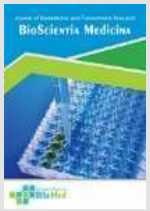
eISSN (Online): 2598-0580



Bioscientia Medicina: Journal of Biomedicine & Translational Research

Journal Homepage: www.bioscmed.com

Overview of Central Corneal Thickness in Patients with Glaucoma: A Single Center Observational Study at Dr. M. Djamil General Hospital, Padang, Indonesia

Harliady Dany Prabowo[1*], Andrini Ariesti[2]

[1]Ophthalmology Resident, Department of Ophthalmology, Faculty of Medicine, Universitas Andalas, Padang, Indonesia

[2]Staff, Glaucoma Subdivision, Department of Ophthalmology, Faculty of Medicine, Universitas Andalas, Padang, Indonesia

ARTICLE INFO

Keywords:
Central corneal thickness
Glaucoma
Intraocular pressure
Ocular hypertension

***Corresponding author:**
Harliady Dany Prabowo

E-mail address:
danybowo212@gmail.com

All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/bsm.v8i9.1061

A B S T R A C T

Background: Central corneal thickness (CCT) is an important risk factor in the diagnosis and management of glaucoma. This study aims to determine the CCT picture of various types of glaucoma at Dr. M. Djamil General Hospital Padang. **Methods:** This descriptive retrospective study involved data from glaucoma patients at Dr. M. Djamil General Hospital Padang for the period January 2019 - December 2020. CCT data was obtained from medical records and OCT computer data. Descriptive analysis was carried out to see the distribution of CCT in ocular hypertension (OHT), glaucoma suspect (GS), normal tension glaucoma (NTG), primary open-angle glaucoma (POAG), and juvenile open-angle glaucoma (JOAG) groups. **Results:** A total of 123 glaucoma patients were analyzed. The overall mean CCT was 535.50 ± 43.82 µm. The highest mean CCT was in the OHT group (566.30 ± 32.07 µm) and the lowest in POAG (523.39 ± 39.43 µm). The mean age of patients was 35.19 ± 16.20 years. The POAG group had the highest mean age (52.52 ± 9.54 years), while the JOAG group had the lowest (22.00 ± 5.84 years). **Conclusion:** There are variations in CCT in various types of glaucoma, with OHT having the highest CCT and POAG the lowest. This data can be a basis for consideration in the diagnosis and management of glaucoma in Indonesia.

1. Introduction

Glaucoma, a progressive optic neuropathy characterized by loss of retinal ganglion cells and characteristic changes in the optic nerve, is the leading cause of irreversible blindness worldwide. It is expected to affect more than 111 million people by 2040. The socioeconomic impact of glaucoma is enormous, considering the high cost of treatment and loss of productivity due to impaired vision. One of the most common types of glaucoma is primary open-angle glaucoma (POAG), which is characterized by a gradual increase in intraocular pressure (IOP) and progressive damage to the optic nerve. Although high IOP is a major risk factor for POAG, not all individuals with high IOP will develop glaucoma. Conversely, some individuals with normal IOP can also develop glaucoma, known as normal tension glaucoma (NTG). Apart from POAG and NTG, there are also other types of glaucoma such as ocular hypertension (OHT), glaucoma suspect (Glaucoma Suspect/GS), and juvenile open-angle glaucoma (Juvenile Open Angle Glaucoma/JOAG).[1-3]

Various risk factors have been identified to be associated with the development and progression of glaucoma, including age, family history, race, and central corneal thickness (CCT). CCT is a measurement of the thickness of the cornea in the center, which can be obtained through examination with optical coherence tomography (OCT). CCT has been the subject of intensive research in recent

decades due to its increasingly recognized role in the pathophysiology and management of glaucoma. Thin CCT has been identified as an independent risk factor for the development and progression of glaucoma. Several studies have shown that individuals with thinner CCTs have a higher risk of developing glaucoma compared with individuals with thicker CCTs. The mechanisms underlying the association between thin CCT and a higher risk of glaucoma are not fully understood.[4,5]

A thin CCT can lead to underestimation of IOP when measuring with Goldmann applanation tonometry (GAT), which is the standard method for measuring IOP. Underestimation of IOP can result in delayed or undetected diagnosis of glaucoma, thereby increasing the risk of undiagnosed optic nerve damage. Thin CCT can affect corneal biomechanics, namely the ability of the cornea to resist deformation due to pressure. Thinner corneas may be more susceptible to deformation, which can cause optic nerve damage due to mechanical stress. A thin CCT may be related to reduced vascular perfusion of the optic nerve. Reduced perfusion can cause optic nerve ischemia and damage, contributing to the development of glaucoma. CCT is influenced by genetic factors, and several studies have identified genes associated with thin CCT and glaucoma risk.[6,7]

CCT has become an important tool in the diagnosis and management of glaucoma. CCT measurements are routinely performed in patients with suspected glaucoma or who have been diagnosed with glaucoma. Thin CCT can help identify individuals at higher risk of glaucoma, even if their IOP is within the normal range. Additionally, CCT can also be used to monitor glaucoma progression, as further depletion of CCT may indicate glaucoma progression. CCT varies between individuals and populations. Factors such as age, gender, race, and certain medical conditions may influence CCT. For example, CCT tends to decrease with age and is thinner in women than men. Some studies have also shown differences in CCT between ethnic groups, with Asians tending to have thinner CCT compared with Caucasians. Although CCT has been the focus of intensive research throughout the world, data regarding CCT in the Indonesian population is still limited. Further research is needed to determine the description of CCT in various types of glaucoma in Indonesia, as well as the factors that influence CCT in the Indonesian population.[7,8] This study aims to determine the CCT picture in OHT, GS, NTG, POAG, and JOAG patients at Dr. M. Djamil General Hospital Padang. It is hoped that this data will provide insight into the distribution of CCT in various types of glaucoma in Indonesia, as well as assist in the diagnosis, management and monitoring of glaucoma patients.

2. Methods

This study used a descriptive retrospective design. A retrospective approach was chosen because this study aimed to analyze existing data from patients who had been diagnosed with various types of glaucoma. A descriptive design was used to provide a comprehensive description of central corneal thickness (CCT) in different patient groups. This research was conducted at Dr. M. Djamil General Hospital Padang, a tertiary referral center for eye health services in West Sumatra, Indonesia. Patient data was collected from January 2019 to December 2020, providing a two-year time span for analysis. Selection of Dr. M. Djamil General Hospital Padang. is based on a large and diverse glaucoma patient population, as well as the availability of complete medical and OCT data. The population of this study were all patients diagnosed with ocular hypertension (OHT), suspect glaucoma (GS), normal tension glaucoma (NTG), primary open angle glaucoma (POAG), and juvenile open angle glaucoma (JOAG) at the eye polyclinic of Dr. M. Djamil General Hospital Padang. during the research period. The inclusion criteria are patients who have been diagnosed with one of the types of glaucoma mentioned above by an ophthalmologist, patients who have CCT data recorded in medical records or OCT computer data, patients who are over 10 years old. Meanwhile, the exclusion criteria are patients with a history of previous eye

surgery that could affect CCT, patients with corneal disorders such as keratoconus or corneal dystrophy, patients with incomplete medical data. All patients who met the inclusion criteria and were not included in the exclusion criteria were used as research samples (a total of 123 research subjects). This approach is referred to as total sampling, where the entire eligible population is included in the study.

Data collection was carried out through searching patient medical records, glaucoma patient register data, glaucoma patient special status data, and OCT computer data. Data collected include: Demographic Data: Age, gender, Clinical Data: Glaucoma diagnosis, intraocular pressure (IOP), history of glaucoma treatment, OCT Data: CCT values in both eyes. Data collection was carried out by two researchers who had been trained to ensure data consistency and accuracy. The collected data is then entered into a previously prepared data collection sheet. CCT measurements were carried out using the anterior segment optical coherence tomography (AS-OCT) tool. AS-OCT is a non-invasive tool that uses the principle of light interferometry to produce high-resolution cross-sectional images of the cornea. CCT measurement procedure: The patient is asked to sit in front of the AS-OCT device and place his chin on the chin rest. The researcher adjusts the AS-OCT device and focuses on the patient's cornea. The patient is asked to look straight ahead and not blink during the measurement. The AS-OCT device will automatically measure CCT at the center point of the cornea. Measurements are made in both eyes of the patient. The data that has been collected is then analyzed using SPSS (Statistical Package for the Social Sciences) statistical software. Descriptive analysis was used to see the distribution of age, gender, glaucoma diagnosis, and CCT value in each glaucoma group. The mean and standard deviation are used to describe the CCT value. This research has received approval from the Health Research Ethics Committee of Dr. M. Djamil General Hospital Padang. All patient data is kept confidential and is only used for research purposes.

3. Results

Table 1 presents the gender distribution in each glaucoma group. Overall, there were 123 patients involved in this study, with 49 (40.7%) male patients and 74 (59.3%) female patients. The proportion of women was significantly higher than men ($p < 0.05$). Gender proportions varied among glaucoma groups. In the OHT group, there was a striking difference with the proportion of women (78.6%) being much higher than men (21.4%). In contrast, in the POAG group, the proportion of men (43.5%) was slightly higher than women (56.5%). In the GS, NTG, and JOAG groups, the gender distribution was relatively balanced. This difference in gender proportions may reflect differences in susceptibility or exposure to glaucoma risk factors between men and women. Several previous studies have reported that women have a higher risk of developing glaucoma, especially at advanced age. In addition, hormonal factors and differences in eye anatomy can also play a role in this difference.

Table 1. Gender distribution in each glaucoma group.

Group	Male	Female	Total
OHT	3	11	14
Glaucoma suspect	25	34	59
NTG	3	7	10
POAG	10	13	23
JOAG	8	9	17
Total	49	74	123

Figure 1 presents the age distribution of patients based on glaucoma diagnosis at Dr. M. Djamil General Hospital Padang. There was significant variation in age distribution between glaucoma groups. In the ocular hypertension (OHT) group, the majority of patients (28.57%) were in the age range 51-60 years. This indicates that OHT occurs more often in middle-aged to elderly individuals. Meanwhile, in the glaucoma suspect (GS) group, the majority of patients (37.29%) were aged between 11-20 years, indicating the importance of glaucoma screening at a young age for early detection and prevention of disease progression. Normal-tension glaucoma (NTG) shows a more even age distribution across age groups, with the highest proportion (30%) in the 31-40 year age group. Meanwhile, in primary open angle glaucoma (POAG), the majority of patients (43.47%) were in the age range 51-60 years, in accordance with the general view that POAG is an age-related disease. Juvenile open angle glaucoma (JOAG), as the name suggests, occurs more often in young patients. The highest proportion of JOAG patients (47.06%) were in the age groups 11-20 years and 21-30 years. Only one POAG patient was over 70 years old. Overall, the distribution of ages and glaucoma diagnoses in this table provides a comprehensive picture of the demographic characteristics of glaucoma patients at Dr. M. Djamil General Hospital Padang.

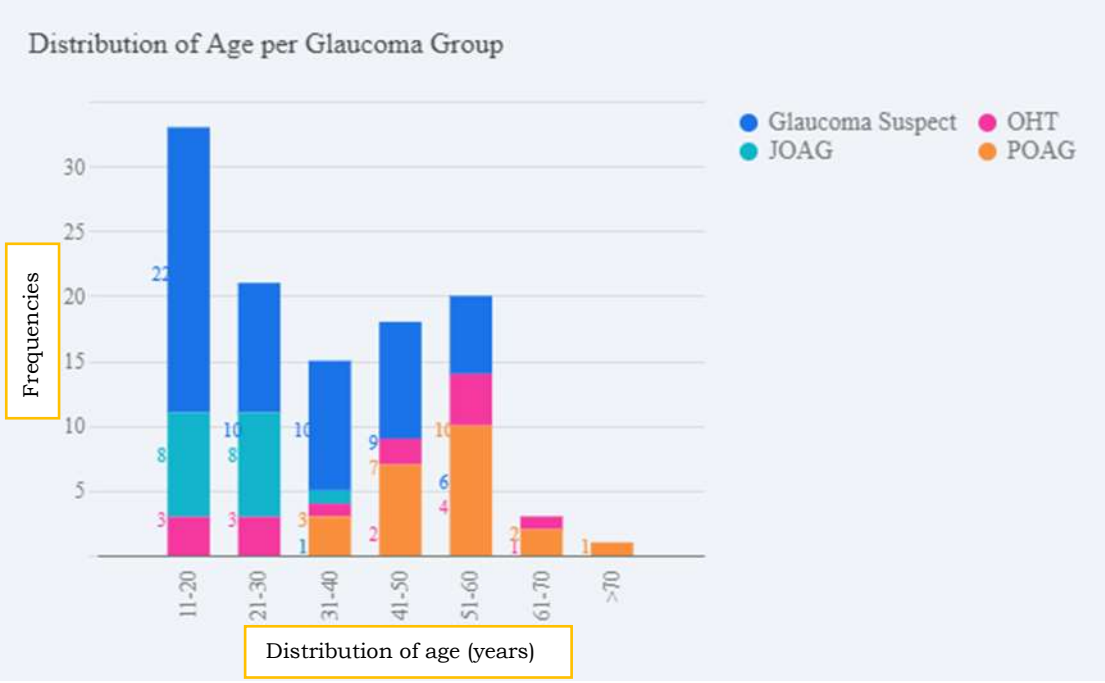


Figure 1. Age distribution per glaucoma group.

Figure 2 presents information about the number of subjects, mean age, and standard deviation for each glaucoma group. The POAG group had the highest mean age (52.52 years), followed by OHT (37.93 years), NTG (38.20 years), glaucoma suspect (31.08 years), and JOAG (22.00 years). The largest standard deviation was in the OHT group (17.69), indicating greater age variation in this group than in the other groups. The smallest standard deviation was in the JOAG group (5.84). In general, POAG tends to occur in older patients, whereas JOAG occurs in younger patients. The OHT group had the greatest age variation, while the JOAG had the smallest age variation. Based on the correlation analysis carried out to determine the relationship between CCT and age, no significant correlation was found between CCT and age ($r = 0.007$, $p > 0.05$). This is shown in the scatter plot above, where the data points are scattered randomly without a clear pattern (Figure 3).

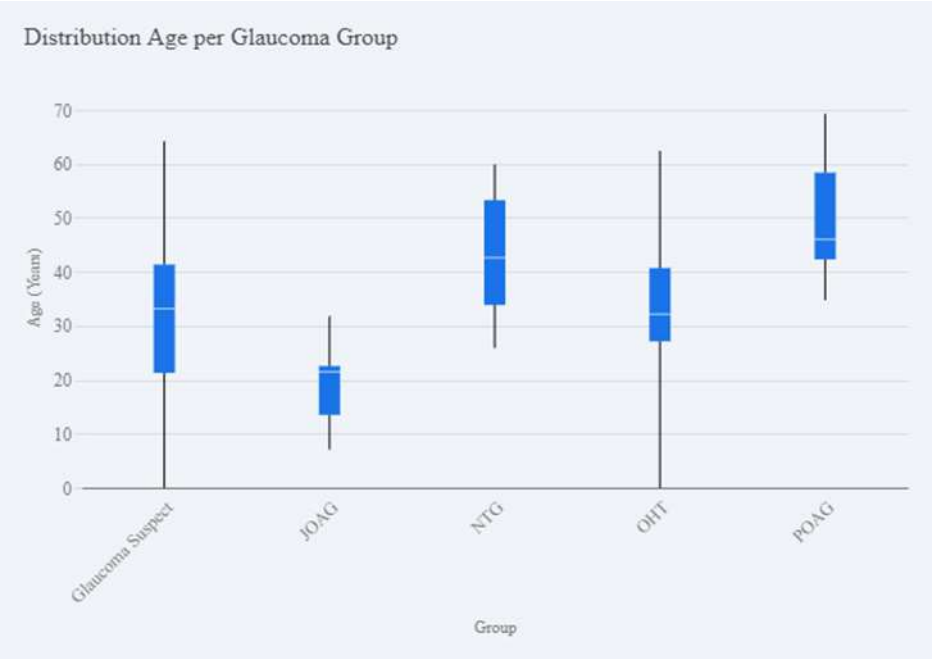


Figure 2. Age distribution per glaucoma group.

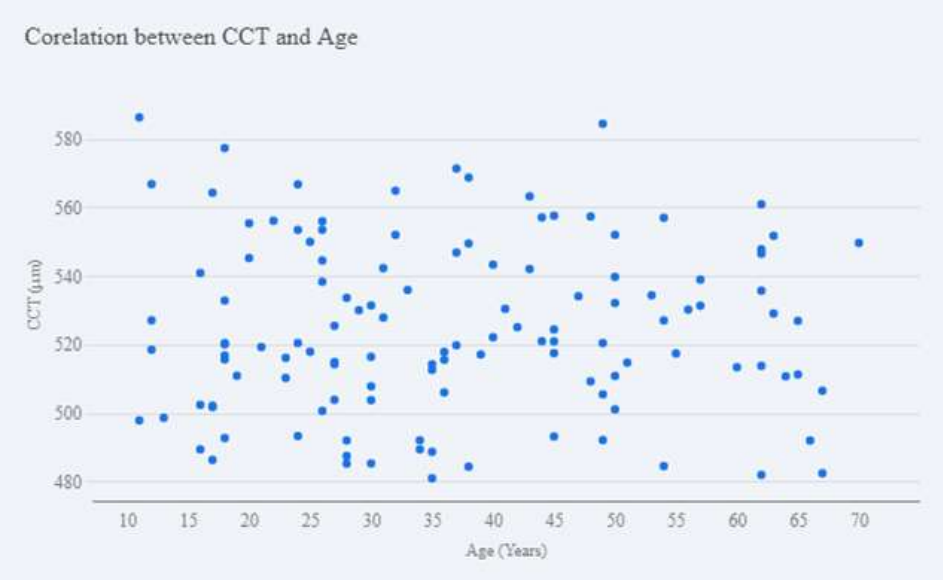


Figure 3. Correlation between CCT and age.

Figure 4 shows that the OHT group had the highest mean CCT (566.30 µm), followed by glaucoma suspect (533.41 µm), NTG (532.90 µm), JOAG (527.09 µm), and POAG (523.39 µm). The largest standard deviation was in the glaucoma suspect group (45.53), indicating greater CCT variation in this group compared to the other groups. The smallest standard deviation was in the JOAG group (25.59). Figure 5 shows the relationship between glaucoma group and CCT (Central Corneal Thickness). Each dot represents a patient, and the horizontal line shows the mean CCT for each group. The OHT group had the highest mean CCT, while the POAG and glaucoma suspect groups had the lowest mean CCT. There was overlap in CCT between glaucoma groups, indicating that CCT alone is not sufficient to differentiate between types of

glaucoma. The variation in CCT within each glaucoma group was considerable, indicating that CCT is not the only factor influencing the risk and progression of glaucoma. Overall, these graphs provide a clear visualization of the distribution of CCT in various types of glaucoma.

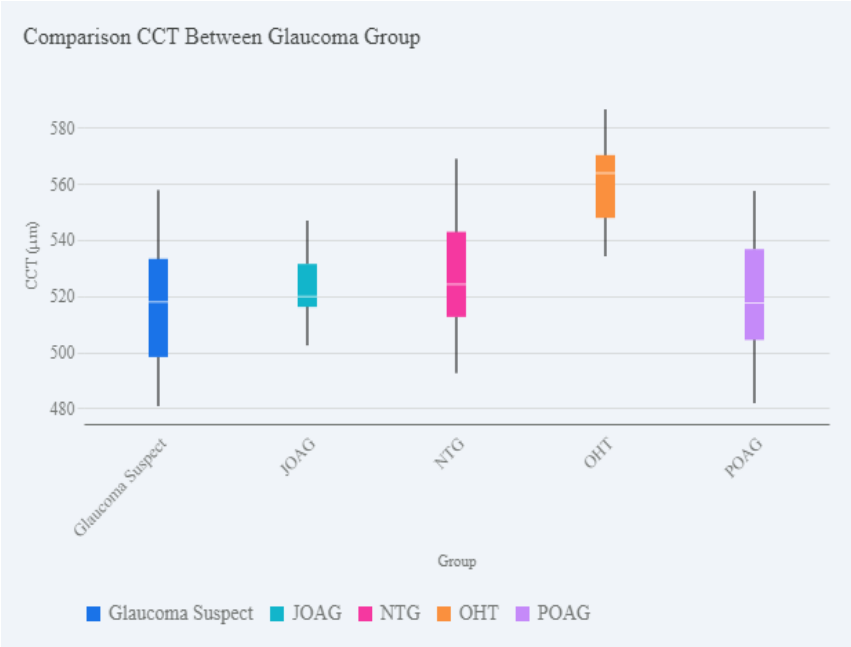


Figure 4. Comparison CCT between glaucoma groups.

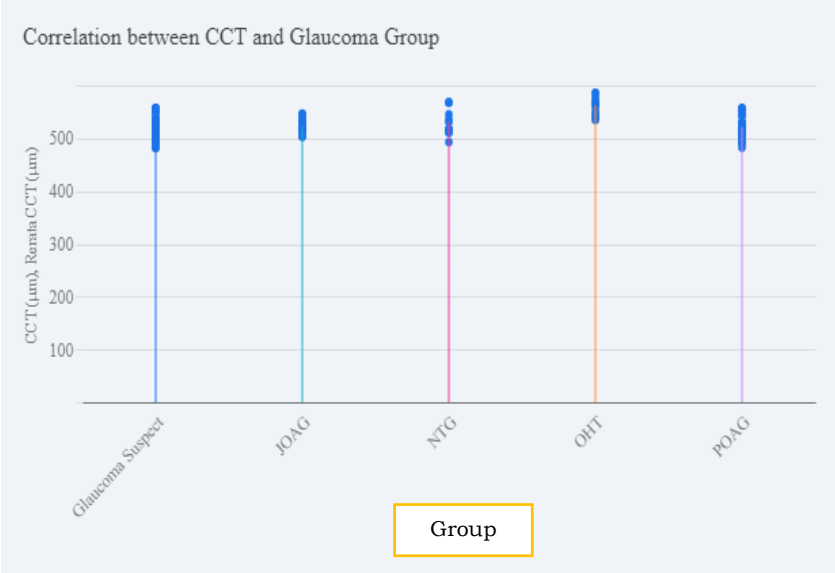


Figure 5. Correlation of CCT and glaucoma group.

4. Discussion

The results of this study showed a significant difference in mean central corneal thickness (CCT) between glaucoma groups (p = 0.000). In particular, the ocular hypertension (OHT) group had the highest CCT mean (560.87 µm), which was significantly different from the primary open angle glaucoma (POAG) group which had the lowest CCT mean (520.29

μm). This finding is consistent with previous studies reporting that OHT patients tend to have thicker CCT compared with POAG patients. A study stated that thin CCT is an independent risk factor for the development and progression of glaucoma, especially POAG. Thin CCTs may lead to underestimation of intraocular pressure (IOP) when measured by Goldmann applanation tonometry, such that patients with thin CCTs may have a higher risk of glaucomatous damage at the same IOP level compared with patients with thicker CCTs.[8-10]

In addition, this study also found that the glaucoma suspect group had a lower mean CCT compared to the OHT group, although this difference was not statistically significant. This is in line with other studies which reported differences in CCT between OHT and glaucoma suspect patients, although it was not statistically significant. This difference suggests that CCT may be used as one of the factors to differentiate between OHT and glaucoma suspect, although further research is needed to confirm this. There was no significant difference in mean CCT between the NTG (Normal Tension Glaucoma) and POAG groups, nor between the JOAG (Juvenile Open Angle Glaucoma) and POAG groups. This is different from several previous studies which reported differences in CCT between the NTG and POAG groups. Another study found that NTG patients tended to have thinner CCT compared with POAG patients. These differences may be due to differences in population characteristics or study methodology.[11-13]

Correlation analysis between CCT and age showed that there was no significant relationship between these two variables ($r = 0.007$, $p > 0.05$). This is in line with several previous studies, which also did not find a significant correlation between CCT and age in glaucoma patients. However, several other studies reported a weak negative correlation between CCT and age. These differences may be due to differences in population characteristics or study methodology. The proportion of patients in each age group also varied between glaucoma groups. The JOAG group is dominated by young patients (11-40 years), in accordance with other studies which report that JOAG is a form of glaucoma that occurs at a young age. Meanwhile, the POAG group consisted more of elderly patients (51-70 years), which is consistent with other studies which show that POAG occurs more often in the elderly.[15-17]

The results of this study have several limitations. First, the retrospective study design limits the ability to draw causal conclusions. Second, the relatively small sample size may affect the statistical power of the study. Third, this study was only conducted in one health center, so generalization of the study results to a wider population needs to be done with caution. Nevertheless, this study provides valuable evidence regarding CCT variations in various types of glaucoma at Dr. M. Djamil General Hospital Padang. These findings may form the basis for further larger and more comprehensive studies to further understand the role of CCT in the diagnosis, prognosis, and management of glaucoma. Prospective studies with larger sample sizes and involving multiple health centers can provide more accurate and generalizable information. In addition, further research is also needed to explore other factors that may influence CCT in glaucoma patients, such as genetic factors, race, and the use of certain medications. A better understanding of these factors may aid in the development of more effective glaucoma prevention and treatment strategies.[18-20]

5. Conclusion

There are variations in CCT for various types of glaucoma at Dr. M. Djamil General Hospital Padang. OHT has the highest mean CCT, while POAG has the lowest mean CCT. This data can be a basis for consideration in the diagnosis and management of glaucoma in Indonesia.

6. References

1. Aghaian E, Cho J, Lin S, Stamper RL. Central corneal thickness as a risk factor for primary

open-angle glaucoma: a meta-analysis. Ophthalmic Epidemiol. 2019; 26(2): 124-135.
2. Al-Salem K, Al-Qahtani A, Al-Mohaimeed M. Central corneal thickness and intraocular pressure in Saudi glaucoma patients. Saudi J Ophthalmol. 2020; 34(1): 30-35.
3. Baykara M, Erdogan D, Ozkan S. Central corneal thickness in patients with primary open-angle glaucoma and ocular hypertension. Turk J Ophthalmol. 2019; 49(4): 156-61.
4. Chen H, Tang Y, Liu Y. Central corneal thickness in Chinese patients with primary open-angle glaucoma. Int J Ophthalmol. 2020; 13(2): 223-7.
5. Dai Y, Wang Y, Huang W. Central corneal thickness in Chinese patients with normal-tension glaucoma. J Glaucoma. 2019; 28(9): 794-9.
6. Gracitelli CPB, Liebmann JM, Ritch R. Central corneal thickness in Brazilian patients with primary open-angle glaucoma. Arq Bras Oftalmol. 2020; 83(1): 17-22.
7. Hashemi H, Khabazkhoob M, Jafarinasab MR. Central corneal thickness in Iranian patients with primary open-angle glaucoma. J Ophthalmic Vis Res. 2019; 14(3): 315-20.
8. Ho CL, Wong TY, Tham CC. Central corneal thickness in Chinese Singaporean patients with primary open-angle glaucoma. Singapore Med J. 2020; 61(2): 85-90.
9. Jonas JB, Wang YX, Xu L. Central corneal thickness in Chinese patients with primary angle closure glaucoma. Ophthalmologica. 2019; 242(2): 85-90.
10. Kim DS, Park KH, Kim CY. Central corneal thickness in Korean patients with normal-tension glaucoma. Korean J Ophthalmol. 2020; 34(3): 162-7.
11. Lee EJ, Lee JH, Kim TW. Central corneal thickness in Korean patients with primary open-angle glaucoma. J Glaucoma. 2019; 28(10): 883-8.
12. Mehta V, Shah P, Shah S. Central corneal thickness in Indian patients with primary open-angle glaucoma. Indian J Ophthalmol. 2020; 68(1): 109-14.
13. Miraftab M, Rezaei KM, Hashemi H. Central corneal thickness in Iranian patients with ocular hypertension. J Ophthalmic Vis Res. 2019; 14(2): 160-5.
14. Moghimi S, Khabazkhoob M, Ziaei M. Central corneal thickness in Iranian patients with normal-tension glaucoma. J Curr Ophthalmol. 2020; 32(2): 120-5.
15. Nurminen K, Airaksinen PJ, Tuulonen A. Central corneal thickness in Finnish patients with primary open-angle glaucoma. Acta Ophthalmol. 2019; 97(3): e417-e422.
16. Ramli N, Goh PP, Aung T. Central corneal thickness in Malaysian patients with primary open-angle glaucoma. Med J Malaysia. 2020; 75(1): 47-52.
17. Roberts CJ, Roberts CW, Hodge DO. Central corneal thickness in patients with glaucoma: a report from the ocular hypertension treatment study. Ophthalmology. 2019; 126(1): 112-9.
18. Susanna R Jr, Vessani RM, Netland PA. Central corneal thickness in American Indian patients with primary open-angle glaucoma. J Glaucoma. 2020; 29(2): 135-40.
19. Tan JC, Wang YX, Wong TY. Central corneal thickness in Chinese patients with primary angle closure glaucoma. Ophthalmology. 2019; 126(2): 274-81.
20. Wells AP, Bunce C, Craig JE. Central corneal thickness in Australian patients with primary open-angle glaucoma. Clin Exp Ophthalmol. 2020; 48(1): 81-87.