Surgical Technique

Comparison of Pacman cutting technique and trisection cutting technique for hydrophobic acrylic intraocular lens removal

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The objective of this retrospective cohort study is to compare the Pacman cutting technique with the trisection cutting technique for hydrophobic acrylic intraocular lens extraction. A total of 29 eyes of 29 patients requiring IOL removal were selected and enrolled in this study. The patients in group 1 (13 cases) underwent the conventional trisection cut technique from May 2022 to Dec. 2022. The patients in group 2 (16 cases) underwent the modified partial IOL cutting technique (Pacman cutting technique) from Jan. 2023 to June 2023. Corneal endothelial cells (CECs) count, slit-lamp examination, and intraocular pressure (IOP) measurement were conducted at all preoperative and postoperative visits. Surgical time, intraoperative and postoperative complications were recorded. The mean surgical time was 3.48 ± 1.54 minutes (range: 2 to 7 minutes) for the trisection cut technique group and 2.52 ± 1.18 minutes (range: 2 to 5 minutes) for the Pacman cut technique group. There was a statistically significant difference between the two groups in terms of surgical duration ($P < .05$). There was no difference in the mean preoperative CEC counts (group 1: 1924 ± 462, group 2: 1876 ± 516, $P > 0.05$). However, three months after the operation, the count of CECs decreased by 213 ± 72 (11%) in group 1 and 142 ± 57 (8%) in group 2. The decrease in CECs in group 1 was greater than that in group 2, and the difference was statistically significant ($P < .05$). There were no serious complications affecting vision in either group during the follow-up period. This study showed that the Pacman cutting technique is more effective and safer than the trisection cutting technique for hydrophobic acrylic IOL removal.

Key words: Hydrophobic acrylic, intraocular lens removal, Pacman cutting technique, trisection cutting technique

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Introduction

Cataract surgery with intraocular lens (IOL) implantation is one of the most commonly performed surgeries worldwide, with nearly 20 million cases annually.[1] In some cases, the IOL needs to be explanted. These include dislocation, decentration, incorrect lens power, and undesirable photic phenomena, such as glare or optical aberrations.[2] Many techniques have been described for removing foldable IOLs through a 2 mm to 3 mm main incision without enlarging the incision. These technologies are mainly divided into two types according to whether they need to be cut. One kind is twist-and-out technique without cutting for IOL removal.[3] The size of the incision required for this technique varies with different dioptric powers of this IOL as central thickness can vary. In addition, the technology is difficult to operate and has a learning curve. Another type of technology requires cutting the IOL, cutting the IOL into two or three to four pieces and then IOL removal separately.[4] This type of technique is more commonly used. The choice of surgical method depends on many factors, including the convenience of surgical operation, the experience of the operator, the material of IOL, the type of IOL haptics, and other factors. It is easier to fracture hydrophilic acrylic and PMMA haptics than hydrophobic acrylic haptics.[5]

In order to analyze the convenience and safety of different surgical procedures, the modified partial IOL cutting technique (Pacman cutting technique) was compared with the conventional trisection cutting technique for hydrophobic acrylic IOL removal in this article.

Patients and Methods

This retrospective nonrandomized comparative cohort study adhered to the tenets of the Declaration of Helsinki and was approved by the Institutional Ethics Committee of Aier Eye Hospital of Wuhan University.

The inclusion criteria stipulate that only hydrophobic IOLs that need to be extracted are considered. Exclusion criteria

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include serious surgical complications such as Descemet membrane detachment, iridodialysis, or an embedded IOL incision requiring enlargement for removal.

All patients were divided into two groups. The patients of group 1 underwent the conventional trisection discrete technique from May 2022 to December 2022. The patients of group 2 underwent the modified partial IOL cutting technique (Pacman technique) from January 2023 to June 2023. All surgeries were performed by a single surgeon (Y. W.).

The primary outcome measure was surgical time. The time of removing IOL referred to the period from the beginning of cutting the IOL to the end of removing the last piece of IOL. The secondary outcome measures were corneal endothelial cell (CEC) counts, intraocular pressure (IOP), and serious complications during and after surgery. All patients have a follow-up record of more than 6 months.

Surgical procedure (see the video)

Trisection cutting technique

A 2.2-mm limbal-corneal incision was created or reopened. If the posterior capsule was not intact, the anterior vitrectomy was required to ensure the ensuing maneuvers do not result in vitreous traction. The IOL was gently dissected from the capsular bag using viscoelastic. Then the IOL was rotated or grasped into the anterior chamber with a Sinskey hook or forceps. Scissors were introduced in the anterior chamber through the main incision [Video 1]. A Nagahara chopper was used for counteraction. Cut the IOL optic into three portions of 2 mm width with scissors [Fig. 1]. The fragments of IOLs were removed from the main incision with forceps [Fig. 2].

Pacman cutting technique

A 2.2-mm limbal-corneal incision was created or reopened. The IOL was rotated or held into the anterior chamber with a Sinskey hook or forceps. With a Vannas or IOL scissors, a radial incision about one half the IOL diameter was made [Video 2]. Then the IOL was rotated 30 degrees to 45 degrees, where a second radial incision connected the previous incision [Fig. 3]. A triangular segment of the IOL that was explanted with forceps via the 2.2 mm incision was freed [Fig. 4]. The inner edge of remaining IOL optic was grasped with toothed forceps, and it was dragged out via the main incision [Fig. 5]. Then it was rotated with forceps and the remaining optic of the IOLs that looks like Pacman was explanted, without enlarging the incision [Fig. 6].

Statistical analysis

Statistical analysis was performed using SPSS V.18.0 for Windows (SPSS Inc., Chicago, IL, USA). Quantitative data are expressed as mean ± standard deviation (SD), and qualitative data are expressed as percentages. Univariate analyses, such as a Chi-square test, were used to compare qualitative data, while *t*-test was used to compare quantitative data. In all the cases, a *P*-value < 0.05 was considered statistically significant.

Results

The 29 eyes of 29 patients fulfilled the inclusion and exclusion criteria. Group 1 comprised 13 eyes (13 patients: 5 males and 8 females) with a mean age of 70.63 ± 8.74 years (range 42–83 years) who underwent conventional trisection IOL removal. Group 2 comprised 16 eyes (16 patients: 6 males and 10 females) with a mean age of 68.21 ± 11.05 years (range 40–87 years) who underwent Pacman IOL removal. The time interval of the IOL removal from the previous cataract surgery was 6.2 ± 8.7months (range, 1–28 months) in group 1 and 7.5 ± 9.9 months (range, 1–36 months) in group 2. There was no significant difference in age, gender, reason of IOL removal, and time interval between the two groups [Table 1].

Efficacy

The mean surgical time was 3.48 ± 1.54 minutes (range: 2 to 7 minutes) for the trisection cut technique group and 2.52 ± 1.18 minutes (range: 2 to 5 minutes) for the Pacman cut technique group. There was statistically significant difference between the two groups in terms of surgical duration ($P < .05$). There was no difference in the mean preoperative CEC counts (group 1 (1924 ± 462), group 2 (1876 ± 516), $P > 0.05$). However, 3 months after the operation, the count of CECs decreased by 213 ± 72 (11%) in group 1 and 142 ± 57 (8%) in group 2. The count of CECs in group 1 decreased more than that in group 2, and the difference was statistically significant ($P < .05$).

Safety

Among the intraoperative complications, there were two cases of mild iris injury with bleeding in group 1 and no

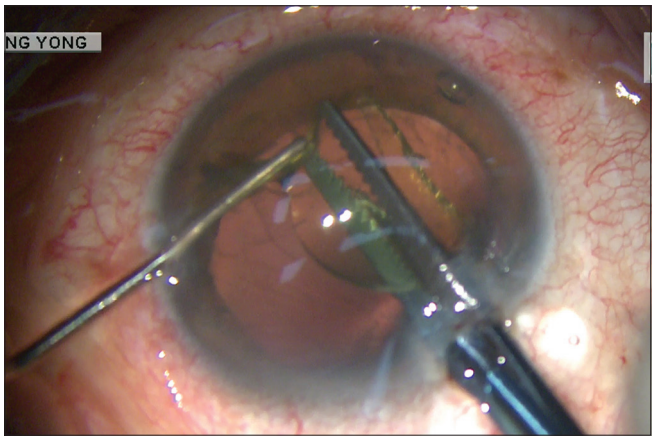

Figure 1: Cut the IOL optic into three portions of 2 mm width with scissors

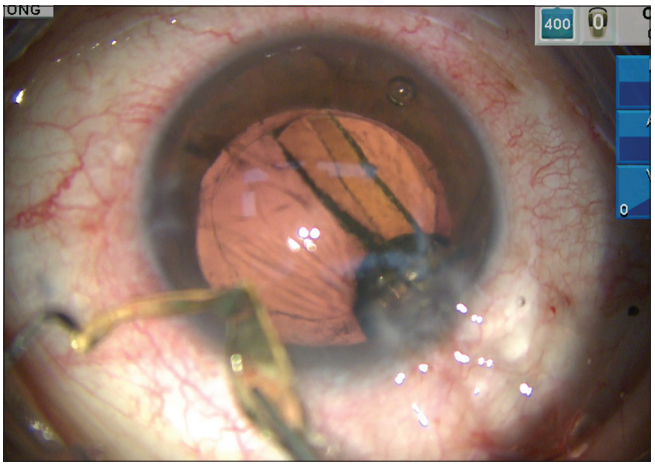

Figure 2: Fragments of IOLs were removed from the main incision with forceps

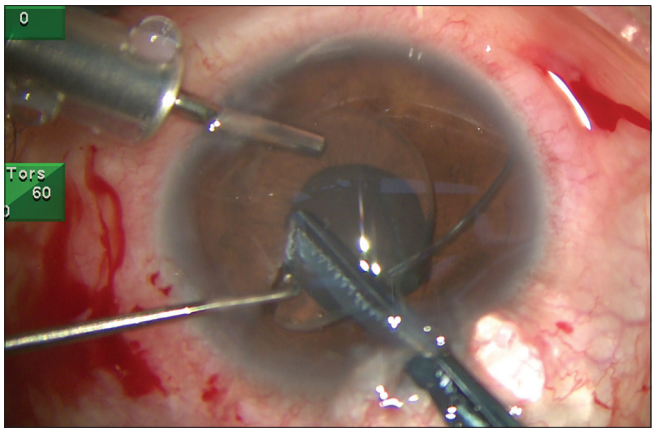

Figure 3: Two radial incision about one half the IOL diameter was made with scissors

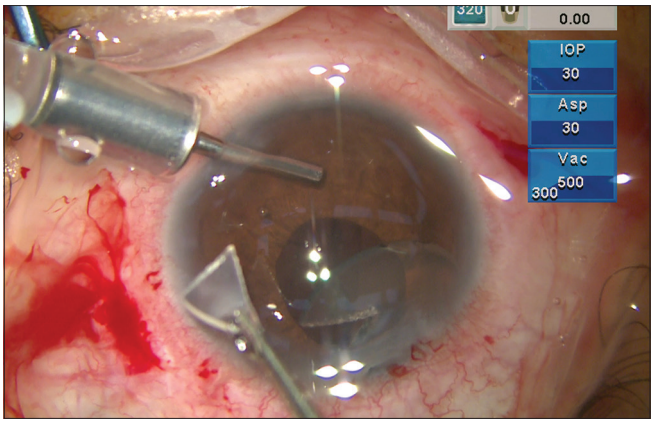

Figure 4: Freeing a triangular segment of the IOL that was explanted with forceps via the 2.2 mm incision

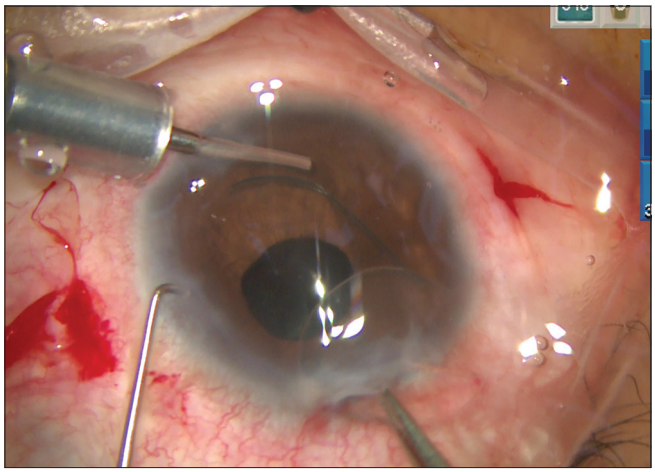

Figure 5: Inner edge of remaining IOL optic was grasped with toothed forceps and dragged out via the main incision

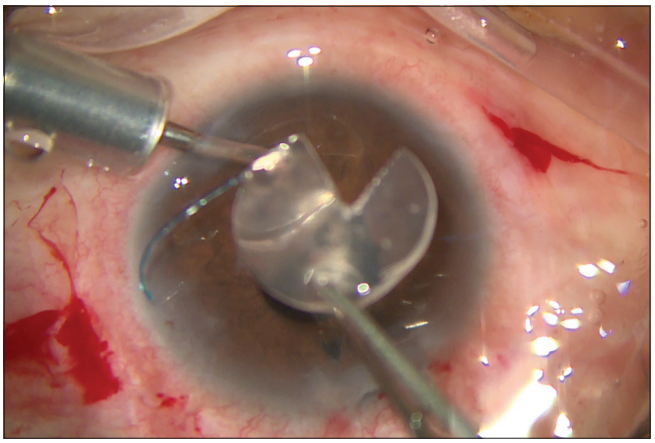

Figure 6: Rotate with forceps and explant the remaining optic of the IOLs that looks like Pacman, without enlarging the incision

Table 1: Preoperative data of all patients

	Group 1	Group 2	*P*
No. of eyes	13	16	
Mean age (range), years	70.63±15.84 (range 42–83)	68.21±13.75 (range 40–87)	0.66
Gender (*n*,%)			0.95
Male	5 (38.46%)	6 (37.50%)	
Female	8 (61.54%)	10 (62.50%)	
Reason (*n*, %)			0.98
Incorrect lens power	8 (61.54%)	10 (62.50%)	
IOL Dislocation	4 (30.77%)	5 (31.25%)	
Dysphotopsia	1 (7.69%)	1 (6.25%)	
Time Interval Range (months)	6.23±8.74 1–28	7.58±9.92 1–36	0.70

complications in group 2. Early postoperative complications included transient elevated IOP and corneal edema in a few patients. There was no difference in postoperative complications incidence between the two groups. There were no serious complications affecting vision in both groups during the follow-up period.

Discussion

A variety of techniques for cutting foldable IOLs have been described. In recent years, interest has been focused on explanting IOLs through small incisions (2.2–2.65 mm) to avoid astigmatism induction, thus improving the predictability associated with the exchange procedure.[6] Some techniques do not require the IOL to be cut. Bhaumik *et al*.[7] used a wire noose to refold and load an IOL into a modified lens cartridge and then removed it through the main incision. Disadvantages of this method include that it cannot be employed with thicker IOLs and it can be challenging, requiring a high level of surgical skill. More widely used IOL removal technologies require cutting the IOL. Because the IOL was cut in the anterior chamber, close to the corneal endothelium and the iris, it may increase the risk of corneal endothelium and iris damage. Therefore, in order to reduce the damage, some modified IOL cut techniques have been developed. Ye reports a technique where the IOL optic was cut into three connected pieces at the 1-mm-wide end with scissors. The middle piece was removed first, followed by the two side pieces, eventually resulting in the explantation of the IOL as an intact piece.[8] However, these modified techniques still required more than half of the IOLs to be cut.

In our study, we evaluated a simple IOL cutting technique. Compared with other technologies, Pacman cut technique had some advantages. About one sixth or one five of IOL optic needed to be cut. Scissors can cut the IOL halfway to the center without cutting it completely from one side of the long axis to the opposite side. The operation of Pacman cutting technique in anterior chamber is less, easier to complete, and has less damage. Our study shows that the Pacman cut technique requires less operation time than the trisection cut technique for IOL removal. On the other hand, IOLs were rotated about 45 degrees in the eye, which can reduce the damage to the iris, CECs, or the angle of the chamber when rotating the IOLs. Conventional trisection or bisection cut technique needs rotation more than 180 degrees.[9] Moreover, complete sectioning would result in keen fragment edges, which may also injure the intraocular tissues. Especially for vitrectomized eyes, unskilled manipulation may cause the fragments to drop down partly or completely into the vitreous cavity, leading to more injuries and unnecessary procedures. Our results show that Pacman cut technique has less loss of CEC count than the trisection cut technique. What is more, the IOL was taken out from the incision and rotated by hand relay, without the need to expand the incision, so the operation was convenient.

There were still some limits in this study. The process of removing IOLs not only involved cutting and removing them from the eye but also included operations such as separating the IOLs from the capsule. These operations may cause damage to the CECs and the zonules, so a comprehensive evaluation was needed.

In conclusion, Pacman cutting technique was more effective and safer than trisection cutting technique for hydrophobic acrylic IOL removal.

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Conflicts of interest: There are no conflicts of interest.

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