NEODYMIUM: YAG CAPSULOTOMY RATES AFTER PHACOEMULSIFICATION WITH HYDROPHOBIC AND HYDROPHILIC ACRYLIC INTRAOCULAR LENSES

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ABSTRACT

Purpose: To retrospectively evaluate the incidence of neodymium: YAG (ND:YAG) laser capsulotomies for posterior capsule opacification (PCO) seen with hydrophobic and hydrophilic acrylic intraocular lens implants 18 months after surgery.

Methods:
One hundred and five eyes that had phacoemulsification with a continuous curvilinear capsulorhexis and implantation of either a hydrophobic or a hydrophilic acrylic posterior chamber IOL were evaluated in order to assess the incidence of PCO. Fifty-six eyes received a hydrophobic IOL (Acrysof- Alcon) and forty-nine eyes received a hydrophilic IOL (Galand-Visional). A standardized surgical protocol was performed by a single surgeon. All surgical complications were excluded and all patients had standardized postoperative medication and follow-up.

Results:
With an average follow-up of 18 months in both groups, the incidence of posterior Nd:YAG laser capsulotomy for PCO was 8.9 % in the hydrophobic group and 24.4% in the hydrophilic group, respectively (p=0.03).

Conclusion:
Intraocular lenses made from hydrophobic acrylic material are associated with a significantly reduced rate of Nd:YAG laser capsulotomies as compared with intraocular lenses made from hydrophilic acrylic material.

SAMENVATTING

Doel:
De retrospectieve evaluatie van de incidentie, 18 maanden na operatie, van neodymium: YAG (ND: YAG) laser capsulotomie voor nastaar in een vergelijkende studie tussen hydrofobe en hydrofiele acryl implantlenzen.

Methode: Bij 105 ogen, die phacoemulsificatie met capsulorhexis en implantatie van een hydrofobe of een hydrofiele acryl implantlens ondergingen, werd retrospectief nagekeken of er een YAG laser capsulotomie werd uitgevoerd. Bij 56 ogen werd een hydrofobe lens (Acrysof-Alcon) en bij 49 ogen een hydrofiele lens (Galand-Visional) ingeplant. Een gestandaardiseerd chirurgisch protocol werd door één enkele chirurg uitgevoerd. Ogen met chirurgische complicaties werden geweerd en alle patiënten hadden een gestandaardiseerd postoperatief protocol voor medicatie en follow-up.

Resultaten:
Met een gemiddelde follow-up van 18 maanden in beide groepen bedroeg de incidentie van YAG laser capsulotomie voor nastaar 8.9 % in de hydrofobe groep en 24.4 % in de hydrofiele groep (p=0.03).

Conclusie:
Na gemiddeld 18 maanden follow-up hebben intra-

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oculaire lenzen gemaakt van een hydrofoob acrylmateriaal beduidend minder YAG capsulotomieën in vergelijking met hydrofiele acryllenzen.

RÉSUMÉ

Objet: Une étude retrospective a été effectuée pour évaluer l'incidence d'une capsulotomie postérieure par laser neodymium:YAG (ND:YAG) pour opacification capsulaire postérieure après phaco-émulsification avec implantation d'une lentille acrylique hydrophobe ou d'une lentille acrylique hydrophile.

Méthode:
Après phaco-émulsification avec capsulorhexie et implantation d'une lentille hydrophobe ou hydrophile acrylique,105 yeux ont été évalués pour l'incidence d'une capsulotomie postérieure par laser YAG. Cinquante-six yeux ont bénéficié d'un implant hydrophobe (Acrysof-Alcon) et 49 yeux d'un implant hydrophile (Galand- Visional).Un seul chirurgien a effectué un protocole chirurgical standardisé. Toute complication chirurgicale fut exclue et tous les patients ont reçu le même protocole post-opératoire concernant les médicaments et les visites de contrôle.

Résultats:
Au terme d'un suivi de 18 mois pour les deux groupes, l'incidence d'une capsulotomie postérieure pour opacification capsulaire après phaco-émulsification était de 8.9 % dans le groupe d'implant hydrophobe et de 24.4 % dans le groupe d'implant hydrophile (p=0.03).

Conclusions:
Au terme d'un suivi d'une moyenne de 18 mois, des lentilles intraoculaires en acrylique hydrophobe sont associées à un nombre nettement inférieur de capsulotomies postérieures par rapport à des lentilles intra-oculaires en matériel acrylique hydrophobe.

KEY-WORDS

ND: YAG laser, posterior capsule opacification, hydrophobic acrylic lens implants, hydrophilic acrylic lens implants, phacoemulsification, intraocular lens

MOTS-CLÉS

ND: YAG laser, opacification capsulaire postérieure, implant acrylique hydrophobe, implant acrylique hydrophile, phaco-émulsification.

Posterior capsule opacification (PCO) is the most common complication following primary cataract surgery. This occurs with an incidence of 10 to 50 % during the first years after cataract surgery. Several studies have evaluated the etiology, pathophysiology and factors that seem to positively and negatively influence the progression of PCO.

The visual axis can easily be cleared with neodymium: YAG (Nd:YAG) laser capsulotomy, but this technique is not without complications. They include damage to the intraocular lens (IOL), intraocular pressure elevation, cystoid macular oedema, retinal detachment, IOL subluxation and localized endophthalmitis exacerbation. Furthermore the procedure poses a serious economical burden, costing the Belgian health insurance (RIZIV) an estimated 4,16 million Euro yearly. Efforts should therefore be made to reduce or even eliminate the need for Nd: YAG laser capsulotomies. Advances in surgical technique, IOL design and material may decrease the incidence of PCO and need for capsulotomy. In a retrospective analysis, over a period of 18 months, we evaluated the incidence of Nd: YAG laser capsulotomy for PCO after phacoemulsification with a continuous curvilinear capsulorhexis (CCC) followed by implantation of a posterior chamber acrylic IOL. The effect of different acrylic lens material on the incidence of Nd:YAG laser capsulotomy for PCO was evaluated.

MATERIALS AND METHODS

In this retrospective study, 105 eyes that had phacoemulsification with implantation of a posterior chamber acrylic IOL between April 1999 till July 1999, were reviewed. For each case, the patients chart was reviewed for the following data: age at time of surgery, sex, surgical complications, IOL type, Nd: YAG laser capsulotomy (indicating significant PCO) and date of capsulotomy. (Table 1)

The patients were divided into two groups according to the type of foldable acrylic IOL.

Group 1: three-piece hydrophobic IOL with a 5mm diameter biconvex optic (Acrysof MA-30 Alcon Fort Worth).

Group 2: one-piece hydrophilic IOL with a 5 mm diameter biconvex optic (Visional Galand, Société médicale de précision, Genève). The number of each type of implanted IOL, the number of eyes needing Nd: YAG capsulotomy in each lens group and the time from surgery to Nd: YAG capsulotomy were determined. The incidence of PCO requiring Nd: YAG capsulotomy in the two groups was then compared.

All cataract surgery was performed by one surgeon (M.H). All patients had topical anaesthesia with 1 drop of oxybuprocaïne 0.4 %, 3 times at a 2 minutes interval. Intracameral lidocaïne 1 % was not used. No rectus suture was used. A 3.0 mm temporal corneal incision was made. A capsulorhexis was created, followed by hydrodissection, phacoemulsification and cortical aspiration. The incision was enlarged to 3.5 mm. A foldable intraocular lens was implanted in the capsular bag. At the end of surgery miotics or antibiotics were not used.

Postoperative therapy included indomethacine (Indocollyre®) and tobramycine- dexamethasone (Tobradex®) drops over a 4 weeks period. A Nd: YAG laser capsulotomy was performed when a subjective decline from best post-surgical visual acuity correlated with decreased Snellen visual acuity and significant PCO as detected on slit-lamp examination.

Only uneventful routine cataract extractions were included in the study. Patients with any previous ocular surgery or multiple procedures at the time of lens surgery were excluded as well as patients with retinal pathology or history of ocular trauma.

RESULTS

One hundred and five eyes were enrolled in the study. Fifty-six received a hydrophobic lens (Acrysof) and forty-nine a hydrophilic lens (Visional Galand). In the two groups there was an equal distribution for gender and age (Table 1). At the end of the study period, with an average follow-up of 18 months, YAG laser capsulotomy was performed in five eyes (8.9 %) of the Acrysof group and in 12 eyes (24.4 %) of the Visional Galand group.Statistical analysis showed a significant difference between both groups ($p=0.03$).

Table 1 *Preoperative patient characteristics*

Characteristics	Acrysof	Visional
Male (n)	14	11
Mean age (years)	72.14	74.18
Female (n)	42	38
Mean age (years)	75.3	78.66

DISCUSSION

The hydrophilic acrylic lenses used in this study were associated with a clearly greater YAG capsulotomy rate than the hydrophobic acrylic lenses, the mean percentage of capsulotomy rates being 24.4% in the hydrophilic group and 8.9 % in the hydrophobic group.

Preventing or reducing the rate of PCO remains one of the major goals of most cataract surgeons and researchers as well as health insurance companies, in order to reduce or even eliminate potential complications and the high cost of Nd: YAG laser capsulotomy.

The pathogenesis of PCO is well understood(1). The epithelium of the lens consists of the anterior epithelial cells (A-cells), which are continuous with the cells of the equatorial lens bow. The latter include the germinal cells undergoing mitosis as they peel off from the equator (E-cells). The A-cells of the anterior epithelium tend to remain in place and undergo pseudofibrosis. The E-cells of the equatorial lens bow tend to migrate. These equatorial cells are the primary source of classic secondary cataract.

There are at least six important risk factors in the development of PCO (1).

There are three surgery-related factors:
(1) hydrodissection-enhanced cortical clean-up, facilitating the removal of cortical material and lens epithelial cells (LEC).
(2) In-the-bag fixation, accomplishing not only good lens centration, but also primarily enhancing the IOL-optic barrier effect. When the lens optic is completely in-the-bag in contact with the posterior capsule, the barrier effect is functional. When one or both haptics are out-of-the-bag, a potential space exists that allows for ingrowth of cells toward the visual axis.

(3) Creating an ideal CCC with edge on the IOL surface to provide a tight fit of the capsule around the optic. It also helps sequester the interior compartment of the capsule containing the IOL optic from the surrounding aqueous humor and any potentially deleterious factor.

There are also three IOL-related factors:

(1) Biocompatibility is the ability of a lens material to minimize stimulation of reactive cell proliferation. Lenses with a higher water content such as hydrophilic acrylic lenses seem to be more biocompatible than lenses with a lower water content such as hydrophobic acrylic lenses(2). In-vitro studies have shown that in highly compatible materials the adhesiveness of LEC's, as well as of inflammatory cells and macrophages to the lens surface, should be lower. However, how biocompatibility influences PCO development remains controversial. There is a suggestion that a very high biocompatibility might accelerate LEC migration on the IOL surface while blocking inflammatory cells and macrophages, which were suggested to clean-up the capsule and IOL from the invasion of LEC's (3,4,5,9).

(2) Maximal IOL optic-posterior capsule contact, the idea of 'no space, no cells', is best achieved by an in-the-bag placement of the haptics. A posterior vaulting of the lens optic by angulated haptics and posterior convexity of the optic help to achieve this goal (1).

(3) The barrier effect of the IOL optic, created by a truncated, squared edge of the optic, forms another important element in preventing PCO. The edge forms an effective barrier against the migrating, mitotic germinal cells of the epithelial lens bow. Rounded optic edges on the other hand seem to allow some ingrowth of cells on the posterior capsule (8).

In our study, the first three surgical factors are eliminated as all operations were performed by the same surgeon using the same surgical technique. Therefore lens factors seem to account for the striking difference in YAG capsulotomy rates between the two groups. Acrysof lenses are known to have a fairly good biocompatibility preventing capsule opacification, where as the higher water content of the hydrophilic Visional lens might make this lens too biocompatible, resulting in higher PCO rates. Some authors believe that there is even a regression of LEC' s growing on the posterior lens capsule in the Acrysof group. The reason for this could be the remarkable adhesiveness of the capsule to the optic (6,7). This 'stickiness' creates a maximal optic-lens capsule contact inhibiting lens cell proliferation. In contrast to the Acrysof lens, the Visional lens has a zero degree haptic angulation, preventing a good posterior vaulting of the lens optic. The Visional lens also has a rounded optic edge profile where as the Acrysof lens has a truncated squared edge, thus creating a better barrier effect.

In conclusion, we found a higher YAG capsulotomy rate with the Visional hydrophilic acrylic lens compared to the Acrysof hydrophobic acrylic lens after 18 months of implantation. We believe that the Acrysof's sharp edge design and posterior vaulting of the haptics and resultant contact inhibition of LEC migration make a strong contribution to the lower rates of capsulotomies. However, a possible effect of lens material and its biocompatibility cannot be excluded. Therefore we conclude that both lens design and lens material play a role in the incidence of PCO and subsequent YAG Nd. capsulotomy rate.

BIBLIOGRAPHY

(1) APPLE D. – Posterior Capsule Opacification (Secondary Cataract), Survey of Ophthalmol, 2000, 45, S100, S130.

(2) ASSOULINE M. – Evolution des designs et des matériaux pour une meilleure biofonctionalité, Réflexions, 1999, T4-25, 1-8.

(3) HOLLICK E.J., SPALTON D.J., URSELL P.G. – Surface Cytologic Features on Intraocular Lenses, Arch Ophthalmol, 1999, 117, 872-878.

(4) HOLLICK E.J., SPALTON D.J., URSELL P.G., MEACOCK W.R., BARMAN S., BOYCE J. – Posterior Capsular Opacification with Hydrogel, Polymethylmethacrylate, and Silicone Intraocular Lenses: Two-Year Results of a Randomized Prospective Trial, Am J Ophthalmol, 2000, 129, 577-584.

(5) KÜCÜKSÜMER Y., BAYRAKTAR S., SAHIN S., YILMAZ Ö.F. – Posterior capsule opacification 3 years after implantation of an AcrySof and a MemoryLens in fellow eyes, J Cataract Refract Surg, 2000, 26, 1176-1182.
(6) LINNOLA, R.J., SUND M., YLÖNEN R., PIHLAJANIEMI T. – Adhesion of soluble fibronectin, laminin, and collagen type IV to intracocular lens materials, J Cataract Refract Surg, 1999, 25, 1486-1491.
(7) NAGATA T., MINAKATA A., WATANABE I. – Adhesiveness of AcrySof to a collagen film, J Cataract Refract Surg, 1998, 24, 367-370.
(8) NISHI O., NISHI K. – Preventing posterior capsule opacification by creating a discontinuous sharp bend in the capsule, J Cataract Refract Surg, 1999, 25, 521-526.
(9) URSELL P.G., SPALTON D.J., VANDE M.V., HOLLICK E.J., BARMAN S., BOYCE J., TILLING K. – Relationship between intraocular lens biomaterials and posterior capsule opacification, J Cataract Refract Surg, 1998, 24, 352-359.

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