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Current scenario of refractive accommodative esotropia management in a tertiary eye care center: A retrospective study

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Aim: To evaluate and analyze the management outcomes of children diagnosed with refractive accommodative esotropia.
Methods: The medical records of 78 patients, who had cycloplegic correction for esotropia correction at the time of their first appointment, were thoroughly reviewed. The initial and latest visits' cycloplegic refraction, deviation for distance and near with and without spectacles in place, stereoacuity, age of onset, management pattern, presence of anisometropia, and changes in hyperopia during the course of the research were among the factors examined.
Results: The inclusion criteria were met by 78 participants in total. The mean age of participants was 5.3 ± 2.4 years. The average follow-up time was 3.1 years. Fully refractive accommodative esotropia was found in 89.74% of the patients. During the follow-up period, the mean cycloplegic refraction (diopters, spherical equivalent) remained steady. The average yearly change in refraction was 0.03 D in the right eye and 0.02 D in the left eye. Stereopsis was identified in 94.87% of patients on the first visit and improved on the second visit.
Conclusion: Current management techniques for this condition result in a considerable reduction in amblyopia prevalence when compared to the prevalence upon presentation. The degree of hyperopia, on the other hand, remains unchanged, with little hope of becoming free of spectacles. It should be noted that long-term full-time spectacle use may affect emmetropization. It is likely that children will be prone to remain hyperopic.

Keywords: refractive accommodative esotropia, accommodation, cycloplegic refraction, binocular vision, stereopsis

1. Introduction

Esotropia is an ocular misalignment condition that affects up to 1 in 25 children and is defined by inward deviation of eyes (1). Accommodative esotropia is a kind of esotropia that develops as a result of accommodative attempts. When the deviation of eyes is completely corrected with hyperopic correction, the condition is referred to as refractive accommodative esotropia (RAET) (1). According to studies, hyperopia either becomes worse or stays the same up until the age of 5—10, after which it gets better with age (2, 3). Astigmatism and hyperopia are typically present with RAET; full correction in terms of ophthalmic lenses is preferred to be the first line of treatment. However, even after the full correction, decompensated RAET or visual developmental anomalies like amblyopia can still occur in particular circumstances (4). Surgery is only used to treat esotropia in situations when it is considerably under corrected despite wearing glasses all the time or when a previously controlled deviation has become uncontrollable. However, some ophthalmologists advise early surgical intervention for this problem (5).

This study was conducted to understand the current treatment modality in patients with RAET in a tertiary care eye hospital and also to understand the treatment outcome of the patients and the success rate of it.

TABLE 1 | Characteristics of the patients.

Variables	1st visit (without spectacles)	Latest follow-up (without spectacles)
Age at initial presentation	5.36 ± 2.42	8.57 ± 2.31
Sex		
Male	31 (39.74%)	
Female	47 (60.26%)	
Visual acuity (Distance)		
RE	0.64 ± 0.43	0.27 ± 0.24
LE	0.55 ± 0.39	0.23 ± 0.21
Stereopsis	298.12 ± 144.17	175.38 ± 136.49
Ocular alignment		
Distance	24.8 (BO)	2.33 (BO)
Near	29.92 (BO)	4.85 (BO)
Refraction (Sph.Eq Diopter)		
RE	4.79 ± 2.80	4.85 ± 4.1
LE	4.3 ± 3.30	4.32 ± 3.39

2. Methodology

A retrospective study approach was made to conduct the study. Children who were diagnosed with RAET and attending the tertiary eye hospital in the time period of January—March 2021 were included in the study. The ones who had a follow-up of less than 24 months and convergence excess-type accommodative esotropia were excluded. Conditions related to ocular pathologies were also excluded (like retinal anomalies, corneal disorders, etc.). Children without any manifest deviation on the cover test were classified as fully accommodative, and individuals who had noticeable residual deviations in their glasses were categorized as fairly accommodating. An ophthalmologist and an optometrist evaluated all the children to assess their current ocular status, and the EMR data were determined. The following characteristics, as well as previous visit findings, were assessed and documented as below. Prism bar covert test was used to measure the degree of misalignment with and without the refractive correction. Stereopsis was measured using TNO, Titmus test, and random stereogram test. When cooperation from the participant's end was sufficient, analysis of the suppression was done with a 20-diopter prism base out test performed in all the gazes and with Bagolini lenses. The distance visual acuity was measured using age-specific charts such as forced choice preferential looking, Kay pictures, teller acuity card, and so on and then converted into log MAR acuity. Every child underwent cycloplegic refraction for at least once every year. When necessary, full cycloplegic refraction was suggested throughout all visits.

TABLE 2 | Mean angle of deviation with or without glasses in the first visit.

	Fully accommodative	Partly accommodative
Distance	24.8	25.2
Near	29.92	28.9
Distance with glasses	0	4.1
Near with glasses	0	6.5

**All values are in base out prism diopters.

3. Results or findings

The average age at the presentation was 5.3 ± 2.4 years. Table 1 shows that the average follow-up time in the hospital was 3.1 years. The inclusion criteria were met by 78 participants in total. Seventy out of 78 children (89.74%) were diagnosed with fully accommodative esotropia. Without correction, the mean deviation was 24.80 prism diopters for distance and for near, it was 29.92 prism diopters, as shown in Table 2. Eleven (14.10%) out of 78 children required surgery. The TNO or other stereo tests revealed stereopsis in 74 (94.87%) of the children examined in the most recent evaluation. Due to the challenges while assessing binocular vision status in young children, uncooperative toddlers, the specific number of children with stereopsis on presentation is unclear. Binocular vision was present in every kid with totally accommodating deviations. Of these kids, 62 out of 78 (79.48%) possessed stereopsis levels of 100 s of arc or greater. The remaining four kids' arcs ranged from 100 to 400 s. Fifty-one (65.38%) of the 78 kids with partly accommodative abnormalities had binocular vision, compared to 11 (14.10%) who did not. Only 22 (43.1%) of the 51 children with binocular vision had stereopsis of at least 100 s of arc, 14 (27.5%) were between 100 to 400 s of arc, and 15 (29.4%) had only gross stereopsis (at least 1500 s of arc). Non-binocular patients made up all three of the decompensating patients that needed surgery.

On comparison with the latest stereopsis to the age of the first visit to the clinic and the age at which motor alignment was established, it was discovered that children who presented later had greater degrees of stereopsis. Both fully and somewhat accommodating esotropes shared this finding.

Children who had their stereopsis of at least 100 s of arc presented to the clinic on average at age 4.16 years and were aligned on an average age of 5.17 years. Children (including non-binocular patients) who had a final stereopsis of less than 400 s of arc first appeared within the mean age of 44 months, and the ocular deviation reached alignment at a mean age of 55 months. Forty-nine children (69%) developed refractive and strabismic amblyopia. As a treatment modality, either patching or atropinization was suggested. The mean visual acuity became 0.27 log MAR in the amblyopic eye from 0.64 log MAR. Twenty-five (49%) out of 49 children maintained a good distance acuity of 0.02 log MAR in the amblyopic eye at the latest follow-up in the hospital. In every follow-up, cycloplegic refraction was performed. The spherical equivalent refractive error of the respective eyes was noted of each visit. The mean change in the refractive error was 0.03 diopter for the right eye and 0.02 diopter in the left eye per year. The refractive error change is plotted against the age of the patients in the graph shown in **Figure 1**. A minute of change in terms of the refractive error was noted in all the cases, and it remained almost the same, as shown in **Figure 2**. It indicates the stability of hypermetropia in the patients throughout the follow-up.

4. Discussion

4.1. Ocular alignment

Our study found that only 11 out of 78 patients, that is, 14% of the instances of completely accommodative refractive esotropia, require surgery to correct the eye alignment, which is consistent with earlier reports. As per a report of Von Noorden and Avilla, one patient out of 30 (3.3%) had functional decline requiring surgery (6). Also, a study by Mulvihill et al. (7) stated that 2.4% of the participants required surgery. The only exception to this is for deviations that appear before the age of 1 year, in which 50% of initial completely corrected aberrations subsequently decompensate and require surgery. (8)

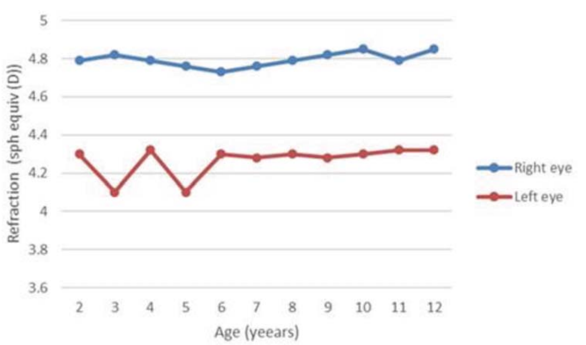

FIGURE 1 | The graph illustrates the mean spherical equivalent of the refractive error of the right eye and left eye versus the age. Almost a minute of change is seen throughout the follow-up in terms of refractive error throughout the follow-ups.

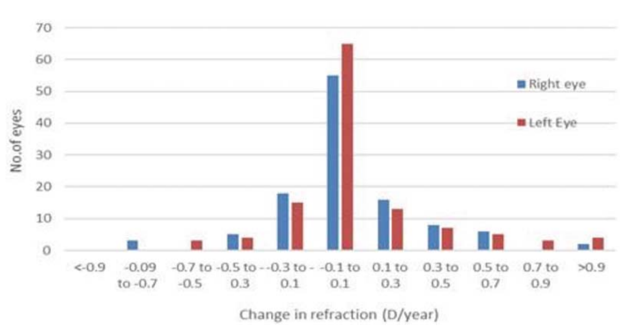

FIGURE 2 | The histogram illustrates the mean change of refraction for every year.

4.2. Binocular vision

The usefulness of stereopsis in daily life is undebatable; also, the existence of binocular single vision (BSV) with fusion unquestionably aids in keeping alignment (9, 10). We discovered that motor alignment and later presentation are connected to higher-grade stereopsis. These data imply that improved binocular vision results as the course of therapy progresses.

4.3. Visual acuity

At the most recent follow-up in the hospital, amblyopia had significantly decreased from 69 to 51%, and amblyopia treatment had successfully improved the visual acuity to greater than 20/80 to 20/30 in 49% of patients who were initially diagnosed with amblyopia. Atropine penalization and/or patching are successful therapies for the majority of amblyopic children; it significantly increased visual acuity. On the other hand, since alternative treatment modalities like active vision therapy are the first of their kind to provide these advantages, they would have improved visual acuity far more quickly (11).

4.4. Cycloplegic refraction

It is widely documented how esotropia and hyperopia are associated. Several studies have shown that rising hyperopia occurs before the development of esotropia (12, 13). Additionally, it has been demonstrated that children who are esotropic and have full-correction hyperopia alter gradually over time (14). It has been demonstrated that beyond the ages of 7 and 8, children become either less hyperopic or more myopic (15). According to research, esotropes may act differently in terms of emmetropization (16). Many studies state that wearing an appropriate optical correction may prevent emmetropization (17, 18). Our results support the idea that wearing hyperopic spectacles prevents emmetropization in esotropes. A study using partial spectacle correction in hyperopic youngsters, however, was unable to show any effects on emmetropization (19). According to the current study, full cycloplegic optical correction makes children optically emmetropic, but partial correction still leaves the eye optically hypermetropic. However, the literature suggests emmetropization should only be totally inhibited by full hyperopic correction (20). An increasing amount of research indicates that environmental factors may contribute to human refractive error development (21). It has been shown in humans that eye development is changed in the presence of a blurred retinal picture, shifting toward myopia (22). Therefore, it is very plausible that removing retinal blur with the right lenses will stop myopic shifts toward emmetropia in hyperopic people.

5. Conclusion

The extremely long follow-up period necessary to properly evaluate the efficiency or otherwise of any type of vision therapy is a considerable challenge. Despite the varied length of follow-up, this study clearly demonstrates a favorable treatment result in refractive accommodative esotropia. We conclude that glasses, in addition to patching therapy or atropinization if amblyopia is present, are still the preferred treatment for accommodative esodeviations at a tertiary eye care center. However, we feel that consideration to long-term consequences of wearing the complete hyperopic correction would yield better reliability. The amount of hyperopia remains the same, with little likelihood of discontinuing spectacle use. It should be noted that long-term spectacle use can affect emmetropization; hence, children should be closely monitored during follow-ups for their refractive error progression.

Author contributions

The RM is involved in designing the study, manuscript preparation, and conceptualization. The VB is involved in manuscript writing, editing, and reviewing.

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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