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Clinical Paper

Prevalence of Corneal Astigmatism in an NHS Cataract Surgery Practice in Northern Ireland

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ABSTRACT

PURPOSE: Post-operative corneal astigmatism following cataract surgery can leave the patient with visual impairment. Correcting it at the time of surgery with a toric intraocular lens (TIOL) can give patients a better final visual outcome. The purpose was to determine the prevalence of corneal astigmatism in a cataract population and assess the demand for TIOL.

METHODS: Keratometric data was collected and analyzed for all patients who attended for routine cataract surgery under the care of a single surgeon based in Altnagelvin Area Hospital, Northern Ireland (NI). All patients were included between January 2008 and December 2014. Data was collected retrospectively for this observational study.

RESULTS: There were 2080 consecutive eyes of 1788 patients. The mean corneal astigmatism was 1.09 ± 0.83. Corneal astigmatism was 1.50D or less in 1621 eyes (78%). It was more than 2.00 D in 242 eyes (11.6%), more than 2.50 D in 127 eyes (6.1%), more than 3.00D in 68 eyes (3.27%) and more than 3.50 D in 45 eyes (2.16%).

CONCLUSION: For routine cataract surgery, 41.3% of eyes had more than 1.00 D of corneal astigmatism and 11.6% had more and 2.00D. Females had more astigmatism than males. This shows the potential demand for the TIOL in this population.

Keywords: Astigmatism; Toric IOL; Cataract; Northern Ireland; NHS

INTRODUCTION

Corneal astigmatism can cause blurred or impaired unaided vision and post-operatively can reduce the final visual outcome after cataract surgery[1]. Correcting astigmatism at the time of cataract surgery can give spectacle independence for distance or near vision[2]. Calculation of pre-existing corneal astigmatism (CA) can be easily done by looking at the keratometric data pre-operatively. Various surgical techniques are available to correct small amounts of CA but can be unpredictable for correction of 1.5 dioptres or more of astigmatism[3]. Toric intraocular lens (TIOL) insertion is a predictable method of correcting astigmatism at the time of cataract surgery[4].

A small number of studies have attempted to ascertain the prevalence of corneal astigmatism (PCA) [2,5,6]. None have analysed first eyes or studied our Northern Ireland (NI) population. It would be useful to know the PCA to establish the demand for the TIOL and emphasise the need to consider the correction of pre-operative astigmatism.

MATERIALS AND METHODS

Data was collected retrospectively for consecutive patients who attended for elective cataract surgery between January 2008 and December 2014 under the care of a single surgeon in a public health service. The surgery was performed at

TABLE 1:

Characteristics of population

Age	Mean ± SD	75.20 ± 10.57
	Range	15 - 99
Patients (n)	1788	
Eyes (n)	2080	
Sex, n (%)	Male	805 (38)
	Female	1228 (59)
Corneal Astigmatism (Dioptres)	Mean ± SD	1.09 ± 0.83
	Range	0.00 - 7.47
K1 (Dioptres)	Mean ± SD	43.09 ± 1.61
	Range	33.90 - 48.01
K2 (Dioptres)	Mean ± SD	44.16 ± 1.62
	Range	38.14 - 51.37

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Altnagelvin Area Hospital, Londonderry or Tyrone County Hospital, Omagh. Experienced technicians measured keratometric data across the two sites, using either the IOLMaster (Carl Zeiss Meditec AG, Switzerland) or the Nidek hand held keratometer (NIDEK KM-500 Auto Keratometer, NIDEK Company Ltd, Japan). There were no exclusion criteria. The data was collected as part of a service improvement project and so did not require Institutional Review Board approval.

RESULTS

Data was compiled for 2080 consecutive eyes. The population was Caucasian and their characteristics are shown in Table 1. Results revealed a mean CA of 1.09 ± 0.83. CA was 0.50D or less in 521 eyes (25.0%), between 0.51 D and 1.00 D in 700 (33.7%) and between 1.01 and 1.50D in 400 eyes (19.2%). It was 1.50D or less in 1621 eyes (77.9%), more than 2.00 D in 242 eyes (11.6%), more than 2.50 D in 127 eyes (6.1%), more than 3.00D in 68 eyes (3.27%) and more than 3.50 D in 45 eyes (2.16%). This is illustrated in Figure 1. Females had a higher degree of corneal astigmatism with a mean CA of 1.12D as compared to males whose mean CA was 1.05D. Analysis of a sub-group of patients' first eyes from 2012 to 2014 showed a mean CA of 0.97 ± 0.68 dioptres (n=222) for male patients and 1.11 ± 0.85 dioptres (n=312) for female patients. This difference was statistically significant (p=0.03) confirming the trend noted in the total eye population. Table 2 outlines the distribution of CA by age showing a gradual increase in both the steep and flat meridians with age, except for the patients less than 30 years of age.

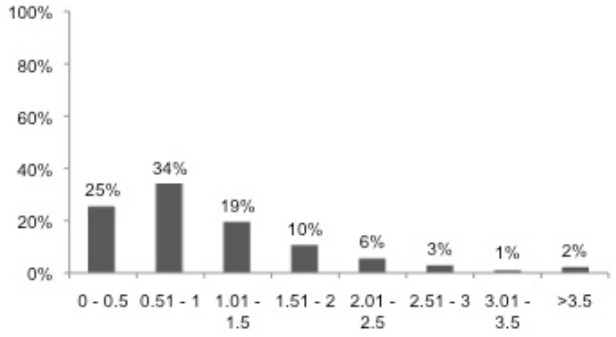

Fig 1. Distribution of Prevalence of Corneal Astigmatism

DISCUSSION

Our data on over 2000 eyes is presented. This showed the PCA in a cataract population and established the potential demand for the TIOL in patients with PCA of greater than 3 or 3.5 dioptres. The data highlighted the need for cataract surgeons to consider intraoperative correction of CA. As a real world sample our findings can be applied to similar populations in developed countries. We used two different keratometers over the duration of the study as technology changed over time. There is no gold standard instrument for keratometry and both give valid results.

Our mean CA of 1.09 ± 0.83 was higher than previously reported by Khan MI et. al (1.03 ± 0.728) on 1230 eyes in a British population and Ferrer-Blasco et. al (0.90 ± 0.93) on 4540 eyes in a Spanish population[2,6]. CA greater than 1.5 dioptres affects 15 – 20% of the general population[2,5,6]. Our results were similar for small to moderate degrees of CA showing 22% of patients with greater than 1.5 dioptres. Interestingly our population showed a higher prevalence of higher degrees of astigmatism, 11.6% having more than 2 dioptres and 2.16% having more than 3.5 dioptres[2,6]. Khan et al reported 9.69 % and 0.96% respectively. They had a similar number of eyes and mean age[6]. Unlike other populations[2,6,7]. our population had a gradual increase in both steep and flat values with age and a similar mean CA (Table 2). Females had a higher degree of mean CA compared to males and a higher prevalence of higher degrees of CA with 23% having more than 1.5 dioptres as compared to 18% of males.

TABLE 2:

Distribution of Corneal Astigmatism by each age group

Age Group	Average K1 (Dioptres)	Average K2 (Dioptres)	Mean Corneal Astigmatism (Dioptres)	*Number of Patients*
< 30 Years	43.65	44.82	1.17	*8 (0.38%)*
30-40 Years	42.21	43.45	1.24	*16 (0.77%)*
41-50 Years	42.50	43.73	1.23	*27 (1.30%)*
51-60 Years	42.87	44.05	1.18	*128 (6.15%)*
61-70 Years	43.04	44.05	1.01	*370 (18.0%)*
71-80 Years	43.13	44.16	1.03	*853 (41.0%)*
81-90 Years	43.08	44.20	1.12	*625 (30.0%)*
≥91 Years	43.75	44.92	1.17	*53 (2.55%)*

Post-operative CA following cataract surgery can cause blurred or impaired unaided vision with disappointment from patients increasingly expectant of spectacle independence. It can be corrected post-operatively with spectacle, contact lenses or further surgery (laser, secondary or Piggy-back IOL surgery). Identification of CA pre-operatively can however, allow correction at the time of cataract surgery (incisions along the steep axis of the cornea, limbal relaxing incisions, or the use of TIOL). Combining an on axis incision with a peripheral relaxing incision may overcome approximately 2.00 D of astigmatism[8] but has limitations with regard to wound positioning. Furthermore, there are risks associated with limbal relaxing incisions such as infection, wound gape and perforation. The outcome can also be variable[3]. The TIOL was first described in 1994. It corrects astigmatism in a single procedure and its use is becoming more frequent[9]. It allows the correction of 11 dioptres of astigmatism[10]. The TIOL outcome is more predictable[11] but correct axis placement in the eye is critical to effectiveness. Like Khan et al. we found that moderate CA (> 1.00 D) was prevalent in greater than 40% (41.3%) of patients, a group who may benefit from a TIOL[6].

The cost-effectiveness of TIOL versus the non-toric intraocular lens (NTIOL) is not yet established. The cost of a TIOL is up to £240 more expensive than the standard NTIOL. More clinic time is required to perform corneal topography

prior to selecting the TIOL. More theatre time is required to mark the axis on the eye and orientate the lens into position. The long-term costs of contact lens or spectacle correction are unknown and are often borne by the National Health Service through a spectacle voucher scheme. Correcting refractive error as a single procedure at the time of cataract surgery could be more cost-effective. Our data could inform a cost-effectiveness study.

CONCLUSION

We report the prevalence of CA in a UK cataract population of over 2000 eyes. The prevalence of CA within a Northern Ireland cataract population is a new finding. Of patients selected for elective cataract surgery, 41.3% of patients had more than 1.00 D of corneal astigmatism, 11.6% had more than 2.00D, 3.27% had more than 3.00D and 2.16% had more than 3.50D. Our study of 2080 consecutive eyes is likely to be representative of a public health service practice in the UK. It highlights a group of patients, particularly at the higher end of the spectrum with PCA of greater than 3 or 3.5 dioptres who may benefit from TIOL as a method of correcting their pre-existing corneal astigmatism at the time of cataract surgery. In particular, the procedure may be of benefit to Female patients.

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Four years of data were presented as a poster at ARVO 2013, Seattle, Washington, USA; 5th May 2013. It has not been published anywhere else

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