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Axial Length Analysis in Patients with Retinal Detachment in New Zealand

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Authors' contributions

This work was carried out in collaboration among all authors. All authors contributed to the studies and designs. Data collection and analysis were performed by authors JG and FMDR. The manuscript was written by authors PJ, FMDR, JG and AMDR. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Aim: The aim of the study is to analyse the axial length (AL) in patients with rhegmatogenous retinal detachment (RRD) in Dunedin Public Hospital (New Zealand).
Methods: Retrospective analysis was performed on the records of 105 patients who underwent retinal surgery with pars plana vitrectomy (PPV) in Dunedin Public Hospital between 1 January 2020 and 1 January 2022. AL was collected with a Zeiss IOL Master500. Data was compared to matched control groups: Dunedin patients requiring cataract surgery, a previous study of healthy individuals from Dunedin (Dunedin Multidisciplinary Health & Development Study) and an Auckland control group comprising of two publications of patients in Auckland undergoing cataract surgery.
Results: Total data of 108 eyes of 105 patients, of which 42 were female and 63 were male, with an average age of 63.25± 16.40 years (mean ± SD), was included in this study. The mean AL of the patients was 24.30 ± 0.33 mm compared to the control group of 23.48 ± 0.06 mm. The difference in AL between RRD patients and the Auckland control group was 0.82 ± 0.23 mm, $p<0.0001$. The difference in AL between the RRD and the Dunedin Cataract surgery group was 0.75 ± 0.29, $p<0.0001$. The difference between male and female mean AL was 0.75 ± 0.67 mm, $p < 0.0285$.

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Conclusion: Patients with RRD have been shown to have a greater AL when compared to those without, with a difference of 0.82 ± 0.23 mm representing approximately 2.2 diopters. Men have a greater mean AL when compared to women, with a difference of 0.75 ± 0.67mm, $p < 0.0285$ representing approximately 2.0 diopters.

Keywords: Axial length; rhegmatogenous retinal detachment; retinal detachment; New Zealand Axial length.

1. INTRODUCTION

Rhegmatogenous retinal detachment (RRD) is a sight-threatening condition that occurs due to anomalous vitreous detachment, where vitreous syneresis and collapse exceed the rate of vitreous separation, leading to vitreoretinal traction. Treatment for RRD aims to seal the retinal break with surgery, by pars plana vitrectomy (PPV) or scleral buckling (SB) [1]. The main risk factor for RRD, apart from aging, is myopia [1,2]. People with more severe myopia have longer eyes (high AL) which means that the retina is more stretched and therefore prone to peripheral retinal tears. The risk of developing retinal detachment is eight times greater in people with myopia compared to those with emmetropic eyes (OR = 7.8) [3]. This is explained by a posterior segment size exceeding the production of the vitreous humour, leading to a degenerated vitreous, which is a known predisposing factor for rhegmatogenous retinal detachment [4,5]. The incidence of RRD varies with geographical location and ranges between 6.3 and 17.9 per 100,000 individuals annually [4]. A study conducted in New Zealand determined an incidence rate of 11.9 per 100,000 annually, meaning every year an estimated 580 patients are affected [6].

Myopia is a refractive error that leads to images being focused in front of the retina instead of on the retina. Myopia is caused by a high axial length or a high corneal curvature [7]. Myopia is highly associated with RRD, myopic maculopathy, glaucoma and early-onset cataracts. Risk factors for myopia include genetic factors, outdoor sun exposure, time spent near work, and level of education [7,8]. Myopia is a common condition causing major visual impairment worldwide. The prevalence of myopia varies by country, age and ethnic group, with countries in Asia such as China, Taiwan and Korea reporting up to 84% prevalence among their teenage and young adult population [9]. By 2050, it is predicted that half of the world will be myopic [6,9].

To the best of our knowledge, there has not been previous research conducted on axial length in patients with RRD in New Zealand. This study aims to identify the average AL of patients with RRD referred to the Dunedin Eye Department. We hypothesise that New Zealand patients with RRD will have an average AL longer than age and sex-matched patients without RRD.

2. METHODOLOGY

Retrospective analysis of the postoperative ophthalmology and biometry records of all patients undergoing retina surgery with PPV in Dunedin Public Hospital (New Zealand) service during a 24-month period was performed between 1 January 2020 and 1 January 2022 (n=108). This hospital serves a population of more than 250,000 people. Ethics approval was obtained from the University of Otago Human Ethics Committee (reference number: HD20/115) and from Health Research South (project number: 01739).

Inclusion criteria were patients presenting with RRD and who had been treated with PPV. The diagnosis of RRD was confirmed through the patient's medical records. In addition, biometry data was collected from the patients measuring the AL of the affected eye after the surgery. The AL was collected with the Zeiss IOL Master500 (Carl-Zeiss AG Germany). Exclusion criteria were patients with records missing any of the included data, and patients with other types of retinal detachment. Patients that presented with RRD and received SB as treatment or re-operations of RRD were not considered. Statistical analysis was performed using R, by R Core Team, 2014. A p-value less than 0.05 was considered statistically significant, and the results were expressed as a mean ± 95% confidence interval. Clinical significance is determined in diopters where 1 diopter corresponds to 0.35 to 0.40 mm [10,11].

The data was compared to the axial length of several control groups: a Dunedin healthy population (from the Dunedin Multidisciplinary

Health & Development Study), a sample of patients from Dunedin undergoing cataract surgery, and an Auckland control group comprising of two publications of patients from Auckland undergoing cataract surgery. As these patients didn't have RRD, they were therefore selected as the control group for our study [12]. For statistical analysis, the difference in mean AL was analysed through an unpaired "t" test between the two groups.

3. RESULTS

This study included 108 eyes of 105 patients with RRD, and three patients presented with bilateral RRD. The study population included 42 (40%) women and 63 (60%) men. The average age for the patients in this study was 63.25 ± 16.40 years (mean ± SD). The mean AL of the patients presenting with RRD was 24.30 ± 0.33 mm.

Patients from the Auckland control studies had an average AL of 23.48 ± 0.06 mm (Fig. 1). The difference in AL between RRD patients and the Auckland control groups was 0.82 ± 0.23 mm, *P* < .001. The differences approximately represent 2.2 diopters.

Patients from the Dunedin cataract surgery group had an average AL of 23.55 ± 0.11 mm. The difference in AL between the RRD and the Dunedin cataract surgery group was 0.75 ± 0.29, *P* <.001. The differences approximately represent 2.0 diopters.

When compared to the healthy Dunedin Study group, patients with RRD had a greater AL than those without. The median AL of the Dunedin Study was 23.49 and 23.47 for the right and left eyes, respectively.

In our study when analysed separately, males had a greater average AL of 24.60 ± 0.41 mm compared to females, who had an average of 23.84 ± 0.53 mm. The difference between male and female mean AL was 0.75 ± 0.67 mm, *P* <.029. The differences approximately represent 2.0 diopters. This result is similar to other studies referenced in this paper.

The Auckland AL study demonstrated that males had a greater average AL of 23.88 ± 1.13mm compared to females 23.31 ± 1.15 mm [12]. Another Auckland study showed that the AL of the male patients was significantly longer at 23.45 ± 0.94 mm when compared to female patients at 22.94 ± 1.03 mm [13]. The Dunedin cataract surgery group similarly found that males had a greater average AL of 23.84 ± 0.16 mm compared to females 23.32 mm.

4. DISCUSSION

Axial length is related to multiple factors, including age, ethnic group, genetics, outdoor sun exposure, time spent near work, and level of education [7,8]. Considering these variables, we decided to use three control groups (patients without RRD): one group of healthy individuals (from the Dunedin Study), one group of individuals with cataracts (Dunedin cataract study) and one group of individuals with cataracts from a different environment (Auckland AL studies). These control groups allow us to validate our results and extrapolate conclusions.

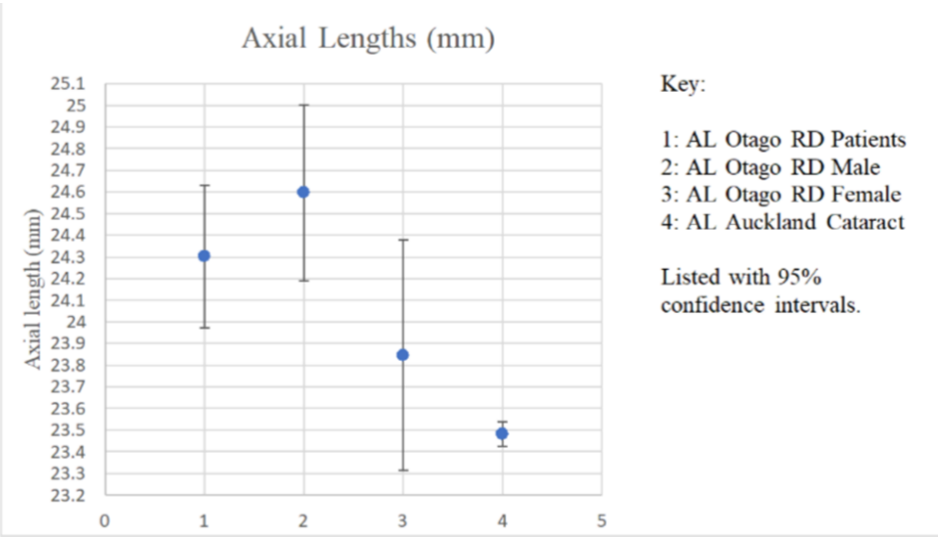

Fig. 1. Axial length of patients (mm) from Otago and Auckland (control) with 95% CI

Our results are consistent with previous research as there is a notable difference observed in AL between different sexes, with males having a longer AL compared to females [14,15]. For example, one of the Auckland cataract studies found the mean AL in males was 0.51 mm higher than in females [13]. Our study could have been influenced by the different proportion of males to females compared to other studies, however this was not evidenced in our results.

Patients with RRD in this study had an average AL of 24.30mm compared to 24.96 mm in another study that explored biometry in patients who developed RRD post-cataract surgery [15]. This difference in AL can be explained by multiple variables including different environments, race, sex and age distributions [16].

The AL measurements collected in this study were obtained once the retinal detachment had been operated on because in the presence of macula-off retinal detachment, measurements of AL are likely to be underestimated [17]. This underestimation of AL can be due to multiple factors, including detachment of the fovea, reduction in intraocular pressure due to RRD, changes in the refractive index in the posterior segment and changes in the effective lens position post-vitrectomy [17,18].

The main limitation of the study is the low percentage of accessible patient data. Of the 277 eligible participants, data was only available for 108 eyes (39%) due to the data not being recorded or incomplete. The patients included had available AL measurements if they had received cataract surgery before RRD or required cataract surgery after the PPV operation. Cataract surgery is commonly required after the PPV operation [19,20]. Higher incidences of moderate or visually significant lens opacification are found within 2 years of operation, with this being the most significant in the first 6 months [21]. Also, cataract surgery before RRD has been linked to risk of subsequent RRD, which is estimated to be between 0.1 and 0.81%.20 One particular study stated that the risk is highest within the first six months following cataract surgery [22]. This means that our study may not be representative of the general population and selection bias should be considered when interpreting the results of this study.

To expand on these findings, future studies could examine patients with RRD who have not previously had cataract surgery, and biometry should be used to measure the AL of these patients before the onset of RRD.

5. CONCLUSION

In conclusion, the data that has been analysed in this study shows that patients with RRD had a higher AL compared to those in the control population, with a difference of 0.82 ± 0.23 mm representing approximately 2.2 diopters. In addition, the data also shows that males have a greater mean AL when compared to females. The difference between male and female mean AL was 0.75 ± 0.67 mm, $p < 0.0285$, representing approximately 2.0 diopters. There is a paucity of research regarding AL and RRD in a New Zealand context, and the findings of this paper add to this body of knowledge.

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CONSENT

It is not applicable.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. Ethics approval was obtained from the University of Otago Human Ethics Committee (reference number: HD20/115) and from Health Research South (project number: 01739).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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