

Astigmatism: classification of the astigmatic ametropia revisited

Astigmatismo: classificação da ametropia astigmática revista

Astigmatismo: revisión de la clasificación de la ametropía astigmática

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ABSTRACT

The traditional classification of astigmatic ametropia is based on the position of the focal lines of the Sturm's interval relative to the retina. The inconsistency of using the focal lines as a reference becomes evident in the mixed group, which does not specify the spherical refractive condition of the eye. This study aims to propose a novel classification for *astigmatic ametropia* that fills this void becoming, therefore, more useful than the current one.

Keywords: Astigmatism; Refractometry; Refractive Errors.

RESUMO

A classificação tradicional da *ametropia* astigmática baseia-se na posição das linhas focais do intervalo de Sturm em relação à retina. A inconsistência do uso das linhas focais como referência torna-se evidente no grupo misto, uma vez que ele não especifica a condição refrativa esférica do olho. O cavalgamento da retina pelo intervalo de Sturm não fornece pistas que identifique se o olho é míope, hipermetrope ou esfericamente emetrope. Este artigo propõe uma nova classificação para a *ametropia* astigmática que é mais útil que a atual pelo fato de preencher essa lacuna conceitual.

Palavras-chave: Astigmatismo; Refratometria; Erros Refrativos.

RESUMEN

La clasificación tradicional de la ametropía astigmática se basa en la posición de las líneas focales del intervalo de Sturm con relación a la retina. La inconsistencia del uso de las líneas focales como referencia se vuelve evidente en el grupo mixto, dado que no especifica la condición refractiva esférica del ojo. La sobreposición de la retina en el intervalo de Sturm no suministra pistas que identifiquen si el ojo es miope, hipermetrope o esféricamente emetrope. Este artículo propone una nueva clasificación para la ametropía astigmática que es más útil que la actual por el hecho de rellenar esa laguna conceptual.

Palabras Clave: Astigmatismo; Refractometría; Errores de Refracción.

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INTRODUCTION

Astigmatism is a term used to identify both an ametropia and an aberration. Astigmatic ametropia (AA), in particular, is a combination of a spherical ametropia (or emmetropia) with an astigmatic aberration. Although this way of understanding AA is seldom mentioned in the literature, it is the implicit assumption when using the spherical equivalent (SE_a) to evaluate the spherical component of refractive errors corrected with spherocylindrical lenses. This reason explains why SE_a is so well known among those who work with eyeglass lenses, contact lenses, corneal topography, cataract surgery, refractive surgeries, and cross-linking.

Not only is the name astigmatism ambiguous, but also is its classification. Traditionally, AA was classified as myopic, hyperopic, and mixed.¹ It is myopic when both focal lines of Sturm's interval are in front of the retina, or when one of them is in front of, and the other is on, the retina (Fig. 1). The first event configures a compound myopic, and the second, a simple myopic AA. An AA is hyperopic when both focal lines are behind the retina, or when one of them is behind, and the other is on the retina (Fig. 2). The first condition represents a compound hyperopic, and the second a simple hyperopic AA. Mixed AA is when the proximal focal line is in front of, and the distal focal line is behind, the retina (Figs. 1 and 2).

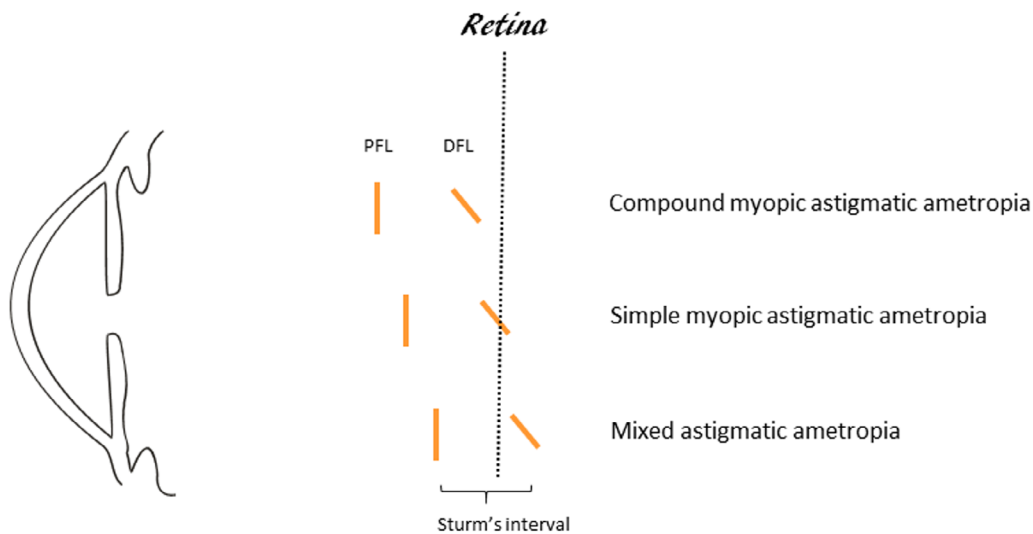


Figure 1. Myopic astigmatic ametropia by the traditional classification. PFL: proximal focal line; DFL: distal focal line.

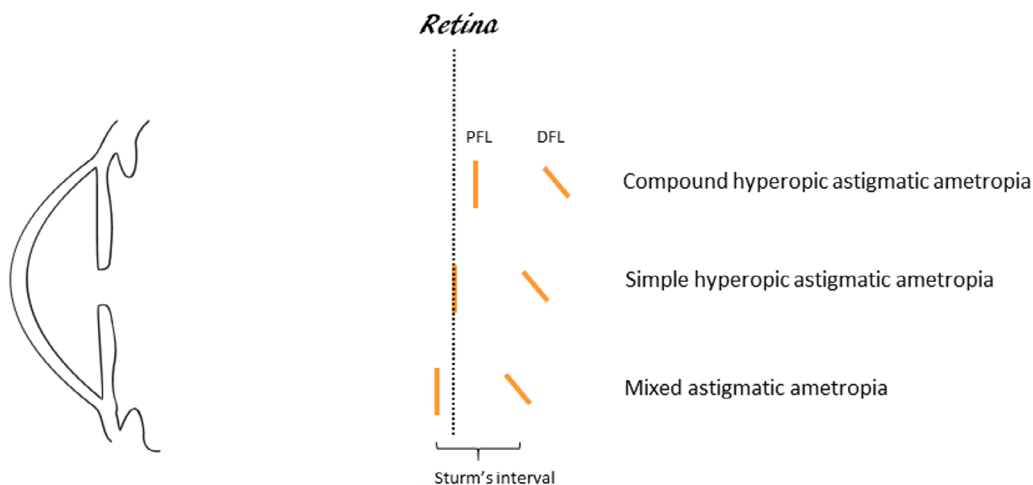


Figure 2. Hyperopic astigmatic ametropia by the traditional classification. PFL: proximal focal line; DFL: distal focal line.

The traditional classification of AA relies, therefore, on the position of the focal lines of Sturm's interval relative to the retina. The inconsistency of using focal lines as a reference becomes evident in the mixed group, which does not specify the spherical refractive condition of the eye. The straddling of the retina by Sturm's interval does not indicate whether the eye is myopic, hyperopic or spherically emmetropic. This article proposes a novel classification for astigmatic ametropia that is more useful than the current one by filling this conceptual gap.

NEW CLASSIFICATION OF ASTIGMATISM

By replacing the limits of Sturm's interval with the circle of least confusion (*CLC*) as the reference point for the classification of AA, we propose a straightforward classification that is perfectly aligned with SE_a . In this novel line of reasoning, AA is classified as myopic, hyperopic, and neutral when the *CLC* is in front of ($SE_a < 0$), behind ($SE_a > 0$), and on the retina ($SE_a = 0$), respectively.

This classification is agreeable with the concept that AA is a combination of spherical ametropia — quantified by SE_a , — with astigmatic aberration — computed by the dioptric extension of Sturm's interval. ² Despite its simplicity, it is sufficient for dealing with all the practical aspects of AA. However, for the sake of completeness, it can be expanded to include the classical concepts of compound, simple, and mixed astigmatism. With this addition, myopic and hyperopic AAs become subdivided into compound, simple, and mixed forms like in the traditional classification (Figs. 3 – 4, and Table 1).

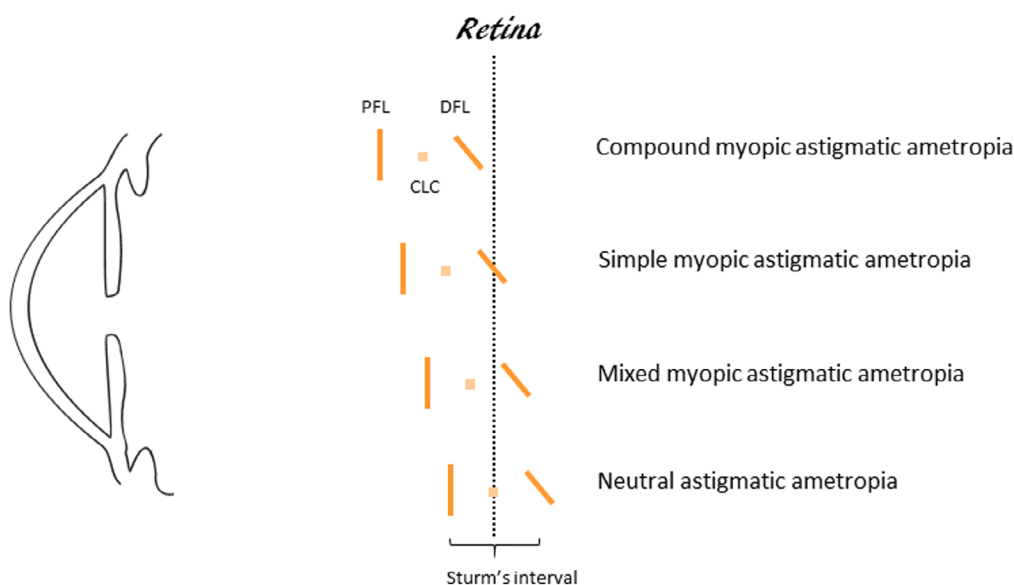


Figure 3. Myopic and neutral astigmatic ametropias by the novel classification. PFL: proximal focal line; DFL: distal focal line; CLC: circle of least confusion.

Therefore, the new classification to its full extent includes the following categories:

- (1) Compound myopic astigmatic ametropia.
- (2) Simple myopic astigmatic ametropia.
- (3) Mixed myopic astigmatic ametropia.
- (4) Neutral astigmatic ametropia.
- (5) Mixed hyperopic astigmatic ametropia.
- (6) Simple hyperopic astigmatic ametropia.
- (7) Compound hyperopic astigmatic ametropia.

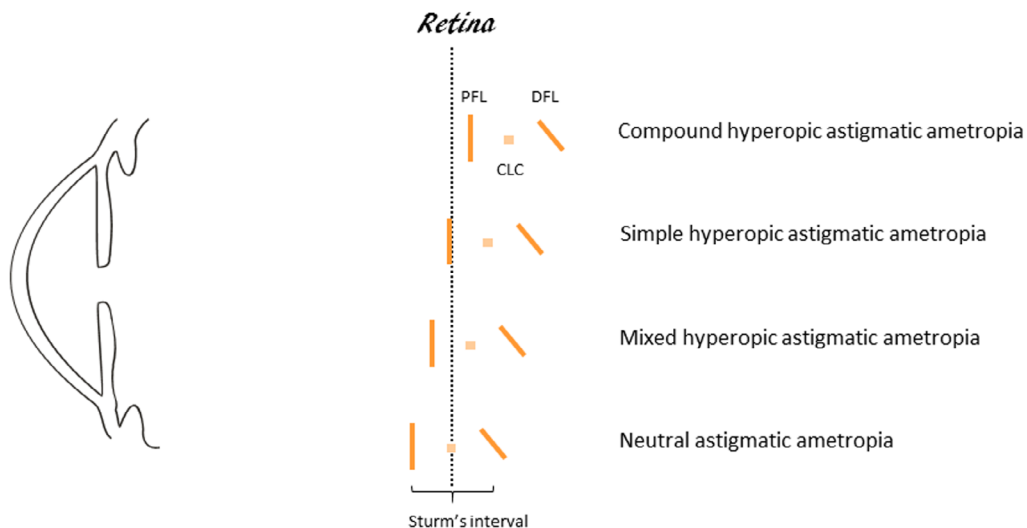


Figure 4. Hyperopic and neutral astigmatic ametropia by the novel classification. PFL: proximal focal line; DFL: distal focal line; CLC: circle of least confusion.

Table 1. Astigmatic ametropia by novel classification.

Astigmatic ametropia	Subtype	SE_s	<i>Retina</i>		
			<i>CLC</i>	<i>PFL</i>	<i>DFL</i>
Myopic	Compound	-	in front	in front	in front
	Simple	-	in front	in front	on
	Mixed	-	in front	in front	behind
Neutral		0	on	in front	behind
Hyperopic	Compound	+	behind	behind	behind
	Simple	+	behind	on	behind
	Mixed	+	behind	in front	behind

SE_s : spherical equivalent of the ametropia; *CLC*: circle of least confusion; *PFL*: proximal focal line; *DFL*: distal focal line.

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