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Original Research Article

Anterior capsulorhexis opening reduction after cataract surgery with subluxated lenses

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ARTICLE INFO

Article history:
Received 5 December 2015
Received in revised form
13 February 2017
Accepted 19 October 2017
Available online xxx

Keywords:
Anterior capsulorhexis opening
Subluxated lens
Capsular tension ring
Pseudoexfoliation

ABSTRACT

Background and objective: This study sought to evaluate anterior capsulorhexis opening (ACO) reductions after surgery for a subluxated lens. Significant reduction of an ACO supports direct zonular involvement (capsular factors excluded by use of capsular tension rings [CTRs] and modern intraocular lens [IOLs]), and these findings question the long-term efficacy of subluxated lens surgery by means of cataract surgery. A small ACO due to lens mobility, non-enlargement of the ACO, and no lens epithelial cell washing due to an additional risk of further zonular damage were left as additional features to evaluate the possible outcomes of this simplified but still complicated surgery.

Materials and methods: Data from 30 patients were used in the final analysis of this prospective study. Phacoemulsifications of subluxated lenses were performed in all patients, and iris/capsule hooks and CTRs or Cionni rings were used as stabilisers of the lens. Photography of the anterior parts (performed at 1 day, 1 week, 1 month, 3 months and 6 months after surgery) was used to evaluate the anterior capsulorhexis openings.

Results: Small initial anterior capsulorhexis openings (13.54 mm^2) were achieved, and the area reduction at 6 months was 16.70% (mean area at month 6: 11.28 mm^2, $P < 0.001$). The reduction of the ACO area in the pseudoexfoliation (PEX) syndrome patients was 20% relative to the initial size (13.49 mm^2 vs. 10.92 mm^2, $P < 0.001$). Two patients exhibited marked ACO reductions, and both were referred for anterior laser capsulotomy treatment.

Conclusions: A weak or partially absent zonule does not markedly affect the reduction of the anterior capsule opening if appropriate surgical techniques, support materials and IOLs are used, even in the presence of a small initial capsulorhexis opening area. Therefore, a cataract surgery approach on the subluxated lens should be used. Ocular comorbidities, particularly PEX syndrome, play more significant roles in ACO reduction, and appropriate ACO size reducing inhibitors (e.g., anterior laser capsulotomy) or other types of surgery should be used.

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https://doi.org/10.1016/j.medici.2017.10.003

Please cite this article in press as: Vanags J, et al. Anterior capsulorhexis opening reduction after cataract surgery with subluxated lenses. Medicina (2017), https://doi.org/10.1016/j.medici.2017.10.003

1. Introduction

The cause of lens subluxation can be congenital (e.g., Marfan syndrome, homocystinuria, Ehlers–Danlos syndrome, hyperlysinaemia, sulphite oxidase deficiency, primary ectopia lentis, and congenital aniridia syndrome) or acquired (e.g., blunt trauma, iatrogenic [following ocular surgery], pseudoexfoliation [PEX] syndrome, and retinitis pigmentosa) [1–4]. Lens subluxation is characterised by a weakness or absence of zonular support [3,5,6], which is also one of the causes of increased anterior capsulorhexis opening reductions [7–9]. Reduction of the equatorial capsular bag diameter, malpositioning of the anterior capsule opening, anterior capsule opacification, hyperopic shifts, intraocular lens (IOL) displacement or encapsulation, zonular traction, ciliary body detachment with resultant hypotony, and retinal detachment can be secondarily caused by marked anterior capsule contraction [10,11], and the visualisation of the peripheral retina during retinal surgery or laserphotocoagulation might also be compromised [12]. Various techniques and devices have been developed for cataract surgeries involving subluxated lenses [4,13–15]. These techniques and devices also decrease the anterior capsular area reduction after surgery [16,17] and allow for the implantation of various IOLs of improved material and design [12,18,19]. The aim of this study was to evaluate the rate of anterior capsulorhexis area reduction following cataract surgeries on subluxated lenses. Significant reduction of anterior capsulorhexis opening (ACO) supports direct zonular involvement (capsular factors excluded by use of capsular tension rings [CTRs] and modern IOLs), and these findings question the long-term efficacy of subluxated lens surgery by means of cataract surgery. A small ACO due to lens mobility, non-enlargement of the ACO, and no lens epithelial cell washing due to an additional risk of further zonular damage were left as additional features to evaluate the possible outcomes of this simplified but still complicated surgery.

2. Materials and methods

A prospective study was performed from 2011 to 2013 in the P. Stradins Clinical University Hospital, Riga, Latvia. A total of 44 patients suffering different grades of lens subluxation and cataracts were included. Grade 1 lens subluxation was defined as iridodonesis and/or phacodonesis and the lack of a visible lens margin in a fully medically dilated pupil (grade 1). Grade 2 lens subluxation was defined by the presence of the above-mentioned signs and a lens margin that was visible over no more than one-third of the pupillary area. Grade 3 was defined similarly for cases in which the lens margin was visible in one-half of the pupillary area. The exclusion criteria were the failure to create a continuous capsulorhexis, rupture of the anterior capsule during surgery, failure to implant the capsular tension ring (CTR), loss of capsules and inability of the patient to return for a follow-up visit within 1 month.

2.1. *Surgery*

In the majority of the patients (30), local sub-tenon anaesthesia was administered. A few patients underwent surgery under general anaesthesia (14). All surgeries were eperformed by a single surgeon (JV). During the surgeries, the main temporal tunnel incision (2.75 mm) and nasal paracentesis (1.2 mm) were performed at the 3 o'clock and 9 o'clock positions, and the anterior chamber was subsequently filled with viscoelastic material. Following continuous capsulorhexis, additional paracenteses at 1.30, 4.30, 7.30 and 10.30 were performed, and iris hooks or capsular hooks were implanted at the margin of the capsulorhexis to provide lens/capsular bag stability during surgery. A CTR or modified CTR (Cionni) was implanted immediately after the hooks if a Cionni ring-sulcus fixation through the scleral flap and a sclerotomy with polypropylene 10/0 were performed. Phacoemulsification of the cataractous lens was performed, subcapsular material was removed via manual irrigation-aspiration without additional anterior capsule polishing to remove the lens epithelial cells, and the IOL bag was then implanted (bags from 3 manufacturers were used: Alcon [Acrysof SN60AT, MN60 MA, IQ SN60 WF; Alcon Surgical, Inc., Fort Worth, TX, USA], AMO [Tecnis ZCB00; Abbott Medical Optics Inc, Santa Ana, CA, USA], and Medicontur [877FABY; Medicontur Medical Engineering Ltd., Zsámbék, Hungary]). Next, the hooks were explanted, the viscoelastic material was removed, and the wound was closed. The IOLs were selected randomly (in terms of the manufacturer). If a Cionni ring was implanted, it was selected to provide the closest fit to the calculated IOL power. If a CTR was implanted, a Medicontour IOL was used based on the surgeon's preference; this preference was formed based on the presence of double haptics, which increased the number of possible IOL resuturing points in the case of late IOL dislocation. Small capsulorhexes were not enlarged because this procedure is complicated and may result in additional zonular damage. After surgery, eye drops (antibiotic + dexamethasone) were prescribed for 1 month.

2.2. *Examination*

All patients were routinely examined before cataract surgery (i.e., visual acuity [VA], intraocular pressure [IOP], and slit lamp examinations). IOL calculations were performed with an IOL Master (Carl Zeiss Meditec AG, Jena, Germany). If the lens was too cataractous, the axial length was measured via an A-scan and then manually entered in the IOL master data sheet. Photography of the anterior parts (Carl Zeiss Fundus camera FF450plus, Visupac 4.3 software [Carl Zeiss Meditec AG, Jena, Germany]) with full medical pupil dilatation was performed at all visits. Video recordings of the surgeries were made. The follow-up visits included the preoperative examination (visit 0), day 1 postoperative visit (visit 1), 1st week visit (visit 2), and 1- (visit 3), 3- (visit 4) and 6- month (visit 5) visits.

The relative anterior capsulorhexis area was measured with the Visupac software that was available with the fundus camera and then calculated manually using the standard IOL diameter (6 mm) as a reference. If the IOL edges were not visible due to poor pupil dilatation, and the horizontal interlimbal distance was used as reference to measure the anterior capsulorhexis opening.

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