DECENTRATION OF THE POSTERIOR CHAMBER LENS IMPLANT: A COMPARISON OF CAPSULORHEXIS WITH ENDOCAPSULAR SURGERY

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SUMMARY

The optical effect of posterior chamber lens decentration is a well-recognised complication of cataract surgery causing significant symptoms even with the larger-diameter implant optics available. In this paper we present the results of a study of implant decentration occurring with extracapsular surgery, in which we compared a group of patients with one tear in the anterior capsule with a second group with two tears in the anterior capsule. Our findings show that lens decentration is greater in those patients with two tears of the anterior capsule, and this difference is statistically significant.

Post-mortem studies[1] have suggested that the degree of posterior chamber lens decentration can be correlated with the number of anterior capsular tears. The greater the number of tears in the anterior capsule the greater the possibility that one haptic will be found in the sulcus and one in the capsular bag. This sulcus/bag fixation of the haptics is associated a greater amount of lens decentration than either sulcus/sulcus fixation or bag/bag fixation of the haptics.

The technique of capsulorhexis consists of an anterior capsulotomy without any anterior capsular tears. Capsulorhexis can be used in extracapsular surgery but carries the risk of delivery of the entire lens or vitreous loss if the capsulorhexis diameter is too small.[2] While Pande[3] has achieved good results with minimal complications using capsulorhexis without any relieving incision, a relieving incision in the anterior capsule has been recommended to prevent these complications.

With endocapsular surgery, using the 'envelope capsulotomy', it has been found that usually two anterior capsule tears extend to the equator (Fig. 1a).[4] Even though the haptics can be reliably placed in the capsular bag at the time of surgery, the presence of two anterior capsule tears would appear to increase the risk of one of the haptics escaping from bag fixation leading to decentration.

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To evaluate the premise that limiting the number of anterior capsular tears will significantly reduce lens decentration, we present the results of our 6 month cataract study comparing one-tear capsulorhexis extracapsular surgery with two-tear endocapsular surgery.

PATIENTS AND METHODS

During a 6 month period 208 consecutive patients underwent routine extracapsular cataract surgery by two surgeons. A careful note was made of the number and position of radial tears in the anterior capsule and whether the haptics were placed within the capsular bag.

Patients undergoing endocapsular surgery had a standard anterior envelope capsulotomy. The linear incision in the anterior capsule was performed with scissors extending towards 10 and 2 o'clock (Fig. 1a). After lens implantation the remaining anterior capsule was removed by a continuous tear (Fig. 1b). These patients were recorded as having two tears in the anterior capsule.

Patients undergoing capsulorhexis had a continuous 6–7 mm diameter tear with one intentional anterior capsule relieving incision (usually at 10 or 2 o'clock) to allow nucleus expression (Fig. 1c). Additional tears occurring at the time of surgery were noted and the number recorded. A similar size of capsulotomy was achieved in both groups.

A Rayner 700U intraocular lens was used in all cases. This has a 7 mm optic with no dialling holes, modified J loop haptics and a total overall diameter of 13.5 mm. In the patients in the capsulorhexis group, the lens was dialled with the haptics placed at right angles to the capsular tear. In the endocapsular group, the haptics were dialled to 3 and 9 o'clock. Each of the two surgeons carried out both operations in equal numbers.

The patients were then photographed 8–20 weeks postoperatively in a fully dilated state, using a Kowa camera, and the displacement of the lens recorded against the red reflex. The amount of displacement was then measured by projecting the slides on to a screen so that the horizontal limbal diameter measured 23 cm in diameter for females

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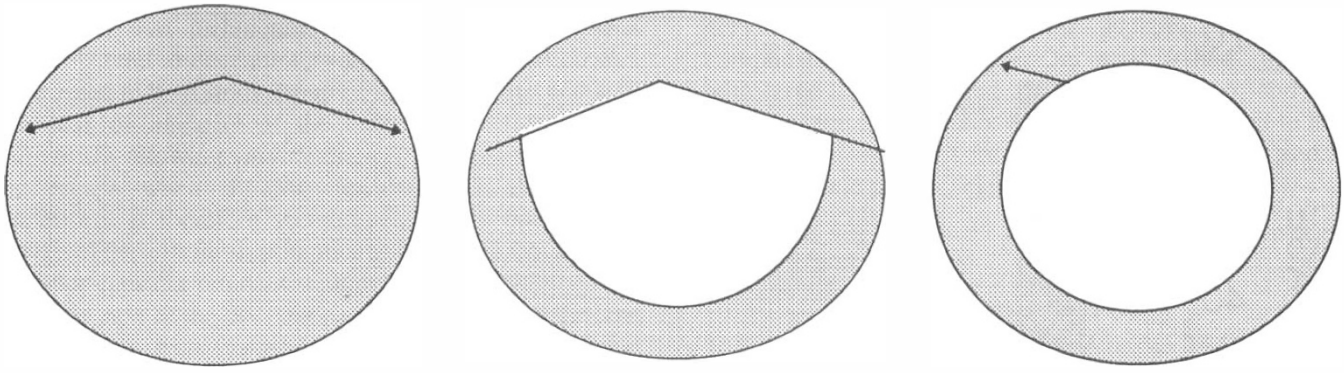

Fig. 1. *The incisions and tears used in extracapsular cataract surgery. Anterior envelope capsulotomy: (a) linear incision and (b) continuous tear to remove the remaining anterior capsule. Capsulorhexis: continuous tear and one intentional anterior capsule relieving incision (c).*

and 24 cm for males. These figures were obtained by taking the average horizontal limbal diameter for 20 females and 20 males. The maximum placement was then recorded in any given direction from the centre of the pupil. This was performed without knowledge of the patient's operative and post-operative details. If a patient's pupil dilated to 6.5 mm or greater, with no edge visible, then the amount of decentration was recorded at <0.25 mm.

Patients were excluded if pre-operatively (1) they had undergone previous intraocular surgery or the globe had suffered previous trauma, (2) they had abnormalities of their iris, or (3) phakodonesis was present. Patients were also excluded if at the time of surgery (1) additional procedures such as a broad iridectomy were carried out, (2) the surgeon found it impossible to obtain bag fixation of implant optic and both haptics, or (3) there were more than two tears in the anterior capsule.

RESULTS

A total of 73 patients had one-tear capsulorhexis extracapsular surgery (CI group) and 61 patients had two-tear endocapsular surgery (E2 group). Thirteen patients from each group failed to attend the special photographic clinics and could not be included. Pupils of a further six C1 patients and five E2 patients did not dilate to or above 6.5 mm with no lens edge visible and, therefore, no comment on their decentration could be made. This left 54 patients in the C1 group and 43 patients in the E2 group.

The mean age of the capsulorhexis group was 72 years, and that of the endocapsular group was 68 years; a paired *t*-test showed no significant difference between the ages of the two groups. The mean post-operative timing of the photograph was 12 weeks for the C1 group and 14 weeks for the E2 group; again a paired *t*-test showed no significant difference between the two groups. Mean pupil size of the C1 group was calculated as 7.25 mm (range 4–9 mm), and for the E2 group was 7.1 mm (range 3.5–8.5 mm). The two groups were, therefore, felt to be comparable.

Although the patients were not directly questioned about symptoms which could be attributed to intraocular lens implant decentration, none of the patients complained of such symptoms during their post-operative visits, despite lens decentration of up to 2 mm.

As can be seen from Fig. 2, the capsulorhexis (C1) group had a much more favourable outcome in terms of lens decentration than the endocapsular (E2) group. Over 60% of the C1 group had a decentration of 0.25 mm or less, as opposed to under 35% of the E2 group. Decentration of more than 1 mm occurred in 9% of patients with one-tear capsulorhexis and in 17% of the endocapsular group. Statistical analysis of our results show that capsulorhexis with one tear is superior to endocapsular two-tear surgery in limiting posterior chamber lens decentration. The data do not lend themselves to parametric testing with the *t*-test due to their distribution, although the means of both groups do have a $p<0.05$. However, one-tear capsulorhexis was found to be statistically significantly better than endocapsular two-tear surgery in limiting decentration to less than 0.5 mm, using Fisher's exact test to compare the groups ($p = 0.01$).

DISCUSSION

To our knowledge no study has looked in a prospective manner at the amount of intraocular lens decentration encountered post-operatively when the numbers of anterior capsule tears at the time of operation have been documented during endocapsular and capsulorhexis surgery. Both these surgical techniques can be used to place a posterior chamber implant into the capsular bag, although the amount of decentration encountered will depend (at least in part) on whether the haptics remain in the bag.

Symptomatic lens decentration is a distressing situation for both surgeon and patient following an otherwise successful cataract procedure. It is unusual and may require re-operation to redial or replace the intraocular lens to relieve symptoms.

Our results show that a single tear in the anterior capsule when using a capsulorhexis technique is superior to an endocapsular technique with two tears in limiting decentration. There is a statistically significant difference between the two groups. Although none of our patients had significant symptoms due to lens displacement the

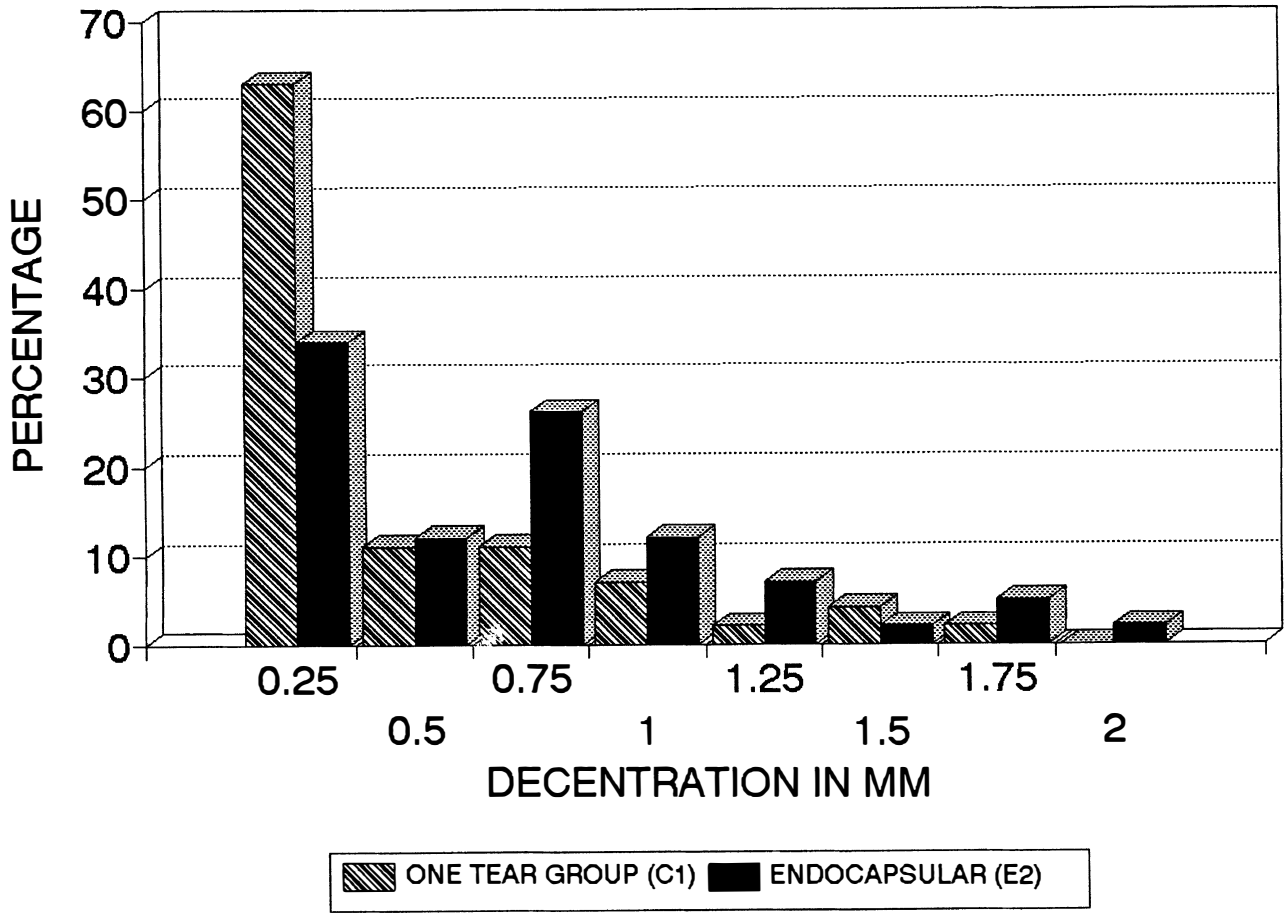

Fig. 2. *The amount of posterior lens decentration encountered in the two groups studied. The data displayed are expressed in percentage terms. It can be clearly seen that the one-tear capsulorhexis (C1) group has a better distribution than the two-tear endocapsular (E2) group. The difference in limiting decentration between the two groups is statistically significant. Using Fisher's exact test, one-tear capsulorhexis (C1) is significantly better in limiting posterior lens decentration to less than 0.5 mm ($p = 0.01$) compared with two-tear endocapsular surgery (E2).*

numbers in this study are relatively small and with larger numbers it would seem likely that patients with two tears in their anterior capsule carry a larger risk of symptomatic lens decentration than those with one tear on the anterior capsule.

Intraoperative bag fixation of the intraocular lens and its haptics is usually easy to achieve with endocapsular surgery but the haptics may not remain in the bag post-operatively. Apple's group[1,4] demonstrated in post-mortem studies that the larger the number of tears in the anterior capsule the more likely the lens haptic will be found in the sulcus rather than in the capsular bag. Most of the patients described had had 'can-opener' capsular incisions, but a small proportion had endocapsular surgery. In the endocapsular patients the linear capsule opening was found to have extended to the equator at each end, resulting in two anterior capsular tears. The retrospective nature of Apple's study makes it difficult to know whether the lenses were placed into the bag.

Many factors may contribute to decentration of the posterior chamber intraocular lens. These include: (1) the number of tears in the anterior capsule, (2) the design of the haptic, (3) contraction and fibrosis of anterior capsule remnants, and (4) zonular weakness.[5,6] We have attempted to minimise these factors by using only one type of lens, by comparing only two surgical techniques and by eliminating patients with known ocular pathology.

The use of 7 mm clear optics without dialling holes will reduce the amount of optical aberration from lens decentration to a minimum, but even a decentration of 1 mm will place the edge of a 7 mm lens level with a 5 mm dilated pupil. This could be associated with potential resultant edge effects, should the pupil dilate beyond this. Since one study showed a mean pupil of 5 mm in dim illumination then a large percentage of patients with 1 mm decentration will have edges visible under these conditions.[6] One-tear capsulorhexis has been shown to reduce the percentage of patients having this amount of displacement to 9%, compared with 17% in the endocapsular group.

Gimbel's technique[7] for dealing with the development of an anterior capsular tear during phacoemulsification is interesting; he creates a second anterior capsular tear at 180° from the first, and places the implant lens within the bag with haptics at 90° to the tears. He argues that this symmetrical arrangement of the tears will balance the concentric fibrosis of the residual anterior capsule and reduce lens displacement. From previous surgical experience

using the two techniques, it became clear that lens implants tend to decentre upwards. This observation was confirmed in both study groups. Presumably, this is due to the loss of integrity of the anterior capsule remnant superiorly, allowing varying degrees of lens implant haptic escape when anterior capsular tears are present superiorly. It therefore seemed sensible to position the apices of the lens implant haptics as far away from areas of anterior capsular remnant weakness as possible.

In the case of the one-tear capsulorhexis group the lens haptic apices were placed at right angles to the tear present. In the case of the endocapsular group, the apices of the haptics were placed at 3 and 9 o'clock when the tears were at 10 and 2 o'clock. This configuration was felt to distribute decentration forces more equally on both haptics, in view of the asymmetrical anterior capsular weakness produced by the technique. If the lens haptic apices had been positioned at 12 and 6 o'clock, then the superior haptic would be supported by only 4 clock-hours of anterior capsule remnant, as opposed to 8 clock-hours of anterior capsule remnant; it was felt that this would result in even larger amounts of lens implant decentration. Further studies are needed to establish whether the orientation of haptics or haptic design makes any difference to decentration.

Although phacoemulsification is becoming increasingly popular, most UK ophthalmologists use extracapsular cataract techniques routinely.[8] There is increasing evidence that the most effective way to reduce decentration is to avoid anterior capsular tears altogether and use capsulorhexis. This can be performed in phacoemulsification and in most patients undergoing extracapsular surgery, but inadvertent anterior capsular tears may complicate either technique. Our patients had implants with large lens optics and a 13.5 mm diameter, and the results of the study cannot be reliably extrapolated to the behaviour of small-incision lenses implanted into capsular bags with one or two anterior capsular tears.

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