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Use of Bimanual Microincision Phacoemulsification for Difficult and Challenging Cases

INTRODUCTION

The advantages of bimanual microincision phacoemulsification have been elaborated in a variety of papers within the literature.[1-6] We believe that the technique has distinct fluidic advantages because by separating inflow from aspiration and phaco, all of the fluid is coming in through one side of the eye and exiting through the opposite side of the eye, so there are never competing currents at the phaco tip. In addition, it is easier to achieve a nearly closed system because of the tightness of the incisions and we can address certain cases that would be less advantageous, or even impossible, with the use of a coaxial phaco tip.

HIGH MYOPIA

In highly myopic eyes, we are able to achieve a situation in which we can maintain the anterior chamber in a completely stable configuration, never trampolining the vitreous face, by keeping the irrigating handpiece in the eye throughout the case. Chopping can take place in the usual manner, and with the completion of chopping, we can keep the irrigating chopper in the eye, remove the phaco needle, place viscoelastic, remove residual cortex, and then place viscoelastic for the implantation of the intraocular lens (IOL) without ever shallowing the anterior chamber. We believe that there may, eventually, be a documented decreased incidence of retinal detachment in high myopia as a result of non-trampolining of the vitreous face during phaco, and the implantation of IOLs that fill the capsule, such as dual-optic IOLs or IOLs that arch posteriorly, such as the crystalens.

POSTERIOR POLAR CATARACT (FIGURE 31.1)

In the situation of posterior polar cataracts, 35 percent have defective posterior capsules and almost all of them have weakened capsules, so it is very important to not over-pressurize the eye and perhaps force nuclear material through the defective posterior capsule. By the same token, it is important to not shallow the chamber and have the nucleus come forward, and possibly open the defect in the posterior capsule. These cases are advantageously done with bimanual microincision phacoemulsification.

We do hydrodelineation, without hydrodissection, and then carefully chop the endonucleus into pie-shaped segments and evacuate them from the eye. Once the

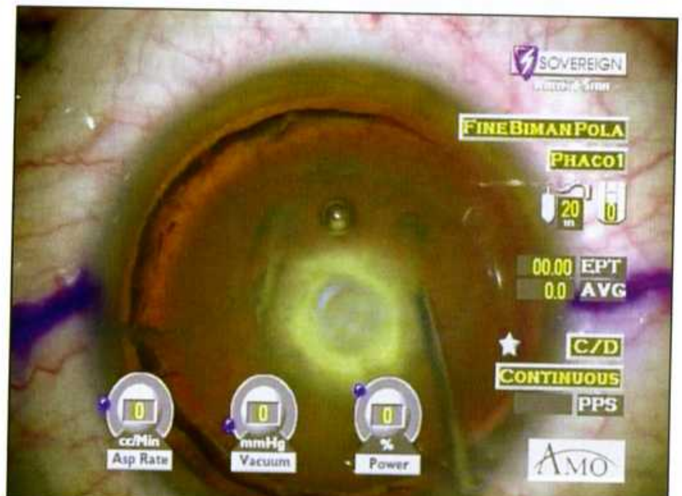

FIGURE 31.1: Hydrodelineation of a posterior polar cataract

endonucleus is removed, we viscodissect the epinucleus up from its position against the cortex without removing the irrigating chopper. In this way, we have a layer of cortex and viscoelastic under the epinucleus when we evacuate it, so should the capsule open, it is less likely that we will spill nuclear material into the vitreous. Once the epinucleus is gone, we leave the irrigation system in the eye, remove the phaco needle, and add viscoelastic. We viscodissect the cortex up into the plain of the capsulorhexis, in the same way and remove it while having a thick layer of viscoelastic on top of the fragile posterior capsule. We never polish the posterior segment of the capsule prior to the IOL implantation, but would rely on YAG laser if there were opacities within the visual axis, post-operatively.

POSTERIOR SUBLUXED CATARACTS (FIGURE 31.2)

For posterior subluxed cataracts, which are hinged to a small zone of attached zonules, we will go through a pars plana incision and prolapse the lens, in its capsule, up into the anterior chamber and then add viscoelastic under the lens. We will then phaco the lens with bimanual microincision instrumentation utilizing an irrigating cannula in the left hand and a phaco needle in the right, keeping the irrigation on top of the viscoelastic, but below the nucleus. We don't try to disassemble these nuclei, but phaco them from the outside in. In general, with the irrigation under the nuclear material, we have a system in which there is fluid circulating in a circuitous pattern on top of the viscoelastic, and chips that are liberated from the mass of the nucleus tend to circulate entirely within the anterior segment and not get deposited into the vitreous. After removal of the cataract, we do a partial anterior vitrectomy and implant, through a 2.5mm incision, a foldable intraocular lens, with the haptics under the iris and the optic on top. This allows the haptics to indent the undersurface of the iris and be easily identifiable. We then suture the haptics to the iris and nudge the optic beneath the pupillary margin. We have had great success with this technique.

MATURE CATARACT WITH ZONULAR DIALYSIS (FIGURE 31.3)

In cases in which there was a dialysis of the zonular apparatus during phacoemulsification, as in a case of unrecognized pseudoexfoliation in the presence of a dense cataract, we can hold the nucleus with the phaco tip, remove the irrigating chopper, place viscoelastic under the lens, and then put the irrigating handpiece, without a chopper, under the lens and again phaco the lens entirely within the plain of the capsulorhexis. Nuclear material can be mobilized from the posterior chamber with an unsleeved phaco tip because there is no irrigation going along with the phaco tip, as in coaxial phaco, which would force the nuclear material into the vitreous cavity. This is not possible with a coaxial phaco tip. In these cases we also see chips that circulate in the fluid above the viscoelastic sitting on top of the vitreous,

FIGURE 31.2: Phacoemulsification of a subluxed cataract in the anterior chamber

FIGURE 31.3: Bringing nuclear material out of the posterior chamber with an unsleeved phaco tip in the presence of zonular dialysis

but we do not see chips that move posteriorly. Once this has been completed, we will do a bimanual microincision partial anterior vitrectomy, or a pars plana 25 gauge microincision vitrectomy, and implant an anterior chamber lens, or a posterior chamber lens, and suture it to the iris.

PUNCTURED POSTERIOR CAPSULE (FIGURE 31.4)

In the case where the capsule is punctured during the course of phacoemulsification, we can keep the irrigation going high in the anterior chamber and go back into the endolenticular space with the unsleeved phaco tip, and complete the phacoemulsification without further enlarging the puncture in the posterior capsule. Without removing the irrigator, we then remove the cortex, and then instill more viscoelastic. We then implant the lens into the capsular bag or into the ciliary sulcus. Residual viscoelastic should be removed with a vitrector to avoid the possibility of bringing vitreous to the wound. This procedure would be impossible with a coaxial phaco tip because a continuously changing fluid wave from the phaco sleeve would enlarge, or extend, the capsular tear out to the periphery of the capsule, with loss of lens material into the vitreous.

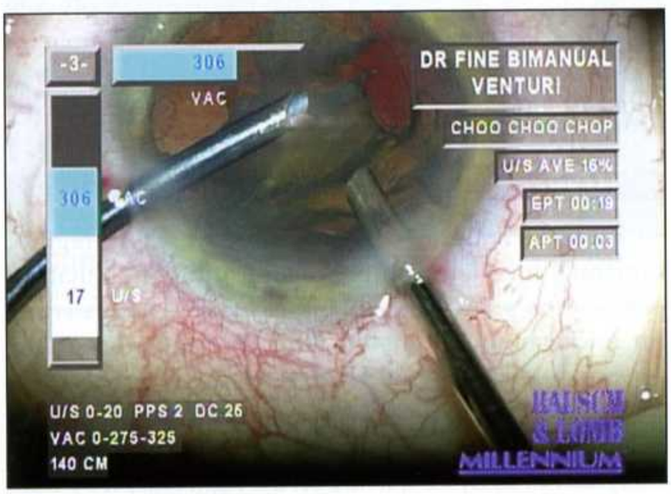

FIGURE 31.4: Completing phacoemulsification in the presence of a punctured posterior capsule

POSTERIOR CAPSULE RUPTURE (FIGURES 31.5 AND 31.6)

In an extensive posterior capsule rupture, we can bring the entire endonucleus up into the anterior chamber by

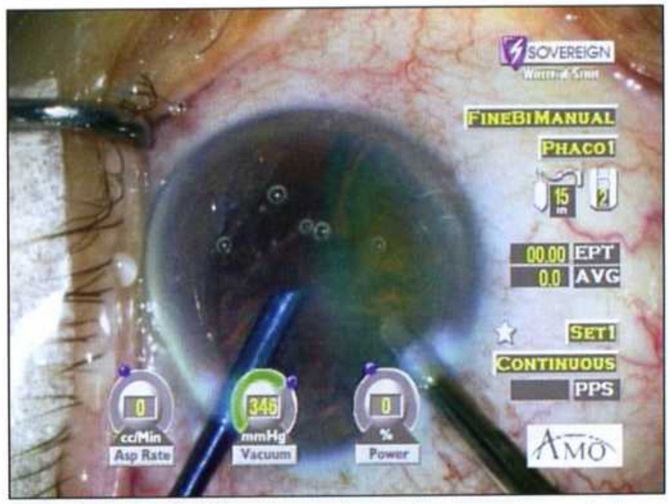

FIGURE 31.5: Holding the nucleus with an unsleeved phaco tip prior to removing the chopper and adding viscoelastic under the nucleus in the presence of a large posterior capsule rupture

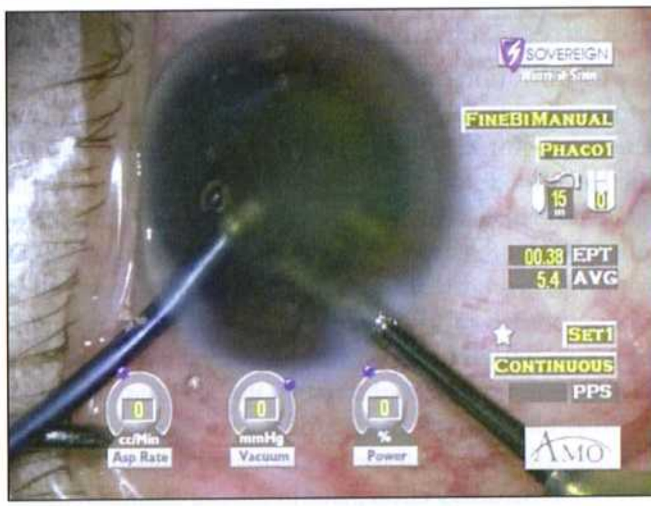

FIGURE 31.6: Irrigating below the cataract in the presence of a capsule rupture

holding it with the phaco tip. Very little fluid leaks out of the incision when we remove the irrigator, place viscoelastic under the nucleus, and replace the irrigator under the lens. We then proceed with phacoemulsification in the plain of the capsulorhexis or in the anterior chamber, with the irrigator beneath the nucleus as we carousel, or phaco, it from the outside in. We can then proceed with cortical clean-up in a similar manner, or first perform a partial anterior vitrectomy, either through the pars plana, or through side-port incisions bimanually. Once all residual cortex has been removed, we implant a posterior chamber lens into the ciliary sulcus.

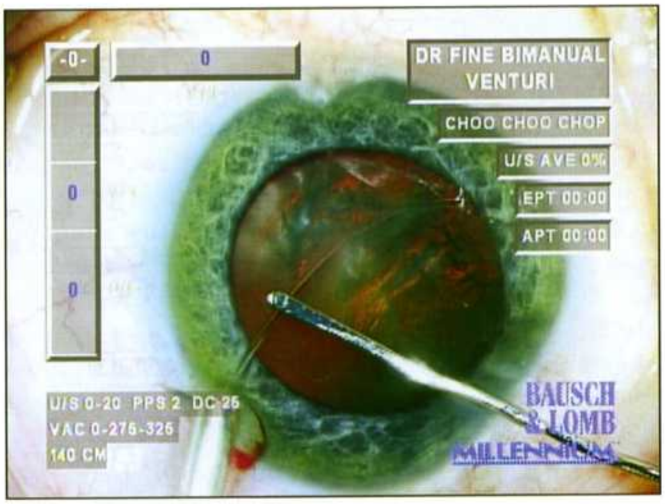

FIGURE 31.7: Injection of a capsule tension ring through a microincision controlled by a Lester hook in the right hand

FIGURE 31.8: Chopping a rock hard nucleus

PSEUDOEXFOLIATION (FIGURE 31.7)

In post-filtration surgery, in the presence of pseudo-exfoliation, we like to use a endocapsular tension ring that we can introduce through a side-port with an injector. The injector doesn't enter the incision; it is just held against the incision, and the forces on the capsule as the endocapsular tension ring is being inserted are contained by the use of a Lester hook in the opposite hand. We then proceed with bimanual microincision horizontal chopping of the lens so as to not add any downward force on the lens which might stress the residual zonules. Cortical clean-up is facilitated in the presence of an endocapsular tension ring, by performing gentle cortical cleaving hydrodissection prior to the implantation of the ring. The lens is then implanted into the capsular bag through an incision between the two side-port incisions, which is our routine method for IOL implantation in the presence of two 1.1 mm phacoemulsification incisions.

ROCK-HARD NUCLEI (FIGURE 31.8)

We can phacoemulsify rock-hard nuclei with the same facility and ease with which we do softer nuclei with bimanual microincision phacoemulsification, and we usually end up with average phaco powers under ten percent with effective phaco times under ten seconds, in spite of the density of these nuclei. This is an enormous advantage in terms of corneal, endothelial protection because of the great stability of the anterior chamber. We prefer a 30 degree phacoemulsification tip used with the bevel down. This allows the achievement of vacuum once the tip touches the endonucleus. A bevel-up tip must go deeply into the nucleus before occlusion and vacuum are achieved. With a bevel-down tip, we are also sending all of the energy toward the nucleus and none toward the endothelium or trabecular meshwork. Finally, one can mobilize pie-shaped segments from the level of the capsulorhexis up, rather than having to go deeply into the endolenticular space to achieve occlusion to mobilize these segments, as we would have to with a bevel-up configuration.

SWITCHING HANDS (FIGURE 31.9)

In cases of zonular dialysis, another advantage of bimanual microincision phacoemulsification is that we can use the phaco tip with either hand. After inserting an endocapsular tension ring through one of the microincisions, we would hydroexpress the lens into the plain of the capsulorhexis and then utilize the phaco tip in either the right, or left, hand, depending on the zonular dialysis. For dialyses that are on the right side, we would use the phaco tip in the right hand, drawing material in the anterior chamber toward the area of weakened zonules, rather than away from it, which would stress the intact zonules. For dialyses that are on the left-hand side, we can use the phaco tip in our left hand and the irrigating chopper in the right to remove the nucleus, thereby closing the zonular dialysis with the activation of flow and vacuum toward the left side.

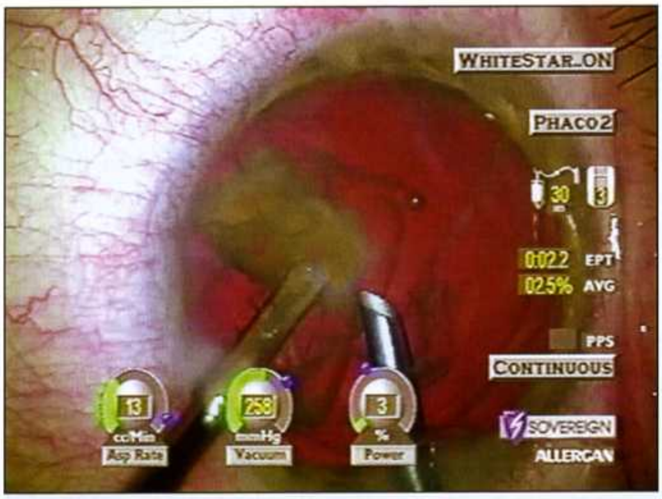

FIGURE 31.9: Phacoemulsification in the left hand in the presence of zonular dialysis (surgeon's perspective)

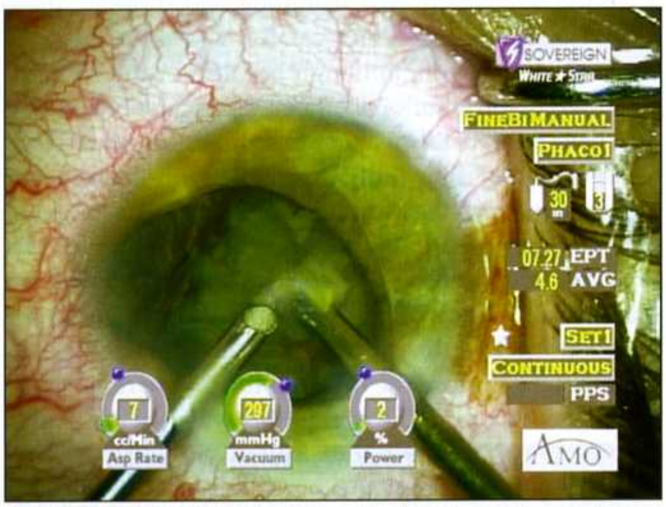

FIGURE 31.10: Microinstruments phacoing a large dense nucleus in an eye with micro cornea and iris coloboma

MICROCORNEA OR MICROPHTHALMOS (FIGURE 31.10)

For very small eyes, such as microcornea or microphthalmos, the use of bimanual microincision phacoemulsification is enormously advantageous because the smaller size of the instruments allow us, through two clear corneal microincisions, to maintain excellent visualization. A coaxial tip, which is much larger in size, would indent the cornea as it was manipulated and partially obscure the visualization of the intraocular structures. This has turned out to be especially advantageous in cases with a microcornea or a microphthalmic eye in the presence of an unusually large lens.

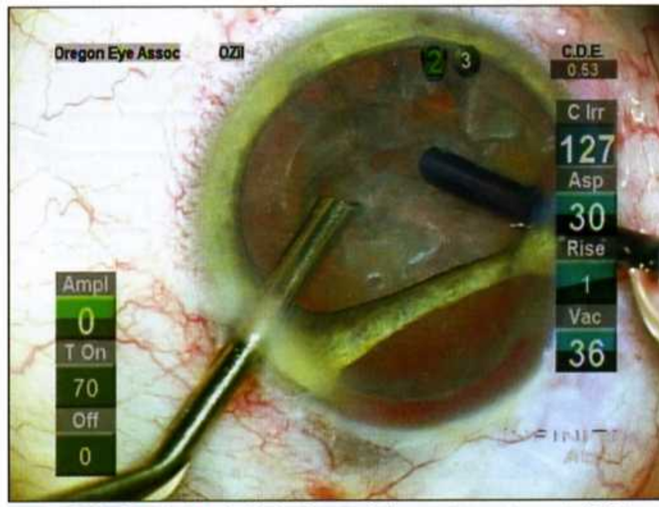

FIGURE 31.11: Initial chop of the cataract post 100° ciliary body excision for malignant melanoma

POST MALIGNANT MELANOMA (FIGURE 31.11)

In one case in which 100 degrees of ciliary body and iris, with the exception of the sphincter, were excised for malignant melanoma, we were able to perform bimanual microincision phacoemulsification through two microincisions on each side of the 100 degree missing ciliary body and iris. The advantage here is that with the vitreous face open to the anterior chamber, we wanted to be drawing material toward the area of missing zonules, after having sequestered the vitreous in that area with Healon 5. Phacoemulsification performed in other locations would bring vitreous to the phaco tip and provide a much more challenging situation. The IOL was implanted nasally over the intact zonules to force the lens to push against the area of missing zonules, rather than to pull away from the area of missing zonules if it had been implanted in the temporal periphery.

INTRAOPERATIVE FLOPPY IRIS SYNDROME (IFIS) (FIGURES 31.12 AND 31.13)

We find bimanual microincision phacoemulsification enormously useful in cases of intraoperative floppy iris syndrome (IFIS). If we have adequate dilation in the presence of a floppy iris, we will perform gentle cortical cleaving hydrodelineation and hydrodissection, and then

FIGURE 31.12: Epinucleus holding the iris back after carouselling the endonucleus in the presence of intraoperative floppy iris syndrome (IFIS)

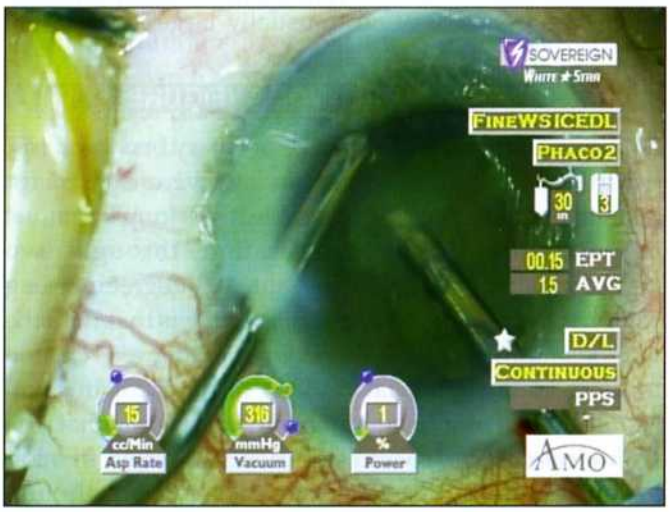

FIGURE 31.13: Endonuclear disassembly in the anterior chamber with the irrigator tamponading the iris

hydroexpress the lens into the plain of the iris. We will then carousel the endonucleus in the plain of the capsulorhexis with the irrigating cannula held high in the anterior chamber. Holding the irrigator high in the anterior chamber allows for a tamponading of the iris and disallows floppiness, or billowing, of the iris. After removing the endonucleus in the plain of the capsulorhexis, we see a fully intact epinuclear shell, which had been sitting on top of the iris, helping to hold it back. This is an extremely advantageous technique for nuclei of less hard densities that can be carouselled and phacoed in the anterior chamber without threatening the corneal endothelium.

For harder cataracts, and in the presence of pupils that will not dilate well, we will dilate the pupil with Healon 5, do a rather large capsulorhexis and then do one endolenticular chop. We then keep the irrigating chopper high in the anterior chamber and with the unsleeved phaco tip, bring nuclear material up to the chopper held high in the anterior chamber for further disassembly. This allows, once again, a tamponading of the iris and prevention of billowing or floppiness. We try to keep the phaco needle occluded and in foot position two or three, but with a clearance of occlusion, we go to foot position one in order to minimize evacuation of Healon 5, which is holding open the pupil.

After the endonucleus is removed in this way, we remove the epinucleus. Since it is harder to keep the tip occluded with epinuclear trimming and flipping, there tends to be evacuation of Healon 5 and a reduction of the size of the pupil, although because of the irrigator held high in the anterior chamber, it does not billow. We then have to re-instill Healon 5 to redilate the pupil. Then, once again, holding the irrigator high in the anterior chamber, we keep the aspirating microincision handpiece *occluded* by going circumferentially around the capsulorhexis, removing the cortical material only from the fornix of the capsule, letting it sit as a cluster in the central portion of the capsule. After all of the cortex has been mobilized from the capsular fornix, we remove the residual cortex from the eye. In this way, we are able to keep Healon 5 in the eye and disallow miosis of the pupil until the case is complete.

REFRACTIVE LENS EXCHANGE

We can do refractive lens exchange very easily, and safely, with bimanual microincision phacoemulsification. We do cortical cleaving hydrodissection and no hydrodelineation. We then hydroexpress the lens into the plain of the capsulorhexis, and carousel it, without any phacoemulsification energy for soft lenses, usually encountered in refractive lens exchange. We do an entirely fluidic-based extraction and then, because of cortical cleaving hydrodissection, we are able to evacuate the cortex by just tilting the phaco tip back into the posterior chamber where it jumps into the phaco tip as a single piece.

FIGURE 31.14: Bimanual microincision phacoemulsification of a cataract between RK incisions

REFRACTIVE LENS EXCHANGE IN POST RADIAL KERATOTOMY (RK) (FIGURE 31.14)

In cases where previous radial keratotomy (RK) has been performed, we can do bimanual microincision clear lens or cataract removal by going between two previously placed radials, making it much less likely that we will rupture the radial incisions during the course of the lens extraction. We then make an incision between our two microincisions for implantation of the IOL, but in the presence of previous RK, we make it through the posterior limbus for implantation of the IOL.

INTRAOCULAR CAUTERY (FIGURE 31.15)

We have found that we can also, with bimanual microincision instruments, do intraocular cautery by using an irrigating cannula in one of the microincisions and a microincision bipolar cautery in the other. Pinching the irrigation tubing allows bleeding to take place, clearly identifying the point source because the eye softens and the bleeding points start to ooze. We cauterize them precisely with the bipolar cautery, and therefore minimize trauma to intraocular structures by avoiding more cautery than is necessary.

BIMANUAL MICROINCISION INSTRUMENTS (FIGURES 31.16 AND 31.17)

There are a number of other instruments that have been developed for use through 1.1 mm microincisions. Iris reconstruction is very much easier utilizing intraocular

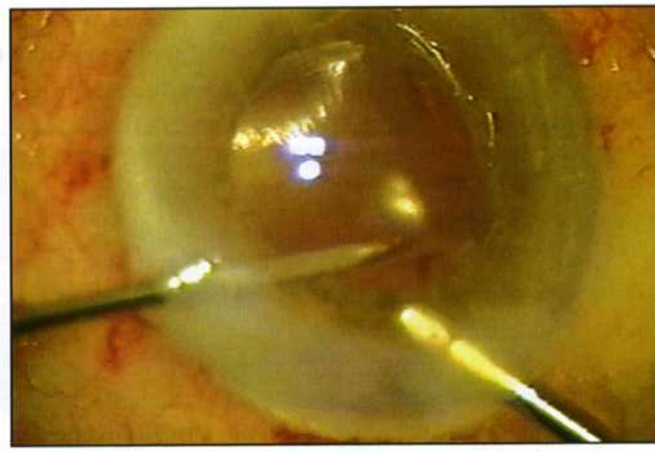

FIGURE 31.15: Bipolar intraocular microcauterization with easy identification of the bleeding point by pinching the infusion tubing

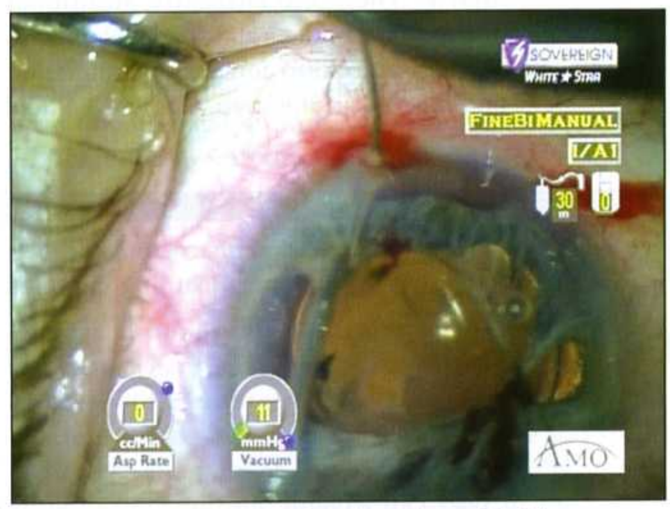

FIGURE 31.16: Suturing of atrophic iris using microincision intraocular forceps

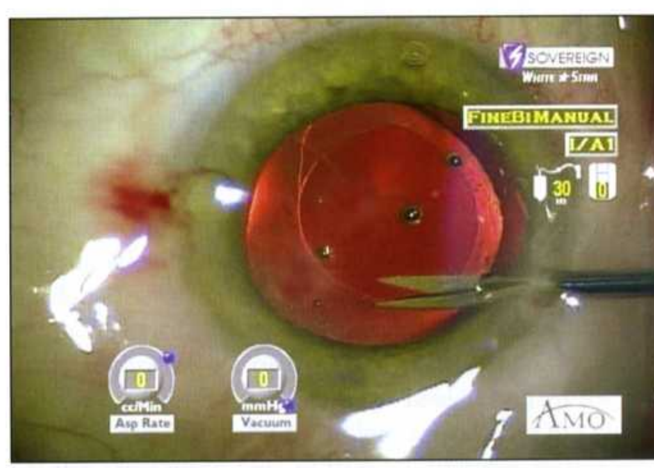

FIGURE 31.17: Nicking the capsulorhexis with microincision scissors prior to enlarging the capsulorhexis

forceps that stabilize the iris for suturing. New intraocular needle holders are also usable through a 1.0 mm incision. In this way, very fragile and atrophic irides can be sutured without putting excessive stress on the iris tissue. The knots are tied with a Seipser external tying mechanism, and the knots are cut with an intraocular microincision scissors, that is also admissible through a 1.0 mm incision.

For late reopening of capsular bags to recenter IOLs, we can enlarge a capsulorhexis in the late post-operative period by nicking the rhexis with intraocular scissors, and then tearing a larger opening with a microincision capsulorhexis forceps. Viscodissection of the lens, within the capsular bag, can be accomplished through micro-incisions which also allow for repositioning of IOLs without the need to make larger incisions to manipulate them intraocularly. There are currently additional microincision instruments under a state of development, including microincision Collibri forceps, microincision iris graspers, and microincision intraocular lens holders and cutters.

CONCLUSION

We believe bimanual microincision phacoemulsification is a technique that has a very short learning curve, is highly atraumatic, and is unquestionably the technique of the future. For those who are willing to go through the short learning curve now, it represents the best and safest technique at present for the management of certain difficult and challenging cases.

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