

Comparison of 23 Gauge and 25 Gauge Anterior Capsulotomy Forceps

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In cataract surgery, the most commonly-used procedure for incision of the anterior capsule is continuous curvilinear capsulorrhexis (CCC), developed by Gimbel and Neuhann [1]. As Gimbel has reported, CCC is a safe technique for phacoemulsification and aspiration (PEA) and intraocular lens (IOL) implantation [1-3]. The optimum incision method for CCC is thought to be that of using anterior capsulotomy forceps [4-8]. Recently, I have developed the side-port 23 gauge anterior capsulotomy forceps (23G forceps), manufactured by Asico, which can be manipulated via a small incision, as well as the side-port 25 gauge anterior capsulotomy forceps (25G forceps) and 25/23 gauge tapered anterior capsulotomy forceps (tapered forceps), manufactured by Inami, which are thought to provide even better ease of handling. In view of the fact that the visibility, ease of handling, bending, adverse effect on the wound, and effect on the cornea of these various forceps are important, the present comparison study among these forceps was conducted on pig lenses by means of 0.1 % trypan blue staining [9] of the anterior capsule. It was found that capsulorrhexis was difficult with the 25G forceps because of the strong bend of the shaft. However, the tapered forceps has little bend, and like the 23G forceps, it showed outstanding handling and visibility and had little adverse effect on the wound.

Key words : Anterior Capsulotomy Forceps, 23 Gauge, 25 Gauge, CCC

INTRODUCTION

Looking at cataract surgery in recent years, Gimbel developed the technique of intentional continuous circular capsulorrhexis (CCC) in 1988 as the optimum method for incision of the anterior capsule [1-3]. The anterior capsulotomy forceps method has come into frequent use for CCC incisions [4-8]. When the forceps is inserted via the wound in order to perform anterior capsulorrhexis, a capsular flap may develop on the periphery during the process of incising the anterior capsule, resulting in incomplete CCC. In order to eliminate this drawback, I designed three types of forceps, a side-port 23 gauge anterior capsulotomy forceps (23G forceps), a side-port 25 gauge anterior capsulotomy forceps (25G forceps), and a side-port 23/25G tapered forceps with a shaft measuring 25G (tapered forceps), in order to make

it possible to operate via a small incision, maintaining a stable anterior capsule depth and directly grasping the capsular flap. I then conducted a comparison of differences in the design of the three types of forceps and a comparison of differences in visibility, handling, bending, and adverse effect on the wound using pig eyes. This is a report on my results.

MATERIALS AND METHODS

Animals:

Eyes from pigs that had been sacrificed within the previous 24 hours were used. A side-port was made from the corneal limbus of the pig eyes using a 20G V-lance, and then the anterior capsules of the eyes were infused with 0.1 % trypan blue stain solution. After they were washed with BSS, it was confirmed that the anterior capsule of the lens was stained blue, and a viscoelastic

material was then injected into the anterior capsule [9].

Materials:

Design comparison: Figure 1 shows respective overall views. The 23G forceps has a combined shaft and tip length of 28 mm (tip 2 mm, shaft 26 mm), the 25G forceps has a total length of 28 mm (tip 1.5 mm, shaft 26.5 mm), and the tapered forceps has a tip length of 1.5 mm and a shaft length of 26.5 mm, with the 23G component measuring 13

mm and the 25G component measuring 13.5 mm. Figure 2 shows expanded diagrams of the tips. The measurements for the 23G forceps were 2 mm with the tip closed and 2.8 mm with the tip opened, and those for the 25G forceps and tapered forceps were 1.5 mm with the tip closed and 2 mm with the tip opened.

For all of the forceps, the tip angle was 55 degrees, and the forceps were subjected to non-glare treatment and non-slip treatment (Figs. 1 and 2).

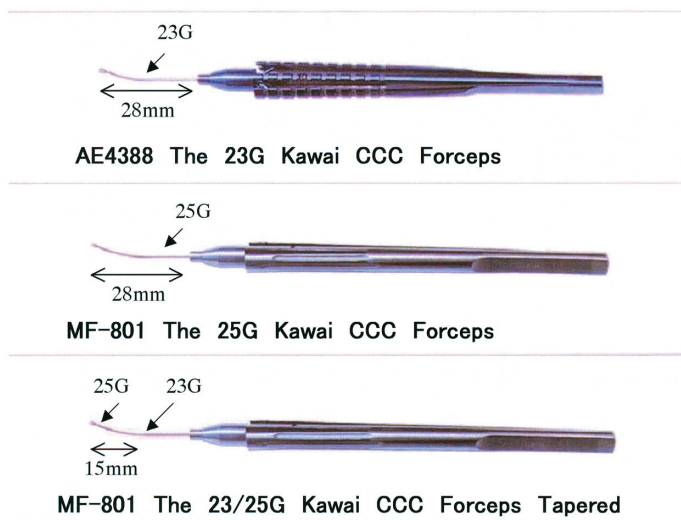


Fig. 1 Overview of three types of forceps

Model Number Product Name	Items	Gauge	Tip Close	Angle	Shaft Length	Serration
			Tip Open			
AE4388 The 23G Kawai CCC Forceps		23G	2mm	55°	2.6cm	○
MF-801 The 25G Kawai CCC Forceps		25G	1.5mm	55°	2.65cm	○
MF-801 The 23/25G Kawai CCC Forceps Tapered		23/25G	1.5mm	55°	2.65cm	○
			2mm			

Fig. 2 Expanded diagrams of the tips

Methods:

The anterior capsule of pig eyes stained with 0.1 % trypan blue were subjected to CCC using the 23G, the 25G, and the tapered side-port anterior capsulotomy forceps (Fig. 3). Videos were taken, and visibility, ease of handling, differences in bending, and adverse effect on the wound were compared.

As differences in bending could not be displayed by video during anterior capsulorrhexis, a 20 g weight was lifted using the various side-port anterior capsulotomy forceps, the shaft of the side-port forceps was aligned with the baseline of the graph, and the degree to which the shaft rebounded when the weight was released was read from

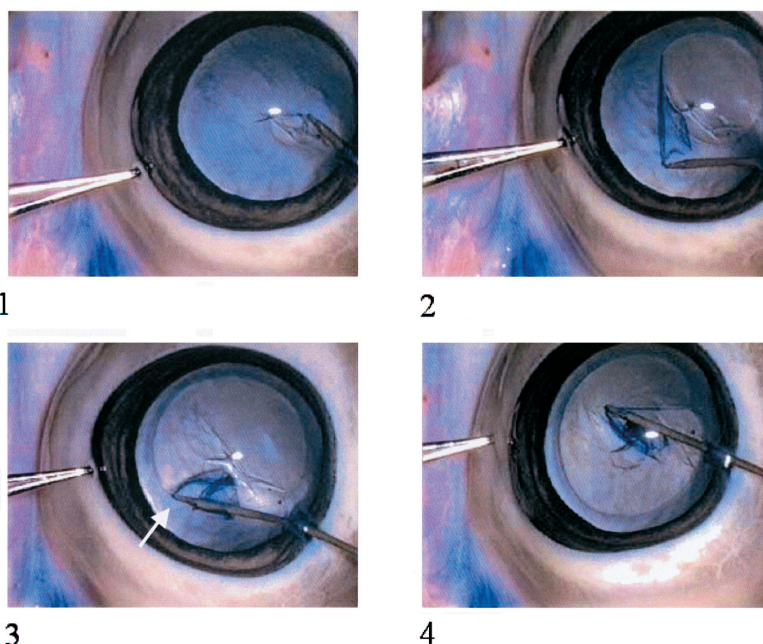


Fig. 3 CCC taken by video.

1. After viscoplastic material was filled in, the center of anterior capsule is incised by the tip of forceps
2. CCC is applied, while holding the top of anterior capsule flap with the forceps
3. Move the forceps into incision point (see arrow) to control flap
4. Repeat the process (3) a few times and CCC is completed.

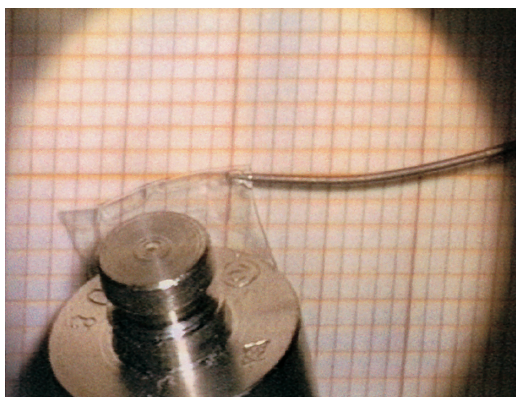


Fig. 4 Measurement of bending.

A 20 g weight was lifted using the various side-port anterior capsulotomy forceps, the shaft of the side-port forceps was aligned with the baseline of the graph, and the degree to which the shaft rebounded when the weight was released was read from the graph and converted into a numerical value.

Table 1 Comparison of visibility, handling and adverse effect on the wound among three types of forceps

	23G	25G	23/25G tapered
visibility	○	○	○
handling	○	△	○
wound stress	○	△	○

○ = good △ = slightly poor

the graph and converted into a numerical value. The same procedure was performed five times for each of the side-port forceps, and average values were taken (Fig. 4).

RESULTS

Visibility, ease of handling, adverse effect on wound:

The 23G forceps showed outstanding ease of handling and visibility. As the 23G forceps measured 2 mm with the tip closed and 2.8 mm with the tip opened, it was concerned that the tip of the shaft could reach the wound due to the longer measurement with an open tip. However, there was no adverse effect on the wound seen in the pig eyes. The 25G forceps measured 1.5 mm with the tip closed and 2 mm with the tip opened, and it was not thought to have any adverse effect on the wound, but because the shaft was 25G over its total length, its supporting component was flexible and bent, making it tend to adversely affect the wound and making it difficult to handle. On the other hand, the 23/25G tapered forceps, which has a shaft length of 28 mm, with 13.5 mm being accounted for by the 25G portion and the remaining 13 mm being accounted for by the 23G, provided a favorable result in all cases, as was the case for the 23G (Table 1).

Bend:

As shown in Table 2, in a test comprising five repeated comparisons of bending using a 20 g weight, the 23G, 25G and tapered forceps measured figures of 2, 3.5, and 2.5, respectively (Table 2).

DISCUSSION

In recent years, the main technique used of anterior capsulotomy in phacoemulsi-

Table 2 Result in comparison of flexibility – average of degree of marks among three types of forceps

	23G	25G	23/25G tapered
Average of degree of marks	2.0 ± 0	3.5 ± 0	2.5 ± 0

fication and aspiration surgery has been continuous curvilinear capsulorrhexis (CCC). With the technique developed in the mid-80s by Gimbel and Neuhann, the procedure can be carried out with no physical cracking of the lens capsule by means of 360-degree incision and removal, and removal of the nucleus by hydrodissection can be carried out with a high degree of safety [1]. In view of the advantages of ultrasound cataract surgery which makes it possible to dissolve the nucleus as desired without harming the corneal endothelial cells, aspirate virtually all of the cortex, and easily insert the intraocular lens into the capsule, I feel that CCC is an important method [1-3]. The ideal CCC can be said to measure 5.5-6 mm, with the cut surface of the anterior capsule being somewhat smaller than the optical diameter of the intraocular lens and covering a full circle concentric with the pupil. For this reason, in the present study, I decided to develop a side-port anterior capsulotomy forceps which would allow completion of the CCC with outstanding visibility and ease of handling but without having an adverse effect on the wound.

Development of side-port anterior capsulotomy forceps:

Numerous anterior capsulotomy forceps have been developed in the past [4-8], but the only anterior capsulotomy forceps that makes it possible to maintain a stable depth of the anterior capsule is thought to be the side-port anterior capsulotomy forceps. In developing the side-port anterior capsulotomy forceps, following three points were emphasized: 1) for purposes of ease of handling and visibility, the tip size should be kept as small as possible; 2) the anterior capsulotomy forceps must be subjected to non-

slip treatment so that it is possible to grasp the incision flap and treatment to prevent reflection (non-glare treatment); and 3) in the procedure of grasping the capsule and performing a continuous incision, the shaft thickness must be of such a size so as to prevent an adverse effect on the wound. Based on these three points, I developed the 23G, 25G, and 23/25G tapered forceps, which make it possible to conduct procedures via a side port. Therefore, in order to compare differences in visibility, ease of handling, and bending, as well as adverse effects on the wound of the three forceps, the eye from pigs sacrificed within the previous 24 hours was selected. Moreover, the anterior capsules of the lenses from the pig eyes were stained with 0.1 % trypan blue [9] so as to allow clear video imaging of the anterior capsule.

Development of 23G, 25G, and 23/25G tapered forceps:

There are some cases where application of CCC would be extremely difficult, i.e. patients with shallow anterior chambers, high vitreous pressure with atopic cataracts, hyper-mature cataracts, microcoria, and Zinn zonules rupture. It is very important for a surgeon to know how to perform a CCC successfully in these cases. Currently, CCC is performed by either cystotome using tip-bent 25 or 27 gauge needles, diathermy or forceps methods. Personally, I have been using forceps for CCC during the last couple of years.

The 23G forceps, which was developed in 2000 in cooperation with Asico, has been used to date in over 1500 cases of cataract surgery, with CCC being completed in over 98 % of the subjects. At the 2003 annual meeting of the American Academy of Ophthalmology, a presentation was made on utilization of the Kawai 23G side-port forceps in difficult cases of CCC. Following this, the June 15, 2003 issue of *Ophthalmology Times* ran an article in its New Product Focus section (page 14) stating that side-port forceps allow better control in difficult CCC cases. It was reported that the 23G forceps is highly useful not only in uncomplicated cataracts, but also in cases of refractory cataract surgery. Based on these results, I used to think that 23G forceps was the best as a side-port anterior capsulotomy forceps, however, a cooperative agreement was entered into in

2002 with Inami in order to develop a smaller sized 25G forceps. As the entire shaft of the 25G forceps was strongly bent, a 23/25G tapered forceps with improved bending was also developed at the same time.

Tip size:

When tip size was compared, it was found that the 23G forceps measured 2 mm/2.8 mm, and the 25G and 23/25G tapered forceps measured 1.5 mm/2 mm (tip closed/opened), with the 23G forceps showing a somewhat longer measurement with an open tip of 2.8 mm, so it was thought that the tip of the shaft might affect the wound, but no problems were observed in the experiment conducted on pig eyes. As all three forceps had a tip angle of 55 degrees and were subjected to non-slip, non-glare treatment, there were no differences in ease of handling or visibility. In the past, the Ikeda-type 23G side-port anterior capsulotomy forceps with a tip angle of 90 degrees (AE4389 Asico) was used, but as it was thought that there were problems with visibility, the tip angle was decreased to 55 degrees, resulting in a remarkable improvement in visibility.

Shaft thickness:

Concerning shaft thickness, among the three types of the 23G, 25G, and 23/25G tapered forceps, the smallest-sized 25G forceps were thought to show the most favorable ease of handling and least adverse effect on the wound before the experimental results came out, but the results showed that when the entire shaft was 25G, bending was strong, making this forceps inconvenient for capsule incision. However, 23/25G tapered forceps had little bend and, like the 23G forceps, showed outstanding ease of handling and little adverse effect on the wound. I am planning to use the tapered forceps as well as the 23G forceps in the future in many cases of cataracts to evaluate its characteristics.

CONCLUSIONS

In anterior capsulotomy forceps for conducting reliable CCC, non-slip treatment was considered important so as to make it possible to reliably grasp the incision flap from the side port, and non-glare treatment and change of shaft thickness from 23 to 25 G were considered important in order to provide ease of handling and visibility.

However, the results showed that in forceps in which the entire shaft was 25G, bending is strong, making such forceps inconvenient for capsulorrhexis, but the 23/25G tapered forceps and 23G forceps have little bending and show outstanding ease of handling and visibility as well as little adverse effect on the wound.

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