in the control group.

Inflammation was observed in neither case. Clear corneal incision did not leak through the observation time. Wound burn was not observed.

Discussion

The development in cataract surgery over the past decade enabled lens extraction through an incision smaller than 2.0 mm. The most common complication after this type of surgery used to be wound burn, which could cause astigmatism or inflammation. To reduce this type of side effect some surgeons tried to use different tip types and tried different positions of the tip in the incision, from which the central position observed to be the least invasive (5). Others proposed enlarging the incision 1 gauge when compared with the phaco tip (6,7) or using an erbium: YAG laser (8). It was also proposed that infusion solution could be used to disperse the heat (3,9). Finally it was shown that performing phacoemulsification in pulse mode can solve this problem (9). Another complication connected with bimanual phacoemulsification was destabilization of the anterior chamber, but this can be resolved with increased pressure in the infusion line or thin walled tubing in the irrigating chopper (14). Soscia and coworkers have proven in experimental work that this method is safe and does not cause significant increases in temperature in the anterior chamber. They used the WhiteStar phacoemulsificator Sovereign produced by Allergan (10,11,12,13). Braga-Mele and coworkers confirmed this data using the machine Millenium produced by Bausch and Lomb Surgical. Also clinical papers published in the last few years describe small-incision bimanual phacoemulsification as an useful technique. The first trials of this technique were performed by Hara and Hara in 1984 (14). This method was introduced into clinical practice on a wider scale by Agarval and coworkers (15) through an 0.9 mm incision and Tsuneoka and coworkers (2001, 2002) through an 1.4 mm (19 g) incision (16,17). A limiting factor in the further improvement of bimanual phacoemulsification was the lack of lenses that would fit into such small incisions. Tsuneoka enlarged the incision to 4.1 mm before implanting a foldable soft acrylic lens. In his next paper he described an improvement of this method, that enabled intraocular lens implantation through a 2.2 mm incision (18). Our preliminary results confirm the data obtained by other authors. Phacoemulsification of the lens is possible through an 1.4 mm incision Acri Smart lenses are an important component of this method and possible to inject through an incision of less than 2.00 mm. It enables further reduction of induced astigmatism. It seems also of great importance that the pulse mode of ultrasound used

reduces the total ultrasound use time, as previously stated by Badoza and coworkers (19). This reduces such a serious complication as wound burn. Another advantage of bimanual microphacoemulsification over standard phacoemulsification is a stable anterior chamber, obtained by microincisions, through which it was impossible for viscoelastic material to leave the eye. However, it is also more difficult for fluids to enter the eye, because 20-gauge irrigating choppers limit fluid inflow. This disadvantage can be easily minimized by maximizing the infusion and placing the infusion bottle on a separate intravenous pole set as high as possible (20). It is a good resolution if the surgeon wants to work at high aspiration. Recently an aspiration flow-restricting method was described, which permits to work on lower vacuum settings as well (Staar Cruise Control Device) (21). The third advantage described previously by Brauweiler (22) is the possibility to remove subincisional cortex easily. It can be obtained by switching the entrance incisions for irrigation/ aspiration.

It seems that the major problem concerning small incision phacoemulsification is the lens size. It is still necessary to enlarge the ultrasmall incision just before lens introduction. Perhaps technological advances in the near future will enable production of intraocular lenses that would fit through incision of less than 1.2 mm. For example Calhoun Vision is developing injectable polymer lenses (23).

In conclusion it must be said that this technique seems to be useful and involves less complications than conventional phacoemulsification. It could be a developmental factor in future cataract surgery.

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