Comparison of Diathermic high-frequency capsulorhexis and Femtosecond laser-assisted capsulorhexis in white cataract surgery

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Research Article

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Abstract

Aim: To compare the integrity, roundness and diameter of the capsulotomy in the white cataract between femtosecond laser assisted capsulotomy and high-frequency capsulorhexis.

Methods: The prospective study included 32 patients with white-nuclear cataracts, 16 of whom underwent femtosecond capsulorhexis and another 16 underwent diathermic high-frequency capsulorhexis. The integrity roundness and diameter of the capsulorhexis post-operation were compared.

Results: Femtosecond group obtained 6 cases(37.5%)of complete capsular. No anterior capsule tear occurred. Diathermy high-frequency achieved continuous complete capsular in 3 eyes(18.75%) and anterior capsule was teared in 13 eyes(81.25%). The femtosecond group has a mean capsular diameter of 5.4 mm, and the diathermic high-frequency group has an average capsular diameter of 6 mm. No posterior capsule tear occurred in both surgical procedures.

Conclusions: Femtosecond laser-assisted cataract surgery can achieve high capsular integrity and stable capsulorhexis diameter. Compared with the diathermic high-frequency capsulorhexis, the frequency of injecting the viscoelastic agent was reduced, and the tear of the capsule was less likely to occur. The continuous complete capsular(CCC) by femtosecond laser is more round, more complete ,more controllable and smoother than diathermy high-frequency(DHC).

Introduction

The safety and integrity of the capsulorhexis is a major difficulty in white cataracts. To consistently create a continuous complete capsular (CCC) ,various methods have been proposed. Such as staining the anterior capsule with indocyanine green or trypan blue^{1,2}, two-stage capsulorhexis³, use of Vannas scissors etc⁴. These methods have improved success of achieving an intact CCC, but which require skill and are tedious and time-consuming¹³. In recent years, femtosecond laser-assisted cataract surgery system(FLACS) and diathermy high-frequency(DHC) capsulotomy have been applied to cataract. According to reports^{5,6,7,8}, in the capsulord surgery, the femtosecond laser capsulosic has higher precision, higher integrity and shorter operation time than traditional phacoemulsification surgery. Also, femtosecond laser system is technically feasible and safe for the treatment of intumescent white cataracts^{9,10}. Besides, DHC also shows good clinical value in white mature and hypermature cataract compared with traditional phacoemulsification^{10,11}. However, there are no studies that have compared the outcomes of FLACS with DHC in the case of white cataract.

In this paper, we compare the result of femtosecond laser capsulotomy and diathermy high-frequency capsulotomy in the cases of white cataract.

Patients And Methods

This is a prospective study comparing the effect of an diathermy high-frequency capsulorhexis with a femtosecond laser capsulotomy. Patients were randomized to two groups according to their wishes. Informed consent was obtained and all aspects of the Declaration of Helsinki were observed. A complete medical history and ophthalmologic examination were performed before surgery. Including intraocular lens measurement, corneal endothelial cell detection and ocular B-ultrasound, etc. All patients underwent cataract surgery under topical anesthesia and all surgery were completed by the same experienced doctor at the Lixiang Eye Hospital of Soochow University. In the FLACS group, all patients had femtosecond laser-assisted cataract surgery (American Alcon femtosecond laser LenSX). All eyes received a 5.3mm diameter capsulotomy (pulse energy 6uj). The main corneal incision at 145 degrees, width 2.2mm, energy selection 6uj. The side slit was located at 45 degrees, the width was 1mm(pulse energy 6uj). Lens fragmentation was attempted in later cases and the diameter of the nucleus was 5.8mm(pulse energy 12uj).

Vacuum suction was initiated after adjusting the vacuum suction ring and the patient's eye surface position. After the eye was imaged on the display screen, the doctor adjusted the limbus locating ring and the optical center. The doctor used video microscope image to determine the horizontal position of the capsulotomy. Anterior segment optical coherence tomography was used to determine the laser depth position of the capsulotomy. After femtosecond surgery, a viscoelastic agent was injected into the lateral incision to further push the edge of the pupil and the capsule was removed with the microcapsulorhexis forceps. After hydrodissection, the phacoemulsification was performed(American Alcon Infinity Cataract Ultrasonic Emulsifier), the nucleus and the cortex were aspirated, the posterior capsule was fully polished, and the intraocular lens was implanted. Finally, the viscoelastic agent was removed and the main incision was watertight.

In the DHC group, the triangular knife was used to make a 2.2mm corneal incision at 10 o'clock, the diathermic capsulorhexis needle entered into the chamber and the continuous circular capsulorhexis was about 5.3 mm. The phacoemulsification process was the same as the FLACS group. In our study, trypan blue stained capsules were not used in either surgical procedure.

Results

In the femtosecond group, 6(37.5%) cases of the capsule were completely detached(free-floating capsulotomy) and 10(62.5%) cases were incomplete. This need to use the capsulotomy to slowly remove the undetached capsule along the capsular trajectory. No anterior capsule tear occurred. The average capsular diameter was 5.4mm(ranged from 5.3mm to 5.5mm) after lens implantation. In the DHC group, only 3 eyes(18.75%) got free-floating capsulotomy, 14 cases (81.25%) occurred anterior capsule tear. Average capsular diameter was 6.0mm(ranged from 5.5mm to 6.4mm). No posterior capsule tear occurred in either surgical procedure. Femtosecond laser capsulotomy time was 10 seconds and DHC capsulotic time was about 1 minute, and Femtosecond laser capsulotomy is a more ideal capsulorhexis technique which can obtained more round, more complete and more controllable capsulorhexis.

Discussion

The main surgical difficulty of white nucleus cataract is achieving a CCC. Due to the lack of red reflex, white cataracts are difficult to visualize during surgery. Since the high intracapsular pressure, it is necessary to inject a large amount of viscoelastic to prevent the anterior capsule tear happening. In recent years, FLACS and DHC have been tried to apply to white cataracts^{10,14}. Ina Conrad-Hengerer et al. used a Catalys Precision femtosecond laser system (Optimedica Corp.) to deal with white cataracts. Two of the 25 eyes treated had radial tears and 3 had an incomplete capsulotomy button. All cases were centered and safely implanted with an intraocular lens¹⁰. Soon-Phaik Chee¹³ et al. treated 58 cases of white cataract by Victus (Bausch+Lomb, Munich, Germany) and pointed out that the main complication of FLACS was incomplete capsulotomy. Li Wang et.al¹² compared the DHC and conventional phacoemulsification in white cataract. It was found that corneal endothelial cell counts results between two methods is not particularly different, and anterior lens capsule derived from DHC is rounder than that of manual CCC in shape under optical microscopy. DHC showed good clinical value. Tim Schultz et al. reported a two-step surgical approach. First make a small capsulorhexis to release the intralenticular pressure. The fluid milky lens material was removed from the anterior chamber before re-adsorbing the eyeball to make a larger capsulorhexis.

As shown in Figure 1, compared with ordinary cataracts, white-nuclear cataracts spray white emulsion when the capsule was ruptured, which prevented laser propagation and caused the anterior capsule of the lens not to be completely created. Equipment supplier may consider speeding up the rate of capsulorhexis and complete the capsulorhexis before the emulsion is ejected. In case of incomplete capsular, we usually use the forceps to carefully remove the capsule along the capsular tract. After the femtosecond laser capsulotomy, the torn capsule is clearly visible under the microscope (Figure 2), and the capsule can be removed without staining with a dye such as trypan blue. In some cases, the femtosecond FLACS capsulorhexis was not round enough, we need second capsulorhexis after the implantation of the intraocular lens (Figure 4). The surgical trajectory of the DHC was similar to a dotted circle. Since this was done manually, the interval between adjacent points may be too large, and the capsule tear may occur (Figure 5). Because minimizing the spacing between adjacent points, the capsulorhexis process was usually slow, which increased the operation time and the edge is not very smooth. Due to the manual operation by doctor, this leads to a certain range of patient's capsulorhexis diameter floating in a certain range.

According to this study, compared with DHC, FLACS has a more stable capsulorhexis diameter, shorter operation time and better integrity. If the equipment manufacturer can speed up the rate of capsulotomy, reduce the laser spot diameter and reduce the layer spacing and dot spacing of the capsulorhexis. Then, we believe that the femtosecond laser system is not only suitable for general cataracts, but also has good surgical results in white cataracts. The CCC by femtosecond laser is more round, more complete, more controllable and smoother than DHC.

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Figures

Figure 1

The screen shows white emulsion floating above the anterior capsule

Figure 2

Under the microscope, the anterior capsule is clearly visible after femtosecond surgery, without the need for trypan blue staining

Figure 3

Anterior capsule removal

Figure 4

The femtosecond laser tearing capsule was not round enough and the second hand-made capsulotomy was performed after the crystal is implanted.

Figure 5

Anterior capsule tear in DHC surgery