

# Strabismus with Refractive Error in Children : Literature Review

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## Abstract

Strabismus is a misalignment of the visual axis that occurs because the requirements for normal binocular vision are not met, including functional, motor, and central nervous conditions. Strabismus is an eye disorder that often occurs in children. One of the risk factors for strabismus in children is impaired visual function caused by refractive errors. The mechanism of strabismus due to refractive errors involves three factors: uncorrected refractive errors, an accommodative urge to produce a clear image, and the patient's fusion mechanism, which is insufficient to compensate for the increased tone. This literature review investigates the correlation between strabismus and refractive error, exploring the types of strabismus with the types of refractive error.

Keywords: Strabismus; Refractive Error, Children

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## 1. Introduction

Strabismus is a misalignment of the visual axis that occurs because the requirements for normal binocular vision are not met, including functional, motor and central nervous conditions [1]. Strabismus is an eye disorder that often occurs in children. One of the risk factors for strabismus in children is impaired visual function caused by refractive error [2]. s. The mechanism of strabismus due to refractive errors involves three factors: uncorrected refractive errors, an accommodative urge to produce a clear image, and the patient's fusion mechanism, which is insufficient to compensate for the increased tone [3]. Children with convergent strabismus (esotropia, occurring in 60.1%) are more common than divergent strabismus (exotropia, occurring in 32.7%). Strabismus and refractive errors are interrelated, especially in children with significant hypermetropia [4].

Many studies have shown that the type of refractive error in strabismus patients influences the type of strabismus. This literature review further investigates the influence type of refractive error on the type of strabismus in children.

## 2. Materials and Methods

The investigation used resources like Google Scholar, PubMed, NCBI, Elsevier, and trustworthy health association websites. The search utilized keywords such as strabismus, refractive error, children, and health literacy. Researcher conducted on November 27, 2023. The research incorporated articles that explored the

relationship between different types of strabismus and various refractive errors in children. No limitations were applied based on gender, language, or demographics, and studies without duplicated datasets.

### 3. Discussion

#### 3.1. Strabismus in children: An Overview

Incomplete visual development can lead to the emergence of strabismus in infants, but strabismus tends to disappear as children grow due to the continuous maturation of their optical system. However, some types of strabismus persist beyond childhood. Binocular fusion disorders, preventing both eyes from focusing on the same point, are a reason for the occurrence of strabismus [5]. Strabismus, commonly known as crossed eyes, is a condition where the eyes are not correctly aligned and point in different directions. One eye may look straight ahead while the other rotates inward, outward, upward, or downward. The misalignment can shift from one eye to another [3].

Approximately 5% of the population suffers from binocular vision disorders, with around 74% experiencing strabismus. Among children with strabismus, convergent strabismus (esotropia or inward deviation, occurring in 60.1%) is more common than divergent strabismus (exotropia or outward deviation, occurring in 32.7%). The onset of strabismus mainly occurs before the age of 5. Therefore, early detection and intervention are essential to ensure optimal visual function [4].

Examination of strabismus in children is conducted comprehensively [6]. Several components of the strabismus examination include obtaining the patient's history, physical examination, visual acuity assessment, stereopsis examination, sensory anomaly assessment, measurement of the strabismus angle, motility examination, and fundus examination for screening other eye diseases [7].

Uncorrected strabismus will result in abnormal binocular vision with sensory problems [1]. This problem occurs when the vision in the distorted eye makes objects appear blurry, which the brain ignores or suppresses so that only one object is visible. In addition, children with strabismus can develop amblyopia. Other detrimental consequences of strabismus are reduced stereo acuity, abnormal head posture, and decreased eye contact, which affects a pre-verbal child's ability to communicate effectively. If a child is found to have reduced visual acuity, then treatment can be started at the right time in an effort to improve visual abilities and prevent permanent visual abnormalities. In particular, children who have strabismus need to be regularly monitored for any vision changes, along with orthoptic assessment [4].

#### 3.2. Strabismus in children with refractive errors

Strabismus with refractive errors typically manifests as horizontal strabismus. Refractive errors such as myopia, hypermetropia, and astigmatism can all be associated with it [8]. Normally, eyes are hypermetropic from birth and gradually transition towards emmetropia within the initial year of life. Emmetropization, the process responsible for this transition, adjusts the optical power of the eyes to match their axial length, enabling unaccommodated eyes to focus on distant objects [9]. However, in instances of significant hypermetropia, the emmetropization process may face obstacles, potentially resulting in the onset of

strabismus. However, on the flip side, emmetropization can increase the progression of myopia. The eye's accommodation process also influences Strabismus with refractive errors. Uncorrected strabismus over an extended period can result in binocular vision dysfunction. When included in global statistics, uncorrected refractive errors are responsible for 53% of vision loss worldwide [10].

### 3.3. Pathophysiology of Refractive Errors as the Cause of Strabismus

Assessing visual function can help determine binocular vision. Differences in visual acuity between the right and left eyes are more sensitive to influencing binocular vision [1]. Variations in vision between the right and left eyes, such as asymmetric cataracts, refractive errors, or other eye diseases, can also cause or exacerbate strabismus. In refractive errors, anisometropia, where the inability to focus both eyes simultaneously leads to the suppression of the image in one eye, is a significant factor. Anisometropia is another cause of strabismus, such as high hypermetropia, where both eyes fail to form a focused image in one eye [11].

The most common refractive error causing strabismus is hypermetropia. Generally, children have hypermetropia (1-3 Diopters) for emmetropization (physiological). However, considerable hypermetropia needs correction by approximately two-thirds [7]. Uncorrected hypermetropia becomes one of the mechanisms of accommodative esotropia. In uncorrected hypermetropia, the patient must accommodate to focus the image on the retina. If the divergence fusion mechanism is insufficient to compensate for the increased convergence tone, esotropia may result [3]. The initial management involves the use of corrective glasses. However, some patients with accommodative esotropia show a decrease in esotropia angle when wearing glasses but still have residual esotropia despite full hypermetropia correction [7].

Refractive errors are a significant risk factor for exotropia. Prescription of corrective eyeglasses is necessary to manage substantial refractive errors. For example, correcting mild myopia can improve exotropia control. Correcting refractive errors with glasses or contacts can enhance retinal image clarity and help control exotropia in these patients. Soft to moderate hypermetropia does not need routine correction in intermittent exotropia children, as refractive correction can worsen deviation. Children with hypermetropia ( $>+4.00$  Diopters) may be unable to maintain accommodation, resulting in a blurry retinal image and apparent exotropia [3].

Vertical strabismus is less common than horizontal strabismus. Generally, vertical strabismus occurs due to dysfunction in extraocular muscles related to vertical function. One possible cause related to refractive errors is DVD (Dissociation Vertical Deviation). DVD is an ocular motor disorder characterized by the slow upward movement of one eye while the patient fixates on the other. DVD is usually not noticeable at birth and typically becomes apparent around 2-3 years old. DVD can affect vision because the shadow from the eye deviates upward or is blocked, resulting in decreased visual acuity [12], [13].

## 4. Conclusion

In the exploration, the literature underscores the intricate relationship between types of refractive errors and the manifestation of strabismus in pediatric populations.

The association between refractive errors and strabismus is multifaceted. Variations in vision, like refractive errors, are pivotal in causing or exacerbating strabismus. Anisometropia, characterized by the inability to focus both eyes simultaneously, becomes a significant factor, especially in high hypermetropia, where a focused image fails to form in one eye. Uncorrected hypermetropia becomes a mechanism for accommodating esotropia, emphasizing the importance of early intervention with corrective glasses. Refractive errors also pose a significant risk for exotropia, necessitating the prescription of corrective eyeglasses for effective management. Vertical strabismus, although less common than its horizontal counterpart, introduces additional complexity. Dysfunction in extraocular muscles related to vertical function, coupled with conditions such as Dissociation Vertical Deviation (DVD), underscores the diverse etiological factors.

In conclusion, understanding the intricate interplay between refractive errors and strabismus types is crucial for early detection and intervention in pediatric patients. The nuances of each refractive error type inform adjusted management strategies, highlighting the necessity of a comprehensive approach to optimize visual outcomes in children with strabismus and refractive errors.

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