

Overminus Lens Therapy in the Management of Children with Intermittent Exotropia

Kaveh Abri Aghdam¹, Amin Zand¹, Mostafa Soltan Sanjari¹, Shabnam Khorramdel¹, Reza Asadi¹

¹Eye Research Center, The Five Senses Institute, Rassoul Akram Hospital, Iran University of Medical Sciences, Tehran, Iran

Abstract

Purpose: To evaluate the results of overminus lens therapy in the management of children with intermittent exotropia or X(T).

Methods: In this retrospective study, 163 consecutive patients with X(T) who were treated with overminus spectacles with at least 12 months of follow-up were included in the study. The outcome measures were the level of X(T) control evaluated using the Jampolsky's qualitative assessment method and refractive error changes under overminus lens treatment.

Results: The mean angle of deviation at the initial visit was 24.7 ± 15.1 prism diopters (PD) that improved to 10.6 ± 4.2 PD with overminus glasses with a median follow-up of 38 months ($P = 0.02$). One hundred and nine patients (66.8%) achieved good controlled X(T) or orthotropia by overminus lens therapy after 1 year. Three patients progressed to esotropia, which disappeared after discontinuing overminus lens therapy. Overminus lens therapy did not have a statistically significant effect on the mean spherical equivalent of cycloplegic refraction in each eye (right eye: $P = 0.13$; left eye: $P = 0.15$).

Conclusions: Overminus lens therapy can be effective for improving the control of X(T) in young children. It can defer the requirement for surgery or decrease the rate of surgical intervention.

Keywords: Intermittent exotropia, Overminus therapy, Refractive error

Address for correspondence: Amin Zand, Department of Ophthalmology, Eye Research Center, The Five Senses Institute, Rassoul Akram Hospital, Iran University of Medical Sciences, Sattarkhan-Niayesh St. Tehran 14456-13131, Iran.

E-mail: sandpost3@gmail.com

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INTRODUCTION

Intermittent exotropia or X(T) is the most prevalent type of exotropia in children.¹ It is the most commonly diagnosed form of strabismus in Iran.² This acquired deviation is described by intermittent divergent misalignment of the visual axes.³ X(T) occurs more frequently in Middle Eastern and Asian populations.⁴

The main goal of treatment in X(T) is to preserve the binocular vision and stereopsis and to prevent further loss. The decision for surgery is based on three major clinical aspects: increasing angle of deviation, deteriorating control of X(T), and decrease in stereopsis at near or distance.⁵

In patients with X(T), considerations should be given to delaying the surgery until age 4.⁶ Moreover, in patients with X(T), the incidence of overcorrection, undercorrection, and recurrence rate of strabismus after the surgery is high.⁷ Notably, postoperative overcorrection may lead to the loss of stereoacuity, diplopia, and development of amblyopia in children under 4 years. According to a systematic review, surgery is the only intervention associated with statistically significant improvements in the angle of deviation and control of X(T). However, there is a risk of overcorrection and additional surgery in children.⁸

Hence, non-surgical treatment options should be considered a first-line treatment in young children. These non-surgical

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therapies include occlusion therapy, orthoptic exercises, prisms, and overminus spectacles. Overcorrecting minus lens therapy has been used as a treatment for intermittent exotropia. It is based on the principle that an exotropic deviation will decrease by stimulating accommodative convergence with additional minus power in spectacles.⁹ However, the success rate of these non-surgical treatments including overminus lens therapy must be viewed carefully because the previous studies suffer from scientific flaws such as small sample sizes, selection bias, inadequately defined treatments and success criteria, and absence of statistical analysis.¹⁰

Here, we aimed to determine the safety and efficacy of overminus lens therapy in children with X(T) who were younger than 6 years old.

METHODS

This was a retrospective study that was performed on children with X(T) under the age of 6 who were examined between January 1, 2006 and December 31, 2016, at the Pediatric Ophthalmology and Strabismus Clinic of Rassoul Akram Hospital, Tehran, Iran. The Ethics Committee of the Iran University of Medical Sciences approved the protocols of this study. All research procedures adhered to the tenets of the Declaration of Helsinki. This study consisted of patients with X(T) who were treated with overminus spectacles. None of the cases showed a tendency for improvement in the control of X(T) 6 months before starting overminus treatment. They had a minimum follow-up of 12 months after starting overminus therapy. 1.00–4.00 D of minus power overcorrection was added to patients' cycloplegic refraction for constant spectacle wear. The amount of this overcorrection was determined by the maximum tolerated lens power. The maximum tolerated lens was chosen based on the children's capability to read 20/25 at distance and near. For younger children, the senior author (M. S. S.) decided how many diopters (D) of overcorrecting minus lenses to prescribe without determining the maximum tolerated overminus lens.¹¹ Patients with major ocular disease in addition to X(T), including high myopia (spherical equivalent > -6.00 D), hyperopia $> +5.00$ D, any neurologic disease, developmental delay, or craniofacial syndrome, previous strabismus surgery, or significant A or V patterns were excluded from the study.

The following clinical data were collected for all included participants: age, sex, visual acuity, cycloplegic refraction, angle of deviation at distance and near measured using the prism and alternate cover test, exodeviation control at distance and near, and fundoscopic examination in a consistent manner.

Amblyopia was defined as best corrected visual acuity (BCVA) of 20/30 or less or a 2-line interocular optotype acuity differences with no pathology.¹² The visual acuities were reported using the logMAR scale. The refractive errors were converted to spherical equivalents. The change in refractive error was determined as the mean annual change in refractive errors of the two eyes.

We measured the level of strabismus control with a 3-point scale (good, fair, and poor).¹³ Good control was defined when deviation was only observed during the cover test and was recovered without blinking and refixation. A fair control was assigned when deviation manifests during the cover test, but it recovers with blinking or refixation. A poor control was given when deviation manifests spontaneously or does not recover with blinking and refixation. As success criteria, we used qualitative criteria described by Caltrider and Jampolsky. Concerning the assessment method of Caltrider and Jampolsky, a qualitative change included patients who had poor or fair controlled X(T) that improved to good-controlled exophoria after the treatment. In patients with good-controlled exotropia, the aim of the treatment was to achieve orthotropia, and the success was defined as discontinuation of the therapy after achieving orthotropia.¹⁴ In patients with poor or fair control X(T) at the first visit who achieved good control X(T) in the next visits after at least 1 year from the beginning of the treatment, the overcorrecting minus power of the spectacles was reduced gradually (0.5 D reduction in 6 months) until they achieved orthotropia to stop the treatment unless they were candidates for strabismus surgery. If an increase in the frequency of the deviation with a reduced power lens was observed, the amount of the lens diopters was increased again. Overminus lens therapy was also stopped if there was deterioration or no improvement in exodeviation control at two consecutive visits for 6 months. In patients who progressed to esotropia, the treatment was stopped immediately.¹¹

The main indications for surgery in patients with X(T) were poor/worsening of control, increase in the angle of deviation, double vision or asthenopia, and overwhelming parental or child concerns.⁵ The reasons for surgery in patients with good control X(T) were psychosocial development and improving the way they interact with society to increase their quality of life. In patients who underwent surgery, the follow-up visits were continued for 1 year after the surgery for evaluating any adverse events including under or overcorrection or recurrence.

The SPSS software (version 23.0 for Windows, Armonk, NY, USA: IBM Corp) was used for statistical analyses. The results were presented as mean \pm standard deviation. The Chi-square test was used to analyze the difference in the strabismus control level between baseline and follow-up visits. The repeated measures analysis of variance (ANOVA) was performed to analyze the difference in the mean spherical equivalent of cycloplegic refraction of each eye between the baseline and follow-up visits. The repeated measures ANOVA was also used to analyze differences in the mean angle of deviation between the baseline and follow-up visits. $P < 0.05$ was considered statistically significant.

RESULTS

One hundred and sixty-three children with X(T) who had at least 12 months of follow-up data after starting overminus lens therapy were enrolled. The mean age was 3 ± 2.6 years.

Ninety-nine children were male (60.7%). The mean treatment duration was 36.3 ± 22.5 months, and the mean follow-up time was 47.3 ± 20.3 months.

At the initial visit, BCVA was only measurable in 74 patients. At the final visit, 14 patients remained amblyopic. Initial and final BCVA values were compared using paired *t*-test. After the treatment, the BCVA improved, and a significant difference (*P* = 0.01) was observed. To compare the BCVA during the follow-up period, the annual change in the BCVA was defined as:

$$\text{Annual BCVA change} = (\text{BCVA initial} - \text{BCVA final}) / \text{treatment duration}$$

Accordingly, the mean annual change in BCVA was -0.22 in the logMAR scale.

The mean angle of deviation was significantly improved from 24.7 ± 15.1 prism diopters (PD) at the initial visit to 10.6 ± 4.2 PD at a median follow-up of 38 months (*P* = 0.02) [Table 1].

At the initial visit, the exodeviation control was good in 8 (4.9%) patients, fair in 29 (17.8%), and poor in 126 (77.3%). One year after the treatment, the X(T) control was good in 109 (66.9%) patients, fair in 20 (12.3%), and poor in 31 (19.0%), while the overcorrecting minus lenses were not worn during the examinations. This visit was the last follow-up time before the surgery and without losses to follow-up. Three patients (1.8%) progressed to esotropia, which could induce the risk of amblyopia and decreased stereoacuity. However, esotropia disappeared in these cases after discontinuing overminus lens therapy, and their original exodeviations returned. We considered treatment to have failed in these patients, and they were scheduled for strabismus surgery. However, two of them did not turn up for surgery, and the parents of the third child refused surgery and never returned. Table 1 demonstrates the level of strabismus control at baseline and each follow-up visit in detail.

The level of X(T) control improved significantly after 6 months and after 1 year from the beginning of overminus lens therapy as compared to the baseline (Chi-square test: *P* = 0.03 and *P* = 0.014, respectively). Since >20% loss to follow-up occurred in the subsequent follow-up visits, the results of the differences between them and the baseline may not be trustworthy.¹⁵ Hence, we preferred not to compare the level of strabismus control at these follow-up visits with the baseline.

All eight patients with good control X(T) at baseline achieved orthotropia. Furthermore, 101 patients with fair or poor control X(T) at baseline achieved good control X(T) after 1 year. Hence, 109 patients (66.8%) achieved orthotropia or good control X(T) by overminus lens therapy according to the Jampolsky's qualitative assessment method. None of 51 patients with fair or poor control X(T) in year 1 improved to good control X(T) in the next follow-ups, and all of them required surgery after 2 years.

Strabismus surgery was performed in 95 (58%) children. Of the 95 patients, 44 had good control X(T) without wearing

Table 1: The mean spherical equivalent, mean angle of deviation, and the level of intermittent exotropia control at baseline and each follow-up visit

Time	Mean spherical equivalent (right eye) (D)	Mean spherical equivalent (left eye) (D)	Mean angle of deviation (PD)	Patients who did not undergo surgery			Patients who underwent surgery			Loss to follow-up (from baseline), n (%)	Total (n)	P ^s
				Orthotropia, n (%)	Good control X(T), n (%)	Fair control X(T), n (%)	Good control X(T), n (%)	Fair control X(T), n (%)	Poor control X(T) or manifest XT, n (%)			
Baseline	+0.24	+0.24	24.7±15.1	0	8 (4.9)	29 (17.8)	126 (77.3)	0	0	0	163	-
Month 6	-0.30	-0.29	20.2±11.3	0	97 (59.5)	23 (14.1)	43 (26.4)	0	0	0	163	0.03
Year 1	-0.34	-0.28	16.9±8.2	0	109 (66.9)	20 (12.3)	31 (19.0)	0	0	0	163 [§]	0.014
Year 2	-0.31	-0.35	13.4±6.6	5 (3.0) [†]	51 (31.3)	0	0	22 (13.5)	19 (11.7)	32 (19.6) [*]	163	-
Year 3	-0.58	-0.61	12.3±6.1	2 (1.2) [†]	32 (19.7)	0	0	15 (9.2)	0	0	163	-
Year 4	-0.66	-0.69	10.1±4.3	1 (0.6) [†]	21 (12.9)	0	0	7 (4.3)	0	0	163	-
Year 5	-0.85	-0.80	8.8±4.1	0	18 (11.0)	0	0	0	0	0	163	-
Year 6	-1.26	-1.18	8.1±3.7	0	14 (8.6) [#]	0	0	0	0	0	163	-

D: Diopter, PD: Prism diopter, n: Number, X(T): Intermittent exotropia. [†]These patients had good control X(T) at the baseline. [§]Three patients progressed to esotropia and were scheduled for surgery, but they did not return. ^{*}Four patients progressed to manifest exotropia. [#]These patients eventually achieved orthotropia. [§]Strabismus control frequency in comparison to the baseline (Chi-square test)

overcorrecting minus lenses [Table 1]. They underwent surgery to improve the quality of life as the most common non-clinical indication for strabismus surgery.⁵ As mentioned above, 51 patients with fair or poor control X(T) (47 of 51) and manifest exotropia (4 of 51) underwent surgery after an average time of 25.3 months, while they did not wear overcorrecting minus lenses. Only one of the participants required reoperation 10 months later that resulted in eye alignment. Other patients achieved orthotropia 1 year after the surgery. The mean age of the patients at the time of the surgery was 6.2 ± 3.7 years.

Table 1 also shows the mean spherical equivalent of cycloplegic refraction of the right and left eyes at baseline and follow-up visits. A repeated measures ANOVA analysis revealed that the 6-year overminus lens therapy did not have a statistically significant effect on the mean spherical equivalent of cycloplegic refraction in each eye (right eye: $P = 0.13$; left eye: $P = 0.15$).

DISCUSSION

Performing surgery for X(T) at a very young age has poorer sensory results than later operations. Furthermore, postsurgical recurrence is prevalent, regardless of age. Part-time alternate occlusion, overminus glasses, and prism have been used to postpone or avoid surgery in these patients. Here, we evaluated the long-term outcomes of prescribing overminus spectacles for children with intermittent exotropia.

In a randomized clinical trial by Holmes *et al.*¹⁶ in children 3–7 years old with X(T), minus therapy with spectacles improved distance control at 8 weeks. In another study by Bayramlar *et al.*¹¹ on 19 children with X(T) that were treated with overminus lenses, 84% achieved a good control score based upon both the Newcastle control score (NCS) and Jampolsky's system after an average of 18-month follow-up. Watts *et al.*¹⁷ evaluated the success rate of overminus lens therapy with NCS system in 24 children with X(T) aged from 2 to 17 years. They showed that 72% of these patients had improvement, while still wearing overcorrecting minus lenses. In a study by Rowe *et al.*¹⁸ based upon the NCS system, a 51% improvement rate was achieved in 21 patients 1–9 years old in a 5-year follow-up. Considering the sample size of our study, our success rate (66.8%) is comparable with the previous studies.

In a study by Paula *et al.*,⁷ the treatment of X(T) with overcorrecting minus lens did not induce refractive error changes. Kushner⁹ reported that overcorrecting minus lens therapy for X(T) did not appear to cause myopia in patients with X(T). In another study by Rutstein *et al.*,¹⁹ most patients with X(T) who were treated with overminus lenses did not demonstrate more myopic progression than would normally be expected. We found that the 6-year overminus lens therapy did not appear to cause myopia, similar to the previous studies.

In a study by Kushner,²⁰ a total of 279 patients with initial poor control X(T) underwent conservative treatment by alternate occlusion therapy followed in some cases by overminus

spectacles with base-in prism. In 207 (74%) patients, this conservative treatment delayed surgery for at least 1 year. Hence, this conservative treatment can defer the need for surgery in a large percentage of patients with X(T). In our study, surgery was performed in 95 (58%) children, with failure in minus therapy or health-related quality of life problems. It has been shown that children are concerned about what others think of their appearance, and strabismus can affect their ability to socialize. At the same time, parents worry more about the visual functions and the need for surgery. In such a situation, surgical correction may help in the psychosocial development of the individual and improving the way they interact with society.²¹

Despite promising results, this study had several limitations. First, it is retrospective and hence is subjected to selection bias, especially with excluding incomplete medical records. In this study, we applied Jampolsky's qualitative assessment as success criteria, but another success rate evaluating system is NCS which includes three components of home control and clinical control for both near and distance fixations. However, our study was retrospective and due to lack of enough records, we could not utilize this system. Second, the lack of a control group is an important problem in the design of this study. The alignment of 11 cases after discontinuation of treatment may be due to spontaneous resolution, not overminus lens therapy. However, if the pretreatment status of the patients assumed as a control group, as Watts *et al.*¹⁷ suggested, none of our cases showed a tendency for improvement in the control of X(T) 6 months before starting overminus treatment. Furthermore, the improvement of BCVA during treatment may be simply due to the increasing of the children's ages. Therefore, the presence of a control group is necessary for this study. Third, the accurate determination of the deviation is not generally possible in very young children, so the decrease of deviation in the course of the present study may be due to measurement error. Fourth, no long-term follow-up was conducted to measure the persistence of effects.

In summary, overminus lens therapy with spectacles can be effective for improving the control of X(T) in young children, deferring the need for surgery or decreasing the rate of surgical treatment.

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Conflicts of interest

There are no conflicts of interest to declare.

REFERENCES

- Mohney BG, Huffaker RK. Common forms of childhood exotropia. *Ophthalmology* 2003;110:2093-6.
- Hashemi H, Yekta A, Jafarzadehpour E. The prevalence of strabismus in 7-year-old schoolchildren in Iran. *Strabismus* 2015;23:1-7.
- Liebermann L. Intermittent exotropia: Characteristics and overview. *Am Orthopt J* 2016;66:11-5.
- Chia A, Roy L, Seenyen L. Comitant horizontal strabismus: An Asian perspective. *Br J Ophthalmol* 2007;91:1337-40.
- Chougule P, Kekunnaya R. Surgical management of intermittent

- exotropia: Do we have an answer for all? *BMJ Open Ophthalmol* 2019;4:e000243.
6. Kim SH, Cho YA. Can we effectively delay surgery for intermittent exotropia in children less than 4 years of age? *J Korean Ophthalmol Soc* 1996;37:1382-8.
 7. Paula JS, Ibrahim FM, Martins MC, Bicas HE, Velasco e Cruz AA. Refractive error changes in children with intermittent exotropia under overminus lens therapy. *Arq Bras Oftalmol* 2009;72:751-4.
 8. Joyce KE, Beyer F, Thomson RG, Clarke MP. A systematic review of the effectiveness of treatments in altering the natural history of intermittent exotropia. *Br J Ophthalmol* 2015;99:440-50.
 9. Kushner BJ. Does overcorrecting minus lens therapy for intermittent exotropia cause myopia? *Arch Ophthalmol* 1999;117:638-42.
 10. Coffey B, Wick B, Cotter S, Scharre J, Horner D. Treatment options in intermittent exotropia: A critical appraisal. *Optom Vis Sci* 1992;69:386-404.
 11. Bayramlar H, Gurturk AY, Sari U, Karadag R. Overcorrecting minus lens therapy in patients with intermittent exotropia: Should it be the first therapeutic choice? *Int Ophthalmol* 2017;37:385-90.
 12. Faghihi M, Hashemi H, Nabovati P, Saatchi M, Yekta A, Rafati S, *et al.* The prevalence of amblyopia and its determinants in a population-based study. *Strabismus* 2017;25:176-83.
 13. Stathacopoulos RA, Rosenbaum AL, Zanoni D, Stager DR, McCall LC, Ziffer AJ, *et al.* Distance stereoacuity. Assessing control in intermittent exotropia. *Ophthalmology* 1993;100:495-500.
 14. Caltrider N, Jampolsky A. Overcorrecting minus lens therapy for treatment of intermittent exotropia. *Ophthalmology* 1983;90:1160-5.
 15. Dettori JR. Loss to follow-up. *Evid Based Spine Care J* 2011;2:7-10.
 16. Pediatric Eye Disease Investigator Group, Chen AM, Holmes JM, Chandler DL, Patel RA, Gray ME, *et al.* A randomized trial evaluating short-term effectiveness of overminus lenses in children 3 to 6 years of age with intermittent exotropia. *Ophthalmology* 2016;123:2127-36.
 17. Watts P, Tippings E, Al-Madfai H. Intermittent exotropia, overcorrecting minus lenses, and the Newcastle scoring system. *J AAPOS* 2005;9:460-4.
 18. Rowe FJ, Noonan CP, Freeman G, DeBell J. Intervention for intermittent distance exotropia with overcorrecting minus lenses. *Eye (Lond)* 2009;23:320-5.
 19. Rutstein RP, Marsh-Tootle W, London R. Changes in refractive error for exotropes treated with overminus lenses. *Optom Vis Sci* 1989;66:487-91.
 20. Kushner BJ. Conservative management of intermittent exotropia to defer or avoid surgery. *J AAPOS* 2019;23:256.e251-6.
 21. Hatt SR, Leske DA, Holmes JM. Comparison of quality-of life instruments in childhood intermittent exotropia. *J Aapos* 2010;14:221-6.