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MODIFIED CURVED ASPIRATION CANNULAS AND END-GRIPPING FORCEPS FOR 25-GAUGE VITRECTOMY ON HIGHLY MYOPIC EYES

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Pars plana vitrectomy in highly myopic eyes with an axial length (AL) of over 27.00 mm using instruments with the standard length is more challenging than surgery on eyes with an average length of 22.00 mm to 24.00 mm.1 One of the most difficult maneuvers is to reach the posterior pole of the eye, especially in the case of posterior staphyloma. To reach the posterior retina, the long AL of myopic eyes necessitates positioning vitrector or vitreoretinal instruments at a sharper angle to the visual axis of the viewing system than for emmetropic eyes. In addition, because of an insufficient length of the instrumentation, a slight depression may be created on the eye wall in an attempt to reach the posterior pole. An inadequate length can also result in the instruments or the surgeon's fingers coming in contact with the distal lens of the viewing system or contact macular lens, which obscures or displaces the microscopic view making further manipulations more complicated. This can lead to prolonging the time of the surgical procedure or even rendering it insufficient.

Previous data have indicated the possibility of using curved instruments in vitreoretinal surgery.2–5 The use of sliding curved laser probes is well known.5 Extra-long straight cannulas and long-shaft forceps for highly myopic eyes to reach the posterior pole are already commercially available.6

The purpose of this work is to report the use of modified aspiration cannulas and end-gripping forceps to improve access to posterior pole during pars plana vitrectomy in eyes with a large AL.

Methods

The study was conducted with the accordance to the declaration of Helsinki and was approved by the Ethics Committee of National Academy of Postgraduate Medical Education in Kyiv, Ukraine. The patients consented to use of modified instruments during their surgery.

The main goal of modifying the instruments was to ensure that the cannulas and forceps would reach the posterior pole of the eye during vitreoretinal surgery in patients with long AL, therefore avoiding displacement of contact lens or distant lens of different viewing systems, obscuration of the surgeon's view, and the depression of the eye wall. Schematic drawings of the eye with an AL of ≥30 mm and the distal lens of a wide-angle noncontact viewing system OFFISS (Topcon Medical Systems, Oakland, NJ) with a lens angle of 120° show the relation between the eye ball, instruments, and viewing system (Figure 1). Semitransparent instruments show the amplitude during the maneuvering in relation to the distal lens of the viewing system OFFISS (Figure 1).

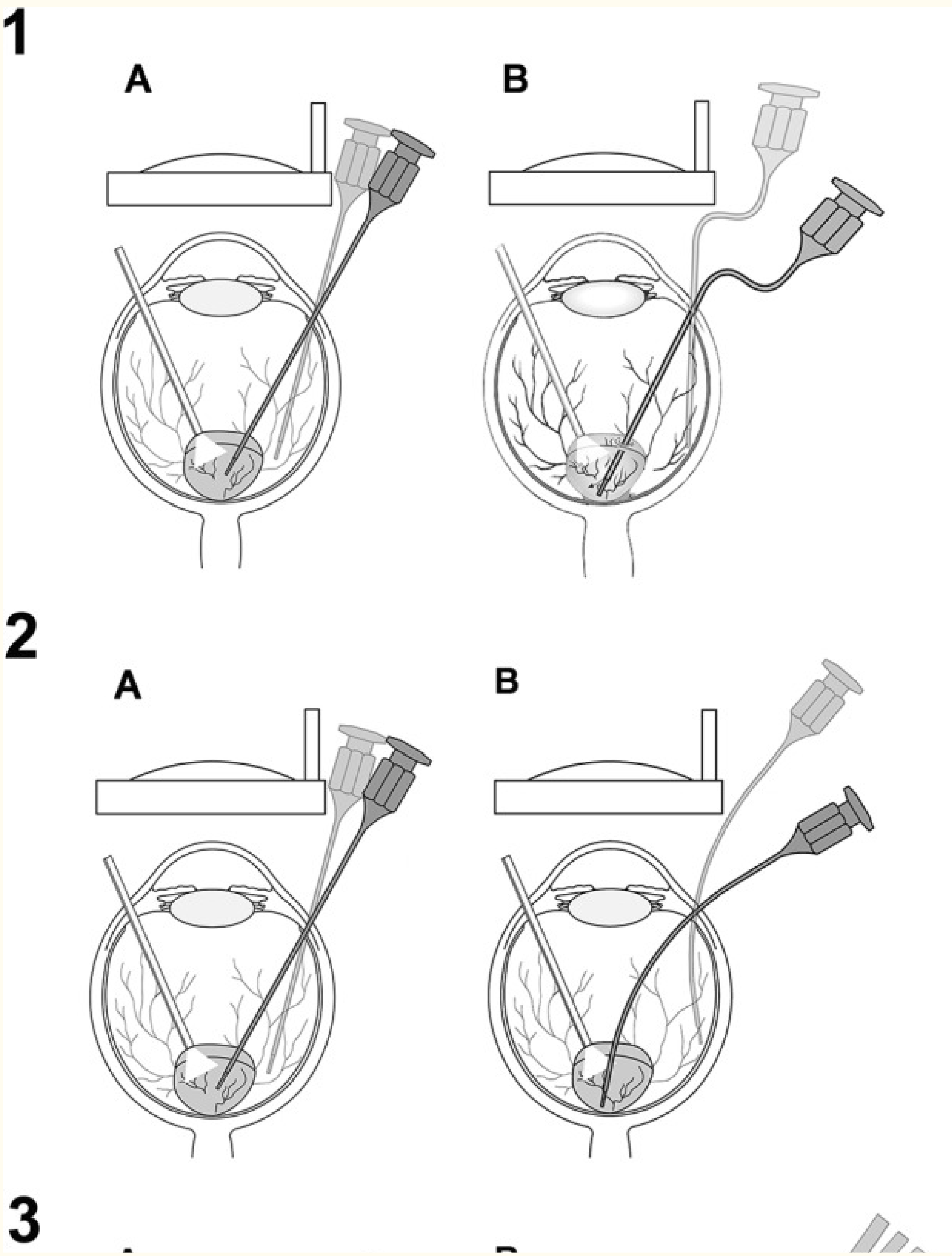

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Fig. 1

Schematic drawing of the standard elongated straight cannula (1**A**, 2**A**) and standard straight end-gripping forceps (3**A**) during pars plana vitrectomy on the eye with an AL of ≥30 mm with the use of viewing system OFFISS (Topcon). Cannulas "Bayonet" (1**B**) and "myopic" (2**B**), and end-gripping forceps "myopic" (3**B**) are shown.

Instrumentation

The concept for these instruments and the production of the prototypes was followed by testing in clinical trials. The cannula "Bayonette" is a titanium 25-gauge cannula with a Luer lock. It has a double opposite bending angle of 105° at the body base, with a total length of 58 mm. The length of the cannula between the folds is 9 mm, the length of the operating distal part is 35 mm, the outer diameter is 0.52 mm, and the length of the 25-gauge silicone tip is 2 mm with an outer diameter of 0.4 mm (Figure 1, 1B). The difference between the positioning of a standard elongated straight cannula and a "Bayonette" cannula compared with the viewing lens is depicted in Figure 1, 1A and B. The semitransparent instruments show the amplitude of intravitreal movements for both cannulas; the distance between the cannula's base and the distant lens of the viewing system is also shown (Figure 1, 1A and B).

The modified cannula "myopic" is also made of titanium. The 25-gauge cannula with a Luer lock is curved with a radius of 22 mm; in addition, the outer diameter is adapted to the 25-gauge trocar system. The 1-mm-long silicone tip with an outer diameter of 0.45 mm permits manipulation on the retinal surface (Figure 1, 2B). The curvature of the cannula helps in avoiding the contact with the distal lens of the viewing system and lens displacement. The elongated intravitreal part facilitates reaching the posterior pole, with a broader movement amplitude than for straight cannulas (Figure 1, 2A and B).

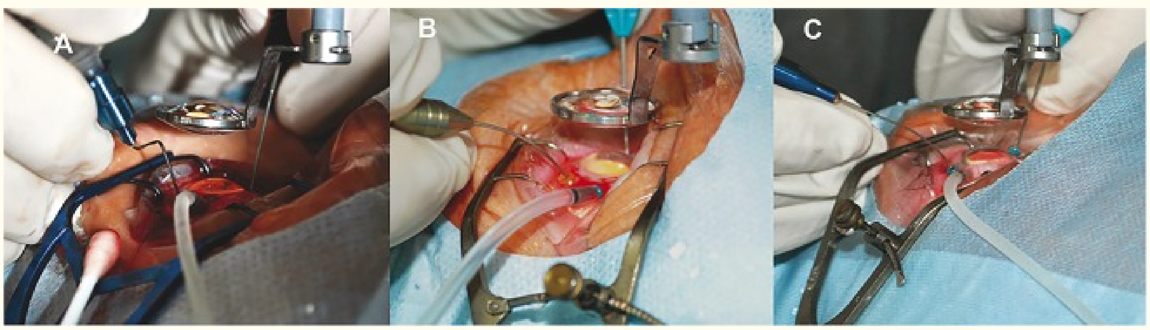

Fig. 2

The prototypes of the cannulas "Bayonette" (**A**) and "myopic" (**B**), and end-gripping forceps "myopic" (**C**) during pars plana vitrectomy on the eye with high myopia.

The "myopic" forceps are modified end-gripping forceps made of titanium with a standard handle. The intravitreal part is curved (radius of curvature, 22 mm). The branches of the tip are situated so that, after introduction into vitreous cavity, they move parallel to the surface of the posterior retina when both closed and open (Figure 1, 3B). The elongated operating part can easily reach the posterior pole of eyes with a long AL. The curvature of forceps moves the handle away from viewing system lens (Figure 1, 3B). The "myopic" forceps have been made as a prototype by Eye Technology Ltd (Essex, United Kingdom) and are waiting for validation to become commercially available. The prototype reference numbers for 23-gauge and 25-gauge "myopic" forceps are P443/A and P443/B, respectively.

Surgery

Pars plana vitrectomy with the assisted 25-gauge trocar system was performed on 31 highly myopic eyes (20 females, 11 males; mean age 46 years, range 25–67 years) with a mean AL of 32.4 mm (range 28.27–36.54 mm) under sub-Tenon's anesthesia. Pars plana vitrectomy was required because of rhegmatogenous retinal detachment (14 eyes) complicated with proliferative vitreoretinopathy B-C1,2; epiretinal membrane (ERM) with vitreomacular traction syndrome and foveoschisis (12 eyes); and macular hole Stage 4 (5 eyes). In all retinal detachment cases, a perfluorocarbon liquid (PFCL)–silicon oil exchange was performed. Fluid–air/gas exchange was performed in all ERMs with vitreomacular traction syndrome and macular hole cases. Surgeries were performed using one of the following 4 different noncontact wide-angle viewing systems: OMS-800 OFFISS (OMS 800, 12 cases; Topcon Medical Systems, Oakland, NJ), BIOM (Oculus, Wetzlar, Germany; 9 cases), EIBOS (Haag-Streit, Möller-Wedel, Haag-Streit International Group, Koeniz, Switzerland; 4 cases), and RESIGHT 500 with a Lumera 700 (Carl Zeiss Meditec AG, Jena, Germany; 6 cases). The mean working distance between the cornea and distant lens was 10.5 mm (range 4–17 mm). A contact macular lens (59 D, 618.60, Alcon Grieshaber AG, Schaffhausen, Switzerland) was used in the ERM and internal limiting membrane removal procedures in 17 cases.

The modified "Bayonette" and "myopic" cannulas were used during the following surgical steps: PFCL injection/aspiration, triamcinolone acetonide injection, Membrane Blue injection, and residual fluid aspiration in fluid–air/gas exchange. Cannulas were attached to syringes or to the aspiration tubing system of the vitrectomy machine (extrusion mode). The modified "myopic" forceps were used during ERM and internal limiting membrane peeling and subretinal membrane removal.

Results

In all cases, the surgery presented no complications. In retinal detachment cases for which the "Bayonette" and "myopic" cannulas were used, it was possible to reach the central part of posterior pole and inject the PFCL, triamcinolone acetonide, and Membrane Blue directly above the epipapillary and epifoveal areas. The aspiration of residual PFCL or fluid during fluid–air exchange was easily performed. No contact with or displacement of the distal lenses of any of the four viewing systems was observed. The length of the instruments' was sufficient to reach the bottom of central staphyloma, even in the eye with the longest AL (36.54 mm).

During removal of the ERM and internal limiting membrane, no difficulties were met in reaching and grasping the membranes in the macular area. The surgeon's fingers on the handle were sufficiently distant from the lenses of the viewing system to avoid contact, displacement, or shielding. The horizontal plane of the forceps jaws enabled a view of the membranes grasped by end-gripping tips. The hand of the surgeon holding the forceps was situated more ergonomically, resting on the supporting surface of the operation table.

Discussion

In addition to standard elongation of the instruments, two types of cannulas with flexible operational regions were applied in this study. The most important advantage of these novel cannulas and forceps is the increase in the distance between the surgeon's finger tips holding the base of the cannula (with an additional handle attached or without) or the handle of the forceps and the distant lens of different viewing systems or the contact macular lens (Figure 2). The surgeon can easily position the cannula at a sharper angle to the visual axis of the viewing system than usual and therefore can reach the very center of the posterior pole of the retina, avoiding contact with the lens or displacement of the lens and the image.

The commercially available cannulas and long-shaft forceps for extra-long eyes were designed to reach the posterior pole.[6] However, in our mind, just elongating instruments does not eliminate the risk of distant lens touch and view displacement.

The extra length of the operating part of the modified instruments (35 mm) made reaching the posterior retina in highly myopic eyes much easier and without the need of scleral depression. The outer diameter and the curvature allow the instruments to pass through the 4-mm-long 25-gauge trocar system ports.

The passive aspiration of residual PFCL or fluid appeared to be faster with the “myopic” cannula compared with the “Bayonette” cannula. This may be due to the double bending of the “Bayonette” cannula, which might slow down the inner liquid flow.

When the surgeon rotates the base of the curved “myopic” cannula and the handle of forceps “myopic,” he immediately displaces the tips of the instruments, exposing them to the neighboring retinal area. This is in contrast to using straight instruments where the surgeon has to move his hand to reach the next area of the retina. During the rotation, the surgeon has to be cautious and keep in mind that the curved tip of the instruments can come in contact with the bowl shape of the posterior pole. While holding the curved cannula or forceps, the handles of the instruments were positioned more horizontally compared with those of straight instruments, thereby bringing the holding hand into a more ergonomic position. It takes time to get used to working with the modified instruments.

Conclusion

The use of modified elongated and curved cannulas and forceps during the surgery on eyes with a large AL provides a more efficient and comfortable working arrangement for the surgeons and eliminates contact with the viewing lens. It also provides for easy maneuvering on the posterior retina. The instruments described here can also be used in emmetropic eyes.

Footnotes

None of the authors have any financial/conflicting interests to disclose.

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