Sutured posterior chamber intraocular lenses for traumatic cataract in Africa

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DECLARATION

I, Dr Graeme John Rogers, hereby declare that this research is based on original, independent work performed by myself and no part of it is being, or has been submitted for any other degree to any other university. This work has not been published or reported prior to registration for the MMed (Ophthalmology) degree.

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DR GJ ROGERS 20/11/2013

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PART A: The PROTOCOL
(As approved by the Surgery Departmental Research Committee)

INTRODUCTION

Problem

Ocular trauma is common in low-income countries. Groote Schuur Hospital manages large numbers of patients with the manifestations of ocular trauma every year[1]. The lens and its supporting structures, major refractive components of the eye, may be damaged in more than half of cases of severe trauma[2].

Despite this, there is still some doubt as which is the best modality for the most successful rehabilitation of patients who have such severe lens damage as to necessitate its removal along with the capsule in which it is contained[3].

Intraocular lenses sutured to the sclera in the posterior chamber of the eye (SLTC – Sutured lenses for traumatic cataract) – in the natural position of the crystalline lens - is standard practice at Groote Schuur Hospital in selected patients. It is a difficult and intricate procedure, usually only performed by consultants experienced in the technique. The majority of patients who undergo ocular trauma are young, necessitating rapid and effective optical rehabilitation to maximise productivity and quality of life.

The use of contact lenses in aphakic, previously traumatised eyes may be the least invasive modality but is not appropriate in all cases. Anterior chamber lenses, especially the older versions with closed loop haptics, have been associated with numerous complications despite being significantly easier to implant[3]. Numerous other options such as Iris claw fixated lenses, intraocular lenses sutured to the Iris and sutureless techniques for the fixation of posterior chamber intraocular lenses have not been used to date at Groote Schuur Hospital[4].

Habit and anecdote regarding the dangers of anterior chamber intraocular lenses in patients with presumed co-existing angle trauma has precluded the use of these anterior chamber lenses in patients known to have had trauma. A marker for such trauma, angle recession, may be found in up to 15% of patients in certain parts of the drainage area of our hospital[5].

The selection of patients for SLTC has not been standardized and there may be some difficulty in prognosticating visual outcome in these patients without large series that pertain directly to those eyes that have sustained trauma[6].

Justification
This study is to evaluate:
1. The outcomes of sutured posterior chamber lenses for traumatic cataract at Groote Schuur Hospital
2. The determinants of poor outcome for the improved selection of patients for this procedure preoperatively.

Objective

RESEARCH QUESTIONS:
1: What are the outcomes of sutured posterior chamber lens implantation operations for traumatic cataract at Groote Schuur Hospital?
2: What are the determinants of good or poor outcomes in the patients who undergo SLTC?

METHODS

Study design
A descriptive and analytical retrospective case series.

Sampling strategy
Data will be collected from case notes of all patients who underwent sutured posterior chamber intraocular lens implantation surgery for traumatic cataract or traumatic aphakia over the five-year period from 2007 to 2012.

Measurement

For the descriptive and analytical retrospective case series the following data will be collected:

Injury type – blunt or penetrating
Preoperative conditions
Preoperative visual acuity
Primary or secondary implantation
Presence of lens in vitreous
Postoperative visual acuity
Postoperative best-corrected visual acuity
Refraction
Spherical equivalents
Astigmatism – total, corneal, lenticular
Postoperative degree of lens tilt
Type of anaesthesia
Grade of surgeon
Postoperative conditions – angle recession, corneal scar, retinal pathology
Length of follow-up

Associated possible risk factors for outcomes, including gender, age, race, type of surgery, surgeon experience i.e. consultant/registrar/medical officer, surgical complications, length of surgery and associated ocular pathology will be compared with outcomes. The improvement in visual acuity will be determined for each case.

ANALYSIS

Data will be analysed using the statistical program Stata Version 9.0. Variables will be described using means, medians, and proportions, as appropriate. Bivariate comparisons will be based on student t test (for means), Wilcoxon sum rank test (for medians), and Chi square or Fisher's exact test (for proportions).

Visual acuities that were either decimal or Snellen notation were first all converted to decimal notation and then to LogMAR for analysis and then re-converted to decimal notation after analysis[7]. This notation was acceptable to JCRS editors in the review process.

The main analysis will focus on:

Mean visual outcome
Preoperative, intraoperative and postoperative determinants of visual outcome

All statistical tests will be two sided at α=0.05.

A chi test was performed on all data and as means would overestimate non-normally distributed outcome measures, medians were used for these if required.

ETHICS AND COMMUNICATION

Ethics

Ethical approval will be obtained from the University of Cape Town Faculty of Health Sciences ethics committee. In case of approval not being required, a letter from the Surgical Research Committee head to this effect will be supplied.

Reporting and implementation

A paper reporting the findings will be submitted to a peer reviewed journal for consideration for publication.

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PART B: THE LITERATURE REVIEW

Objectives

A review of the literature was performed to demonstrate the scope of published material pertaining to traumatic cataract and its management, particularly with reference to the outcomes and complications of sutured lenses implanted for traumatic cataract (SLTC). The research was then grouped and reviewed thematically.

Search Strategy

Several textbooks on ocular surgery, ocular trauma and general ophthalmology were consulted and referenced.

An online search of Pubmed of published peer-reviewed literature was performed using the following keywords:

Sutured intraocular lenses/Scleral fixation of posterior-chamber intraocular lenses/Intraocular lens fixation/Traumatic cataract/Lens dislocation/Lens subluxation/Aphakia correction/Absence of capsular support/Traumatic glaucoma

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1. Trauma to the lens

Eye trauma is commonest in low-income countries. Groote Schuur Hospital in South Africa, for example, repaired or excised 1392 eyes from penetrating eye trauma in a ten-year period from 1995 to 2004[1]. Poor vision from ocular trauma occurs most frequently in young, economically active adults, making rapid optical rehabilitation preferable if possible[2].

Up to half of *all* severe eye injuries involves the crystalline lens, its supporting capsule and/or its zonules[3]. Similarly, the lens and its adnexa may be damaged in up to 65% of cases of *blunt* eye trauma[4]. The lens is responsible for a third of the refracting power of the eye - if the lens is damaged, it may become hazy or cataractous, often necessitating removal. If the capsule and supporting zonules are damaged, the malposition of the lens may cause complications and replacement with a subsequent artificial lens may be required without the advantage of capsular support.

According to the major sources of data from the United States on ocular trauma, lens injuries comprise the following[3]:

74% cataract (USEIR) [HEIR: 63%];

13% subluxation (USEIR) [HEIR: 23%];

13% dislocation (USEIR/HEIR)

Despite the frequency of lens trauma (second only to complicated cataract surgery as the commonest cause of capsular or zonular damage) and its complexity, the literature specific to traumatic cataract management is relatively sparse[3].

The examining clinician may elicit a history of monocular diplopia, glare, myopic shift, or pain, injection and loss of vision from inflammation. The examination may reveal change or irregularity in anterior chamber depth, iridodonesis and phacodonesis, visible lens edge, vitreous prolapse, iridodialysis and iris sphincter tears, ocular hypertension/glaucoma and many other signs of significant eye trauma.

2. Surgery for traumatic cataract

Cataract extraction techniques and timing and intraocular lens (IOL) implantation type and timing in traumatic cataract cases is somewhat more complex than that pertaining to the more common age-related variant.

Agarwal et al reviewed recent developments in the field of cataract surgery and trauma[4]. Surgery for the lens is indicated if the patient has visual loss from cataract or astigmatism, diplopia, corneal touch from an anteriorly dislocated lens, lens-induced inflammation and/or associated ocular hypertension. Lens surgery may also be indicated to facilitate view for posterior segment interventions such as intraocular foreign body removal or miscellaneous vitreoretinal interventions.

Techniques to remove the lens may be extracapsular by lens aspiration, phacoemulsification via a clear corneal incision and manual small-incision cataract surgery via scleral tunnel or by intracapsular cataract extraction (ICCE), lensectomy with anterior vitrectomy or pars plana lensectomy. The former two generally imply the retention of the lens capsule. Lenses may also be dislocated into the vitreous – surgeons may elect to observe these or remove them by fragmatome-assisted posterior vitrectomy. Removal of the lens may be performed at the time of globe repair or be deferred. A cataract may develop only later or complications may develop in the interim because of lens-induced inflammation or lens chafe from

ectopia. Implanting lenses for visual rehabilitation may also be performed primarily or be appropriately deferred.

The most physiological position for an IOL is in the posterior chamber as this most closely mimics the natural state of the crystalline lens[5]. When the capsular bag is somehow deficient, the surgeon should decide whether adequate capsular support exists for in-the-bag (with or without implants to assist with stability in the bag) or in-the-sulcus fixation or whether an alternative option should be considered. In general, surgeons have been uncertain as to whether the intricate and time-consuming suturing into a physiological position is preferable or whether the easier and quicker anterior chamber or iris-claw lenses should be entertained.

Dick et al discusses the choices in selecting IOL's in cases of deficient capsular support based on safety and efficacy[6]. The choices of modern anterior chamber intraocular lenses (ACIOL's), Iris-fixated and -claw lenses or scleral fixated posterior chamber lenses exist. The debate persists as to which is preferable, especially in trauma cases. In all otherwise uninjured eyes, surgeon preference may be the most important factor in this decision – given the little difference in outcomes between them. Sutured lenses are almost never implanted if globe repair is performed prior to lensectomy (unless this is a relatively limited repair). The lens surgery is also often deferred in such cases. IOL biometric power may reliably be gleaned from contralateral uninjured eyes.

In the past, the life expectancy of the patient of more than ten years or age under fifty- chosen presumably as a marker for time to suture erosion or time till endothelial compromise – may have been important factors in the decision for the surgeon. Anatomic considerations like compromised cornea, absence of iris, abnormal angle,

peripheral anterior synaechiae, shallow anterior chamber depth less than 3mm and concomitant glaucoma make a sutured IOL arguably preferable.

A large proportion of traumatised eyes have abnormal angles making ACIOL's anecdotally inappropriate because their haptics are supported in those self-same compromised angles. However, few papers comment on preoperative gonioscopy findings to support such anecdotal practice. Most units consider these lenses relatively contra-indicated in trauma cases, with or without such gonioscopic knowledge.

Chee et al report their noncomparative case series of cataract surgery in traumatic, severely subluxated cataracts[7]. All consecutive eyes with at least six clock hours of zonular dehiscence were included in this series after surgery. Thirty-six eyes underwent surgery with the aid of a modified Cionni capsular tension ring (CTR) for six to nine clock hours and in two eyes a combination of capsular tension segment (CTS) and CTR was used when there was more than nine clock hours of dehiscence present. Three eyes without salvageable capsules had either iris fixation or scleral fixation performed. Ocular hypertension, iridodialysis and traumatic mydriasis were identified as important preoperative comorbidities.

Causes of poor vision at the final visit in one eye each were posterior capsule opacification, rod-cone dysfunction and epiretinal membrane with cystoid macular oedema. There were no cases of endophthalmitis or retinal detachment in this series.

Preoperatively, 54.5% had angle-closure at presentation. Persistent postoperative raised intraocular pressure (IOP) was seen in 31.7% of which more than half still had angle closure. Twelve of 13 eyes required ongoing glaucoma medication and one

required a drainage implant. As the removal of the lens did not improve the IOP, lens position alone was not considered the cause of the high IOP. Despite this reasonable deduction, this paper does not proceed to describe the angle findings in these cases except to state that angle-recession is a contra-indication to ACIOL use.

This series had excellent results with 92.7% of eyes achieving 20/40 or better vision at the final postoperative visit. The visual outcome in this series was ascribed to the limited vitrectomy required and the associated retention of the capsular bag. The alternative intracapsular procedure causes vitreous prolapse, and consequent vitreous traction may result in retinal detachment. The inherent additional manipulation may cause glaucoma, chronic inflammation and conjunctival compromise for future glaucoma surgery.

The limitations of this study were its retrospective nature, the fairly short mean follow-up of 21.4months and a small sample size of 36 eyes.

Loncar et al performed a retrospective study of secondary traumatic cataract extractions and implantation of lenses from Croatia[6]. Clinical outcomes and complications of traumatic cataract were reported. Twenty-four eyes were operated. Five had corneal scars, four had anterior capsule rupture, two had iris sphincter damage, three had anterior synaechiae and one had a macular scar. Only one had zonular loss and two had posterior capsule rupture - these three, however, did not have lenses implanted. Nine had mild to moderate postoperative complications. Seventeen of 24 had improved vision postoperatively. None of these patients had sew-in IOL's implanted however.

Postoperatively, only one of 24 had raised intraocular pressure. One had a retinal detachment and five had uveitis. The six children included in this study may have

influenced the outcome - studies have demonstrated that IOL implantations in children are highly associated with postoperative fibrinous uveitis[9]. The postoperative complications in this series limited the visual acuity outcomes to equal to or less than 6/60 in seven cases.

Advantages and disadvantages of primary or secondary implantation of IOL's were discussed. Primary implantations may lead to more rapid rehabilitation, allow for use of the sulcus prior to the development of fibrosis and limit general anaesthesias. Secondary implantations may facilitate visualization for more accurate and safer placement, allow for precise preoperative biometry and allow for the blood-ocular barrier to stabilize on topical medication prior to further intervention.

It was concluded that eyes could be safely rehabilitated with posterior chamber IOL (PCIOL) with outcomes influenced most by postoperative complications. The most frequent of these was posterior capsule opacification and uveitis, both predominantly in children.

Bowman and co-workers audited the surgical strategy of primary PCIOL implantation for African cases of penetrating eye trauma[9]. In the context described, the impracticality of other forms of aphakic rehabilitation is discussed.
Those with retinal injury or endophthalmitis were excluded from this study because they did not then undergo lens implantation as per the protocol of the unit.

Seventy-two cases were reported from the period 1988 to 1996. All were operated within one month of injury. Mean follow-up was 14.3 months. Fifteen of the 27 (38%) cases required anterior vitrectomy for pre-existing or intraoperative posterior capsular damage. Approximately half of the patients had sulcus and half an endocapsular implantation. The mean age again was low (with many children in the sample) at

14.3 years such that 41% of patients developed uveitis postoperatively and 32% required delayed posterior capsulotomy. Nevertheless, results were good with 71% achieving 20/60 or better visual acuity.

The combined use of anterior vitrectomy, corneal repair, sulcus rather than capsule fixation and limbal rather than corneal section trended towards poorer outcome but were not statistically significant. The fibrosis between capsule and iris preventing later sulcus fixation was re-emphasized. Those with capsular as opposed to sulcus-fixation tended to have less postoperative fibrinous uveitis.

The reduced cost of a single procedure as well as the impracticality of multiple visits from distant, rural areas were also given in support of primary implantation. Late presentation had already meant that 79% of patients with corneoscleral wounds had already healed at the time of presentation and did not require repair prior to lens surgery.

Uncorrected visual acuities of 20/120 or better occurred in 78%. Of the ten patients with acuity worse than 20/60, two had corneal scar inducing irregular astigmatism, two posterior capsule opacification, three developed amblyopia and one had phthisis bulbi. Two had poor vision of unknown causes. Importantly, a quarter of patients in this series were younger than seven years old and they did worse. This phenomenon may be exaggerated by more inaccurate visual acuity testing or may rather be a real consequence of amblyopia. Biometry on the fellow uninjured eye for primary implantation has been adequate and accurate in most studies. However Bowman et al indicate that it may still be less accurate than a delayed biometry on the injured eye.

A review of IOL implantation in penetrating ocular trauma in 2010 by Shah et al looked at many of these matters in some detail[10]. In cases with breach of the capsules, urgent primary lensectomy is the standard of care for decreasing inflammation and subsequent damage. Lenses still enclosed by their capsule may have delayed intervention unless visual rehabilitation or fundal view is required earlier. The question of optimal timing of IOL implantation remains. Primary implantation shortens rehabilitation time to binocularity and reduces the number of operations and anaesthetics. Secondary implantation may allow improved visualization, more accurate IOL power calculation once astigmatism has stabilized for accurate biometry on the injured eye and allows for more detailed surgical planning once the eye has healed and all associated injuries may be accounted for. In numerous reviewed studies of primary implantations, patients overall achieved at least 20/40 corrected vision in 70% of cases. The incidence of serious complications like glaucoma and retinal detachments were low.

In terms of secondary implantation studies, Chuang and Lai demonstrated that 57% achieved 20/40 corrected visions[11]. They concluded that the results were "at least as good but not necessarily better than primary implantation".

Blum et al in his series of 148 traumatic cataracts achieved a mean visual acuity of 20/35 in the 67% who had secondary lens implants[12].

A paediatric series of five eyes from five children by Hyun et al[13] evaluated visual outcomes following scleral fixation of lenses after trauma (see below).

A series by Saleh et al discussing sutureless intrascleral implantation after trauma is discussed in detail later[2].

3. Sutured Lenses: Review articles

The most comprehensive review article on this matter was written by Wagoner et al[15]. Series of cases were compared - both for those after complicated cataract surgery and those combined with penetrating keratoplasty. The latter is beyond the scope of this paper. The outcomes from all series of primary and secondary scleral fixated lens implantations were analysed. The three lens options – sutured posterior chamber IOL's, anterior chamber lenses and iris-claw lenses were also compared in several studies – these were all noted to be small retrospective case series.

The premise that scleral fixation of lenses would have lower rates of corneal decompensation, glaucoma escalation and cystoid macular oedema and that these lower rates would justify the additional time and expertise required was cited. The operative time was 35 to 60 minutes for scleral fixated PC IOL's compared to 8 to 16 minutes for alternative lens modalities.

Additional complications specific to scleral fixation were cited: increased lens tilt, haemorrhage, retinal detachment and erosion of sutures resulting in endophthalmitis. After complicated cataract surgery, primary implantation with 80% achieving 20/40 or better was considered acceptable. Complications in this setting were minor and the series were generally too small to draw further conclusions.

In secondary implantations, series without optic nerve or macular complications achieved 90% rates of 20/40 or better. This dropped to 66% if these complications were included. Retinal detachment averaged at 3.5%, lens tilt or dislocation was 2.6% and endophthalmitis 0.9%.

Importantly, those series involving pars plana lensectomy had a higher proportion achieving 20/40 than those from series of intracapsular cataract extractions with anterior vitrectomies.

Wagoner et al[15] concluded that there was no strong evidence in general that either of the three compared modalities were superior after cataract surgery from 43 articles of level 3 or higher evidence provided that there were no anatomical contraindications. Visual outcomes are similar and ACIOL insertion is technically significantly easier. The major complications previously associated with ACIOL's were also not found to be significantly lower with the other options. A large prospective randomized clinical trial comparing the three was recommended.

Agarwal et al devoted only three lines to the management of cases with deficient capsular support for intraocular lenses in the trauma article previously cited[4].

Over ten years, since Wagoner's landmark review[15], there is still no clear answer as to the best modality and surgeons may be encouraged that multiple good modalities exist and that each case should be individualized.

Hanush et al state that in cases without capsular support, IOL implantation is standard of care for treating unilateral aphakia[16]. They concur that sutured PCIOL requires more theatre time and expertise than ACIOL implantation.

Others, such as Michaeli[17], are also not certain of the safest modality describing all three as having specific indications. The benefits of distance from the endothelium, the preservation of the eyes' "normal" anatomy relating to lens position and the minimization of aniseikonia, its non-reliance on the presence of iris tissue, limited

phacodonesis as well as minimal uveal contact are all cited in favour of scleral fixation.

On the other hand, this modality is more technically complex, takes longer to perform, requires extensive vitrectomy, may be inappropriate in patients with bleeding disorders, may be difficult if extensive conjunctival scarring from trauma exists, and is dependent on the presence of sutures. It may also cause ciliary body erosion by the haptics. Specific recommendations on traumatic cases are not made.

Hoffman compares ab externo and ab interno approaches[18] – essentially the main difference being the direction of the needle pass – but common to both is the passage through uvea and the anterior apron of vitreous as well as the need to avoid erosion of the knot by rotation or burial.

Holt et al[19] agreed that results were generally good from his analysed three alternatives – ACIOL, Sutured PCIOL and *glued IOL*(see State of the art). Iris claw lens, iris fixation by suture and other sutureless scleral-fixated lens studies were not compared. All modalities have been acknowledged to be useful for cases of posttraumatic IOL implantation unless iris damage precludes angle or iris supported modalities. Seven papers are cited referring to scleral fixation after trauma. The following points are emphasized – that specific circumstances relatively contraindicate specific fixation techniques, that further research is required to assess that and that all are viable and successful options if used appropriately.

4. Sutured lenses: Series

Buckley published a series of 33 paediatric eyes, which had undergone scleral fixation of intraocular lenses as well as a paediatric ophthalmologists survey

regarding common practice and opinion[20]. About a third of causes were traumatic in this series but these were not isolated or compared to the non-trauma group. Follow up was for five years. 81% improved with a mean improvement of 0.25 ± 0.23 log MAR.

Donaldson et al[21], in a retrospective interventional comparative case series compared the results of 181 patients who had undergone complicated cataract surgery with either an ACIOL or a sutured PCIOL in eyes with poor capsular support. There was no significant difference in outcome or complications between the two – the assimilation ascribed to the recent improvement in design of modern open-loop haptic ACIOL's. Those with significant preoperative optic nerve or retinal disease were excluded from the series.

Raised IOP postoperatively occurred in 42% of PCIOL patients compared to 38% in the ACIOL group. Four percent of cases from the PCIOL group compared to none from the ACIOL group had retinal detachments and three patients from the PCIOL group had suture erosion. The final refraction in the PCIOL group was -1.30± 2.10DS compared to -0.8±1.70DS in the ACIOL group, which was not statistically significantly different.

In a large retrospective, interventional, comparative case series by Kwong et al[22], 36 eyes after sutured PCIOL were compared to 46 eyes after ACIOL implantation. All were implanted primarily after a complicated cataract operation. After adjustments for other factors, the ACIOL group had a significantly improved visual outcome after a mean follow-up of 33.4±17.9 months. The complications – both early and late- did not differ significantly between the two groups but the study was inadequately powered to be certain. It was also not certain from this study whether any of the cases had zonular damage from previous trauma or whether this inadequate

capsular support was iatrogenic. A recommendation was made for future studies to have longer follow-up to evaluate long-term visual outcomes and complications.

Scharioth et al[23] reported the intermediate results (median follow-up of seven months) of 63 patients from four institutions in Europe who underwent sutureless intrascleral fixation of an IOL. Only six of these patients had lens subluxation from trauma and these cases were not analysed separately. No preoperative conditions were associated with significant postoperative loss of vision. No mention however was made of gonioscopy findings in the trauma cases versus the rest. Two patients suffered IOL dislocation, two had persistent ocular hypertension, and one each had hypotony, IOL capture and cystoid macular oedema. The median spherical equivalent was 0.98DS with a logMAR corrected distance visual acuity of 0.4.

A paediatric series of five eyes from five children by Hyun[13] et al evaluated visual outcomes following scleral fixation of lenses after trauma. There were no serious complications and all children (with a mean age of 90±18 months) had improved or stable vision at final follow-up. Unilateral aphakic spectacles had been unsuitable because of unilateral aniseikonia. Also, contact lenses required more regular corneal surfaces than these traumatised eyes and children were often intolerant to them. An ab externo technique was used and an Alcon CZ70BD IOL was implanted and fixated. One patient required repositioning of IOL three days after the initial surgery. One patient required postoperative topical medication for transient ocular hypertension. Their conclusion was that this modality was safe and effective in children - especially appropriate due to the unilaterality of trauma and consequent requirement for balance as well as the traumatic alterations in the shape of the globe that precludes the use of contact lenses.

In 2008, Kjeka[24] published results from a retrospective case series of 91 eyes, which had undergone sutured PCIOL implantation. Mean corrected vision was 0.5, improved in 89% of patients. Three eyes had retinal detachments postoperatively. Two eyes had suprachoroidal haemorrhages. No eyes had suture erosion or decentration in the mean follow-up of 36 months. Only nine had concurrent intracapsular cataract extraction and anterior vitrectomy. Only ten of these patients had traumatic cataracts and these were not analysed separately from the rest. The mean lens tilt of these eyes was determined by subtracting corneal cylinder from the total cylinder, which had first been determined by "autorefractor-keratometer".

In the first week (described as "early"), 18% of eyes had complications and 9% suffered complications after that (defined as "late"). Ten percent of patients had early high IOP and a quarter of these patients had persistently raised IOP requiring treatment.

A limitation cited was the potential of an underestimation of late complications. The paper concluded that sutured PCIOL is safe in adults for aphakia correction.

Mimura et al[25] demonstrated that most subluxations (indeed most complications) occur within the first two postoperative years and that in 12 years follow-up no patients had suffered spontaneous dislocation of their sutured IOL's. Limited suture loosening causing IOL tilt and ciliary body haemorrhage were the predominant complications within the first two years of implantation.

In a small comparative interventional case series from Saleh et al[2] from France the results of sutureless intrascleral IOL implantation compared with retropupillary iris claw fixation after trauma were reported. The main cited advantage was a smaller corneal incision, inducing less astigmatism. A review of files was performed on 26

eyes of 13 patients. The IOL was injected through a 3mm clear corneal incision, limiting surgically induced astigmatism. All patients had undergone 23-gauge pars plana vitrectomy combined with cataract extraction with either a primary or secondary lens implant.

4. Complications

In general, series about traumatic cataract surgery report results better than 20/40 in more than half of cases but these habitually exclude from their series or from their practice all cases with posterior segment abnormalities. Both the USEIR and the HEIR found that up to half of those with lens injury had concomitant posterior segment injuries and this portended guarded outcomes.[3]

In the USEIR results after traumatic cataract surgery, 28% of eyes achieved 6/12 final vision if the posterior segment was injured as opposed to only 47% if it was not.

These outcomes may have been limited by preoperative, intraoperative and postoperative factors. Of those included in a study by Blum et al, 11% had hand motion or worse vision because of extensive *preoperative* posterior segment disruption[12].

With regard to *postoperative* complications, Hannush contended that PCIOL implantations tended towards early complications while ACIOL's tended towards late complications[16]. Mimura concurred, with his series of PCIOLS giving most complications within 2 years[25] and Saleh reporting those within 3 months[2]. Therefore an intermediate follow-up period for these papers may be adequate to include most complications.

In terms of refractive outcomes, Durak et al[5] in 2000 evaluated tilt and decentration after scleral-fixated sutured PCIOL's. Fifty-six eyes of 53 patients had either primary (14 eyes) or secondary implantation (42 eyes) and were evaluated for these phenomena using modified Goldmann kinetic perimetry. The mean IOL tilt was 6.09 degrees ±3.80(SD) in all eyes with no statistical difference between the primary and secondary implant group. Only nine eyes had more than ten degrees of tilt and eight eyes had more than 1mm of decentration.

Holladay et al had previously determined that more than 1mm of decentration and more than 15 degrees of tilt causes optical aberrations that cannot be corrected with spectacles[26]. Centration of the PCIOL when sutured depends on the symmetry and positional stability of the haptics. Capsular implantation is always best causing least tilt and decentration, especially with continuous curvilinear capsulorhexis as used in routine modern cataract surgery. Previously, Hayashi et al, using scheimpflug videophotography to quantify the tilt and decentration of IOLs, had found a mean decentration of 0.62mm and a mean tilt of 6.35 degrees in that series[27]. Although not statistically significant, the secondary implantation group caused more decentration and tilt - presumably due to greater iridocapsular fibrosis, which had developed between surgeries. Consequently, all efforts should be made to retain the capsular bag as described in the series by Chee et al[7].

Lens tilt or decentration was found in up to 10% of all scleral fixated IOL's by suboptimal suture placement and tension in another review.[6]

With reference to angle and intraocular pressure problems, Buckley's was the only series stating that gonioscopy had been done[20]. None of these eyes had angle anomalies, including the nine of 33 who had sustained trauma. Twenty-one had

raised IOP due to viscoelastic and all but two responded early to medical treatment. None required surgery. Krause[14] had effectively demonstrated in his series that retained viscoelastic was the predominant cause of raised IOP but had not previously excluded angle anomalies by gonioscopy.

Grevin et al[28] looked at the condition of eyes after surgery for blunt traumatic cataract in a retrospective, noncomparative, interventional case series of forty patients all with a minimum of 6 months follow-up. This was a useful paper analysing posterior segment comorbidities limiting outcomes. Potential for improvement was felt to outweigh the risk from the surgical intervention in the selected patients if the posterior segment could not be conclusively examined.

Seventy-two percent of eyes had preoperative visual acuities worse than 5/200. Only 60% had zonular weakness for which a mix of surgical techniques was used, making deductions difficult to extrapolate. 24 underwent lensectomy with pars plana vitrectomy with five PCIOL's sutured, one primary ACIOL and three secondary ACIOL's implanted. Five patients had ICCE of whom three had PCIOL's sutured immediately and one had an ACIOL implanted. 11 had extracapsular cataract extraction with eight immediate PCIOL, one ACIOL and two were left aphakic and rehabilitated with contact lenses. One eye had secondary sutured PCIOL.

Postoperatively, only 30% had a completely normal posterior segment – these abnormalities included vitreous haemorrhage in 45%, retinal detachment in 20%, maculopathy in 23%, choroidal rupture in 13%, subretinal blood in 13%, optic atrophy in 5% and a retinal tear in 3%. All posterior segment complications were ascribed to the trauma and not to the intervention.

No mention was made in this paper of the presence or absence of angle recession, glaucoma or ocular hypertension.

Only 55% achieved 20/40 or better vision. Although not statistically significant there was a trend towards better outcomes in those with better preoperative visual acuities. Preoperative afferent pupil defects or iridodialysis were associated with poorer outcomes.

This series had a total posterior segment complication rate of 28%, much of which was mild and/or transient. The worst outcomes were in those undergoing anterior vitrectomy – which is more comparable to a group of SLTC than those not undergoing this intervention.

Another series by Blum et al[12] cited above on traumatic cataract from both blunt and penetrating eye injuries noted that 8.2% had severe retinal or optic nerve injuries. On the other hand, Weinand et al[29] showed that corneal injury was the predominant limiting factor.

5. The state of the art

The complications and technicalities of suture-fixation have led several to devise alternatives. A detailed analysis of the technicalities of modern advancements is beyond the scope of this review but several articles identify some of those alternatives. For example, several papers[4,22] promote sutureless fibrin-glue fixation, which would eliminate suture-related complications.

The use of smaller incisions for foldable lenses may reduce intraoperative hypotony and additional manipulations and would save on wound suturing and reduce

surgically induced astigmatism. Many authors describe implantation of sutured foldable lenses and this may soon become standard practice[14,22].

More precise suture placement had Holt[19] describe intraoperative endoscopy during pars plana vitrectomy or Hannush[16] postoperative ultrasound biomicroscopy. The latter is presumably intended to confirm suture placement and to improve on future surgeries.

Hoffman et al[18] describe his technique for safe burial of the fixating knot under a non-perforating scleral tunnel.

Dick discusses a PCIOL diaphragm for aniridic eyes and foldable IOLs transclerally sutured via small incisions[6].

Michaeli recommends the suturing of an IOL to both the iris and the sulcus to improve on tilt, decentration and late displacement[17].

The sutureless enclavation of IOL's described by others[30,23] is less technically demanding but there have been no series with long-term outcomes.

Saleh at al[2] have shown that cystoid macular oedema was no higher in the sutureless than in the iris claw group – initially they proposed that the former might induce less iris chafe and hence have less inflammation. It is however stated that this result is difficult to ascribe to lens position and procedure alone after the initial trauma and often multiple subsequent interventions. Otherwise this study did not expand on any ocular manifestations specific to the trauma.

Most postoperative complications occurred in the first three months. Of those with an intrascleral IOL, two patients developed cystoid macular oedema, which responded to medical treatment. One patient required surgery to bury an exposed haptic. In the group with iris claw IOL's, there were three cases of cystoid macular oedema and a post-traumatic disenclavation of the IOL. There were no retinal detachments or endophthalmitis cases in either group.

Iris claw implantation shares the ease and rapidity of implantation advantages with ACIOL. While requiring uninjured irises, iris claw IOL's also need a larger incision of 5.4mm compared to the 3mm of the foldable IOL's implanted into the sclera. There was however no significant difference in induced astigmatism between these two groups.

The intrascleral IOL is thought to have a theoretically safer long-term endothelial attrition profile. The argument for externalized haptics versus tunnel-incarcerated ones is also made to avoid erosion through conjunctiva. A cannula or forceps may be used for either technique.

There was no significant difference too in postoperative inflammation inducing macular oedema despite the theoretical increase in manipulation in the intrascleral group. Again, the manipulation that these eyes have undergone since first traumatised make it difficult to isolate all inflammation to the technique of implantation alone. The authors concluded that because iris claw fixation is easier and quicker that it should be used unless iris damage exists.

6. Conclusion

The visual prognosis of eyes operated for isolated traumatic cataract is generally excellent. A large prospective, randomized series of sutured intraocular lenses for

traumatic cataract or one comparing the different modalities is required to ascertain the impact of preoperative conditions, operative choices and postoperative complications on outcome. At present it is difficult to extrapolate guidelines relevant to SLTC from the literature because the reported series are small [13,14,20], they don't specify when traumatic in origin[15,21,22,23], they do not analyze the results for each cause separately [14,15,21,23,27] and many papers are limited to or slanted by paediatric cases [9, 13,20].

All efforts should be made to save the capsule and limit vitreous loss but if capsule salvage is not possible, a pars plana vitrectomy/lensectomy with proper management of the anterior vitreous skirt is recommended prior to the individualized choice of lens implantation. In a low-income setting, this safer approach to subluxated cataracts may not be feasible or practicable for all cases. Numerous advances in technique and modalities in recent years have made the appropriate management of subluxated cataract easier but these still require significant individualization to ensure best practice.

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PART C: THE ARTICLE FOR PUBLICATION

13-362

Sutured posterior chamber intraocular lenses for traumatic cataract in Africa

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Sutured posterior chamber intraocular lenses for traumatic cataract in Africa

Abstract

Purpose

Ocular trauma comprises a significant proportion of the workload of eye clinics in many middle and low-income countries. Eyes with traumatic aphakia may be unsuitable for anterior chamber intraocular lens implantation or contact lenses. This study aims to determine the outcomes of sutured scleral fixation of posterior chamber intraocular lenses after trauma in an African population.

Setting

Records were drawn from a state hospital and its affiliated district hospital in Cape Town, South Africa.

Design

Data collection was retrospective of all case notes of appropriate patients.

Methods

A retrospective review was performed of the medical records of 59 patients who had undergone implantation of a sutured posterior chamber intraocular lens for traumatic aphakia in the preceding five years.

Results

Eighty five percent of patients had a significant improvement in uncorrected visual acuity (0.39) at their final visit. Two-thirds of patients achieved a good visual outcome of 6/18 or better. Those not improving had severe pre-existing macular or corneal pathology. A significant number of patients (28%) with angle recession developed ocular hypertension within the follow-up period after this intervention.

Conclusions

Sutured posterior chamber lenses are an effective modality in the visual rehabilitation of eyes with traumatic subluxated cataract where the capsular bag cannot be retained, provided that careful preoperative selection is performed.

Introduction

The management of unilateral traumatic cataract with inadequate zonular integrity or capsular support poses unique challenges to surgeons. Contact lenses and anterior chamber lenses for aphakic rehabilitation, despite being respectively less invasive and technically easier to implant, are not appropriate in all patients. A sutured posterior chamber lens may be safer, not further compromising traumatised angle structures. Suturing posterior chamber intraocular lenses is time-consuming and intricate. In low-income countries such as South Africa, indigent patients with unilateral *posterior* segment ocular trauma with guarded prognoses are often denied intervention. Similarly, one may argue that such unilateral *anterior* segment interventions may also be deemed inappropriate. This study was performed to determine whether the visual results of sutured posterior chamber intraocular lens for traumatic cataract justify this intervention in middle and low-income settings.

Methods

The clinical records of 59 adult patients who underwent sutured posterior chamber intraocular lens for traumatic cataract (SLTC) over a five-year period from 2007 to 2012 were reviewed. All patients had a definite history of ocular trauma, previous ocular surgery for trauma or evidence of trauma on examination additional to the lens subluxation. Patients studied had varying degrees of zonular damage – varying in severity from mild subluxation with poor vision from cataract and lens tilt, functional apahakia due to severe

subluxation, patients with dislocated cataracts anteriorly or posteriorly as well as those who had already undergone a simple lens extraction with no implantation. All the patients had been selected for surgery on the assumption that there would be visual benefit. The surgeon and the patient in consultation determined the need for surgery. No patients were selected for surgery if they had a preoperative afferent pupillary defect, an abnormal b-mode ultrasonography, or unimproved potential acuity (PAM) measurements. Benefit of the doubt was given to patients whose poor fundal view precluded accurate assessment of the fundus, or whose vision was too poor for PAM unless other factors excluded them on the basis of poor prognosis.

The intraocular lens dioptric power was based on preoperative biometry with an aim for emmetropia in all patients. All patients had traumatic cataract and were either aphakic after primary intra-capsular cataract extraction, had capsular dehiscence too severe for the use of capsular tension rings and salvage of the capsular bag, or had dislocated crystalline lenses.

Surgery was not performed for cosmesis or improved peripheral visual field in any patient with known significant posterior segment trauma. Patients with short follow-up were not excluded because poor follow-up is typical of trauma patients at our unit (1).

A standard surgical technique, with some minor variation between surgeons, was performed under subtenon, peribulbar or general anaesthesia. All patients underwent anterior vitrectomy (with or without lensectomy) via 7mm

scleral tunnels at 180 or 90 degrees. In the ab externo cases, the sutures were threaded through 26-G needles at 1mm under scleral flaps. This suture was hooked and withdrawn from the eye and sutured to the haptic's eyelets of a CZ70BD IOL (Alcon Laboratories, Fort Worth, Texas USA). In ab interno cases, a STC-6 needle was passed via the tunnels 1mm posterior to the limbus. A double-armed 10-0 polypropylene (Prolene) suture was used in all cases with either CIF-4 curved or Straight STC-6 needles. The lens was placed under the iris via the scleral tunnel and the sutures were tightened and tied after a second partial thickness scleral pass and the knot buried under sutured flaps. The scleral tunnel was then closed with 10-0-nylon interrupted sutures. Many recent improvements have been developed but those with significant alterations in technique were excluded from the series.

Data regarding postoperative measurement of the visual acuity, auto-refraction, biomicrosocopy of the anterior segment, intraocular pressure measurement, gonioscopy and fundoscopy were recorded.

Lenticular astigmatism was determined by deducting autorefractor keratometry values from the total astigmatism (2). Snellen and decimal visual acuities were converted into LogMAR visual acuities for statistical analysis (3). Hand movements and counting fingers vision were recorded first as 0.01 and 0.001 in decimal notation (3). The data were then entered into a custom designed Excel spreadsheet. For purposes of uniformity, the visual acuities were then reverted to decimal acuities. Statistical analysis with Stata (version 11.1) was performed and the Wilcoxon rank sum test was used to determine

associations between age, surgeon, primary or secondary surgery, presence of angle recession, pre- and postoperative visual acuities, lens tilt, associated injuries and other factors. Ethical approval for the study was obtained from the University of Cape Town Faculty of Health Sciences human ethics committee.

Results

Over the five-year period from 2007 to 2012, 59 patients underwent SLTC at our unit. The case notes were unavailable for three patients and one patient defaulted from follow up in the early postoperative period (included in the analysis of preoperative data).

Of the 56 patients for whom the case notes were available, no eyes had ocular co-morbidities unrelated to the trauma they had sustained. Seven patients had undergone prior penetrating corneal laceration repairs as opposed to none with scleral injuries. The remainder of the patients had sustained blunt, closed globe injuries.

The mean age of the patients at surgery was 51.76 years (range 22 to 84 years) and the majority was male (44 patients, 78.57%).

The mean preoperative best-corrected visual acuity was 0.02 ± 0.146 (range 0.001 to 0.63).

The mean follow-up for ophthalmologic examination and refraction was 7.39 months (range 0 to 54 months).

The postoperative visual outcomes are shown in table one.

The median postoperative best-corrected visual acuity at the last visit was 0.5 (range 0.001 to 0.8). Those patients followed up for longer had worse vision (0.21 versus 0.48 (p=0.0443)).

Forty-seven (85.5%) eyes had improved uncorrected visual acuities and an equal number had improved best-corrected visual acuities. The median visual improvement was 0.39. 66% achieved a good result with a best-corrected visual acuity of 0.32 (6/18) or better at the final visit. Six eyes were unchanged and two were worse postoperatively.

There was no significant difference in outcome in those older (mean 0.484) or younger than 50 years of age (mean 0.438) (p=0.425).

Fourteen (25%) cases were performed by senior residents and 42 (75%) by qualified specialists experienced in sutured lens techniques. There was no difference in the visual outcome (p=0.684) or lens tilt (p=0.679) between these two groups.

The mean postoperative spherical equivalent was -1.797DS (range +2.5 to -11DS).

Autorefractor reading were included of outliers with poor fixation, a limitation of this series. The mean lenticular astigmatism was one diopter, and the range was 0–6 diopters. No patients had clinically obvious decentered or tilted intraocular lenses.

The seven patients with corneal scars and a history of penetrating trauma had better vision than those without, with a mean best corrected visual acuity of 0.49 +/- 0.19 compared to 0.27 +/- 0.23 (p=0.1734).

Those eyes with postoperative evidence of previous posterior segment injury had a significantly worse best corrected visual acuity of 0.21 compared to those eyes without posterior segment injury with visual acuity of 0.33 mean (p=0.0017). One eye was found to have optic atrophy postoperatively, and vision did not improve beyond 0.25. The remainder had significant macular scars, choroidal ruptures or epiretinal membranes involving the fovea. Those with transient vitreous haemorrhage were excluded from this group.

Eighteen patients (32.7%) were treated and controlled medically for ocular hypertension postoperatively. All of these except two had one or more clock hours of angle recession. One patient without angle recession developed raised IOP, which resolved on withdrawal of topical steroids. One patient developed glaucoma without angle recession but had peripheral anterior synechiae. Only one patient required surgery - a glaucoma drainage implant - due to refractory high intraocular pressure in her only seeing eye within the follow-up period. The presence of angle recession glaucoma in 28% did not,

however, significantly influence the visual outcome in our series (p=0.849). Figure one shows the association between angle recession and the presence of postoperative ocular hypertension.

All patients had mild to moderate corneal oedema within the first postoperative fortnight. Two patients developed longstanding mild corneal decompensation.

Other recognized complications occurred. Two eyes developed significant hypotony within the first postoperative month, one of which had evidence of hypotony maculopathy, 18 eyes had mild postoperative vitreous haemorrhage, all of which cleared within the first postoperative month. One eye required Nd:Yag vitreous strandectomy for a residual vitreous wick. No eyes developed endophthalmitis in the follow-up period. No eyes developed spontaneous suprachoroidal haemorrhage. There were also no eyes with suture-related complications during the follow-up period.

One patient sustained postoperative trauma to the operated eye, also an only seeing eye, within two months of SLTC and required pars plana vitrectomy for rhegmatogenous retinal detachment, suprachoroidal haemorrhage and extrusion of the intraocular lens.

Discussion

Approximately half of all severe eye injuries involve the lens (4). The management of these traumatic cataracts may be far more difficult than that for age related cataract where a routine phacoemulsification operation may be performed. There is however a paucity of evidence that any sort of lens implantation is optimal for traumatic cataracts without adequate capsular support; indeed this uncertainty may apply to management for all causes of subluxated lenses (5,6). Comparison with other series is therefore difficult. An excellent review article by Shah et al about intraocular lens implantation in penetrating ocular trauma does not specifically deal with cases without capsular support (7).

Analysis of a cohort of sutured lenses for traumatic cataract was performed to determine whether outcome of such surgery justifies intervention.
To our knowledge, this is the largest single centre series of sutured intraocular lenses for traumatic cataract. Deductions relevant to SLTC may be made with difficulty from the literature because the reported series are small (2,8,9), they don't specify when traumatic in origin and/or they do not analyze the results for each cause separately (2,5,8,10,11). Also some SLTC papers are restricted to pediatric cases (12, 13).

Some of the most applicable papers relevant to traumatic cataract management involve the retention of the capsular bag. A large series from Singapore looked at results from management by fixated capsular tension

devices and phacoemulsification. These achieved good visual outcome in 92.7% (14). This solution may be considered the gold standard. In contrast, our series has excluded all cases where the capsular bag was deemed salvageable. This may mean that these eyes with more subluxation have suffered more severe trauma or that the surgical management or results are inferior. It seems intuitive that using retained capsular rim as the literature recommends would yield better results (15). The consequences of additional manipulation, intracapsular extraction and anterior vitrectomy may help to explain our significantly worse outcomes. Lens tilt and decentration may also be important contributors to poor vision postoperatively due to the absence of capsular support with unreliable positioning of haptics in the cillary sulcus (16). Chee and others found that retention of the capsule bag resulted in better vision (14). It has been found that lens tilt of more than 15 degrees causes coma aberration that cannot be corrected by spectacles (17). There was no significant difference in lens tilt in primary and secondary surgeries, which has also been the finding in a prospective series using Purkinje images (17). We may have expected more tilt and decentration from the secondary group given the increased likelihood of iridolenticular fibrosis. We have also found lenticular astigmatism to be less contributory than corneal astigmatism in our series but the surgically induced astigmatism compared with preoperative astigmatism was beyond the scope of this study.

The only relevant African study was conducted in Kenya, yielding good results in 71% of patients with primary intraocular lens implantation for traumatic cataract (18). However, none of these cases were SLTC. Nevertheless, the

presence or degree of lens subluxation has previously not been predictive of final visual outcome but all series have been small. Papers about the management of traumatic cataract with predominantly intact capsules in middle to low income countries report rates between 43.5%(19) and 71%(18) achieving 20/60 or better.

Several papers controversially quote youth (7) and the presence of angle or iris anomalies as contra-indications to anterior chamber lens implantation (3; 20). In our study, patient age was not significantly associated with visual outcome and our unit has traditionally avoided these lenses in traumatized eyes.

The cumulative lifetime prevalence of angle recession in parts of our hospital's drainage area is as high as 14.6%, of whom 5.5% develop glaucoma (21). In eyes with previous closed globe injury, both angle recession of more than 180 degrees and lens subluxation have a separately increased relative risk of developing glaucoma. Those with subluxated cataract had a relative risk of 3.5 of developing glaucoma (22). In our series, with known ocular trauma, 16 of the 31 with one or more quadrants of recession developed postoperative raised intraocular pressures. This proportion of patients with angle recession developing glaucoma is higher than the 35,8% of patients reported elsewhere (23). While it is known that increasing degrees of recession may be associated with an increased likelihood of glaucoma, we may postulate that angle recession and coexistent lens subluxation may be associated with a cumulatively increased risk of

glaucoma. This secondary finding may require further investigation as to whether SLTC precipitates glaucoma in eyes with more severe or more widespread recession. Only two (10.5%) of our patients without recession, developed transient raised intraocular pressure.

Other studies report markedly variable proportions of patients without preoperative glaucoma developing persistent postoperative glaucoma (8) from as low as 2.2%(4), to 9%(15) of patients. However, gonioscopy findings were not mentioned in these series and length of follow up also varies significantly between studies (2). Krause et al effectively demonstrated that viscoelastic use was the predominant cause of glaucoma in their paper but again no mention was made of the presence or absence of angle recession (8).

Better results in those patients with corneal scars is in keeping with the findings by others that patients with traumatic cataract from penetrating trauma do significantly better than those from blunt injury (7, 19). Those with posterior segment injury do worse in all studies involving management of concomitant cataract (24). Posterior segment injury in our series was 30.3% - more than the 11-23% in other studies (24,25). Again, our sample may involve a more severely traumatised group of eyes.

There was one retinal detachment within the follow-up period, which is similar to other series (2,8).

Our study has a number of weaknesses. It is a retrospective case series, with all the weaknesses implicit in that study design. Data was not available for three patients. There were some minor variations in the surgical technique used. The follow-up was relatively short and possibly more comparable to intermediate follow-up series (9). Long term complications such IOL instability, glaucoma, corneal decompensation and suture erosion would probably have been underestimated in this series. However, a 10-year follow-up of scleral-fixated lenses reports that complications tend to occur in the first two postoperative years (10) and average time to first complication was 1.1 months in another large series (26). Those patients in our series who suffered complications were understandably followed up for longer and often had poorer outcomes.

There may be merit in conducting a prospective randomized trial comparing sutured posterior chamber intraocular lens, iris fixated intraocular lens, and anterior chamber intraocular lens for traumatic cataract where there is inadequate capsule support for a bag or sulcus fixated intraocular lens. This may be particularly relevant because other non-traumatic series have demonstrated either no difference (6) or better results with anterior chamber lenses (5).

Notwithstanding the weaknesses of our study, it is a large series, and it provides important evidence that there is benefit, in our resource poor setting, of offering this surgery, where indicated, for traumatic cataract. Visual rehabilitation after severe lenticular trauma is effectively achieved by scleral

fixation of posterior chamber intraocular lenses even in a low-income setting where phacoemulsification with capsular salvage may not be available or possible. Careful preoperative patient selection, regular postoperative follow up and early recognition and management of complications are mandatory.

What was known

Trauma is a common cause of subluxated cataract and an accepted procedure to rehabilitate such eyes is to implant scleral-fixated lenses.

What this paper adds

A large series of scleral fixated lenses for traumatic cataract demonstrates the unique characteristics of this group of patients and that good results may be achieved despite severe ocular trauma. This is the largest paper of its kind specifically looking at traumatic, subluxated lens rehabilitation in a low-income context.

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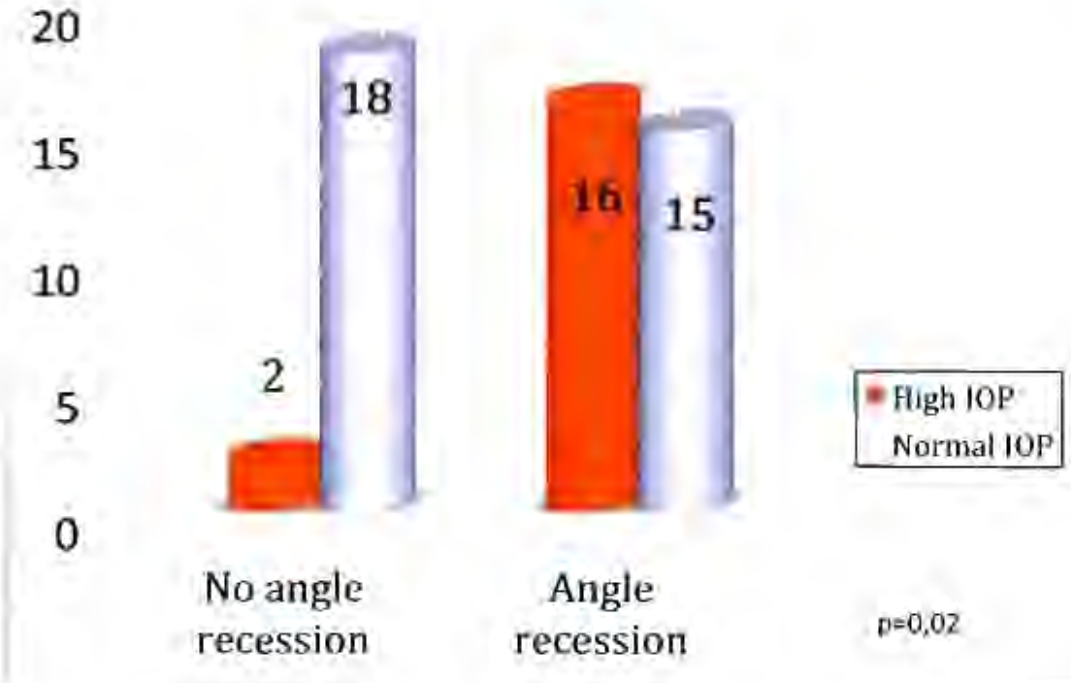

Figure 1: Angle Recession and IOP after SLTC

Visual acuity	WHO category	Preoperative best corrected vision [n(%)]	Postoperative best corrected vision [n (%)]
1-0.32	A	4 (7)	40 (71,4)
<0.32-0.1	B	15 (26,8)	10 (17,9)
<0.1-0.05	C	2 (3,5)	1 (1,8)
<0.05-NLP	D	35 (62,5)	4 (7)
Unrecorded		0	1 (1,8)
Total		56	56

Table 1: Visual acuities after SLTC

Part D: SUPPORTING DOCUMENTS

• Guide to Online Submission • Information for Authors

Guide to Online Submission

All manuscripts, including letters to the editor, replies to the editor, and correspondence, **must be submitted online** via the Elsevier Editorial System (EES) web site. Go to http://ees.elsevier.com/jcrs and select "log in." You will immediately see the screen "Elsevier Editorial System Log-In." You will be asked for your username and password. If you have not yet registered, you will see a place to do so. If you are registered, type in your username and password and click on author login. You will be guided step-by-step through the creation and uploading of various files including the manuscript, synopsis, figures, and tables. Once the uploading is complete, the system will automatically generate an electronic (PDF) proof, which is used for reviewing. All correspondence regarding submitted manuscripts will be handled via e-mail through EES.

The article must be in **12-point type, double-spaced, with 1-inch margins (with all pages numbered consecutively).** It should follow the general instructions for authors about content and style. The text should use the wrap-around-end-of-line feature; ie, returns at the end of paragraphs only. Place 2 returns after every element such as title, headings, paragraph. *Please do NOT use a citation generating program (e.g., End Notes), or any automatically generated numbering or bulleting systems or hidden text (eg, for footnotes, lists).*

See the *JCRS* Information for Authors for descriptions of the content and format of each type of article (full length article, case report, technique, review/update, letter, correspondence). Manuscripts with incorrect formating will be returned unreviewed for modifications.

Files Required for New Submission The following files **must be** included with each submission. The files should be in the following order:

Manuscript File (with the Following Items)

1. Title page. The title of the paper should be short and specific. A short running head should also be provided. The title page should include the following: (1) each author's full name (ie, first name, middle initial if used, and

last name) and no more than 4 degrees (only first 4 will be published); (2) affiliation of each author; (3) if presented at a meeting, provide the exact name of meeting and city, country, and month and year of the meeting; (4) sources of public and private financial support, including organization's name, city, and country; (5) statement about the authors' financial or proprietary interest in a product, method, or material, or lack thereof; and (6) name and address of author to receive reprint requests.

2. Abstract: This should follow the title page.

3. Text of the article, including the references. If there are figures, the figure legends must follow the references. (The figures themselves go in a separate file.)

Synopsis File A synopsis is required for full-length articles and review/date articles, but not for case reports or techniques. The synopsis goes in the table of contents. It should be **no more than 30 words** and should describe the main finding(s) of the paper and the significance but should not duplicate the abstract conclusion.

Figure File Each figure should be attached in a separate file. (All figures legends should be in the manuscript file, not with the figure itself.) The preferred formats are TIF or EPS (jpg and gif formats are more suitable for viewing on the Web, not for print) at the standard resolutions (ie, 300 dpi for photos - final size in print journal; 1200 dpi for line art).

Table File All tables can be in 1 file. Include the legends with the tables.

Video File Preferred video files are MPEG-4 video/MP3 audio. If another format file is used, the typesetter will have to convert it to .mpg format so it can be accepted by the online platforms. Elsevier recommends 10 MB as the optimal size as this ensures that end users are able to download and view files in a reasonable timeframe. Elsevier can handle up to 160 MB but anything more than that will have to be compressed for conversion as a zip file, meaning the video will be online as a .zip file. **REMINDERS FOR SUBMITTING A NEW MANUSCRIPT Abstract** is required in 2 places: at the beginning of the submission process, where requested; in the manuscript file, following the title page.

Techniques and case reports: **150-word descriptive** abstract
Full length articles: **250-word structured** abstract

Text must be submitted as a Word (.doc) file, not as a PDF.

Figures and tables should not be embedded in the text; they must be submitted as separate figure and table files.

Figure legends should be included in the manuscript file, following the references.

Synopsis (required for full length articles and review/update articles) should be no more than 30 words.

Files Required for Revised Submission

The following files must be included, in the order given, with a revised submission:

Revision Notes

Indicate the specific changes that were made to the submission.

Revised Manuscript with Highlighted Changes

Highlight all the changes that were made to the text.

Revised Manuscript (without highlighting)

Do not include any highlighting or notations in this file as it is the one that will be used for production purposes.

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Include the synopsis even if it is the same as the one in the first submission.

Figure File

Attach the figures even if they are the same as the ones in the new submission. (The figure legends should be in the revised manuscript files.)

Table File

Attach the tables with their legends even if they are the same as those in the new submission.

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Information for Authors

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Submission Information

Manuscripts should be submitted via the online submission system at www.jcrsjournal.org. See the Guide to Online Submission for specific submission instructions.

Manuscripts submitted to the journal must be original material that has not been published or accepted for publication, in whole or in part, in English or in another language, elsewhere. All papers are submitted to an international panel for peer review. Criteria for editorial review include suitability of subject matter, originality of content contribution to the field, and timeliness.

Manuscript Preparation

The title of the paper should be short and specific. A short running head should also be provided.

The title page should include the following: (1) each author's full name (ie, first name, middle initial if used, and last name) and highest degree; (2) city, state, and country in which work was carried out; (3) if presented at a meeting, name of the organization, city, country, and exact date of presentation; (4) sources of public and private financial support, including organization's name, city, and country; (5) name and address of author to receive reprint requests; (6) statement about the authors' proprietary or financial interest in a product or lack thereof.

Credit for authorship requires substantial contributions to the area enumerated in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals (www.icmje.org). The number of authors is limited to 8 for a single-center study and 12 for a multi-center study. If more authors are included, each must sign a statement confirming that he or she fulfills the authorship criteria. No more than 8 and 12 authors, respectively, will be listed under the title; other names will appear in a footnote.

Groups of people who have contributed materially to the paper but do not meet the authorship criteria will be listed in an appendix (eg, Clinical Investigators, Participating Investigators, Study Group).

References and legends for figures should be double-spaced and should follow the text of the paper. There is a limit of 30 references in clinical studies.

All papers are subject to revision to conform with terminology and style used by the journal. Authors should adhere to accepted English usage and syntax. Suggested references: American Medical Association Manual of Style, 9th ed. Baltimore, MD, Williams & Wilkins, 1998; Scientific Style and Format; the CBE Manual for Authors, Editors, and Publishers, 6th ed. New York, NY, Cambridge University Press, 1994.

Content

For both clinical/laboratory studies and techniques, JCRS now requires the inclusion of a short section that indicates the value of the paper relative to the existing literature. The section should be added at the conclusion of the text just before the references. Using the following format (1-2 bullet points per statement), please summarize what was known about the topic before the paper and what the paper adds. Note that in the following example, the "What Was Known" section ends with a clear statement about the gap in knowledge that the current paper attempts to address.

WHAT WAS KNOWN
• In phakic eyes prior to endothelial transplantation, it is common practice to first remove the patient's crystalline lens, even in the absence of a cataract. This measure, while believed to facilitate DSEK/DSAEK surgery, and/or to reduce subsequent cataract formation, has not been studied in DMEK patients.

WHAT THIS PAPER ADDS
• Descemet membrane endothelial keratoplasty can be easily performed in phakic eyes, and leaving the crystalline lens in-situ rarely results in secondary cataract formation.
• As better overall optical quality may be achieved in phakic DMEK eyes when accommodative function is spared, it is worth considering leaving the (clear) crystalline lens in situ prior to DMEK.

"What This Paper Adds" should not simply restate the results. Rather, it should specifically highlight the **novelty** of the findings relative to prior studies or reports. It should also not repeat the synopsis text, which is a brief summary of the results and conclusions of the paper.

Clinical Studies

Reports of clinical studies should be prefaced by a 250-word structured abstract. The structured abstract should have the following sections:

Purpose: Indicate the question that the study answers or the hypothesis that it tests.

Setting: Indicate where the study took place; this enables readers to assess the study's applicability to their practice.

Design: Describe the study design, indicating randomization and masking and masking and whether the data collection was retrospective or prospective.

Methods: Identify the patients, including selection procedures, inclusion and exclusion criteria. Indicate the intervention procedures and the outcome

measurements.

Results: Present the outcomes and measurements. Data should include the level of statistical significance.

Conclusions: State the conclusions and their clinical pertinence.

Reports of clinical studies should include a synopsis for the table of contents. The synopsis should be no more than 30 words and should describe the main finding of the paper but not duplicate the abstract conclusion.

The text must follow a standard format: introduction, materials and methods used, presentation of results, and discussion. Conclusions can be incorporated into the discussion or placed in a separate section.

The description of materials and methods must be explicit enough that the study can be repeated by others; results must be reproducible. If a method has been published in an English language, peer-reviewed journal, a reference is adequate. Use generic or descriptive nomenclature for drugs and instruments, with the brand name in parentheses.

In clinical studies involving experimental investigations, the manuscript must state that informed consent was obtained from all participants and that the study was reviewed by an ethics committee or review board (IRB) or that no IRB approval was required.

In experimental studies using animals, the manuscript must describe the care of the animals and indicate ethics committee or IRB approval. These studies should conform to principles of animal maintenance such as those described in the Association for Research in Vision and Ophthalmology Statement for Use of Animals in Ophthalmic and Vision Research.

Statistical methods should be defined; any not in common use should be described in detail or supported by references. General guidelines on the use of statistical methods and specific recommendations on statistical estimation and significance are given under Statistical Guidelines.

Visual acuity should be reported in Snellen format for means and ranges. Mean visual acuity should be determined by calculating the geometric mean with standard deviation stated in logMAR format (Holladay JT, Prager TC. Mean visual acuity. Am J Ophthalmol 1991; 111:372-374)

In the results section, avoid redundant data presentation. As a rule, information stated in the text should not be repeated in the tables. Graphs and tables should be used for detailed lists of findings. Note: If reporting preoperative and postoperative data for more than 3 factors, data should be presented in a table. If too many data are presented in the text, the article will be returned to the author for revision.

Techniques

Articles that describe a technique should be prefaced by a 150-word descriptive abstract. The text should include an introduction, description of the technique, discussion, and references. If the technique was used in patients, the results should be presented as a subsection of the technique section; in a technique article, the emphasis should be on the technique, not on the clinical results.

Although not required, inclusion of a video is encourages. All technique videos will become part of a Technique Video Collection on the JCRS Web site. See "Format for Video" section for a description of the formats that are accepted.

The video must not include the device/product names, manufacturer, or surgeon name, must be cited in the text, and a legend that fully describes the video should be included with the figure legends. The video and legend will appear on the ASCRS and JCRS web sites.

The purpose of the video is to supplement but not replace the description of the technique in the article itself. Therefore, the manuscript should be self-contained; ie, the reader should be able to understand and repeat the technique based on the text and figures in the manuscript alone. The article and video will be reviewed according to the journal's standard review process.

Format for Video: Preferred video files are MPEG-4 video/MP3 audio. If another format file is used, the typesetter will have to convert it to .mpg format so it can be accepted by the online platforms.

Elsevier recommends 10 MB as the optimal size as this ensures that end users are able to download and view files in a reasonable timeframe. Elsevier can handle up to 160 MB but anything more than that will have to be compressed for conversion as a zip file, meaning the video will be online as a .zip file.

Case Report

Case reports should be prefaced by a 150-word descriptive abstract. The text should include 4 primary sections: introduction, case report(s), discussion, and references.

Correspondence

Short reports do not require an abstract or a structured format. They should not exceed 700 words and can have no more than 8 references and 2 figures or tables. They should not include more than 4 authors. A title page or cover sheet must provide full names of all authors, a financial interest statement, and the postal and email addresses of the corresponding author. Short

reports are reviewed and are subject to editing.

Letters to the Editor

Letters about recently published JCRS articles are encouraged and should be submitted within 8 weeks of the article's publication. A letter should have a title that indicates the focus of the letter; ie, not the same as the title of the article. The text should not exceed 500 words and can have no more than 5 references and 1 figure or table. Gratuitous comments (eg, "We congratulate . . . on their excellent work") should be avoided. A title page or cover sheet must provide full names of all authors, a financial interest statement, and the postal and email addresses of the corresponding author. Letters are reviewed by the journal editors and are subject to editing. The authors of the article will be given an opportunity to reply.

References

Papers are judged in part on the appropriateness of the references cited, and references are expected to reflect the most current literature on the subject.

General Guidelines

- All sources must be acknowledged by a reference, and all references must be cited in the text.
- Use caution when citing review papers, editorials, and correspondences. They are appropriate to cite when novel concepts, data, models or meta-analyses are presented, but primary sources should always take precedence.
- Don't overlook papers with negative results. First consider whether sample sizes were adequate and methods were sound, and if so, such results may be important to address.
- Use more specific callout text to the literature. Be sure the reader knows why the source is critical to the current argument. If a reference does not have a clear connection to the argument, perhaps it can be omitted.
- Include the citation immediately after the clause or phrase that calls on it. Clustering references at the end of a sentence with a string of callouts dissociates references from the their text.
- Avoid listing references for the sake of showing the number of manuscripts available on a topic. Such lists are often cited at the end of an introductory statement such as "LASIK is the most commonly performed refractive surgical procedure" to efficiently acknowledge a body of generally related work. A problem with this practice is that it increases the number of citations dramatically, inflates the impact of each paper in the list, and at the same time dilutes the impact of other cited papers that were chosen on the basis of specific impact. An alternate approach is to indicate that a search was performed, specify the search engine and key word(s) used, and report the number of relevant articles that were identified. In general, though, such statements rarely require references.

- Scrutinize any self-citations carefully and subject them to the same criteria used for other references. Awareness of the omnipresent temptation for promoting our own work or that of close colleagues can help keep these forces in check.

Formats

JCRS uses a 2-part reference list: REFERENCES for peer-reviewed material and published texts, which should appear in the text of the paper as superscript numbers, and OTHER CITED MATERIAL for non-peer-reviewed material (web sites, abstracts, meeting presentations, drug/manufacturer material), which should appear in the text as superscript letters. This change avoids cumbersome text insertions citing non-peer-reviewed sources.

Peer-Reviewed Material

The list of references should be numbered in the order that the references are cited in the text. Journal names must be abbreviated according to the form used by Index Medicus. All authors should be listed.

Article:

Yildirim R, Aras C, Ozdamar A. Reproducibility of corneal flap thickness in laser in situ keratomileusis using the Hanstome microkeratome. J Cataract Refract Surg 2000; 26:1729-1732

Book:

Apple DJ, Kincaid MC, Mamalis N, Olson RJ. Intraocular Lenses; Evolution, Designs, Complications, and Pathology. Baltimore, MD, Williams & Wilkins, 1989

Chapter:

Bains RA, Anderson Penno EE, Gimbel HV. Laser in situ keratomileusis. In: Gimbel HV, Anderson Penno EE, eds, Refractive Surgery: A Manual of Principles and Practice. Thorofare, NJ, Slack, Inc, 2000; 127-157

Other Cited Material

Non-peer-reviewed material includes manuscripts not yet in press, abstracts, web sites, meeting presentations, articles in news magazines, personal communications, and drug/manufacturer material. These items should be cited alphabetically in the text as superscripts and in an "Other Cited Material" list following the peer-reviewed reference list.

A. Smith JD, "The AcrySof IOL and Its Complications," presented at the ASCRS Symposium on Cataract, IOL and Refractive Surgery, Philadelphia,

Pennsylvania, USA, June 2002

B. Smith JD, "The AcrySof IOL and Its Complications," Ocular Surgery News, December 12, 2005, pages 3-5

C. Lamasil [package insert]. East Hanover, NJ, USA: Sandoz Pharmaceuticals Corp; 1993

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An original, edited CD-ROM in IBM compatible PC format will be the standard format for submission of videos and computer graphics (ie, slide presentations with or without animation). Journal of Cataract & Refractive Surgery (JCRS) will not edit any video or computer graphics, but reviewers, following the usual policy with illustrations, may suggest changes in the video or computer graphic. A sound track is highly recommended. Maximal cumulative length of videos or computer graphics is 8 minutes, and may be divided into several smaller clips not to exceed 8 minutes in total. If the video or animation is divided into several clips, each clip should be identified at the beginning of the section and on the CD-ROM, eg, Video Clip 1 or Graphic 1. Several videos/graphics may be on the same CD-ROM, but if they are separate clips, the separation must be clearly indicated. Concise legends (typed on a separate page) must accompany each video clip or computer graphic presentation.

The following formats for video will be accepted: MPEG-1 or MPEG-2 (.mpg), Quicktime (.mov), Audio/Video Interface (.avi) or Compuserve GIF (.gif). Please contact the publisher about the use of other formats. A graphic will be used to indicate the location of a video clip or computer graphic. Videos/computer graphics for accepted manuscripts will not be returned. Videos and computer graphics will not be accepted separately from a manuscript that has been rejected. If the article is accepted for publication, the video will be digitized and archived on the JCRS website (⊟→ http://www.jcrsjournal.org). The location of the video on the Web will be linked in the online version of the article. Reminder: Videos must not include the device Mdash; product name, manufacturer, or surgeon name.

Statistical Guidelines

To ensure meaningful statistical analysis of the study results, authors should consider the following questions:

1. Was the source of subjects satisfactorily stated?
2. Were concurrent controls used (as opposed to historical controls)?
3. Were the treatments well defined?
4. Was random allocation to treatment used?
5. Was the randomization method described?
6. Was the duration of post treatment follow-up satisfactory (at least 6

months)?

Conduct of Study

7. Were the treatment and control groups comparable with relevant measures?
8. Did a high proportion of subjects achieve adequate follow-up?
9. Were the dropouts characterized by treatment received?
10. Were the side effects of treatment reported?

Analysis and Presentation

11. Was there a statement adequately describing or referencing all statistical procedures used?
12. Were the statistical analyses appropriate?
13. Were confidence intervals given for the main results?
14. Was the level of significance stated for outcomes that were reported as significant?
15. Was the reported level of significance corrected for the number of statistical analyses that were performed?
16. When the null hypothesis was accepted (no difference between experimental groups), was the statistical power of the study calculated and reported?
17. Was the conclusion justified by the statistical analysis?

Alterations

If authors make extensive changes to the text or the figures at the production stage (on page proofs), the journal reserves the right to charge the cost of the changes to the authors. No charge will be made for correcting errors made during the editorial process or by the printer.

Recommendations

Manuscripts from non-English-speaking countries should be reviewed and edited by someone proficient in the use of English.

Study design should be reviewed by a methodologist.

Reprints

The senior author of each article will receive a reprint order form, which must be sent to the publisher at the time the page proofs are returned.

Submission Checklist

1. Complete title page (including acknowledgment of financial and proprietary interests and public and private support (if any)

2. Structured abstract (for clinical articles)
3. Descriptive abstract (for techniques, case reports)
4. Synopsis of article (for clinical articles)
5. Acknowledgment of financial and proprietary interests
6. Acknowledgment of public and private support

Manuscripts will not be reviewed until all these items have been submitted.

Submission Information

New manuscripts should be submitted through the JCRS submission and review web site (⊡→ http://ees.elsevier.com/jcrs). See Guide for Online Submission for an explanation of the files required for a new manuscript. Once the submission files are uploaded, the system automatically generates an electronic (PDF) proof, which is used for reviewing.

Updated March 2012