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“Uncomplicated Cataract Surgery: Attaining a Dream - 2016 Update”

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ADDRESSES
Anesthesia serves two purposes: first of all, to achieve full analgesic effect on the patient, and secondly to allow the surgeon to operate in the best possible conditions and with minimal problems. Furthermore anesthesiological techniques and anesthetic drugs should combine the lowest possible risks with the least collateral effects.

In the history of cataract surgery, the second goal has long prevailed. In fact, although local anesthesia (retro or peribulbar anesthesia, orbicular block) is not a new development, until recently general anesthesia had been generally preferred, as both the complete lack of movement and reaction on the part of the patient as well as the precious vitreous hypotony that comes with it were considered fundamental. All of us probably can recall the great confusion in the operating room and the hasty cries for anesthesiological assistance whenever a patient would begin to wake a little too early from narcosis.

The risks and the problems connected with general anesthesia in the old and often sick cataract patient and the need to organize surgical activity on an out-patient basis have finally convinced an increasing number of ocular surgeons to switch to local anesthesia. Surgeons have consequently been forced to get used to head and body movements, vocal comments, sometimes outbursts of coughing: great advantages have been a significant decrease of anesthesiological risks and collateral effects and the possibility of a more agile organization of surgical activity.

Topical anesthesia is a further and maybe final step in the same direction: the risks and the problems connected to retro and peribulbar anesthesia are eliminated and a quicker resumption of normal visual function is assured, if the surgeon is able to adapt to operating on an eye which is not still and therefore less under control. This situation certainly represents a disadvantage for the surgeon as lack of immobility goes against one of the most radicated principles of ophthalmic surgery. However, we are convinced that with a change of mentality and the adoption of adequate surgical techniques, this method can be applied safely and successfully to most cataract patients.

ADVANTAGES
Local anesthesia complications are rare but well documented in ophthalmic literature.
As far as retrobulbar anesthesia is concerned, both local and general complications are described. In the latter group are: bradycardia and cardiac arrest, respiratory depression and arrest, intradural injection with CNS depression, convulsions or coma. Among local complications, apart from retrobulbar hemorrhagia, which is a relatively frequent cause of postponement of operation, are optical nerve or bulbar lesions and perforation, extra and intraocular muscle paresis with ptosis, diplopia, persistent midriasis, lagophthalmos. With peribulbar anesthesia, injections are limited to the extraconical space, so that anesthesiological risks are certainly lower. However, nine cases of permanent vertical rectus paresis following peribulbar anesthesia have recently been signalled (1). A complete list has been made by Zahl and Meltzer (2). Another advantage is avoiding the use of an oculopressor. With an injection of anesthesia, preoperative decompression is essential in order to favour retrobulbar diffusion of anesthetic solution and to induce a hypotonic effect on the vitreous body. Unfortunately, many cases of retinal complications have been described, especially in high myopia, such as retinal detachment and both venous and arterial occlusion, even after a correctly performed compression manoeuvre, which of course requires short pauses every 7-8 minutes. Compression is not necessary in topical anesthesia as the bulb has a lower tone than in peribulbar, probably because no extra volume of fluid has been injected into the retrobulbar space. Of course, by adding a beta-blocker during preparation for surgery, there follows a more distinct hypotonic effect. Local anesthesia sometimes causes persistent paresthesia, nausea and headache. Because of long-lasting corneal anesthesia and lack of blinking reflex, many cases of keratopathy and corneal abrasions are observed. In cases of allergic reaction to the anesthetic solution, reaction may easily be systemic with injective anesthesia, while it remains local with topical anesthesia. A more practical advantage involves operating room organization. Topical anesthesia, in fact, consists of a single fairly straightforward action: the repeated instillation of anesthetic eyedrops which is familiar to ophthalmologic personnel and substantially devoid of risk. It may, therefore, be administered by paramedics, thus simplifying preoperative patient preparation and reducing operating room time. On the contrary, local anesthesia consists of a series of manoeuvres which ophthalmologists usually prefer performing personally. As an alternative, anesthesia is performed by a fellow ophthalmologist or by an anesthesiologist, but if it so happens that intraoperative anesthesia is incomplete, the surgeon will always wonder if the injections have been correctly executed. This might lead to unpleasant altercations among colleagues. Topical anesthesia patients experience rapid physical recovery with no nausea and lethargy (3-4). Patients report optimal analgesic effect and overall intra and postoperative comfort. In our experience, only 3.2% reported intraoperative discomfort (5). Most patients who have experienced peribulbar anesthesia for one eye and topical for the other
prefer the latter (6) Both visual and motor functions promptly return close to normal early in the postoperative period (7), as they are actually never really interrupted. Since we started using topical anesthesia for cataract surgery, we have performed automatic refraction and visual acuity tests 20 minutes to two hours after surgery (our operating schedule is interrupted by pauses every two to three hours for patient discharge): elaboration of this data demonstrates that 22.2% have a visual acuity without correction of at least 20/30 and 82.5% of at least 20/80 (unpublished data). The realization that vision is fair or even good makes both patient and surgeon happy. Patients wear an eye-patch only a few minutes and are discharged with just a pair of normal eyeglasses for protection. They feel and appear to others as persons who have not been operated on and that is gratifying or even quite useful in some cases (monocular patients, psychologically unstable subjects). The recent addition of highly hydrophilic corneal lens (Protek, Ciba), which is applied to our patients during the first 24 postoperative hours, adds to patients' sensation of well-being while preserving the psychological boost of the unpatched eye. A faster closure of the lateral corneal wound due to the immediate recovery of normal blinking has been suggested by I.H.Fine (Eugene, Oregon), while a normal lachrymal function represents a good prophylaxis against postoperative infections.

**DISADVANTAGES**

It is certainly more difficult to operate on a mobile eye. A new category of complications directly connected to lack of akinesia now exists. The most frequent complication is irregular incision which tends to cause an increase of wound suturing during the learning curve of topical anesthesia. Probably even more important is the reduced control over ocular pressure. Although baseline pressure is usually rather low, unexpected orbicular muscle contractions may cause sudden variation of intraocular pressure and anterior chamber depth. Potential epithelial toxicity (8) does not appear to be a problem. Many different anesthetic agents have been used (3 - 4 - 9). We think it is important to protect the corneal surface by instilling a few artificial tear eyedrops in case of a prolonged waiting period before surgery.

No cases of untoward effects connected with the instillation of preoperative topical anesthetic agents have been reported. Depth and length of anesthetic effect is somewhat lower than local anesthesia. Patients can feel pressure and pressure may suddenly be transformed into a troublesome or even painful sensation after abrupt or rough manoeuvres that cause traction on zonular fibres or ciliary body. Suture and scleral cautery (6) often induce discomfort or mild pain. The management of surgical complications is, of course, more difficult. However, if the surgeon remains in control, he can brilliantly mend very difficult situations, as a good anesthetic effect actually persists longer than 30 minutes. All ophthalmologists should keep in mind that the pain threshold differs from one individual human being to another, depending on drug sensibility as well as many other physical and psychological factors and that the barrier between tactile and pain sensation is very thin. As a matter of fact, the same principles apply to injective anesthesia, which some patients remember as an unpleasant or even painful experience: just think of the tension anyone feels on the dentist's chair, fearing that the drill vibratory sensation may turn into pain. The psychological role of both surgeon and staff to avoid this transition is a nodal point in the management of topical anesthesia. With this in mind, topical anesthesia has been called "vocal anesthesia". If one does not understand this point, topical anesthesia becomes pure surgical exercise, both dangerous and morally wrong. As far as surgical technique is concerned, topical anesthesia is not equally applicable to all. Even extracapsular cataract extraction can be performed as it actually was as far back as 1988, with the sole addition of some infiltration in the superior rectus area (10). However, the rough manoeuvres of this technique (nuclear expression, sutures) will easily stimulate pain reactions and the lesser control over intraocular pressure and chamber depth in topical anesthesia greatly increases risks in a widely open bulb. We do not have any experience of planned extracapsular extraction, but we have only performed a few conversions.

Topical anesthesia is ideal with phacoemulsification and lateral clear corneal incision, as this is a fast, atraumatic technique with the easiest approach for the surgeon and a position of the bulb easy to maintain for the patient by simply fixing the microscope light. It is probably not by chance that topical anesthesia was first applied in its actual form in 1992 by R.A.Fichman (11), only one year after the introduction of self-sealing lateral clear corneal incision (12).

Scleral tunnel is longer, the surgical approach at twelve is somewhat more laborious and the patient may find it a little more difficult to find and keep the required position. Topical anesthesia is certainly possible, but patient selection should be more attentive and sedation or adjunctive anesthesia more often required (13).

**TRANSITION TO TOPICAL ANESTHESIA**

Transition to topical anesthesia is a long and delicate process, in many ways comparable to transition from extracapsular extraction to phacoemulsification. Several ophthalmologists that approached phacoemulsification without adequate training had so many problems, and of such a serious nature, that they had to hastily turn back to extracapsular extraction.

And so it is with topical anesthesia; even well trained and mentally prepared surgeons have to pay a tribute in the form of a slight increase in the complication rate during their learning curve. A more superficial approach may bring
about disaster, as any slight complication will become difficult to handle. After a few negative experiences, many ophthalmologists will simply give up.

The first rule for an atraumatic approach is perfect knowledge and control of phacoemulsification and one’s surgical technique (e.g., lateral clear corneal incision). Lack of akinesia will amplify any technical imperfection making complications more frequent. It is advisable, therefore, to test any major technical change with peribulbar anesthesia. Crossing the psychological barrier that a free moving eye represents is certainly more difficult. Perfect absence of motion and of reaction has been one of the cornerstones of classical ophthalmologic surgery, so much so that even rather recent treatises state that complete extraocular muscle akinesia is not only preferable but even necessary. On the contrary, topical anesthesia is applicable not only to a few ideal cases, but to the majority of uncomplicated cataract cases. The entire surgical team should be convinced of it as any negative attitude or sceptical remark make patients insecure and difficult to control.

It may be very useful to assist during several surgical sessions in which topical anesthesia is routinely applied and observe the management of anxious patients, complicated cataracts and intraoperative complications. It is advisable to adopt a gradual approach. There are several possibilities. First of all, the volume of anesthetic solution injected during peribulbar anesthesia can be gradually diminished causing a parallel increase in ocular mobility.

A second possibility is to maintain orbicular block for some time, in order to exclude the problems created by orbicular muscle contraction (intraocular pressure and anterior chamber depth variability). A third possibility may be to associate a subconjunctival injection at the incision site or to use the modified perlimbal approach (subtenon anesthesia using a blunt cannula through a small peritomy made 2 to 3 mm from the limbus). The first ophthalmologist who used subconjunctival anesthesia for phacoemulsification was, to our knowledge, W. Petersen (Seattle, Washington). D.N. Serafano (Long Beach, California) has proposed associating topical and subconjunctival anesthesia for scleral tunnel. Due to its greater complexity scleral tunnel construction may stimulate pain reaction more frequently than corneal incision. Serafano uses scleral tunnel when implanting 5 mm optic PMMA lenses as he believes it to be safer due to the square shape of the tunnel. He prepares it temporarily starting 1.5 mm from the limbus on the scleral side, associating 1 cc of 2% Lidocaine locally to 4% Xylocaine eyedrops every ten minutes three times before surgery. When implanting silicon lenses through a 4 mm wound, Serafano chooses lateral clear corneal incision with topical anesthesia only.

In conclusion, if one understands that the patient assumes a new role during surgery by becoming a more active agent to the point of being directly responsible of an entirely new kind of complication, it naturally follows that the doctor-patient relationship must change. Patients should be given adequate information before and during the surgical act. Ideally, understanding and trust between doctor and patient should be fully established both on a professional and human level. If the ophthalmologist is not able to reach this goal, he probably will do better to renounce topical anesthesia.

PATIENT SELECTION

During the learning curve of topical anesthesia, patients should be carefully selected (15). Uncomplicated cataracts with soft nuclei and well dilated pupils and fully co-operative patients are ideal. Selection should eventually become less strict, as experience and confidence builds up in the surgeon. Exclusion criteria can be divided into two groups. The first group is made of cataract cases presenting aspects of particular difficulty and being therefore at high risk of intraoperative complications. For the expert surgeon, they progressively come to coincide with cases in which phacoemulsification itself is not recommended. The second group consists of patients who, for different reasons, are not able to collaborate: deaf persons, children, collaborating elderly people, mentally handicapped, usually foreigners. Overanxious patients are to be evaluated case by case, and the number of persons excluded greatly decreases as the personal capability of the surgeon in gaining their confidence rises. To our knowledge, there is no medical contraindications to topical anesthesia. On the contrary, there is at least one case that represents a strong indication for its use: hemorrhagic diseases. High myopia is possibly a relative indication, as the reduced scleral resistance and large bulbar size may represent a risk for retro and peribulbar injections and ocular compression. Glaucoma may be another, as anesthesia may impair optic nerve blood flow and therefore damage visual field. In order to fully exploit its advantages, topical anesthesia should not be applied only occasionally but on the contrary it should become one of the favourite choices in cases of uncomplicated cataract surgery. We used topical anesthesia in 75% of our uncomplicated cataract cases in 1993, and 99% in 1996.

DOCTOR-PATIENT RELATIONSHIP (VOCAL ANESTHESIA)

Preoperative examination

We advise doctors to speak to their patients about topical anesthesia right from the preoperative examination, because most people may have never heard of that possibility. Even patients who may have consulted us for the very reason that they want “no-needle” anesthesia, usually do not really know what it is all about. We believe that topical anesthesia should be clearly indicated in the written informed consent to surgery after advantages and disadvantages of the different anesthesiological techniques have been explained. We think, however, that the patient should not just be given a completely free choice between the two techniques (or between extracapsular extraction and
phacoemulsification): the patient should clearly know what his doctor’s preference is, as he will expect the doctor to suggest those solutions that are more advantageous to his case. Most patients well understand the concept of anesthesiological risk; they are happy to avoid periocular injections and postoperative eye-patch and eagerly anticipate the promised faster visual recovery. However, some will have doubts about the effectiveness of eyedrops or fear they will not be able to cooperate adequately. A few even claim they want general anesthesia.

Observing patient behaviour and reactions is important aid in identifying patients unfit for topical anesthesia.

Preparation to surgery

We advise doctors to spend a little time with the patient just before surgery. The ophthalmologist should first remind him of the different sensations he will feel during surgery (microscope light, oxygen blow, dampness from BSS flowing down to his ear, tactile and pressure sensations from instruments), reassuring him that they are not a prelude to pain. A practical demonstration of the permanence of some eye sensibility should be given. Briefly reviewing the few simple positions and maneouvers he may be asked to take, it should be stressed that everything will be easy and that there will never be urgency. The patient should not be worried that loss of fixation, body movement or a cough will compromise surgical outcome. On the contrary, he should know that he is free to express any worries, fatigue or pain sensations so that problems may promptly find adequate solution. Operating room personnel should help make the patient relax by treating him with kindness and solicitude. The anesthesiologist should be introduced and should assure the patient that he will look after him throughout surgery.

It may help to invite the patient to think back to happy memories.

If a patient remains overanxious, some sedation may be administered or it may be decided to switch to peribulbar anesthesia.

Management of the patient during surgery

Before incision, patient reaction to corneal wetting should be controlled. If it is excessive, corneal wetting should be limited and be done only in conditions of full safety (still and protected instruments). Ability and speed in responding to orders should be controlled. In any case these should be limited in number and clearly stated: for example, it is wrong to say "Look at the light" if the patient is fixating correctly already. In fact, the patient would probably think he is in the wrong position and, therefore, he would move in order to find the non existent correct aim, soon going back to microscope light. If a command is given, the surgeon should wait a few seconds to give the patient time to understand it, move towards and firmly take the new position. By adapting his technique to limited movements and small deviations from the ideal position, the ophthalmologist should avoid bothering the patient with excessive requests, which would confuse and finally wear him out. From time to time, patients should be encouraged and in some way informed about the good progress of the operation. Any pause or unusual manoeuvre that might cause sudden alarm reactions should be announced and explained. In any case, the surgeon and operating room staff should always appear to be in command of the situation. If the patient hears unfavourable remarks, if he perceives a negative attitude, uncertainty or nervousness, he may suddenly lose control. This is particularly the case when dealing with complications. As the patient will probably notice that something is the matter, common sense would suggest giving him some simple, reassuring explanation, such as: "Your cataract is a little harder than expected and it will take longer to clean everything up...". Long silent pauses or altered voices should be avoided.

Postoperative management

Operated eyes are kept patched for just about half an hour. At dismissal, patients wear sun glasses for protection. Particular attention should be given to making sure patients correctly understand postoperative prescriptions and recommendations. In day surgery, the duties of cleaning and medicating operated eyes are entrusted to people who are not experts. It is, therefore, important that patients and relatives (or neighbours, or nurses) that assist should learn how to properly instill eyedrops and judge the importance of symptoms that may emerge between two control examinations. Instructions should be repeated several times and written directions should be given for home consultation. It should be kept in mind that lack of paresthesia and significative pain, as well as a perfectly normal exterior look, may induce patients to be excessively confident and forgo prescribed recommendations.

PATIENT PREPARATION: MIDRIASIS AND ANESTHESIA

Our schedule of patient preparation in case of uncomplicated cataract begins the day before surgery with home instillation of sodium diclofenac (Voltaren Ofta®, Ciba Vision) t.i.d., completed by a single instillation of 0.5% tropicamide with phenylephrine (Visumidriatic fenilefrina®, M.S.D.). On the morning of the day of surgery. Patients are invited to arrive at the Operating Center about an hour before surgery scheduled time in order to complete the following preparation:

- 0.5% tropicamide phenylephrine five times every 10 minutes
- ciclopentolate (Ciclolux®, Lux), one time
- 1% atropine (Atropina 1%, Lux) one time
This schedule may seem a little complex. However maximal and long lasting midriasis is of the utmost importance in topical anesthesia, in order to perform a rapid phacoemulsification without iris manipulation. According to Grabow (4), adequate cycloplegia may minimize discomfort induced by stretching of zonules and ciliary muscle. We find that atropine does not keep the pupil from readily responding to intracamerular miotics when necessary (actually we seldom use miotics). Besides, when patients are examined 12 to 24 hours after surgery, pupils are usually miotic already. As for the anesthesiological preparation, at the moment, each surgeon who is familiar with topical anesthesia uses a number of different anesthetic agents with personal protocols (3 - 4 - 9). We use the following scheme:

- 2% lidocaine hydrochloride, 5 times every ten minutes
- 0.4% benoxinate, 5 times every ten minutes

Benoxinate is produced in Italy as monodose eyedrops by Alfa Intes, while lidocaine has to be drawn from vials (Lidrian®, Bieffe Medital), using a syringe with no needle. The same syringe serves as personal eyedropper for each patient.

In case of delay, artificial tears and occlusion are used to protect corneal epithelium.

No premedication is given. In many patients atropine apparently causes a systemic effect vaguely resembling preoperative sedation.

A vein should be incannulated for possible intraoperative needs or emergencies. If some sedation is necessary, we use propofol (Diprivan®) injecting a volume which depends on patient weight. This helps keep restless patients under control without putting them to sleep. Contrary to North American authors, we seldom recur to intravenous sedation (Diprivan®) injecting a volume which depends on patient weight. This helps keep restless patients under control without putting them to sleep. Contrary to North American authors, we seldom recur to intravenous sedation: 1.7% of cases in our first year of experience with topical anesthesia (1993), 0.61% in 1996.

The role of the anesthesiologist may seem marginal. On the contrary we deem his presence necessary both before and throughout surgery. Remember that his intervention, when needed, is usually urgent.

**SURGICAL TECHNIQUE**

**Operating room - Patient preparation for surgery**

Eye position is more difficult to control with topical anesthesia, as any kind of mechanical fixation is lacking. Eye must be horizontal and corneal limbus possibly visible at 12 o’clock. Head tilt is the fundamental factor. Having microscope light as a reference mark, neck extension tends to uncover limbus at 12. However, excessive extension may be fatiguing. Head position should, of course, be harmonized with antitrendelemburg body position. Patient comfort is quite important. Common operating tables are narrow and rigid and, therefore, certainly unfit for topical anesthesia.

The ideal table should be quite large in order to accommodate well even obese patients; it should be provided with a soft 10 cm thick mattress that may alleviate the not unusual back problems of the elderly. Headrest should also be comfortable and easy to regulate in any direction. Additional ring-shaped head holders should be avoided. Ideal head restraining systems must prevent sudden movements while not bothering patients: sticking plaster should be anallergic, and easy to remove. Lid speculum cannot be too rigid as that would cause an occlusive reaction with synergetic bulbar elevation. Younger patients may manage to actually expel an inadequate instrument during surgery. We suggest using a speculum with branches connected on the nasal side (which makes lateral clear corneal approach quite easier) and curved in such a way as to keep lids a little lifted from the bulb. Care should be taken when draping the patient. A well-positioned horizontal oxygen bar sustaining the surgical drape high over the patient’s chest will give him ample breathing space. Nasal cannulas are not suitable as they can induce patient reaction due to mechanical stimulation or chemical irritation of nasal mucosa by oxygen flow.

Microscope settings must be carefully checked before every case. Both focus and XY should not be at the end of scale, as the surgeon will need to change focus and centration quite often due to continuous eye movements.

**Surgical technique**

**General guidelines are: rapidity, essentiality and lightness (no touch surgery).**

**Lateral clear corneal incision**

Incision is a very delicate step, set as it is at the beginning of the surgical act, with the patient having had no experience yet and sudden movement being possible at any time.

We usually adopt a three step clear corneal incision in the temporal quadrant. We only employ diamond blades. The cornea should be adequately wetted before incision as a dry epithelium may be irregularly damaged. During the manoeuvre itself, wetting should be avoided, because possible reactive movements may end up in an irregular, not waterproof wound and greater induced astigmatism. Some surgeons use forceps to fixate the bulb. We believe that holding instruments may cause an unpleasant tactile sensation and some fear of later pain, impairing patient collaboration. Besides, if a diamond is used, the cornea does not usually offer much resistance to penetration. Once the blade has entered the stroma, control becomes quite better.

**Viscoelastics and capsulorhexis**

Before capsulorhexis, the anterior chamber is filled with a viscoelastic substance. As is well known, viscoelastics will oppose the tendency of some light nuclei to readily come into the anterior chamber as the anterior capsule is being opened.
Viscoelastics are of the utmost importance in modern cataract surgery as they give protection to the endothelium and other ocular tissues throughout the entire operative act. Many products with different physical and chemical properties are available (16) and every surgeon has a preferred substance that best suits personal technique and habits. We have been routinely using a viscoelastic substance since 1985 (Healon®); we switched to Viscoat® in 1992. We have always removed the viscoelastic at the end of surgery. The importance of viscoelastic substances increases with topical anesthesia. Risks to the endothelium are higher as a consequence of unanticipated ocular saccades and anterior chamber variations following sudden orbicular muscle contraction, which may cause direct trauma and make leakage of viscoelastic from incision easier. It is therefore important to choose a substance that gives the greatest possible protection and rarely leaves the anterior chamber throughout phacoemulsification. This is why we prefer viscoelastics with low cohesiveness: within this group, Viscoat is by far the best. Its imperfect transparence makes continuous control on its protective presence possible so that timely additions can be made, if viscoelastic is unintentionally removed, as is often the case during emulsification of hard nuclei. It is certainly true that low cohesiveness makes aspiration at the end of surgery difficult: Viscoat has to be carefully removed from each quadrant. With the advances in surgical technique within the last few years, this is hardly a problem; on the contrary, it can be considered another warranty of particularly good protective qualities. Moreover, in our experience, incomplete removal does not cause significant increases of intraocular pressure.

Viscoelastic is also quite useful in isolating and selectively moving pieces of tissue: e.g. blocking small capsular ruptures, protecting iris tissue damaged by phaco tip, repositioning iris that has prolapsed into the incision. On these occasions, it serves as a precious auxiliary instrument.

Among cohesive viscoelastics, we prefer high molecular weight products such as Healon GV®, which works well in creating and maintaining spaces. We sometimes use one of these before lens implantation to reform the capsular bag. We perform capsulorhexis with needle and forceps. Forceps seem to us to provide more precise control of rhexis as well as more effectiveness when it is necessary to modify direction in case of peripheral extension: it is sufficient to grasp the capsule at its very implant base and operate a perpendicular traction

Hydrodelineation - hydrodissection

A complete mobilization of the cataract nucleus is quite important in topical anesthesia. If the nucleus is free from adhesions to cortex, it will be easy to rotate it without exerting any traction on zonular fibres and ciliary body, which may otherwise elicit pain reactions. Separation from the epinucleus, moreover, provides a cushion protecting the posterior capsule from variations in vitreous pressure. Hydrodelineation is certainly more successful if a flat cannula is used in place of the normal round air cannula. The distinctive golden ring will tell the surgeon the manoeuvre has been completed. Since adherence to posterior capsule is often considerable, hydrodissection of the epinucleus is also important.

Phacoemulsification

We commonly adopt chip and flip phacoemulsification. Our experience has been that the use of a second instrument may more easily generate compression sensations and, therefore, induce reaction while not enhancing eye control, confirming the philosophy that the simpler the surgical technique, the better (no touch technique). If hydrodissection and hydrodelineation are complete, monomanoval manipulation and emulsification present no problem.

Aspiration of epinucleus and cortex

Usually the epinucleus is well mobilized and can, therefore, easily be flipped and aspirated with the phaco tip. If there is residual adherence, it is safer to use the I/A tip with patient and delicate manoeuvres. Posterior capsule scraping is tricky, as a central rupture is always possible, especially in topical anesthesia.

Lens implantation

We enlarge the incision to 5.25 mm or to 3.5-4.1 mm when implanting respectively 5 mm optic PMMA lenses or foldable lenses. Excess viscoelastic substance should be injected to fully reform capsular sac, repeating the injection after enlarging the incision, if needed. An incompletely filled capsule may cause posterior capsule folding or rupturing during lens implantation and rotation.

Implantation should be simple and gentle. Until 1994 we found that PMMA lenses were superior to available foldable lenses in spite of the larger incision needed (17). With careful technique, sutures were not usually needed (9.5% in our experience). In our opinion, the main problem with foldables was the lack of well-working insertion forceps or injectors. Lenses opened inside the eye in a rather rough and abrupt, and sometimes explosive way. Instrumentation and lens materials have since improved and, therefore, we have switched to routine implantation of foldable lenses and 3.5-4.1 mm incision since January 1995. At the moment, we prefer to use thermoplastic lenses (Memorylens®) which are provided ready for implantation and slowly unfold within the eye in a completely traumatic way. As an alternative, we implant acrylic lenses (5.5 mm optic Acrysoft®) which have a high refractive index and are, therefore, particularly thin, even for higher powers. In our opinion, they are also easy to fold with appropriate forceps and gentle in unfolding. We now use 5 mm optic PMMA lenses, primarily for low power implants.

Concluding surgery
After implantation, the viscoelastic substance is aspirated as completely as possible and the anterior chamber is reformed, testing the incision for good self-sealing properties. With a 4.1 mm incision, suture incidence has fallen to 2.4% (unpublished data). If necessary, a single central suture is sufficient to make incision perfectly watertight and has little influence on corneal curvature. In any case, the suture can be removed after a few days. It should be remembered that most patients will feel some discomfort when the sclera is being punctured.

Time should not be wasted with unimportant details, as many patients may be at the end of their tolerance and collaboration capabilities. Care should be taken in removing lid speculum as rough manoeuvres may bring about anterior chamber loss even in the presence of a perfect incision.

COMPLICATIONS AND COMPLICATED CASES
Among the most delicate problems one can face during topical anesthesia are a miotic pupil, a capsular rupture, an irregular incision and a conversion to extracapsular extraction. It is perfectly possible to manage complications in topical anesthesia if the surgeon keeps control of the situation. On the contrary, if the patient becomes restless, the surgeon should stop briefly, to let the anesthesiologist give some intravenous sedation. Propofol usually calms down agitated patients while maintaining some collaboration capability. In a few cases, some kind of infiltrative anesthesia may be added. Resorting to general anesthesia should be the exception.

We have never had to switch either to general or to any infiltrative anesthesia. We have recently begun to use intracameral anesthesia in case of mild pain. We inject 0.2 cc of preservative-free 1% Lidocaine (Astra). We would like to insist on one point: rather than pain, the wider concept of surgical stress should be considered. Patients naturally feel the strain of undergoing an operation and also of the unusual situation of having to provide some kind of collaboration. This strain is quite different from person to person and varies with many factors, such as comprehension, mental elasticity, and the quality of patient - doctor relationship. Strain may be high at the beginning of surgery, followed by a decrease and a subsequent increase again in the last phases of surgery. In our experience, the ophthalmologist can reasonably expect about 15 minutes of maximal collaboration. Although this begins to decrease, it is generally possible to go on with topical anesthesia for about 30 minutes. Afterwards many patients may become quite difficult to control, although very co-operative patients may feel perfectly fine for as long as one hour, as other ophthalmologists have confirmed. It is therefore evident that in order to have an adequate safety margin, average surgical time for an uncomplicated cataract should be 15 minutes or less, so that there will be plenty of time to face any possible complications. Necessary instrumentation should be ready at hand and operating room personnel should be trained in setting it up swiftly. All this implies that faster surgical techniques (e.g. lateral clear corneal incision) are ideal for topical anesthesia. An occasional iris touch with phaco and I/A tips is not usually painful. However, repeated touch or iris manipulation is bothersome. Therefore, spatula and hooks should be used gently. Viscoelastic substance can be ideal in repositioning iris prolapsed into the corneal tunnel and may help in slightly enlarging miotic pupils or detaching sinechias. Capsular rupture significantly prolongs surgical time, especially if vitrectomy is needed. However, if operating room staff is efficient, it is perfectly possible to conclude surgery with topical anesthesia.

Conversion is more complex and strategy should be decided from case to case. Intravenous sedation may be necessary and some kind of injective sedation can be chosen as appropriate. We do not have much of a practical experience in this field and we think that the cautious surgeon will seldom face that situation if he wisely chooses peribulbar anesthesia in cases that, according to his personal experience, are to be considered at high risk. In our opinion, suture is to be considered a complication, although minor, since it depends on an incorrect wound construction and always induces some kind of pain reaction from the patient. A new and sometimes peculiar kind of complication is patient-related complications. They are due to orbicular muscle contraction or ocular saccades. Orbicular muscle contraction and its potentially serious effects should be prevented by careful use of viscoelastics, regulation of bottle height, accurate hydrodissection, and no touch surgical techniques. Complications following bulbar movements should be minimized by adequate preparation of the surgeon. He should learn to get the best possible cooperation from each patient while adapting his technique to small movements and positions that may not always be ideal.

REFERENCES
INTRODUCTION
Although clear—cornea cataract surgery dates back to the days of Albrecht on Graefe, its introduction in the present era of phacoemulsification (phaco) and foldable intraocular lenses (IOLs) is credited to Fine in 1992. Clear corneal incision has become progressively successful on account of the safety and predictability of induced astigmatism and limited complications. Several authors have confirmed its role in controlling and stabilizing astigmatism. The elimination of conjunctival incision and of continuous sclerocorneal suture made possible by clear corneal incision reduces surgical time and enhances procedure standardization. At present, clear corneal incision represents the best available wound for the latest advances in cataract surgery temporal incision allowing easy access even to the most difficult, deep socketed eyes, and use of topical anesthesia.

WOUND CONSTRUCTION IN CLEAR CORNEAL INCISION
The first step in constructing a wound is choosing between diamond and metal blades. Cuts made using metal blades are less accurate but, as they meet more resistance from the cornea, the incision can be created gradually with the planned segments. However, the cicatrization of an incision made with a metal blade may be hampered by its irregularity. Diamond blades make for a faster, more regular cut: nevertheless, there is less opportunity to change the direction of the cut if it has been planned incorrectly. This may easily lead to a short tunnel. Diamond blade incisions are less forgiving, particularly if the blade sides are sharp.

Even if the standardization of cataract surgical techniques tends to smooth out the differences among eyes, the surgeon must always remember that each eye is unique. Therefore, a simple technical approach like the constant use of the same level of magnification at the beginning of surgery will help the surgeon to understand the type of eye he is facing, i.e. small eye or long eye. A long or short eye means different—longer or shorter—ocular curvature. and thus the same incision width will exert a different influence on the final astigmatism. A shorter eye also means a shallower anterior chamber which requires careful incision to prevent damage to the anterior capsule, iris, etc. Currently accepted techniques for clear corneal wound construction share the common goal of creating a valve seal mechanism as well as the reduction of induced astigmatism. The hydrostatic valve seal is reached when the surface architecture of the incision is square. Ernest demonstrated that a square tunnel is the most effective solution in maintaining the valve seal mechanism. The ideal tunnel size is between 2.8 and 3.2 mm. a neutral size that induces no measurable astigmatism.

Three basic incision techniques with self-sealing properties can be considered with diamond blades. A classic incision involves a ‘preincision’. i.e. vertical cut that creates a vertical step of 250—350 pm in the cornea. This step helps to expose the corneal stroma, detect the appropriate corneal plane for the horizontal part of the incision and prevent the roof of the incision from sliding. The incision must then be continued between the superficial half and one-third of the corneal stroma, following the corneal curvature for at least 1 mm. The blade then pushes down the cornea and continues forwards to create an inner lip (responsible for the valve seal mechanism) before entering the anterior chamber. Thus the total tunnel length is greater than 2 mm. The second technique is similar to a classic incision but without preincision. With this method, the corneal stroma is not exposed and the incision depends greatly on the surgeon’s experience and sensitivity. The third technique, the hinged incision, was developed in the light of the theoretical goal of a longer, square tunnel, maintaining the incision well away from the optical axis. This technique requires a preincision (500—600 jm) far from the optical axis, in the gray zone of the limbus. After this deeper preincision, the rest of the incision is made in a similar fashion to the classic incision, although there is a parallel component of some 3 mm. Hinged incisions are most capable of withstanding an applied external force.

CLEAR CORNEAL WOUNDS AND IOLs
The wound constitutes the way out for the lens and the way in for the IOL. Wound construction is therefore closely related to the type and features of the IOL to be used. According to the theoretical model, to prevent the incision from stretching, the minimum size of the incision is determined by the perimeter of the IOL or the complex IOL-insertion instrument. Another factor to take into consideration is corneal elasticity: the wound can increase in size by approximately 15—20% before tearing. Consequently, the minimum size of the incision may be calculated by dividing the perimeter of the insertion complex by two and multiplying the resulting figure by 0.85%. Let us consider a freshly made, unstretched incision. A polymethylmethacrylate (PMMA) IOL resembles the profile of the wound, so if the incision is the same size as the diameter of the lens, inserting the IOL should not stretch the incision. In practice, a rigid IOL has a certain thickness and the perimeter is slightly larger than twice the diameter (Fig 18.1). If the surgeon
plans to insert a foldable IOL, the limitation is constituted by the perimeter of the complex folded IOL-insertion instrument (Figs 18.2 and 18.3).

The section of the complex is almost circular and the wound profile is inevitably distorted. In this case, the minimum incision size to prevent the incision from stretching is not determined solely by the complex perimeter, on account of the inevitable fishmouth effect and consequent gaping of the wound. Thus the diameter of the unstretched wound must be 6% larger than the diameter of a PMMA IOL (Fig 18.4), but 57% larger than the perimeter of the folded IOL-insertion instrument (Fig 18.5).

Therefore, a carefully planned wound requires a wider incision to allow the IOL to be inserted quickly and easily even if conditions are not ideal, such as in the event of an IOL that is not folded symmetrically. Another critical piece of information that must be available to the surgeon is the power of the IOL to be inserted.

A lens with a high power will require greater wound enlargement before insertion, unless it is a lens style that is designed for constant central thickness at all optical powers. For limited widening (about 20%), a precalibrated blade may be used. Before widening, the preincision must be evaluated. Finally, the surgeon must bear in mind that the thickness of the IOL varies according to the power of the IOL, the refractive index, and the material from which it is made (Fig 18.6).
Therefore, insertion of an IOL through a 3.2-mm incision will seriously stretch the wound and can result in loss of watertight properties. A stretched wound means stretched corneal stroma and Descemet’s membrane. Phaco also enlarges the incision, and the size of the keratome may not correspond to the size of the final incision. Instrument maneuvering is also important in the interaction with the wound size. Tunnel distortion may occur in torsion of the complex folded IOL insertion instrument. A thermoplastic lens, such as the MemoryLens, which does not need to be kept folded by an instrument during insertion, is the only foldable lens that does not require the optic and inserter to be placed in the tunnel at the same time. Furthermore, this particular lens is always correctly folded before insertion (Fig 18.7), given that it is prerolled by the manufacturer.

WOUND COMPLICATIONS: PREVENTION AND MANAGEMENT

Below are considered the most frequent complications related to wound construction: tunnel length and related problems, stretch, burn, and astigmatism.

TUNNEL CONSTRUCTION

Corneas vary in size, curvature and resistance to pressure and cut. A peripheral arcus is commonly present in older patients and may complicate corneal visualization. A tunnel of the proper width and length can be constructed using a precalibrated diamond or metal blade.

Preincision

A preincision must be made at the periphery of the clear cornea. A precalibrated diamond blade allows the best precut. The surgeon should precut during apnea to avoid an irregular wound profile caused by diaphragm motion. An irregular preincision may lead to an uneven incision. If the preincision is irregular, widening the incision may be dangerous. Therefore, it is recommended to check the depth of the incision microscopically to detect which side offers the best opportunities for widening at the proper depth, i.e., in the event that one hp of the incision has been torn due to a superficial precut and trauma during phaco. In this case, the side with the preserved lip should be widened for lens insertion.

Tunnel size

Corneal folds and limitations in phaco probe motion are indications of an excessively long tunnel. A long tunnel enhances the hydrostatic valve seal mechanism. Pressure on the external side of the incision will not cause the wound to leak but it will increase intraocular pressure and push up the inner hp of the incision, further increasing the wound’s valve seal properties. However, a long tunnel restricts phaco probe motion, and potentiates sleeve infusion compression and the risk of reduced infusion and corneal burn. Phaco requires angling the probe deep into the nucleus: if the tunnel is long, this will generate corneal folds, obscuring the surgeon’s view of the anterior chamber. Particularly in a small eye, a long tunnel means that the phaco probe is closer to the visual axis, with the risk of greater damage to the corneal endothelium. Finally, a long tunnel hampers in-the-bag IOL insertion, mostly of its distal loop. A tunnel may be considered short in the event of leakage during surgery and this may occur even in the hands of an experienced surgeon. Pressure on the incision may easily cause the hp to open up on the outer side of the incision, with consequent leakage. Wound leak may he observed during phaco, requiring a higher infusion bottle to maintain the anterior chamber. A short tunnel would be safer with a properly placed suture, to prevent postoperative wound leak, iris prolapse, etc.

Tunnel evaluation

In small eyes, the anterior chamber must be entered carefully to avoid the knife puncturing the anterior capsule. Immediate tunnel evaluation is mandatory. As soon as the incision has been made, the surgeon should assess whether the wound is likely to leak, as well as if it is necessary to place a suture at the end of surgery. In view of the fact that the wound may be stretched during surgery, the wound valve seal mechanism should also be evaluated at the end of surgery. Stromal hydration of the wound at the end of surgery may help to increase the valve seal mechanism.

WOUND BURN

The infusion flow rate has the important role of safeguarding the fluid balance in the anterior chamber and also influences phaco probe cooling. An excessively long tunnel, the surgeon’s imperfect knowledge of phaco machine
parameters, as well as any maneuver or situation leading to a constriction of the phaco sleeve and a consequent decrease of the infusion, may cause wound burn. Sleeve constriction may be the result of excessive elevation, lowering or lateralization of the phaco probe. This is especially true in deep-socketed eyes when working at the 12 o’clock position. A lateral clear corneal incision prevents the occurrence of this kind of complication.

 Imperfect knowledge of phaco machine parameters may lead to wound burn because of excessive heating due to a prolonged use of high ultrasound (US) power. The choice of a low flow rate (12—16 ml/min) phaco technique, together with phaco in extremely dense nuclei requiring up to 100% US power, may all lead to inadequate cooling of the phaco probe. With new-generation phaco machines, US power should be set at 50—60% and increased only if necessary.

 Sleeve aging may also cause wound burn: resterilization weakens sleeves, with consequent loss in elasticity and the ability to maintain a constant inflow. Disposable sleeves must be used once only. Damage to the endothelial cells following phaco with clear corneal incision has been reported.

 Our personal experience indicates that after topical anesthesia, lateral clear corneal incision and phaco, the density of the central corneal endothelial cells is reduced but the two most sensitive parameters of endothelial damage (coefficient of variation and percentage of hexagonal cells) are not significantly influenced. Therefore, even if the necessary caution is always recommended, especially in eyes with a low preoperative endothelial cell count, phaco through clear corneal incision can be considered to be safe with respect to the endothelium.

 WOUND_STRETCH

 A clear corneal incision may be stretched during phacoemulsification or the insertion of an IOL. Phaco will always cause the incision to stretch and widen. The amount of stretching that a tissue can withstand before lacerating varies according to the consistency, strength and elasticity of the tissue. Differences between patients can be expected. A stretched incision means the potential loss of the valve seal mechanism. Safe surgery requires a safe strategy, i.e. a precise incision made with a precalibrated knife. Standardizing wounds means standardizing the stretching imparted by surgery. An incision of the correct size will result in minimal tissue damage after the IOL has been inserted. An incision of up to 4.0 mm, varying with the IOL, is a safe option: it is large enough for the IOL to be inserted without causing stretching or jeopardizing the valve seal mechanism.

 Using a shooter in a small (3.2—3.5-mm) wound may not only stretch the wound but also cause corneal stromal molding of the two lips of the incision, since it adapts to the shooter’s circular section. The corneal tissue will maintain this curvature for some time and result in a partial loss of the valve seal mechanism. Detecting a leakage during the reconstruction of the anterior chamber at the end of surgery is essential in deciding whether a suture is required. The risk of endophthalmitis, suggested as being more frequent in clear corneal incision, has proved to be comparable to that observed with in scleral incision.

 INDUCED_ASTIGMATISM

 It has been demonstrated that clear-corneal cataract surgery does not bring about significant changes in central corneal astigmatism when compared to other types of incisions. After cataract surgery, the cornea is nearly always flattened along the incision meridian. Reducing the width of the incision, creating a watertight wound and eliminating sutures has led to a considerable reduction of induced astigmatism, leaving the surgeon with the problem of managing preoperative astigmatism by means other than the incision. Much energy and effort has been expended in this area, mostly through changing the meridian of incision. In practice, moving the incision also means surgery in uncomfortable positions and reduced surgical wound construction standardization.

 The astigmatism management strategy we recommend is that of standardizing wounds. This means knowing the average astigmatism induced by the personal standard incision. To develop predictability in the creation of wounds, the surgeon must standardize wounds in the most straightforward way. Once the mean induced astigmatism is reasonably predictable, managing preoperative astigmatism can be left to specific keratotomy at the end of surgery, according to well-developed protocols.

 CONCLUSIONS

 Effectively standardizing the procedure shortens the learning curve and offers better results to less experienced surgeons. The recommended size of a clear corneal temporal incision is 3.2 mm, enlarged to 4 mm for IOL insertion, as may be necessary with certain lens implants.

 SMALL EYES

 Short tunnels are more likely in small eyes, so the incision must begin closer to the limbus. In this case, a clear corneal incision will have a greater influence on the final astigmatism, on account of the smaller corneal curvature rays. Greater care is required when penetrating the chamber in order to prevent damage to the anterior capsule, because the anterior chamber is less deep.

 LONG EYES

 In comparison, long or larger eyes mainly offer surgical advantages. The anterior chamber is wider, the clear corneal incision arc has a lesser influence and the distance between the inner hp of the incision and the visual axis is greater.

 REFERENCES


19 Piovella M, Camesasca FI, Gratton I. Morphometric analysis of endothelial cells after phacoemulsification with topical anesthesia and lateral clear-corneal incision. Ophthalmology 1996; 103(suppl: 140.


“Hydrogel Ocular Bandages to Protect and Increase Watertight Proprieties of Corneal Incisions after Cataract Surgery: Four Years Experience”
Matteo Piovella, MD & Barbara Kusa, MD
OcuSeal™
(BVI - Beaver Viaflo International)

- If OcuSeal™ is accidentally applied a little too much to some corneas, the excess disappears in all cases within 12 hours, apparently because of eye blinking.
- About 30 Euros per batch
- Patient comfort during the initial healing is an important reason.
- Studies have implicated unsealed clear corneal incisions as a possible cause of post-op infections. (Researchers suggest that rapid IOP fluctuations such as those that might happen with eye rubbing can cause unhealed corneal wounds to gape, allowing conjunctival fluid and bacteria into the eye).

RaSure™ Adherent Ocular Bandage
Ocular Therapeutics - USA
Characteristics and Kit Configuration

RaSure™ is a synthetic hydrogel (89% water)
(Hydrogel is cross-linked chemical with attached water molecules)
packaged as three components: PEG powder, diluent and activator

- Preparation:
  - PEG powder and diluent should be mixed for 10 seconds
  - PEG solution and accelerator drops are positioned on the foil pouch for mixing.
  - One drop of PEG solution should be mixed with one drop of accelerator for 5 seconds before use.
  - Solution must be used within 10 seconds!
- Application:
  - Hydrogel film is spread over patient’s wound.
  - RaSure™ naturally degraded by hydrolysis.
  - Forms a seal lasting 7 days.

A Comparison of Wound Strength with and without Hydrogel Liquid Ocular Bandage in Human Cadaver Eyes
Clear Corneal Incision

Meeting presentation: presented at the ASCRS/AOA Symposium & Congress, Boston, USA, April 9, 2010.

- N=20 for each group
- Maximum Pressure that could be measured = 44.8 mm Hg
- Avg. Band Pressure
  - 69.48 mm Hg w/o OcuSeal
  - 221.84 mm Hg w/ OcuSeal

RaSure™ Adherent Ocular Bandage
Ocular Therapeutics - USA

Feature
- Synthetic
- Biocompatible
- Non-toxic, non-exothermic
- Biodegradable
- Softens and sloughs off in tears
- Persistence
- Remains localized over the incision
- Colored
- Easy to visualize application; later becomes transparent
- Comfortable
- Smooth and lubricious surface barrier

Adherent ocular bandage for clear corneal incisions used in cataract surgery

After RaSure™ application:
1) Wait 40 sec for bandage to cross-linking.
2) Fill the anterior chamber with BSS.
3) AC depth increase is induced
4) Incision water-tight properties are improved as consequence of bandage application
May Protect Against Bacteria

- Purpose: Study conducted to assess the efficacy of the ReSure™ Bandage to reduce P. aeruginosa keratitis in a rabbit model (6 control vs. bandage-treated).
- Results: The hydrogel bandage group showed a decrease in mean P. aeruginosa colony forming units (CFUs) in rabbit corneas over time, suggesting it protected against infection.

ReSure™ Ocular Therapeutics - USA

Study Design

- Purpose:
  - To assess the performance of a hydrogel ocular bandage for providing ocular protection for patients undergoing clear corneal cataract surgery with phacoemulsification and foldable Intraocular lens (IOL) implantation.
- Methods:
  - 74 eyes of 66 patients
  - 22 males / 43 females
  - Mean age 65.11 ± 8.86 yrs
  - Uncomplicated clear corneal cataract surgery
- Application of the ReSure™ Bandage

ReSure™ Hydrogel Ocular Bandage

Results

BCVA after SVI ReSure™ Use
74 EYES

Patient Foreign Body Feeling at Day 1 po.
With ReSure™ - 74 Eyes
Without ReSure™ - 72 Eyes

BCVA after OculeSel™ Use
27 EYES

BCVA after ReSure™ Use
27 EYES

0.5
0.75
1.0

1 Hour PO
3 Day PO
1 Hour PO
3 Day PO
1 Hour PO
3 Day PO

Patients who Received OculeSel™ in One Eye and ReSure™ on the Fellow One

ReSure™ Ocular Bandage: Overall Results

- The bandage was present in all cases at 24 hours.
- No discomfort was reported with 78% of the patients.
- No adverse events occurred.

ReSure™ Adherent Ocular Bandage Surplus
Ocular Therapeutics - USA

1 hour po
1 day po
Conclusion

Now we use Hydrogel Bandages routinely after ophthalmic surgery.

- I cannot prove scientifically any potential for Hydrogel Bandages to decrease the endophthalmitis rate. It would be difficult, perhaps impossible, to show this, because of the large case numbers required to detect any effect.
- But if Hydrogel Bandages does prevent these horrible infections, then I will be protecting my patients’ eyes. And, at the least, this will help me serve my patients better by giving them greater comfort after surgery.

Thank you for your attention!
“Multifocal IOLs: Directions to Improve Patient Satisfaction”
Matteo Piovella MD; Barbara Kusa MD

Effect of Contrast Sensitivity Reduction

MTF (50 lp/mm) Sensitivity to IOL Rotation Error
Up to 2.0 D Cylinder Correction – Pupil Size 5 mm

Weak Points of Most Popular Multifocal IOLs
(Diffractive Bifocal Technology Limits)

- Reduction of Contrast Sensitivity (up to 30%)
- Small P.O. refractive errors may be critical: Postop. 0.5 Diopter SE generates loss of two lines of Visual Acuity
- TORIC MULTIFOCAL OVER 0.75 D ASTIGMATISM
- Diffractive IOLs: Diffractive Grooves (Blaze high) Creates Different Diffractive Efficiency and Light Loss
- Heales, glare and Ghost images are difficult to manage in Suspicious Patients
- Poor Intermediate Distance Vision
- Perfect Target: Plano Postop

With Accommodative IOLs there is no loss of light, so quality of vision is not compromised.

Best results with eyes that provide:
- Opportunity to apply high standard Biometry to get high precision results for IOL calculation
- Opportunity to get 20/20 vision after the surgery
- Opportunity to get emmetropia and normal stereopsis Postop
- Inform the Patients they have to:
look for the light and not to look for glasses

AT LISA® tri - Trifocal Optic

- Diffractive Technology Provides Reduction of Contrast Sensitivity (up to 30%)
- This Weak Point Should be Easily Overcome by Increasing Light Efficiency
- Inform the Patients they have to Look for the Light and not to Look for Glasses
- The Easier, Faster and More Efficient Way to Improve the Dim Light is to Use Smartphones Torce Function. Every Patient has one immediately available.
- Patients Like it and Thank You to Provide Simple and Perfect Solution

AT LISA® tri (Zeiss)
Specific Asymmetrical Light Distribution

- AT LISA® tri implanted in 96 eyes of 58 patients
- Mean Age 67.80 ± 11.18
- Mean Preoperative BCVA 20/42 ± 46.67
- Mean Time Follow Up 3 years ± 1 month
- Mean Preoperative Sphere Equivalent -0.01 ± 3.06

### Materials and Methods

- AT LISA® tri - Trifocal Optic
  - The optical zone of the AT LISA® tri 839MP provides:
    - a near addition of +3.00 D for a comfortable reading distance
    - an intermediate addition of +1.66 D
  - It improves intermediate vision without compromising near or far vision.

AT LISA® tri 839MP geometry

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**AT LISA® tri (96 Eyes) UCDVA - BCDVA and Sphere Equivalent (96 Eyes)**

**AT LISA® tri toric Materials and Methods**

- AT LISA® tri toric implanted in 65 eyes of 41 patients
- Mean Age 65.37 ± 12.58
- Mean Preoperative BCVA 28.77 ± 12.77
- Mean Time Follow Up 2 year
- Mean Preoperative Sphere Equivalent -0.94 ± 3.42
- Mean Preoperative Corneal astigmatism 1.45 ± 0.55
- Mean Preoperative Refractive Astigmatism 0.92 ± 0.59

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- 23 Eyes - yag laser treatments (23.95%)
- Mean days PO: 326.13 ± 211.18 days

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**Look for the Light and not to Look for Glasses!**
By the point of view of the patients, many complaints seem similar for:

- 22.00% of patients in the “right range”
- 21.37% of patients in the “right range”
- 22.70% of patients in the “right range”
- 25.40% of patients in the “right range”

Outcomes:

- Vision (EDTRS) 20.92
- Adaption of new technologies takes time and is very expensive
- Normally we are presenting long-term data that do not match the today technology
- Small Amount Patients

Trifocal IOLs

- Have Replaced Bifocal Technology
- Improve Presbyopic IOLs Implantation over 50%

Multifocal Bifocal IOLs Limits:

- Too sensitive to Small Amount Post-Operative Refractive Errors
- (0.50 Dioptr SE Refractive Outcomes is the limit for good patient compliance)
- No Intermediate Distance Vision Provided

Trifocal IOLs:

- Less Sensitive to Small Amount Post-Operative Refractive Errors
- Provide Intermediate Distance Vision
- Best Available Refractive Near Vision Correction

Trifocal Technology has replaced Bifocal Technology

- Normally we are presenting long-term data that do not match today’s technology
- Normally, eye doctors have no enough direct experience on advanced technology IOLs make all their efforts and criticisms to support the patients to not understand their problems
- The eye after cataract surgery needs at least three months to get back to standard quality of vision
- The point of view of the patients many complains seem similar for multifocal and advanced technologies IOLs
- Adoption of new technologies takes time and is very expensive

Biometry is a Key Point

Refractive Postoperative Goal:

- Sphere equivalent within -0.50 and +0.50

How many patients have 1 or both eyes in the “right range”?

-0.50 sph / +0.50 sph

-0.96
-0.21
-0.16
-0.20
-0.26
-0.50

67 BILATERAL IMPLANT

83% OF PATIENTS IN THE RIGHT RANGE
I started to implant modern multifocal IOLs routinely in 2006

In 2015 in our centre 73.5% of our patients were implanted with Trifocal IOLs

Today trifocal advanced technology has replaced standard Multifocal (bifocal) technology because provides intermediate distance

Zeiss AT LISA® tri is our first and standard choice for presbyopia correction since its introduction

Our Center is the mirror Surgical Centre for Multicent Refractive Surgery

I am an international recognize surgeon and I had in my plans to go on for long time to perform eyes surgery

The Trifocal Diffractive IOLs technology overcome this weak point

Why I Decided to Implant Zeiss AT LISA® tri in my Eyes? 73.5% of my Cataract Patients (2015) were implanted with Trifocal IOLs

It is well known that the highest rate of complication is due to Capsulorhexis weak management

In February 2014 I have visited Burkhard Dick Bochum Center: he performed 8 FLACS, with only one surgical bed, within 2 hours and was assisted only by a nurse and one assistant

I have used the AMO Catalyst Femtolaser for my patient for 4 months before having treated my eyes

Burkhard Dick was the Medical Monitor for AMO Catalys and at that time had upgraded the machine with more that 6 advanced options

The efficiency of AMO Catalys related to capsularhesis is outstanding

Summary

Eyes Selection

Look for the Light and not to Look for Glasses!

Possibility to perform high standard Biometry to get high precision results for IOL calculation

Possibility to get 20/20 vision after the surgery

Possibility to get emmetropia postoperatively

Inform the Patients they have to look for the light and not look for glasses

Conclusions

• AT LISA® tri 839MP and AT LISA® tri toric provided effective and comfortable distance and intermediate visual acuity.

• This lenses as all diffractive multifocal IOLs present a penalization of contrast sensitivity up to 30%, and this situation obliged the patients to increase of minimum 30% the light for near vision.

• AT LISA tri and tri toric IOLs design is more pupil independent and with a different asymmetrical light distribution: even in dim light the contrast should be significantly better if compared with apodized "bifocal" IOLs. Due to these features AT LISA tri and tri toric IOLs provided higher spectacle independence and patient satisfaction.

• Due to lost of contrast sensitivity (up to 30 %) we provided to our patients a small led high power light to get Jaeger 1 near vision in dim light condition.

Conclusions

• Bilocal Diffractive IOLs technology is difficult to manage to avoid quality of vision penalization on a significant number of patients. Bilocal Diffractive IOLs technology has no significant % of light for intermediate distance and an important amount of light loss.

• The Trifocal Diffractive IOLs technology overcome this weak point providing specific % of light for Intermediate distance and reduces the light loss % improving diffractive efficiency and quality of vision.

• Realos, Glare and Ghost Images are difficult to manage in demanding Patients. Trifocal Diffractive IOLs technology is an effective tool to reduce night driving problems due to non symmetric % of light distribution.

• Perfect Target after Diffractive IOLs Technology implantation is Plano Postop results.

For any question or further information please contact me:
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References


“Lens Surgery in Patients at Risk for Narrow-Angle Glaucoma: Four Years Follow Up”
Barbara Kusa MD, Matteo Piovella MD
Discussion

Given the insidiousness of glaucoma and the increased life expectancy of the population, prevention of glaucomatous damage is of the foremost importance. The AC OCT provides previously unseen images of the anterior segment, with immediate visualization of its structures and almost instantaneous diagnostic opportunities. Presently, the indications for cataract surgery in eyes with very shallow ACD and narrow angle are being reconsidered on the basis of the new images provided by AC OCT as well as on the increasingly limited invasiveness of cataract and lens surgery. Our studies indicates that it is possible to determine these three parameters:

The Three “A”

Age: over 60 y.o. - ACD: ≤ 2.4 mm - Angle Width ≤ 16°

OCT Technology Widened Indications for Clear Lens Extraction

In Patients at risk for glaucoma, removal of cloudy lens implies:

- Reduced need for iridectomy.
- Reduced need for topical glaucoma therapy.
- Reduced social cost of glaucoma.
- Reduced number of challenging cataract cases.

Refractive Clear Lens Exchange vs Cataract Surgery: Age and Life Expectancy

68 Patients (Technis® & ReZoom® Implantation)
Patients Age Range Variables

- Refractive Lens Exchange: 63.60 yrs ± 7.82 SD
- Lens Exchange BCVA ≥ 0.9: 86.00 yrs ± 6.69 SD
- Cataract Surgery: 76.06 yrs ± 7.84 SD
“Eliminating complications with proper technology & techniques.”
Steve A. Arshinoff MD
Tight Incisions

- Better control of AC pressurization.
- Far better control of phaco parameters.

“Phaco is Rheology”

Two physical components of Phaco:

- Phaco power modulations.
- Rheology: Control of flow in, maintenance of the AC.

OVDs are pseudoplastic fluids used to create an AC surgical environment optimized for surgery.
Creative use of OVDs reduces complication rates.

Argentinean Flag Syndrome

- Discussions on this subject are usually clear evidence of fundamental misunderstanding of rheology.
- By all accounts: “Rheology is a difficult subject.”
- Argentinean Flag Syndrome should never occur.

Pressure Equalized Cataract Surgery

Why do we need to pressurize the AC?

- There is always posterior pressure.
  - Extracapsular muscle pull.
- Anterior capsule is convex anteriorly.
  - It will always want to tear peripherally.
- Only a viscous elastic OVD will neutralize the posterior pressure (HMM NaHa).
- Important for: Capsulorhexis, IOL implantation

Tri-SofT SHELL TECHNIQUE (TSST):

SST Enhanced by adding BSS below the cohesive OVD

SSTs: suggestion, not a formula
Dispenser OVD   Cohesive OVD

Capsulorhexis is easier when BSS is injected onto the capsule surface, after OVD injection, when using SofT Shell Techniques, or any viscous cohesive OVD alone.

Combining OVDs in precise “Techniques” can always achieve more:

OVD Techniques (Soft Shell, Ultimate Soft Shell, Soft Shell Bridge, TSST & multiple variations) allow surgeons to achieve more than with one OVD physical space in the anterior chamber by pressurizing, stabilizing & partitioning.
<table>
<thead>
<tr>
<th>Little capsulorhexis tear-out rescue</th>
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<tbody>
<tr>
<td>Riot C. Unke, FRCOphth, Jennifer H. Smith, MD, Mark Packer, MD</td>
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![Image of eye surgery]  
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<tr>
<th>Uncomplicating Cataract Surgery... Summary</th>
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<tbody>
<tr>
<td>1. Hold instruments like top chopstick</td>
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<tr>
<td>2. Use intracameral Xylo &amp; phe</td>
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<tr>
<td>3. Make tight incisions</td>
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<tr>
<td>4. Understand Rheology</td>
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<td>5. Use SST &amp; variations</td>
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<td>6. Shear, don't stretch rhexis</td>
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<td>Higher AC pressure = smaller rhexis</td>
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<tr>
<td>7. CC Hydrodissect a lot!</td>
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<tr>
<td>8. Do not sculpt.</td>
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<td>9. Chop all pieces before removing any.</td>
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"In Cataract Surgery, the slower you go, the less time it takes!"
## Addresses

<table>
<thead>
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<th>Company/Location</th>
<th>Contact Info</th>
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