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·Clinical Research·

Comparison of two different methods of preoperative marking for toric intraocular lens implantation: bubble marker versus pendulum marker

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Abstract

• AIM: To compare the accuracy of two different methods of preoperative marking for toric intraocular lens (IOL) implantation, bubble marker versus pendulum marker, as a means of establishing the reference point for the final alignment of the toric IOL to achieve an outcome as close as possible to emmetropia.

• METHODS: Toric IOLs were implanted in 180 eyes of 110 patients. One group (55 patients) had preoperative marking of both eyes done with bubble marker (ASICO AE-2791TBL) and the other group (55 patients) with pendulum marker (Rumex ® 3-193). Reference marks were placed at 3-, 6-, and 9-o´clock positions on the limbus. Slit-lamp photographs were analyzed using Adobe Photoshop (version 7.0). Amount of alignment error (in degrees) induced in each group was measured.

• RESULTS: Mean absolute rotation error in the preoperative marking in the horizontal axis was 2.42±1.71 in the bubble marker group and 2.83±2.31 in the pendulum marker group (*P*=0.501). Sixty percent of the pendulum group and 70% of the bubble group had rotation error ≤3 (*P*=0.589), and 90% eyes of the pendulum group and 96.7% of the bubble group had rotation error ≤5 (*P*=0.612).

• CONCLUSION: Both preoperative marking techniques result in approximately 3 of alignment error. Both marking techniques are simple, predictable, reproducible and easy to perform.

• KEYWORDS: toric intraocular lens; pendulum marker; bubble marker

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INTRODUCTION

Toric intraocular lenses (IOLs) have become an integral part of cataract and refractive surgery. Toric IOLs were developed to neutralize preexisting corneal astigmatism in cataract patients [1]. They provide the opportunity to correct preexisting astigmatism, offering patients optimum distance vision without the use of spectacles or contact lenses [2]. Alignment of the toric IOLs at the calculated alignment axis is necessary to achieve effective astigmatism correction. Misalignment of the IOL can be caused by inaccurate placement of the IOL, rotation of the IOL, or both[3]. Accurate placement of the IOL is the most important step in avoiding misalignment as the design and fixation techniques of most of the IOLs today give them good rotational stability.

In addition to careful keratometry and biometry for a toric IOL, accurate preoperative marking, intraoperative marking and correct alignment of the IOL in the bag are of utmost importance.

Various preoperative marking techniques have been described, ranging from simple methods like single free hand mark and simple toric reference markers, to slit-lamp based methods which include alignment by a narrow slit beam and marking by gentian violet pen, Nd: YAG laser [4] and devgan axis marker[5].

New techniques to improve the accuracy of toric IOL alignment have become available. Osher [6] described an iris fingerprinting technique, in which a preoperative detailed image of the eye is obtained and the alignment axis is drawn. A printout of this image is used during surgery to align the toric IOL based on iris characteristics. A second technique to align toric IOLs is by intraoperative wavefront aberrometry[7] (Orange, Wavetec Vision Systems). This device is connected to the operating microscope and enables intraoperative measurement of residual refraction. A third device, the Surgery Guidance SG3000 system (Sensomotoric Instruments GmbH), uses real time eye tracking based on iris and blood vessel characteristics.

In our series, we have compared two different methods of preoperative marking for toric IOL implantation- bubble marker and pendulum marker. The purpose of this study was to compare the accuracy of the two methods as a means of establishing the reference point for the final alignment of the

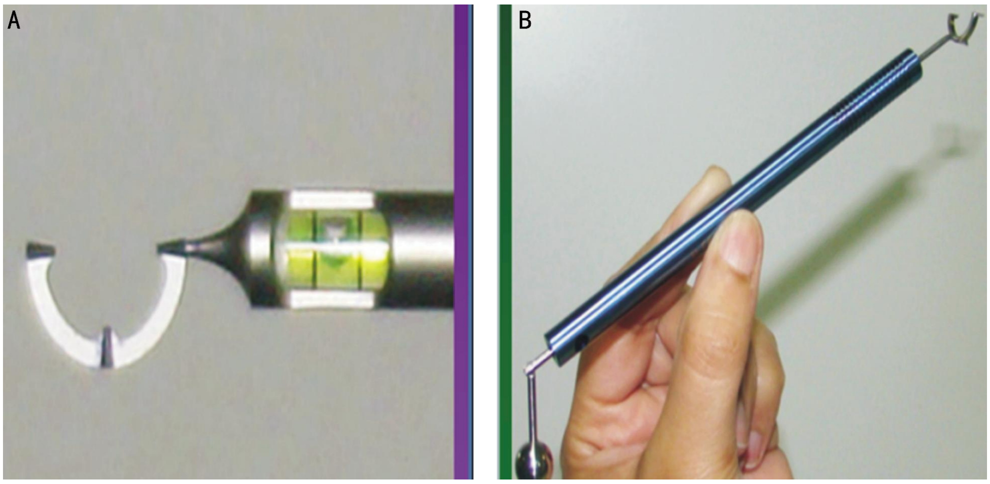

Figure 1 The use of two preoperative markers A: Bubble marker (ASICO AE-2791TBL); B: Pendulum marker (Rumex®3-193).

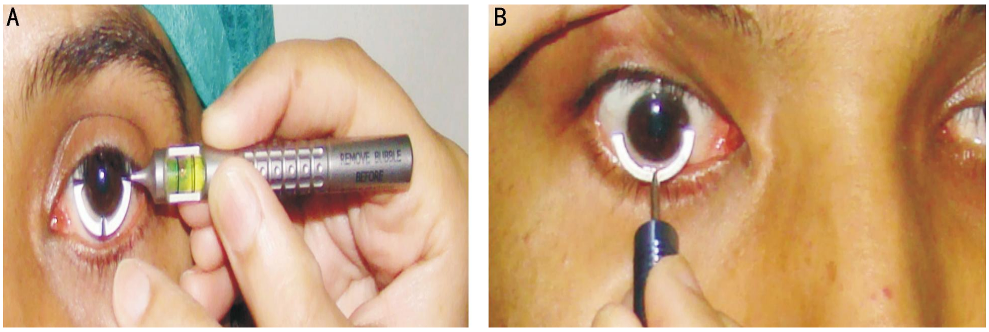

Figure 2 Preoperative marking being done A: Bubble marker; B: Pendulum marker.

toric IOL. This was done to achieve an outcome as close as possible to emetropia.

SUBJECTS AND METHODS

Study Design and Patient Population This prospective study comprised recruitment of 180 eyes of 110 patients presenting to the Outpatient Department of Shroff Eye Centre, New Delhi from January 2012 to January 2013. The study was carried out in accordance with the Declaration of Helsinki and was registered with the institutional review board and an approval was obtained from the ethics committee. All patients enrolled in the study were explained the procedure and were made to sign an informed consent.

The patients were divided in two groups. Patients were assigned alternately to both groups. In group 1, which comprised of 90 eyes of 55 patients, preoperative marking was done using a bubble marker (ASICO AE-2791TBL) (Figure 1A). In group 2, which also comprised of 90 eyes of 55 patients, preoperative marking was done using pendulum marker (Rumex® 3-193) (Figure 1B). Prior to the marking, the eye was anesthetized with 0.5% proparacaine drops. The patient was seated in the upright position and made to fixate at a distant target. Bubble marker (ASICO AE-2791TBL) was used for marking the reference marks for identifying the 3-, 6- and 9-o'clock positions on the limbus. When the bubble was in between the two vertical lines, it indicated that the 3- and 9- wedges of the marker were truly horizontal (Figure 2A). A special gentian violet pen was used to ink the wedges. The marker was gradually advanced towards the eye while the examiner ensured the bubble was in the central position when the wedges make contact with the limbus. Similarly, for the pendulum marker, the patient was asked to fixate on a distant target. The 0, 90 and 180 degrees contact wedges on a hemicircle of this device are rotatably coupled *via* a shaft within a hollow handle to a gravity pendulum which ensures that these wedges remain perfectly horizontal even if the handle is rotated to either side (Figure 2B). All marking procedures were performed by the same observer (Koul A).

Image Analysis Slit-lamp photographs were analysed using tools in Adobe Photoshop (version 7.0) and were taken by a single masked observer (Dutta R). Amount of alignment error in each group, as well as inter eye difference within the same group was calculated. A preoperative photograph with the reference marks was imported in the Adobe Photoshop (version 7). Using the "single row marquee tool" a straight line was placed on the image adjacent to the limbal reference marks using the "transform tool" straight line was rotated in such a manner so as to align through the reference marks on the limbus. The amount of rotation (clockwise or anti-clockwise) was noted from the "set rotation" dialogue box, which is a feature of the Adobe Photoshop (version 7).

RESULTS

The study enrolled 180 eyes of 110 patients. The mean age was 65y (range from 45 to 80y). The mean absolute rotation of reference marks in the horizontal axis in group 1 was 2.42±

1.71 and in group 2 was 2.83±2.31 (P=0.501) (Figure 3).

We also analysed the percentage of eyes showing absolute rotation of reference marks ≤3 degrees and ≤5 degrees. In group 1 70% (63 eyes) and in group 2 60% (54 eyes) showed absolute rotation of reference marks ≤3 degrees (P=0.589). Also, an absolute rotation of reference marks ≤5 degrees was seen in 96.7% (87 eyes) of group 1 patients and 90% (81 eyes) of group 2 patients (P=0.612) (Figure 4).

DISCUSSION

We performed all our preoperative markings in sitting position to avoid cyclotorsion. Cyclotorsion of the eye from the upright to supine position is approximately 2 to 4 degrees on average, but can be up to 15 degrees in individual patients[8-10].

During our study, there was no statistical difference between the two marking techniques and both of them induced almost similar amount of error.

Also, there were few observations that we made. In the bubble marker group, we found it difficult to concentrate simultaneously on patient's eye as well as the position of the bubble. Marking of right eyes with the investigator's left hand (non-dominant hand) was difficult compared with marking of left eye with the right hand (dominant hand). Similarly, with the pendulum marker, right eyes as well as left eyes could be marked with equal ease using the dominant hand. However, attention had to be paid to ensure that all the three wedges of the hemi-circle touch the limbus simultaneously. Premature contact with any one wedge would induce a rotation leading to improper marking. Having said that, we still consider both the bubble marker and the pendulum marker to be superior to the slit-lamp technique and the free hand technique, which were used earlier, as both the bubble marker and the pendulum markers are more precise and reproducible techniques. Also, the advantage of both the bubble marker and pendulum marker is that it can be done in the operating theater. However, if the earlier slit-lamp technique is to be used, then the patient has to be transferred to the Outpatient Department where the slit-lamp is available, and this causes unnecessary movement of the patient before the surgery and may be specifically difficult for older patients or patients with gait abnormalities.

In a comparative study done by Popp *et al* [11] and colleagues in Vienna, the pendulum-marking device showed the least rotational deviation to the reference meridian (mean 1.8 degrees). There was no statistically significant difference between slit-lamp marking and pendular marking (P=0.05); however, there was a significant difference between the pendulum marker and the bubble marker.

To the best of our knowledge, we could not find any other study done on Indian eyes where a comparison was made between various preoperative marking techniques.

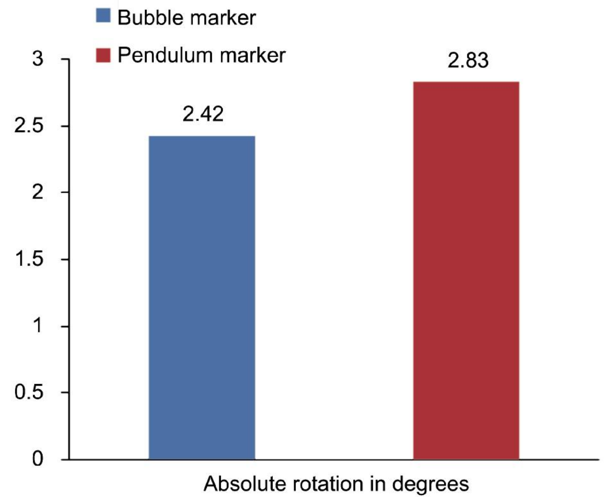

Figure 3 Comparison of rotational misalignment.

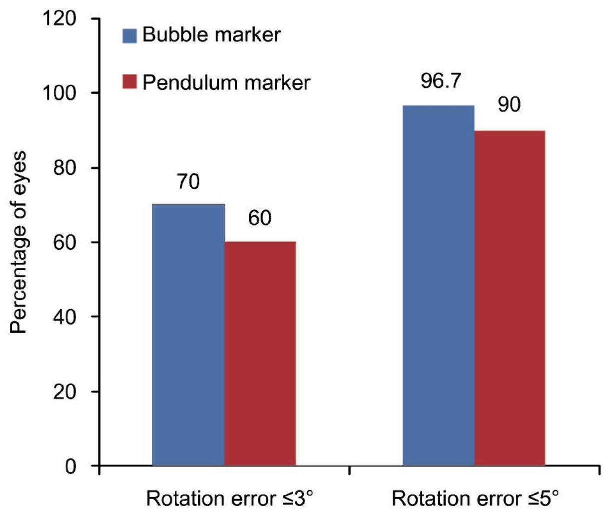

Figure 4 Comparison of misalignment of ≤3° and ≤5° in both groups.

In our study, both preoperative marking techniques resulted in approximately 3 degrees of alignment error. It is seen that with 10 degrees of axis deviation, 1/3 of the desired effect is lost. With 20 degrees of axis deviation, 2/3 of the effect is lost. Lens misalignment greater than 30 degrees will actually increase the net astigmatic error [12]. Our results were better than results shown by another study done comparing the toric reference marker, slit beam marking and mapping method[13] and also by newer marking techniques like iris fingerprinting[6]. The next step would be to study newer marking techniques which are now available in the market, like electronic preoperative two steps toric IOL reference marker[14].

Accuracy of corneal marking before surgery is critical to achieving good surgical-astigmatism correction outcomes, and both our marking methods gave good results. Errors in intraoperative marking and final alignment of the IOL in the bag could possibly add on to this error. We believe that slit-lamp based methods are cumbersome to perform and require greater patient cooperation; the YAG laser method requires additional instrumentation. Also, sophisticated methods such as iris fingerprinting and intraoperative wavefront aberrometry, although highly accurate, cannot be routinely incorporated in the average ophthalmologist's practice. However, both the bubble marker and the pendulum marker for preoperative marking were simple, predictable, reproducible and easy to perform.

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Conflicts of Interest: Farooqui JH, None; **Koul A,** None; **Dutta R,** None; **Shroff NM,** None.

REFERENCES

1 Shimizu K, Misawa A, Suzuki Y. Toric intraocular lenses: correcting astigmatism while controlling axis shift. *J Cataract Refract Surg* 1994;20 (5):523-526.

2 Visser N, Berendschot TT, Bauer NJ, Jurich J, Kersting O, Nuijts RM. Accuracy of toric intraocular lens implantation in cataract and refractive surgery. *J Cataract Refract Surg* 2011;37(8):1394-1402.

3 Lane SS. The Acrysof toric IOL's FDA trial results. *Cataract & Refractive Surgery Today* 2006;5:66-68.

4 Crespo Bordonaba M, Alvarez-Rementería Fernandez L. Marking the axis for toric IOL implantation. *Cataract & Refractive Surgery Today* 2009; 7:27-28.

5 Graether JM. Simplified system of marking the cornea for a toric intraocular lens. *J Cataract Refract Surg* 2009;35(9):1498-1500.

6 Osher RH. Iris fingerprinting: new method for improving accuracy in toric lens orientation. *J Cataract Refract Surg* 2010;36(2):351-352.

7 Packer M. Effect ofintraoperativeaberrometryon the rate of postoperative enhancement: retrospective study. *J Cataract Refract Surg* 2010;36 (5): 747-755.

8 Arba-Mosquera S, Merayo-Lloves J, de Ortueta D. Clinical effects of pure cyclotorsional errors during refractive surgery. *Invest Ophthalmol Vis Sci* 2008;49(11):4828-4836.

9 Chernyak DA. Cyclotorsional eye motion occurring between wavefront measurement and refractive surgery. *J Cataract Refract Surg* 2004;30(3): 633-638.

10 Swami AU, Steinert RF, Osborne WE, White AA. Rotationalmalposition during laser in situ keratomileusis. *Am J Ophthalmol* 2002;133 (4): 561-562.

11 Popp N, Hirnschall N, Maedel S, Findl O. Evaluation of 4 corneal astigmatic marking methods. *J Cataract Refract Surg* 2012;38 (12): 2094-2099.

12 Chang DF. Pearls on implanting the Staar toric IOL. *Br J Ophthalmol* 2001;85:1-126.

13 Cha D, Kang SY, Kim SH, Song JS, Kim HM. New axis- marking method for a toric intraocular lens: mapping method. *J Refreact Surg* 2011; 27(5):375-379.

14 Farooqui JH, Sharma M, Koul A, Dutta R, Shroff NM. Evaluation of a new electronic pre-operative reference marker for toric IOL implantation by two different methods of analysis: Adobe photoshop versus iTrace. *Adv Ophthalmol Vis Syst* 2015;2(5):00057.