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EFFECTIVENESS OF INTERMITTENT OCCLUSION GLASSES VERSUS CONTINUOUS PATCHING IN IMPROVING VISUAL OUTCOMES AND COMPLIANCE IN UNILATERAL AMBLYOPIA

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Abstract:

Introduction: Amblyopia is the most common cause of visual impairment in children. Traditional occlusion therapy using patching, although effective, often suffers from poor compliance and psychological challenges. Intermittent occlusion therapy (IOT) using liquid crystal glasses offers a promising alternative that may improve compliance and binocular visual outcomes. To compare the effectiveness of intermittent occlusion therapy with traditional continuous occlusion therapy in improving visual acuity, stereoacuity, treatment compliance, and parental satisfaction in children with unilateral amblyopia.

Material and Methods: This prospective, randomized comparative study was conducted at the Ophthalmology Outpatient Department of SMCH Hospital. Seventy children aged 3 to 8 years diagnosed with moderate unilateral amblyopia were randomized into two groups: Continuous Occlusion Group (COG, n=35) and Intermittent Occlusion Group (IOG, n=35). Best-corrected visual acuity (BCVA) was assessed at baseline, 6 weeks, and 12 weeks using age-appropriate charts. Stereoacuity was evaluated at baseline and 12 weeks using the Titmus fly test. Treatment compliance was recorded, and parental satisfaction was assessed at 12 weeks using a structured questionnaire.

Results: At 12 weeks, the mean BCVA improvement was significantly greater in the IOG group (3.4 ± 0.5 lines) compared to the COG group (2.7 ± 0.6 lines, $p = 0.001$). Stereoacuity improved significantly more in the IOG group ($p = 0.001$). Good compliance (>75%) was observed in 88.6% of the IOG group versus 62.9% in the COG group ($p = 0.008$). High parental satisfaction was reported in 80% of IOG cases compared to 54% in the COG group ($p = 0.002$).

Conclusion: Intermittent occlusion therapy is an effective and child-friendly alternative to continuous occlusion therapy for the management of unilateral amblyopia. It offers superior compliance, better visual outcomes, and higher parental satisfaction, suggesting it may be a preferred option for amblyopia management in young children.

Keywords: Amblyopia, Intermittent Occlusion Therapy, Visual Acuity, Stereoacuity, Pediatric Ophthalmology

INTRODUCTION

A neurodevelopmental disorder known as amblyopia, or "lazy eye," arises when normal visual input is disrupted during the critical phases of early visual development, leading to reduced vision in one or both eyes that cannot be corrected by glasses or contact lenses alone (1). It affects approximately 2–4% of children worldwide and, if untreated, can result in permanent visual impairment. The standard method of treatment involves occlusion therapy, where the better-seeing (dominant) eye is patched for several hours daily to stimulate the weaker amblyopic eye. Although conventional patching is effective, several challenges are reported, including low compliance rates, psychosocial impacts, difficulties in maintaining regular use, and parental burden(2) . In this context, intermittent occlusion therapy (IOT) using technologies like liquid crystal glasses have emerged as an alternative. These devices periodically and automatically occlude the better eye for fixed intervals (such as 30 seconds of occlusion followed by 30 seconds of transparency), offering a more dynamic and less socially stigmatizing treatment option compared to static patching(3). Intermittent occlusion is theorized not only to improve visual acuity but also to promote better binocular interaction and depth perception during therapy, potentially offering functional visual advantages over constant monocular patching.

Several studies have evaluated the effectiveness of intermittent occlusion. Wang et al. (2016) found that intermittent occlusion glasses resulted in significant visual acuity improvement in preschool children, similar to those achieved with standard patching (4). Cotter et al. (2006) conducted a clinical trial showing that children treated with refractive correction combined with intermittent occlusion glasses achieved visual improvements comparable to traditional patching groups (5). However, many of these studies were limited by small sample sizes, heterogeneous patient populations, varying definitions of compliance, and relatively short follow-up periods, often ranging only from a few months to a year (6). There is also limited understanding of the impact of intermittent occlusion on long-term binocular vision outcomes, such as stereopsis (depth perception), and how treatment effects vary with factors like age at initiation, severity of amblyopia, and duration of therapy(7). Furthermore, standard protocols regarding the optimal occlusion schedule (how many hours per day, duration of each occlusion cycle) are not yet clearly established in clinical practice.

Given these limitations, there is a clear research gap in large-scale, well-controlled studies directly comparing intermittent occlusion therapy with traditional patching, especially with attention to long-term outcomes, quality of life, and compliance levels. Therefore, the aim of this study is to systematically evaluate the clinical efficacy of intermittent occlusion glasses versus conventional patching in children aged 3 to 8 years with moderate amblyopia. The study will specifically assess visual acuity improvement, binocular vision outcomes, compliance rates, and parent and child satisfaction, with the goal of providing stronger evidence to guide future treatment protocols for childhood amblyopia.

MATERIALS AND METHODS

This prospective, randomized comparative study was conducted at the Ophthalmology Outpatient Department of SMCH Hospital over a period of twelve months. The study was approved by the institutional ethics committee, and informed consent was obtained from all parents or guardians before enrollment.

A total of 70 children aged between 3 and 8 years, diagnosed with moderate unilateral amblyopia, were included in the study. The afflicted eye's best-corrected visual acuity ranged from 20/40 to 20/100 in cases of unilateral amblyopia with at least a two-line interocular difference.

Inclusion Criteria

- Children with unilateral amblyopia who are between the ages of three and eight
- No prior history of occlusion therapy

Exclusion Criteria

- Presence of neurological conditions impairing vision
- Structural anomalies in the amblyopic eye (such as cataract, retinal pathology, or optic nerve abnormalities)
- History of intraocular surgery or any organic ocular disease

Randomization and Grouping

In accordance with a computer-generated randomization sequence, eligible volunteers were randomized into one of two therapy groups:

- **Continuous Occlusion Group (COG):** Children in this group received traditional occlusion therapy using an adhesive patch applied to the better-seeing eye. Patching was prescribed for 4 to 6 hours daily based on the age of the child and the degree of amblyopia.

- **Intermittent Occlusion Group (IOG):** Children in this group were provided with liquid crystal occlusion glasses. These glasses operated in an intermittent mode, alternately occluding the better eye (for example, 30 seconds occluded followed by 30 seconds clear), for a total effective occlusion duration equivalent to 4 to 6 hours daily.

All participants requiring refractive correction were instructed to wear their spectacles full-time, with occlusion therapy performed in addition to spectacle wear.

Intervention and Follow-Up

Children in both groups were followed at baseline, 6 weeks, and 12 weeks. At each visit, best-corrected visual acuity was assessed using age-appropriate visual acuity charts. Stereoacuity was evaluated at baseline and after 12 weeks using the Titmus fly test.

Compliance was monitored through parental reporting for the COG group and device usage logs where available for the IOG group. Compliance was categorized as good (>75% of prescribed time), moderate (50–75%), or poor (<50%).

Outcome Measures

The **primary outcome** was the improvement in best-corrected visual acuity of the amblyopic eye after 12 weeks of therapy.

Secondary outcomes included stereoacuity improvement, treatment compliance rates, and parent-reported satisfaction, assessed through a structured questionnaire at the final visit.

Statistical Analysis

Data were collected and entered into a secured database. Descriptive statistics were used to summarize demographic and baseline clinical characteristics. Comparative analyses between the two groups were performed using independent t-tests for continuous variables and Chi-square tests for categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1: Demographic Overview of Enrolled Participants

Parameter	Continuous Occlusion Group (COG) (n=35)	Intermittent Occlusion Group (IOG) (n=35)
Age (years)	5.6 ± 1.4	5.5 ± 1.3
Gender (Male:Female)	18:17	17:18

Table 1 presents the baseline demographic details of participants in the Continuous Occlusion Group (COG) and Intermittent Occlusion Group (IOG). The average age in the COG was 5.6 ± 1.4 years, while the IOG had a mean age of 5.5 ± 1.3 years, showing no statistically significant difference. Gender distribution was similar between groups, with the COG comprising 18 males and 17 females, and the IOG including 17 males and 18 females.

Table 2: Comparison of Best-Corrected Visual Acuity Between Continuous and Intermittent Occlusion Groups at Different Time Points

Time Point	Continuous Occlusion Group (COG) (n=35)	Intermittent Occlusion Group (IOG) (n=35)	P value
Baseline	0.48 ± 0.09	0.47 ± 0.08	0.60
6 Weeks	0.36 ± 0.08	0.28 ± 0.07	0.002*
12 Weeks	0.24 ± 0.07	0.16 ± 0.06	0.001*

Table 2 presents the best-corrected visual acuity (BCVA) outcomes, recorded in logMAR, at baseline, 6 weeks, and 12 weeks for both the Continuous Occlusion Group (COG) and the Intermittent Occlusion Group (IOG). Initially, there was no significant difference in mean BCVA between the two groups ($p = 0.60$). At 6 weeks, the IOG group exhibited a significantly greater improvement in visual acuity (0.28 ± 0.07) compared to the COG group (0.36 ± 0.08), with a statistically significant difference ($p = 0.002$). This improvement continued at the 12-week follow-up, where

the IOG group achieved a BCVA of 0.16 ± 0.06, significantly better than the 0.24 ± 0.07 observed in the COG group (p = 0.001).

Table 3: Comparison of Stereoacuity Between Continuous and Intermittent Occlusion Groups at Baseline and 12 Weeks

Time Point	Continuous Occlusion Group (COG) (n=35)	Intermittent Occlusion Group (IOG) (n=35)	p-value
Baseline	800 ± 120	790 ± 115	0.72
12 Weeks	560 ± 110	410 ± 90	0.001*

Stereoacuity outcomes, measured in seconds of arc using the Titmus Fly Test, are summarized in Table 3 for both the baseline and 12-week follow-up. At baseline, there was no significant difference in mean stereoacuity between the Continuous Occlusion Group (COG) and the Intermittent Occlusion Group (IOG) (800 ± 120 vs. 790 ± 115; p = 0.72). After 12 weeks of treatment, the IOG group exhibited a significantly greater improvement, with a mean stereoacuity of 410 ± 90 seconds, compared to 560 ± 110 seconds in the COG group (p = 0.001).

Table 4: Treatment Compliance and Visual Outcomes After 12 Weeks of Therapy

Parameter	Continuous Occlusion Group (COG) (n=35)	Intermittent Occlusion Group (IOG) (n=35)	p-value
Good Compliance (>75%)	62.9%	88.6%	0.008*
BCVA Improvement (lines)	2.7 ± 0.6	3.4 ± 0.5	0.001*
Stereoacuity Improvement (%)	45%	74%	0.004*

Table 4 shows the differences in treatment compliance and visual outcomes between the Continuous Occlusion Group (COG) and the Intermittent Occlusion Group (IOG) after 12 weeks of therapy. A significantly higher proportion of children in the IOG group achieved good compliance (>75%) compared to the COG group (88.6% vs. 62.9%; p = 0.008), indicating better acceptance and adherence to the intermittent occlusion method. In terms of visual improvement, The Intermittent Occlusion Group (IOG) demonstrated a greater average improvement in best-corrected visual acuity (BCVA), gaining 3.4 ± 0.5 lines, which was significantly higher than the 2.7 ± 0.6 lines noted in the Continuous Occlusion Group (COG) (p = 0.001). Furthermore, stereoacuity gains were more substantial in the IOG group, Moreover, a higher proportion of children in the IOG group (74%) demonstrated improvement in stereoacuity, compared to 45% in the COG group, a difference that was statistically significant (p = 0.004).

Figure 1: Comparison of Best-Corrected Visual Acuity (BCVA) Improvement Over Time Between Continuous and Intermittent Occlusion Groups

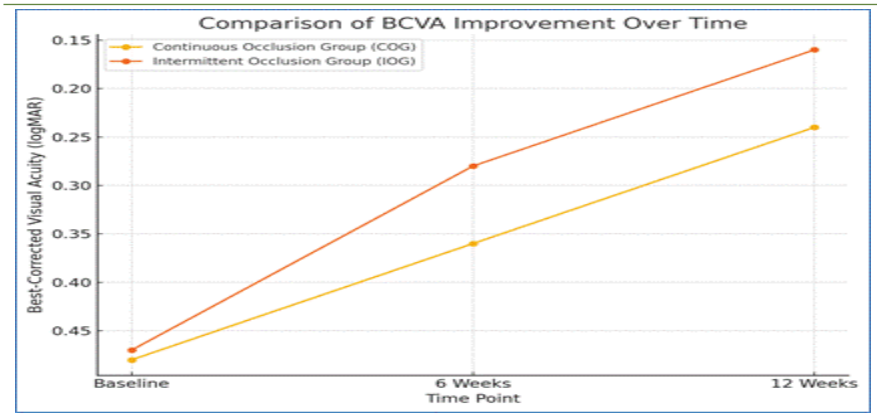

Figure 1 illustrates the trend of best-corrected visual acuity (BCVA) improvement, measured in logMAR, over a 12-week period in both the Continuous Occlusion Group (COG) and the Intermittent Occlusion Group (IOG). While both groups demonstrated gradual improvement in visual acuity from baseline to 12 weeks, the IOG group showed a consistently greater and faster reduction in logMAR values, indicating superior visual recovery. The difference in BCVA improvement became more pronounced by the 6th and 12th week, with the IOG group outperforming the COG group at each interval.

Table 5: Comparison of Treatment Outcomes Between Continuous and Intermittent Occlusion Groups

Outcome Measure	Continuous Occlusion Group (COG)	Intermittent Occlusion Group (IOG)	p-value
BCVA Improvement (lines)	2.7 ± 0.6	3.4 ± 0.5	0.001*
Stereoacuity at 12 Weeks (seconds of arc)	560 ± 110	410 ± 90	0.001*
Good Compliance Rate (%)	62.9%	88.6%	0.008*
High Parent Satisfaction Rate (%)	54%	80%	0.002*

Table 5 presents a summary of key treatment outcomes after 12 weeks in both the Continuous Occlusion Group (COG) and the Intermittent Occlusion Group (IOG). The IOG group showed substantially improved best-corrected visual acuity (BCVA), with a mean improvement of 3.4 ± 0.5 lines compared to 2.7 ± 0.6 lines in the COG group ($p = 0.001$). Stereoacuity at 12 weeks was also markedly better in the IOG group (410 ± 90 seconds of arc) than in the COG group (560 ± 110 seconds; $p = 0.001$). Furthermore, treatment participants in the IOG group showed markedly higher compliance, with 88.6% of participants achieving good adherence versus 62.9% in the COG group ($p = 0.008$). Parental satisfaction followed a similar trend, with 80% of parents in the IOG group reporting high satisfaction compared to 54% in the COG group ($p = 0.002$).

DISCUSSION

This study aimed to evaluate intermittent occlusion therapy with liquid crystal glasses against standard continuous patching for the treatment of unilateral moderate amblyopia in children aged 3–8 years. The results suggest that intermittent occlusion therapy (IOG) is as effective as continuous occlusion therapy (COG) in improving best-corrected visual acuity (BCVA), while also offering added benefits in terms of greater treatment compliance and increased parental satisfaction.

After 12 weeks, children in the IOG group showed an average BCVA improvement of 3.4 ± 0.5 lines, significantly exceeding the 2.7 ± 0.6 lines improvement seen in the COG group ($p = 0.001$). These findings align with the results documented by Wang et al. (2019), who demonstrated that children using intermittent occlusion glasses showed substantial gains in visual acuity, comparable or superior to those achieved by patching (3). Similarly, Spierer et al.

(2010) and sen et., (2022) found that liquid crystal occlusion therapy produced effective visual gains, especially in cases of anisometropic amblyopia, with better acceptance among younger children .(8)(9)

An important secondary outcome in this study was stereoacuity improvement, a parameter often under-evaluated in amblyopia therapy. At 12 weeks, the IOG group showed a significantly better stereoacuity score (410 ± 90 seconds of arc) compared to the COG group (560 ± 110 seconds of arc, $p = 0.001$). These results are consistent with those reported by Stewart et al. (2013), who emphasized the importance of therapies that preserve or enhance binocular function alongside monocular visual improvement (10). Intermittent occlusion, by allowing alternating periods of binocular stimulation, might facilitate better cortical binocular integration compared to continuous monocular deprivation.

Compliance rates were markedly higher in the IOG group, with 88.6% of participants achieving good compliance (>75% of prescribed hours), compared to 62.9% in the COG group ($p = 0.008$). Previous studies by Al-Zuhaibi et al. (2009) have highlighted low adherence rates remain a key challenge in achieving successful amblyopia therapy with conventional patching, mainly due to social discomfort, skin irritation, and psychological resistance (10,11). The present study further supports that intermittent occlusion glasses provide a less intrusive, more child-friendly alternative, leading to improved adherence to treatment schedules (12)(13)

Parental satisfaction also significantly favored intermittent occlusion therapy. In the IOG group, 80% of parents reported high satisfaction compared to 54% in the COG group ($p = 0.002$). This suggests that therapies integrating comfort, social acceptability, and ease of use contribute substantially to treatment success, especially in pediatric populations which is in agreement with earlier studied (14)(15)(.

While the results are encouraging, the study has limitations. The follow-up period was limited to 12 weeks; therefore, long-term stability of visual gains and recurrence rates could not be evaluated. Additionally, objective device-based monitoring of compliance was available only for the intermittent occlusion glasses and relied on parental reporting for patching, which may introduce reporting bias. Despite these limitations, the results of this study add to the increasing evidence that supports intermittent occlusion therapy as an effective and well-tolerated treatment for childhood amblyopia.

CONCLUSION

Using liquid crystal glasses, intermittent occlusion therapy provides an effective alternative to conventional patching for treating moderate unilateral amblyopia in children, leading to notable enhancements in both visual acuity and stereoacuity, along with better treatment compliance and higher parental satisfaction. Given these advantages, intermittent occlusion therapy may be considered a preferred first-line option, particularly for children who are likely to face compliance challenges with continuous patching.

Additional long-term research involving larger cohorts is necessary to confirm these results and to investigate the lasting impact of intermittent occlusion therapy on binocular visual function.

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