Original Article

Astigmatism in Iraqi Clinical Setting: Distribution and Axis Patterns

PJO – Official Journal of Ophthalmological Society of Pakistan

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ABSTRACT

Purpose: To investigate the astigmatism distribution and axis patterns among Iraqi patients and explore its associations with age and gender.

Study Design: Cross-sectional observational study.

Place and Duration of Study: College of Medicine, University of Fallujah, Iraqfrom January to March 2024.

Methods: A total of 112 patients (224 eyes) with astigmatism were included. Data included visual acuity, auto refraction, and astigmatism axis. Astigmatism was classified by magnitude and axis orientation. Statistical analysis was done using Chi-square test and Pearson's correlation test was used to assess association with age and gender.

Results: Mild astigmatism was the most common (87.5%), followed by moderate (8.5%) and severe astigmatism(4%). With-the-rule (WTR) astigmatism was the predominant axis pattern (54.9%), with against-the-rule (ATR) and oblique astigmatism accounting for 39.3% and 5.8%, respectively. WTR astigmatism occurred more frequently in younger individuals, whereas ATR predominated in older patients ($p < 0.001$). There was no significant association between axis type and gender ($p = 0.992$). Visual acuity improved in most cases after refractive correction, with 87.9% achieving normal vision.

Conclusion: WTR astigmatism is more common in younger individuals, whereas ATR astigmatism becomes more prevalent with age. These findings highlight age-related changes in astigmatism patterns and provide valuable local data to guide refractive correction in Iraq.

Keywords: Astigmatism, Refractive Errors, Vision, Ocular, Visual Acuity, Refraction.

How to Cite this Article: Abady N, Muhsin MM, Al-Dehaimy EB. Astigmatism in Iraqi Clinical Setting: Distribution and Axis Patterns. 2026;42(1):1-5. **Doi:10.36351/pjo.v42i1.2209**

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Received: August 22, 2025
Revised: November 30, 2025
Accepted: December 24, 2025

INTRODUCTION

Astigmatism, a common refractive error, can affect the visual acuity and quality of life. Understanding its characteristics is important for proper refractive correction and clinical planning.[1] It results from the refraction of light on irregular corneal surfaces (corneal astigmatism), or on irregular lens surfaces (lenticular astigmatism) or both.[2,3] Astigmatism is classified according to the positions where the foci of light are formed in relation to the retina into; simple, compound and mixed astigmatism.[3] According to the steepest meridian alignments, astigmatism is also classified into; with-the-rule (WTR), against-the-rule (ATR), and oblique.[4]

Astigmatism can interfere with the normal development of vision in children causing amblyopia, as well as causing symptoms such as eye strain (asthenopia) and spectacles intolerance. It is important to analyze the patterns of astigmatism in order to guide effective refractive correction such as eyeglass, contact lens, laser corrections and surgical procedures like Toric intraocular lens implantation.[5] Previous researches have shown that the pattern and distribution of these axis types of astigmatism vary across different geographic regions and ethnic groups.[6,7,8] Additionally,

other factors such as age, gender and environmental influence the development and characteristics of astigmatism.[9,10]

Local data regarding prevalence, characteristics, types and patterns of astigmatism is limited.[12,13] However, astigmatism is recognized as the most frequent refractive error globally, and numerous studies have shown that its prevalence changes across different age groups, where it accounts for 15% of refractive errors in children and can reach as high as 40% in adults.[11] In Iraq, a prior study reported astigmatism as the most frequent type of refractive error, affecting 24.6% of children and adolescent patients and 32.8% of adult patients at eye clinic.[13]

This study aims to investigate the distribution of astigmatism axis among Iraqi patients, with a particular emphasis on the relationship between axis orientation and demographic variables such as age and gender.

METHODS

A cross-sectional study was conducted from January 2024 to March 2024 to investigate the characteristics and axis patterns of astigmatism. It was conducted at College of Medicine, University of Fallujah. This clinic is the only one that provides ophthalmic public health services to the residents of Fallujah city with a total population of around 380,000 people.[14] The study was carried out in accordance with the Declaration of Helsinki, and ethical approval was obtained from the local ethics committee at the College of Medicine, University of Fallujah **(University Reference no: 341)**. Inclusion criteria were any patient visiting the outpatient eye clinic, of all ages who presented with astigmatism and who consented to participate in the study. Patients with a history of ocular surgery or ocular trauma, as well as those who did not provide consent, were excluded from the study.

All participants had full eye examination by trained ophthalmologists. Unaided visual acuity (UVA) and autorefraction were done and best corrected visual acuity (BCVA) was obtained. The results were recorded in a Microsoft office Excel sheet.

Definitions of the International Classification of Diseases (ICD-11) by World Health Organization (WHO) were used. Normal to subnormal visual acuity (VA) as Snellen chart distance visual acuity of 6/6 to 6/18, moderate visual impairment as VA of 6/18 to 6/60, severe visual impairment as VA worse than 6/60, and blindness as VA worse than 3/60.[15]

To ensure consistency in data collection and analysis, all astigmatism cases were recorded in minus cylinder notation, and the cut-off value used for astigmatism was ≥0.5 dioptre cylinder (DC). Astigmatism severity was categorized based on cylindrical power into mild (-0.5 to ≤ -3.00 DC), moderate (≥ -3.25 to ≤ -5.00 DC), and severe astigmatism (≥ -5.25 DC).

Patterns of regular astigmatism axes were defined as follow; with-the-rule astigmatism (WTR) as a minus cylindrical axis at 180◦± 15◦, against-the-rule (ATR) as a minus cylindrical axis at 90◦± 15◦ and oblique astigmatism (neither WTR nor ATR).[15]

To analyse magnitude of astigmatism and axis patterns, the subjects were stratified by age into the following groups:1-10, 11-20, 21-30, 31-40, 41-50, 51-60 and ≥ 61 years groups.

Descriptive analysis included demographic characteristic of the study participants. The presenting monocular visual acuity and the visual acuity after refractive correction were analysed. Chi-square test and Pearson correlation were used to assess the association between astigmatism magnitude and axis pattern with demographic factors such as age and gender. IBM SPSS V28 software was used in data analysis, and *p*-value of less than 0.05 was regarded as statistically significant.

RESULTS

This study included 112 patients, accounting for (224) eyes. Of these cases, 53were males (47.3%) and 59 were females (52.7%). Mean age of the participants was 36.95 ± 18.2 years (range4 – 78years).

There were 71 eyes(31.7%) which presented with normal uncorrected visual acuity(Snellen Chart 6/6 to 6/9), while (87 eyes, 38.8%)presented with subnormal UCVA(Snellen Chart ≤ 6/18),58 eyes (25.9%) had UCVA of 6/18 to 6/60and only8 eyes (3.6%) had visual acuity worse than 6/60.

After the refractive correction, most of the eyes (87.9%) were corrected to normal VA(Snellen Chart 6/6), 23 eyes (10.4%)were corrected to 6/12 to 6/18, 3 eyes (1.3%)to 6/18 to 6/60, and only one case(0.4%) had best corrected visual acuity less than 6/60.

A total of 196 eyes (87.5%) had mild astigmatism, followed by 19 eyes (8.5%) with moderate

Table 1: *Astigmatism magnitude categorized by age groups.*

Age (Years)	Magnitude of Astigmatism			No. of Patients (%)
	-0.5 to ≤ -3.00	≥ -3.25 to ≤ -5.00	≥ -5.25	
≤ 10	9	0	1	10 (4.5%)
11-20	43	2	3	48 (21.4%)
21-30	36	0	0	36 (16.1%)
31-40	30	3	2	35 (15.6%)
41-50	30	7	2	39 (17.4%)
51-60	27	2	1	30 (13.4%)
≥ 61	21	5	0	26 (11.6%)
Total (%)	196 (87.5%)	19 (8.5%)	9 (4%)	224(100%)

Table 2: *Astigmatism axis patterns categorized by age groups.*

Age (Years)	Axis of Astigmatism			No. of Patients (%)
	WTR	ATR	Oblique	
≤ 10	9*	1	0	10 (4.5%)
11-20	35*	10	3	48 (21.4%)
21-30	21	10	5	36 (16.1%)
31-40	30*	4	1	35 (15.6%)
41-50	17	21	1	39 (17.4%)
51-60	8	20*	2	30 (13.4%)
≥ 61	3	22*	1	26 (11.6%)
Total (%)	123 (54.9%)	88 (39.3%)	13(5.8%)	224 (100%)

Note: * indicates statistically significant value ($p< 0.05$)

astigmatism and 9 eyes (4%) with severe astigmatism.

In patients under 40 years, astigmatism magnitude was mostly ≤ -3.00 DC increasing with the age.

Astigmatic magnitude showed no significant association with age (p = 0.447) nor with gender (p = 0.508). The severity of presenting uncorrected visual impairment increased significantly with greater astigmatism magnitude (Chi Square test, p < 0.001) **(Table 1).**

In general, WTR astigmatism was the most frequent pattern observed in the study sample with 123 cases (54.9%), followed by ATR with 88 cases (39.3%), and oblique astigmatism with only 13 cases (5.8%). Below the age of 40 years, WTR astigmatism was common (95 out of 129 patients), and beyond the age of 40 years, ATR astigmatism was common (41 out of 69 patients). Oblique astigmatism did not show a clear trend across age groups but was more commonly observed in subjects aged 11 to 30 years (8/84), **(Table 2).**

A statistically significant relationship between the age of patients and astigmatism axis was found, while the gender of the patients had no statistically significant relation (p = 0.992).

DISCUSSION

This study aimed to examine the distribution and characteristics of astigmatic axis patterns among a group of patients ranging in age from 4 to 78 years. The key outcome revealed that WTR astigmatism was the most common type, particularly in the younger age groups. Conversely, ATR astigmatism showed an increasing prevalence with age, while oblique astigmatism was the least common pattern across all age categories.

In this cohort, the presence of any form of astigmatism corresponded with a reduction in the presenting uncorrected visual acuity. The increase in the astigmatic magnitude correlated with worse unaided visual acuity. This finding agrees with previous studies conducted in Southern China and in Maldives, where astigmatism was also found to significantly affect the visual acuity.[16,17] Notably, in Maldives, 14.5% of patients had presenting visual acuity of 6/60 or worse, with only 2.2% improved after glasses correction.[17] In our study, only 8 patients (3.6%) had presenting visual impairment of ≤ 6/60 which was corrected with glasses, and only one eye (0.4%) remained below 6/60.

In terms of astigmatic axis patterns across the entire study sample, WTR astigmatism was the most

detected pattern, followed by ATR, while oblique astigmatism was the least prevalent (54.9%, 39.3%, 5.8% respectively). The axis of astigmatism was dependent on age but not on gender of the participants. These results align with previous international studies[7,20] which also found that WTR astigmatism was the most prevalent pattern, followed by ATR astigmatism and oblique astigmatism.

A prior study conducted on 277 astigmatic patients in Maldives,[17] WTR was most common astigmatism (48.7%), then ATR astigmatism (30.3%) and oblique astigmatism (20.9%).

A large-scale cross-sectional study conducted in China on 25,945 students aged 9 to17 years, reported that the majority of the astigmatic cases had WTR astigmatism (76.9%), while ATR and oblique astigmatism was found in only (13.1%) and (10%) of them.[18] Similarly, a study conducted in Iran on 5528 schoolchildren aged 6 to 12 years, found that the prevalence of WTR astigmatism, ATR astigmatism and oblique astigmatism were (14.2%, 2.1%, and 0.33% respectively).[19] In contrast, a study on Iranian geriatric patients above the age of 60 years, found that 20%, 10%, and 21% of study participants had ATR, WTR, and oblique astigmatism, respectively.[20]

A previous local study carried out on adult patients over 18 years of ag, reported an astigmatism prevalence of 34.25%.[12] Among these cases, ATR astigmatism was the most frequent astigmatism pattern (20.3%), followed by WTR astigmatism (11.7%), oblique astigmatism (2.25%). The observed findings may be explained by the study's focus on adult patients over the age of 18 years, in which the WTR is usually more common in the older individuals. It is hypothesized that with increasing age, astigmatism axis shows shifting from with-the-rule to against-the-rule orientation.[21] This shifting is believed to be caused by several aging factors including the change in the corneal curvature, structural changes in the corneal layers, alterations in the extraocular muscles and eyelids' tension and anatomy.[21,22]

CONSLUSION

In conclusion, WTR was a common pattern of astigmatism among young people and ATR was more common in older individuals. Studying and reporting astigmatism characteristics has its importance as a source of documented data, and for further refractive correction planning. Although this study was limited by its cross-sectional design and lack of data on genetic, environmental or lifestyle factors, it provides important baseline data for refractive errors. Future longitudinal research is warranted to explore additional factors affecting the development and the characteristics of astigmatism.

Funding: This study was not funded by any organization.

Patient's Consent: Researchers followed the guidelines set forth in the Declaration of Helsinki.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Institutional review board/Ethical review board **(Reference no: 341)**.

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