SFO COMMUNICATION

Impact of lens thickness on complications of hypermature cataract surgery:
A prospective study

Impact de l’épaisseur cristallinienne sur les complications survenant au cours de la chirurgie des cataractes blanches obturantes : étude prospective

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Summary
Purpose. — To assess the correlation between lens thickness (LT) measured by ultrasonography and duration of surgery as well as complications.
Setting. — The study was conducted in a hospital in the Parisian suburb of Bobigny, France.
Design. — A prospective and monocentric study was conducted. All patients undergoing surgery for hypermature cataract between January 2013 and March 2014 were included.
Methods. — Morphological features, including LT, axial length, anterior chamber depth and vitreous length were assessed using A-scan ultrasonography. The other parameters assessed were the duration of surgery, occurrence of complications during surgery, visual acuity (VA) and corneal edema score one week after surgery.
Results. — Thirty eyes of 29 patients were included. Mean LT was 4.11 \pm 0.64 mm (median: 3.89 mm). Mean surgery duration was 24.2 \pm 8.7 min. Three patients experienced complications during surgery: 2 capsular breaks and 1 posterior lens dislocation. At one week, the mean decimal VA was 0.49 \pm 0.34 and the mean corneal edema score was 0.76 \pm 1.09. The Pearson

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correlation coefficient was $r = 0.27 \ (P > 0.05)$ between LT and surgery duration while it was $r = -0.53 \ (P = 0.01)$ between VA and LT. No correlation was found for the other parameters studied.

Discussion. — In this study, the linear correlation between LT and the surgery duration was low. The visual recovery at day 7 appeared inversely correlated with the LT.

Conclusions. — LT did not seem to be a marker for longer surgery duration but appeared related to the visual recovery at one week.

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Introduction

Cataract is the leading cause of vision loss in developing countries [1,2], and a major cause of visual impairment in developed countries [3]. Phacoemulsification has been for many years used the standard treatment for lens opacification in developed countries. This is a well-controlled surgery with a low complication rate. However, lens extraction by phacoemulsification of a white hypermature cataract is always challenging for the surgeon: the retro-illumination being absent, performing capsulorhexis is sometimes hazardous, because it tends to spread to the periphery due to a high intracapsular pressure [4,5]. Furthermore, the capsular bag of white hypermature cataracts can be weakened by manipulation of a harder and/or denser nucleus. However, Ermis et al. [6] have found a capsular break rate comparable between white hypermature cataracts and posterior subcapsular, nuclear, cortical, or mixed cataracts. In contrast, others have found a capsular break rate of 11% in white hypermature cataracts [7]. Moreover, the lens density and surgical difficulty may vary depending on the white cataracts and it would therefore be useful to have objective preoperative parameters to anticipate surgical difficulty.

The primary aim of this study was to evaluate the lens thickness (LT) measured by ultrasonography as a criterion for surgical difficulty. The secondary aim was to assess the correlation between the LT and the postoperative clinical course.

Patients and methods

Patient population

All consecutive patients operated on for white hypermature cataract in the Ophthalmology Department of Avicenne hospital, Bobigny, France, between January 2013 and March 2014 were prospectively included. The study was conducted in accordance with the tenets of the Declaration of Helsinki, and an informed consent was obtained from all patients. The diagnosis of white hypermature cataract was based on the presence of a white cataract with absence of fundus...
visualization after maximum pupil dilation, in the absence of other opacity disorder. Patients with preoperative zonular weakness or exfoliation syndrome were excluded.

**Pre- and postoperative data**

The LT, anterior chamber depth, vitreous cavity length and axial length were measured preoperatively by A-scan ultrasonography (OcuScan® Alcon-Irvine). The surgical difficulty was assessed based on the surgery duration and recorded intraoperative complications. Surgery duration (minutes) was the time from the incision to the control of the corneal leakage.

Examination at day 7 (D7) post-surgery included the measurement of the best-corrected visual acuity (BCVA) in decimals, and assessment of the corneal transparency using biomicroscopy and a 0–3 visual analog scale (VAS) with stage 0 corresponding to no corneal edema, stage 1 to a minimal corneal edema with visible details of the iris, stage 2 to a moderate corneal edema with fuzzy but still distinguishable details of the iris, and stage 3 to a significant corneal edema without visible details of the iris.

**Surgical procedure**

Surgery was performed by senior surgeons. The surgical procedure was standardized: performing a corneal incision of 2.2 mm, trypan blue injection (0.06% VisionBlue®, DORC laboratories) in the anterior chamber prior to viscoelastic injection (Viscoat®, Alcon), second incision with a n 15 blade, capsulorhexis with forceps, hydrodissection, lens phacoemulsification using the “divide and conquer” technique using the Infinity® (Infiniti Vision System, Alcon Laboratories, Fort Worth, Texas) or Stellaris® (Bausch & Lomb, Rochester, New York) device, aspiration of cortical masses, filling the capsular bag with Provisc® (Alcon Laboratories, Fort Worth, Texas) and placing the implant within the capsular bag, aspiration of the viscoelastic, and controlling the absence of leakage from the incisions.

**Statistical analysis**

Means were compared using a Student t-test. A $P < 0.05$ was considered as significant. All correlations between the LT and the other parameters studied were assessed using the Pearson correlation coefficient.

MedCalc software (Mariakerke, Belgium) was used for statistical analysis.

**Results**

**Patient population**

A total of 30 eyes of 29 patients (19 women and 10 men) with a mean age of 70 ± 14.5 years were included. The white hypermature cataract was bilateral in one patient.

**Preoperative and postoperative data**

Preoperative VA ranged from light perception (LP) to counting fingers (CF) at 1 meter. The mean LT was $4.11 ± 0.64$ mm (median: $3.89$ mm; range: $3.3–5.4$ mm). Two groups were identified based on the median LT: in group 1, eyes had a thin lens ($LT < 3.89$ mm) and in group 2, eyes had a thick lens ($LT ≥ 3.89$ mm). (Table 1).

The mean surgery duration was $24.2 ± 8.7$ min. Three intraoperative complications occurred: 2 capsular breaks with implantation in the sulcus and 1 posterior lens dislocation into the vitreous requiring posterior vitrectomy and implantation during a second surgery. In all cases, the capsular break occurred during the phacoemulsification. No extension of the capsulorhexis beyond the equator was noted, and no conversion to extracapsular extraction was performed. At 7 days post-surgery, the mean decimal BCVA was $0.49 ± 0.34$ (range: $0.05–1.00$) and the mean corneal edema VAS score was $0.76 ± 1.09$.

**Correlation studies**

A positive correlation was found between the LT and the surgery duration ($r = 0.27; P > 0.05$) (Fig. 1). The correlation coefficient between the LT and the BCVA at D7 was $r = −0.53$ ($P = 0.01$) (Fig. 2). The correlation coefficient between the LT and the anterior chamber length was $r = −0.32$ ($P > 0.05$).

**Subgroup analysis (thin and thick lenses)**

The mean surgery duration in the group 1 and group 2 was respectively $24.1 ± 9.5$ min and $28.7 ± 10.9$ min ($P = 0.08$).
Discussion

In this study, the linear correlation between the surgery duration and the LT measured by A-scan ultrasonography was low. It could be assumed that a thicker cataract could require longer phacoemulsification duration, but this was not the case in our series of patients.

Similarly, no statistically significant linear correlation was found between the LT and the rate of complications.

Conversely, the LT significantly correlated with the early postoperative visual recovery. Patients with thinner lens (group 1) tended to have a better postoperative VA at D7. A larger nucleus could require a greater amount of ultrasounds, which could be responsible for an important postoperative edema. The LT did not correlate with the anterior chamber depth. Praveen et al. [8] have found that the anterior chamber depth decreases significantly with the increase in LT while others have shown the opposite [9].

Ermis et al. [6] had previously shown in 82 patients, that the surgery duration was significantly longer in eyes with white mature cataracts than that in the unaffected fellow eyes. The mean ultrasonography duration during phacoemulsification was 40.4 ± 23.6 seconds in mature cataracts and 21.1 ± 10.7 seconds in other types of cataract (P < 0.001). However, even in the white cataract group, the ultrasonography duration was highly variable as shown by the large standard deviation found by Ermis et al. [6] and it is not specified whether preoperative factors were identified to explain this variability in the white cataract group. In our study, after exclusion of patients who experienced complications (with longer surgery duration: respectively 52, 52 and 39 min), the surgery duration ranged between 13 and 35 min, confirming the high duration variability in surgery for white hypermature cataract.

Only a few studies have so far correlated the intraoperative difficulty based on the surgery duration with preoperative cataract data. White hypermature cataracts are a heterogeneous group with differences in lens density and thickness. Brazitikos et al. [10] have correlated the surgery duration and the difficulty to perform capsulorhexis with preoperative biomicroscopic and ultrasonographic parameters. The white cataracts were divided into 3 categories, with type I corresponding to white cataracts with liquefied cortex, type II to white cataracts slightly liquefied, and type III to cataracts slightly liquefied with anterior capsule fibrosis. Performing capsulorhexis was more difficult in type I cataracts but the surgery duration was longer in type II and III cataracts. However, no information on the LT was available.

A few studies have found correlations between the surgical difficulties, surgery duration and LT. In the study of
Hypermature cataract surgery using Aqualase, which included mild to moderate cataracts with Lens opacities Classification System (LOCS) grade less than 3, Kang H and Kun Chung. [11] have found no correlation between the LT measured by Scheimpflug camera and the liquefaction duration. However, the LT could not be assessed in white hypermature cataracts because Aqualase cannot be used in this indication. E Hughes et al. [12] have shown that lens extraction using Aqualase was more difficult in cataracts whose grade was greater than 2 according to the LOCS classification.

Another objective parameter, the lens density assessed by Pentacam correlated with the phacoemulsification duration in the study by Kim et al. [13]. They have shown that the amount of delivered energy and phacoemulsification duration increased with the lens density. Pei et al. have confirmed the correlation between the LOCS III classification and the lens density assessed by Pentacam in nuclear cataracts [14]. Lens density assessment by Scheimpflug imaging is based on the quantification of the light transmitted by the lens. However, the technique may be limited in case of white hypermature cataract and is not available in all ophthalmology departments.

This study has some limitations, including the low number of patients included. The lack of statistical power of the study could have contributed to the low correlation found between the LT and the different parameters studied. Furthermore, the BCVA was analyzed at D7 while the visual recovery is known to be maximal a few weeks after cataract surgery. However, as the aim was to assess corneal edema at the same time, an examination at D7 seemed the best time to assess the short-term impact of white hypermature cataract on visual recovery.

In conclusion, this study shows that the LT seems to have a limited effect on phacoemulsification duration in white hypermature cataracts, but it may potentially affect the early postoperative visual recovery.

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Disclosure of interest
The authors declare that they have no competing interest.

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