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Prism Prescription in Strabismic and Non-Strabismic Cases

Ejike, Thaddeaus Chukwudi[1]; Ubani, Udo Ahanna[2]; and Onyekwere, Ike Francis[2]

[1]Department of Optometry, Gregory University Uturu, Abia state.

[2]Faculty of Optometry, Abia State University Uturu, Abia State.

*Correspondence:
Ubani Udo Ahanna, Faculty of Optometry, Abia state University, Uturu Abia State, Nigeria.

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ABSTRACT

This systematic review investigates the clinical effectiveness, prescription techniques, outcomes, and complications associated with prism therapy in both strabismic and non-strabismic binocular vision disorders. Prism lenses remain a key non-invasive intervention for managing ocular misalignment and vergence anomalies, but clinical variability in application and outcomes necessitates a comprehensive synthesis of current evidence. A systematic search was conducted across PubMed, Embase, Cochrane Library, Scopus, and Google Scholar for studies published between January 1990 and June 2025. Inclusion criteria encompassed randomized controlled trials, observational studies, and case series evaluating prism use in strabismic or non-strabismic patients. A total of 498 records were identified, with 38 studies meeting all inclusion criteria. Data extraction and quality assessment were conducted using standardized forms, and risk of bias was evaluated with the Cochrane Risk of Bias Tool and Newcastle–Ottawa Scale. Prism therapy in strabismic cases demonstrated effectiveness in alleviating diplopia, improving fusion, and providing cosmetic alignment in patients with small, comitant deviations. Fresnel and ground-in prisms were commonly employed. In non-strabismic cases, particularly convergence insufficiency and vertical phoria, prisms effectively reduced symptoms such as eye strain, blurred vision, and difficulty with near work. However, outcomes varied with dosage, adaptation, and patient compliance. Complications such as prism adaptation, diplopia persistence, and suppression were noted across both populations. Prism therapy is effective in selected strabismic and non-strabismic cases when guided by appropriate clinical evaluation and patient selection. The evidence supports conservative, individualized prescription practices with close monitoring. Further high-quality trials are needed to establish standardized protocols and long-term outcome data for prism use in diverse patient populations.

Keywords

Prism prescription, Strabismus, Heterophoria, Convergence insufficiency, Binocular vision, Fresnel prism, Prism adaptation.

Introduction

Background and Significance of Prism Prescription in Strabismic and Non-Strabismic Cases

Prism prescription is a non-invasive optical intervention widely used in the management of binocular vision anomalies. Prisms alter the path of light entering the eye, enabling individuals with ocular misalignments or vergence disorders to maintain binocular single vision or to alleviate asthenopic symptoms. Their clinical utility spans a wide spectrum of visual conditions, particularly strabismic and non-strabismic binocular vision disorders, where they serve different but complementary roles [1,2].

In strabismus, which involves a manifest deviation of one eye relative to the other, prisms are primarily prescribed to eliminate diplopia, facilitate fusion, and occasionally improve cosmetic alignment, especially in patients with small to moderate, comitant deviations [3]. They are also commonly used in patients with cranial nerve palsies or post-surgical residual deviations, where temporary symptomatic relief is desired [3,4].

In contrast, non-strabismic conditions—such as convergence insufficiency, divergence excess, and vertical heterophoria—

typically involve latent deviations (heterophorias) that are kept in check by fusional vergence mechanisms. In these cases, prisms serve a relieving function, reducing the vergence demand on the visual system and thus alleviating symptoms such as eye strain, blurred vision, and difficulty concentrating during near tasks [1,5-8].

Despite the widespread use of prisms in both categories, there remains substantial variability in prescription methods, clinical outcomes, and reported complications. Moreover, questions remain regarding how best to prescribe prisms, the appropriate dosage, and the patient characteristics that predict successful outcomes. While several studies have explored the effectiveness of prism therapy, there is a need to consolidate current evidence to guide clinical practice.

Research Question and Objectives

This systematic review aims to synthesize existing literature on prism prescription in both strabismic and non-strabismic binocular vision disorders. The review is guided by the following research question:
"What is the clinical effectiveness, optimal prescription method, and associated complications of prism therapy in strabismic versus non-strabismic patients?"

The specific objectives of this review are to:

1. Examine the effectiveness of prism prescription in strabismic and non-strabismic cases.
2. Identify and compare prescription techniques, such as Fresnel and ground-in prisms, in both patient populations.
3. Evaluate the clinical outcomes, such as symptom relief, visual comfort, and binocular fusion.
4. Document and compare the complications and limitations of prism use in each group.
5. Provide evidence-based recommendations for clinical practice based on the comparative analysis.

By achieving these objectives, the review seeks to inform clinicians on the optimal application of prism therapy and identify gaps in the literature that warrant future investigation.

Methods

This systematic review adhered to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2020 guidelines to ensure transparency, consistency, and methodological rigor throughout the review process [9].

Search Strategy and Databases Searched

A comprehensive literature search was conducted to identify studies evaluating the use, outcomes, and complications of prism prescription in both strabismic and non-strabismic binocular vision disorders. The following electronic databases were systematically searched:

- PubMed/MEDLINE
- Embase
- Scopus
- Cochrane Library
- Google Scholar (for gray literature and additional sources)

The search included literature published between January 1990 and June 2025, using both Medical Subject Headings (MeSH) and free-text terms. Boolean operators were applied to combine search terms such as:
("prism prescription" OR "prism therapy") AND (strabismus OR "non-strabismic binocular disorders" OR "heterophoria" OR "convergence insufficiency" OR "vertical phoria") AND (effectiveness OR outcomes OR complications)

Manual searches of references in key articles and optometric textbooks were also conducted to identify additional relevant studies not captured in the database searches.

Study Selection and Screening Process

The initial database and manual search yielded a total of 498 studies. After removal of 118 duplicate records, 380 unique articles remained for screening.

- Title and abstract screening was performed independently by two reviewers to assess relevance to prism therapy in strabismic and non-strabismic conditions.
- Full-text review was conducted for 94 articles that met the inclusion criteria based on the abstract.
- 56 articles were excluded due to reasons such as insufficient data, lack of focus on prism use, or inappropriate study design (e.g., editorials, case reports).

Ultimately, 38 studies met all inclusion criteria and were included in the final qualitative synthesis.

Inclusion Criteria

- Studies evaluating prism therapy in strabismic or non-strabismic binocular vision conditions
- Studies reporting on effectiveness, techniques, outcomes, or complications
- Peer-reviewed RCTs, cohort studies, cross-sectional studies, or case series
- Articles published in English

Exclusion Criteria

- Case reports, letters, or editorials
- Studies unrelated to prism use in binocular vision therapy
- Non-English publications or inaccessible full-texts

Data Extraction and Quality Assessment

A structured data extraction form was developed to ensure uniformity. Two reviewers independently extracted data from all 38 included studies. Extracted variables included:

- Study title, author(s), and year of publication
- Country and clinical setting
- Study design and sample size
- Patient demographics and type of binocular vision disorder
- Prism prescription technique, dosage, and duration
- Reported clinical outcomes, such as diplopia relief, visual comfort, reading efficiency, and symptom reduction

- Documented complications or limitations of prism use

To assess study quality and potential bias:
- The Cochrane Risk of Bias Tool was used for randomized controlled trials [8]
- The Newcastle–Ottawa Scale (NOS) was used for non-randomized and observational studies [10]

Each study was rated as low, moderate, or high risk of bias, based on selection criteria, comparability, and outcome assessment methods. Discrepancies between reviewers were resolved by discussion or, if necessary, by a third reviewer. The quality assessment results informed the interpretation of findings but did not serve as exclusion criteria for final inclusion.

Prism Prescription in Strabismic Cases

Prism prescription plays a critical role in the non-surgical management of strabismus, aiming to improve binocular vision, alleviate diplopia, and enhance visual comfort. While surgical correction remains the definitive treatment for many cases of manifest strabismus, prism therapy serves as a valuable adjunct or alternative in specific cases, especially where surgery is contraindicated, refused, or used temporarily.

Types of Strabismus

Strabismus is broadly categorized into esotropia (inward deviation) and exotropia (outward deviation), with further subdivisions based on constancy, comitancy, and age of onset. In constant esotropia, especially in adults, diplopia is common due to sudden misalignment. Intermittent exotropia may benefit from prism adaptation during decompensated phases [11]. Vertical deviations such as hypertropia or hypotropia also respond well to prismatic correction, particularly in cases of fourth nerve palsy or skew deviation [12].

Prism Prescription Techniques

There are two main types of prisms used in clinical practice: Fresnel prisms and ground-in prisms. Fresnel prisms are flexible, press-on prisms applied to spectacle lenses. They are advantageous for trial use, temporary corrections, or high prism diopters, and can be easily modified [13]. However, they may degrade optical quality and cosmesis.

Ground-in prisms are permanently incorporated into spectacle lenses and provide better clarity and cosmetic appearance. They are typically used when a stable deviation is established and long-term correction is needed [14].

Several prism prescription techniques exist in strabismus management:
- Diplopia-relieving prisms are prescribed to fuse double images in small-angle deviations.
- Cosmetic prisms are used in large-angle strabismus to shift the image toward the dominant eye to reduce the visual impact.
- Yoked prisms are used bilaterally to alter head posture in cases like nystagmus or compensatory head tilts [15].

The prism adaptation test (PAT) is frequently employed in esotropic patients to determine surgical dosage or confirm fusion potential. This involves increasing prism power over time to assess whether the deviation increases, suggesting the potential for post-surgical sensory fusion [16].

Outcomes and Complications

The effectiveness of prism therapy in strabismus depends largely on the type, chronicity, and presence of sensory adaptations. In small-angle strabismus, prisms can eliminate diplopia and facilitate binocular single vision [17]. In long-standing or large-angle deviations, their use may be limited to cosmetic improvement or temporary relief. In sixth nerve palsy, temporary Fresnel prisms often alleviate horizontal diplopia during the recovery phase. Similarly, in superior oblique palsy, vertical prisms can effectively manage hypertropia and torsion [18].

However, not all patients adapt successfully to prisms. Prism adaptation syndrome—where the deviation increases after initial correction—can reduce long-term effectiveness [19]. Patients may also experience visual disturbances such as image distortion, chromatic aberration (especially in high-powered Fresnel prisms), and lens discomfort.

Improper prism prescription may cause asthenopia, worsen suppression in amblyopic strabismus, or even disrupt fusion in patients with borderline sensory capabilities [20]. Nevertheless, with accurate prescribing and proper monitoring, prisms remain an essential conservative management tool in strabismus, particularly in adults with acquired diplopia and patients not suited for surgical intervention.

Prism Prescription in Non-Strabismic Cases

Prism prescription in non-strabismic binocular vision disorders is primarily aimed at reducing visual discomfort, improving binocular coordination, and alleviating asthenopic symptoms rather than correcting ocular misalignment. These conditions often involve subtle sensory-motor imbalances that do not manifest as overt strabismus but still significantly impact visual function and performance, especially during near tasks.

Types of Binocular Vision Disorders

Non-strabismic binocular vision disorders are more common than strabismic conditions, especially among school-aged children and adults engaged in intensive near work. Key conditions include:
- Convergence insufficiency (CI) – characterized by a receded near point of convergence, exophoria greater at near than at distance, and reduced positive fusional vergence [21].
- Divergence insufficiency and excess – involving esophoria or exophoria greater at distance than near, respectively [14].
- Vertical heterophoria – a latent vertical misalignment causing symptoms such as headaches, dizziness, or eye strain.
- Decompensated heterophoria – where a phoria that was once asymptomatic begins causing symptoms due to stress, fatigue, or visual overload [22].

These disorders can significantly impact reading fluency, academic performance, and workplace productivity, even in the absence of overt strabismus.

Prism Prescription Techniques

Prism therapy in non-strabismic cases typically aims to reduce the fusional demand on the visual system. Several techniques are used based on the type and severity of the disorder:

- Relieving prisms: prescribed to compensate for part of the phoria, typically using Sheard's criterion for exophoria and Percival's criterion for esophoria [14].
- Vertical prisms: often effective in small amounts (usually ≤1Δ) for vertical heterophoria or associated postural imbalance [23].
- Fixation disparity prisms: determined using subjective methods like the Mallett Unit, especially in cases of symptomatic fixation disparity [15].
- Yoked prisms: occasionally prescribed to alter posture or gait in patients with visually induced postural instability [24].

Prism amounts in non-strabismic cases are generally low—often less than 6 prism diopters—and require careful trial framing or use of Fresnel prisms before committing to permanent ground-in lenses.

Outcomes and Complications

When properly indicated, prisms have been shown to be effective in alleviating symptoms of visual discomfort, particularly in convergence insufficiency, vertical heterophoria, and asthenopic patients with decompensated phorias [25,26]. They may help reduce symptoms such as eye strain, blurred vision, diplopia, and headaches, especially during near work. A key advantage is that prisms offer immediate symptom relief, unlike vision therapy which may require weeks to months. However, prisms do not rehabilitate the underlying vergence or accommodative deficits and, when used improperly, may lead to prism dependence or worsen fusional vergence capacity [27]. Overprescription is a potential complication. Providing too much prism may induce visual confusion, disrupt binocular coordination, or promote adaptation that increases the original phoria [22]. In some cases, symptoms may shift or recur if the underlying binocular disorder remains untreated. Therefore, prism therapy in non-strabismic conditions is best considered as a supplement to active vision therapy, especially in children and motivated adults. Trial use, objective and subjective confirmation, and regular follow-up are critical components of successful outcomes.

Comparison of Prism Prescription in Strabismic and Non-Strabismic Cases

Prism prescription serves as a cornerstone in the conservative management of both strabismic and non-strabismic binocular vision anomalies. Despite their shared use, the goals, application methods, effectiveness, and complications of prism therapy differ significantly between these two patient populations. A nuanced understanding of these differences is vital for optimizing patient care and clinical outcomes.

Comparison of Outcomes and Complications

Therapeutic Goals and Expectations

In strabismic patients, prisms are often used to eliminate diplopia, promote fusion, and improve cosmetic alignment in small to moderate deviations or as a temporary intervention before or after surgery [28,29]. Conversely, in non-strabismic patients, prisms are typically prescribed to reduce fusional demand, alleviate visual discomfort, and stabilize decompensated phorias during tasks requiring sustained convergence [30]. Thus, while the goal in strabismus management is usually to restore binocular single vision (BSV) or comfort in the presence of a manifest deviation, in non-strabismic cases the objective is more preventive—maintaining visual efficiency and preventing symptoms like headaches, blurred vision, and fatigue [31].

Outcomes and Duration of Relief

Studies have shown that prisms are more likely to provide immediate relief of diplopia in acute or small-angle strabismus, such as cranial nerve palsies or post-surgical residual deviations [29,32]. However, in large-angle or longstanding deviations, prisms may offer limited success due to the absence of sensory fusion or significant suppression [33]. In non-strabismic conditions like convergence insufficiency or vertical heterophoria, small amounts of prism—often under 6Δ—have demonstrated moderate to high success rates in reducing visual symptoms, especially when combined with vision therapy [34]. However, prisms alone may not address the underlying vergence or accommodative dysfunction, which can lead to recurrence of symptoms or prism dependence [35].

Complications and Limitations

In strabismic cases, common complications include:

- Prism adaptation—where the deviation increases over time after initial relief [28]
- Visual confusion or suppression, particularly in children with amblyopia
- Limited cosmetic benefit in large-angle deviations

In contrast, non-strabismic patients may experience:

- Over-reliance on prisms, without addressing the root cause
- Reduction in fusional reserves, especially if prisms are used continuously without therapy
- Symptom shift, where discomfort changes in nature rather than being resolved [30]

Conclusion

Prism prescription remains a vital and adaptable tool in the management of both strabismic and non-strabismic binocular vision disorders. This systematic review has highlighted the nuanced differences in the goals, techniques, and outcomes associated with prism use in these distinct clinical populations.

In strabismic cases, prisms are primarily prescribed for diplopia relief, alignment improvement, and visual comfort in patients with small-angle or stable deviations [7,10]. Techniques such as Fresnel prisms and ground-in prisms are selected based on patient needs and the permanence of the deviation. While effective in selected

cases, challenges such as prism adaptation, suppression, and sensory fusion limitations necessitate careful patient selection and follow-up [3,8].

In non-strabismic binocular vision disorders, particularly convergence insufficiency, vertical heterophoria, and decompensated phorias, prisms are used to relieve visual strain, reduce fusional demand, and enhance reading and near-task performance [2,16]. Although prisms provide rapid symptom relief, their use must be balanced with the risk of prism dependency and decreased fusional flexibility if not supported by active vision therapy [1,4].

A central finding across both categories is that low-powered prisms, prescribed based on individualized evaluation and trial adaptation, yield the most favorable outcomes. Trial framing, objective and subjective testing, and ongoing monitoring are essential for success.

Implications for Future Research and Clinical Practice

Despite their widespread clinical use, several areas of prism therapy remain underexplored. Future research should focus on:

- Randomized controlled trials comparing prism therapy to vision therapy or surgical interventions in both strabismic and non-strabismic populations.
- Longitudinal studies to assess the durability of symptom relief, sensory fusion development, and adaptation phenomena over time.
- Neurophysiological studies examining how prisms influence vergence adaptation, cortical plasticity, and visual perception in different age groups.

For clinical practice, practitioners are encouraged to:

- Implement standardized protocols for prism trial and evaluation.
- Educate patients about the intended goals and possible side effects of prism wear.
- Integrate prism therapy with vision therapy where appropriate to promote sustainable visual function.
- Continuously monitor patient outcomes and remain flexible with dosage adjustments.

In summary, prism prescription is most effective when customized, conservatively applied, and closely monitored. With ongoing research and evidence-based practice, clinicians can further refine this powerful intervention to enhance visual performance and quality of life in diverse patient populations.

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