The Analysis of AC/A Ratio in Nonrefractive Accommodative Esotropia Treated with Bifocal Glasses

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All the glory to God

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W. K. Kim

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

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Purpose : To report the long term results of bifocal treatment and analyze the change of accommodative convergence to accommodation (AC/A) ratio according to the result of treatment in patients with nonrefractive accommodative esotropia and find out the early factors that predict the result of bifocal treatment.

Materials and Methods: Sixteen patients who were treated with bifocal glasses with follow-up of more than 5 years were retrospectively evaluated. At each visit, data of near and distance deviation, refractive error, the AC/A ratio by the lens gradient method and bifocal treatment were collected. We analyzed these data after divide into two groups as the result of bifocal treatment, which consist of bifocal stop group and bifocal continue group.

Results : Six patients (38%, bifocal stop group; BSG) were able to stop using bifocal glasses at an average age of 10.8 years (range, 6.5-15.4 years) during their follow up.

However, the other ten patients (62%, bifocal continue group; BCG) had to continue using bifocal glasses until the last visit at an average age of 13.8 years (range, 11.3-18.5 years). The AC/A ratio decreased from time of the bifocal prescription to the last visit in both groups, from 4.4 to 2.7 in BSG and from 5.9 to 4.5 in BCG. AC/A ratios were significantly higher in BCG than that of BSG from the beginning of bifocal treatment (p=0.03) and this difference was persistent until the final visit (p=0.03).

Conclusion : About one-third of patients with nonrefractive accommodative esotropia who were treated with bifocal glasses were able to stop using bifocal glasses without surgery. The average age of bifocal stop was 10.8 years, which may indicate that surgical treatment of nonrefractive accommodative esotropia to eliminate the need for bifocal glasses should be deferred until patients are at least this age. The AC/A ratio decreased with age in both groups but AC/A ratio in BCG was significantly higher than that of BSG throughout the entire follow up period. AC/A ratio at bifocal prescription could be an important factor in predicting response to bifocal treatment. In our study, all the AC/A ratio of bifocal stop group were less than 5.5 at bifocal prescription.

Key words : AC/A ratio, Age, Bifocal, Lens gradient method,
Nonrefractive accommodative esotropia

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I. INTRODUCTION

Non refractive accommodative esotropia is a condition that can be diagnosed when an emmetropically corrected patient with a high accommodative convergence to accommodation (AC/A) ratio shows orthotropia at distance fixation but displays more than 10 prism diopters of esotropia at near fixation which can be corrected with a +3.00 diopter add lens.

The AC/A ratio is the amount of induced convergence that occurs when accommodation is exerted. In normal eyes, the ratio is thought to remain stable without change until presbyopia, after which the AC/A ratio increases[1-4]. However, the change of the AC/A ratio with age in nonrefractive accommodative esotropia has not been studied.

Nonrefractive accommodative esotropia can be treated with bifocal glasses or miotics[5-10]. Miotics pharmacologically decrease accommodative convergence and correct esotropia at near fixation. Long term effects of miotics have been studied in detail and reports of iris cysts, cataracts, retinal detachment, iridocyclitis and punctal

occlusion are abundant in the literature[11] and thus are used only for diagnostic purposes or for short term correction. Bifocal glasses horizontally divide the visual field with a +2.50 - +3.00 diopters add lens in the lower portion and uses the upper and lower portions for distance and near fixation, respectively. Bifocal glasses induce orthotropia for both far and near vision, decrease chances of amblyopia with appropriate development of stereopsis.

As patients grow older, some can discontinue the use of bifocal glasses due to spontaneous normalization of the AC/A ratio[12], but others need to keep their bifocal glasses or undergo strabismus surgery in an attempt to eliminate the need for bifocals[13-15]. Surgical options include augmented recession, slanted recession, and recession with posterior fixation suture of the medial rectus muscles[14,16,17].

The AC/A ratio can be calculated in several ways, among which only the lens gradient method gives a true estimate of the ratio. In the lens gradient method, the change in stimulus to accommodation is produced by means of ophthalmic lenses, not a change in viewing distance. Burian and Franceschetti[18] reported that the normal range of the AC/A ratio by the lens gradient method is lower than that by the heterophoria method. The heterophoria method does not account for proximal convergence, which is kept constant in the lens gradient method by performing both measurements at the same distance[19]. Previous studies[10,20] did not evaluate the AC/A ratio by lens gradient method but by heterophoria methods. However, in this study, we computed the AC/A ratio by the lens gradient method.

II. MATERIALS AND METHODS

1. Subjects

The medical records of all patients who were treated with bifocal glasses for nonrefractive accommodative esotropia with more than 5 years of follow-up were retrospectively reviewed. Sixteen patients treated with bifocal glasses were included. Seven patients were male, and nine were female (Table 1). Institutional review board approval was obtained for this study. The research adhered to the tenets of the Declaration of Helsinki. Patients who received strabismus surgery, which can affect the AC/A ratio, during the 5-year follow-up period, were also excluded. Visual acuity, angle of deviation at near and distance fixation, cycloplegic refractive errors, and the AC/A ratio by the lens gradient method at each follow-up visit were collected. Ocular alignment was measured with the prism cover test, and cycloplegic refraction was assessed approximately 30 minutes after topical instillation of two eyedrops of Cyclogyl (cyclopentolate 1.0%) and Mydrin-P (tropicamide 0.5% and phenylephrine 0.5%) three times at every 10 minutes. Cycloplegia was considered complete if the pupillary light response was absent.

Table 1. Sex distribution in included 16 Patients with Nonrefractive Accommodative Esotropia.

Characteristics	Number (%)
Male	7 (44%)
Female	9 (56%)
Total	16(100%)

Average age at last visit was 13.5 years (range, 10.0-18.5 years), and the average age at bifocal prescription was 6.1 years (range, 2.4-11.2 years). Average added power was +2.78 diopters. Average follow-up duration was 88 months (range, 60-142 months) (Table 2).

Table 2. Characteristics of 16 Patients with Nonrefractive Accommodative Esotropia.

Characteristics	**Mean (range)**
Age at last visit	13.5 years (10.0-18.5)
Age at bifocal prescription	6.1 years (2.4-11.2)
Add power	+2.78 diopters (+2.50-[+3.00])
Duration of follow-up	88 months (60-142)

2. AC/A ratio calculation

In this study, we computed the AC/A ratio by the lens gradient method using the angle of deviation with and without +3.00 lenses at near fixation. The AC/A ratio was calculated from the differences between the upper and lower segments of bifocal glass which were divided by the added power of lower segment.

3. Bifocal glasses prescription

Bifocal glasses were prescribed if the angle of esodeviation with near fixation was at least 10 prism diopters greater than the angle with distance fixation with full optical correction and the angle of esodeviation with near fixation could be eliminated or nearly eliminated with plus spherical lenses. Plus adds were initially prescribed from +2.50 to +3.00 diopters but were decreased to +2.50 diopters during the follow up period if the patient who were prescribed +3.00 diopters at initial visit showed orthotropia at near fixation. Executive, flat-top bifocals were fitted high, bisecting the lower margin of the pupil in the primary position.

During the course of follow-up, cycloplegic refractions were performed semiannually, and the distance and near correction were adjusted if the refractive error had changed. Bifocals were discontinued if the patient was able to keep fusion at near through distance correction lenses and show no or only minute differences in angle of deviation at both distance and near fixation. Binocular vision was also tested when stopping bifocals.

4. Statistical analysis

Statistical analysis was performed using descriptive analysis and Mann-Whitney U test. P-value of < 0.05 was considered statistically significant. SPSS statistical software (Statistical Product and Services Solutions, version 12.0, SPSS Inc., Chicago, IL, USA) was used.

III. RESULTS

1. Comparisons of bifocal stop group and bifocal continue group

Of the 16 patients, six patients (38%), referred to as the bifocal stop group(BSG), were able to stop using bifocal glasses at an average age of 10.8 years during their follow up, and ten patients (62%), referred to as the bifocal continue group(BCG), continued using bifocal lenses until the last visit (Table 3). The mean age at bifocal prescription in BSG was 6.4 years, which was older than that in BCG, but without statistical significance.

Table 3. Clinical Characteristics of 16 Patients with Nonrefractive Accommodative Esotropia Grouped According to Therapeutic Results.

6 patients (38%) in bifocal stop group and 10 patients (62%) in bifocal continue group.

Characteristics	**Bifocal Stop Group** Mean (range)	**Bifocal Continue Group** Mean (range)	**P Value***
Age at bifocal prescription (years)	6.4 (3.9-11.2)	5.8 (2.4-8.6)	0.91
Add power (diopter)	+2.83 (+2.50-[+3.00])	+2.75 (+2.50-[+3.00])	0.53
Duration of wearing bifocal glasses (months)	53 (26-70)	94 (64-142)	0.13
Age at bifocal discontinuation (years)	10.8 (6.5-15.4)	NC	

* calculated by Mann-Whitney U test

The mean angle of esodeviation at near fixation at prescription in BCG was 24 prism diopters, which was significantly larger than the 18 prism diopters in BSG. The angle of esodeviation at near fixation was measured without added power. Differences of angle of deviation between distance and near fixation in BCG was 19.8 prism diopters, which was larger than the 15.7 prism diopters in BSG (Table 4).

Table 4. Esodeviation of Two Groups According to Therapeutic Results.

6 patients (38%) in bifocal stop group and 10 patients (62%) in bifocal continue group.

Characteristics	**Bifocal Stop Group** Mean (range)	**Bifocal Continue Group** Mean (range)	**P Value***
Esodeviation at onset of therapy			
Distance (prism diopters)	2.3 (0-8)	4.4 (0-10)	0.32
Near (prism diopters)	18.0 (16-20)	24.0 (16-40)	0.05
Difference (near-distance) (prism diopters)	15.7 (10-20)	19.8 (12-30)	0.15
Near after +3.00 sphere (prism diopters)	5.3 (0-8.0)	5.0 (0-20)	0.61
Esodeviation at last visit			
Distance (prism diopters)	4.3 (0-14)	3.8 ([-8]-20)	0.82
Near (prism diopters)	5.3 (0-16)	15.5 (0-30)	0.06
Difference (near-distance) (prism diopters)	1.0 (0-4)	11.7 (0-20)	0.01
Near after +3.00 sphere (prism diopters)		6.7 (0-20)	

* calculated by Mann-Whitney U test

The average refractive errors in BSG were 1.5 diopters in right eye and 2.5 diopters in left eye, which were not significantly different with those of BCG (Table 5).

Table 5. Refractive Errors in Two Groups According to Therapeutic Results.

6 patients (38%) in bifocal stop group and 10 patients (62%) in bifocal continue group.

Characteristics	**Bifocal Stop Group** Mean (range)	**Bifocal Continue Group** Mean (range)	**P-Value***
Refractive errors			
Right (Spherical equivalent, + diopter)	1.5 ([-1.6]-4.5)	1.7 ([-6.9]-6.0)	0.52
Left (Spherical equivalent, + diopter)	2.5 ([-1.3]-6.2)	2.2 ([-2.4]-6.0)	0.79

* calculated by Mann-Whitney U test

2. Change in AC/A ratio over time for two groups

The AC/A ratio by the lens gradient method decreased with age from 4.4 to 2.7 in BSG and from 5.9 to 4.5 in BCG. The AC/A ratio at bifocal prescription in BSG was 4.4, which was significantly lower than the 5.9 in BCG (p=0.03). The AC/A ratio at last visit in BSG were 2.7, which was significantly lower than the 4.5 in BCG (p=0.03) (Table 6).

Table 6. The change of AC/A ratio of 16 Patients with Nonrefractive Accommodative Esotropia. 6 patients(38%) in bifocal stop group and 10 patients(62%) in bifocal continue group.

Characteristics	Bifocal Stop Group	Bifocal Continue Group	Total	P Value*
	Mean (range)	Mean (range)	Mean (range)	
AC/A ratio[a] at bifocal prescription	4.4 (4.0-5.3)	5.9 (4.0-8.3)	5.3 (4.0-8.0)	0.03
AC/A ratio[a] at last visit	2.7 (0-4.0)	4.5 (2.0-6.3)	3.9 (0-6.3)	0.03
Change of AC/A ratio[a]	1.8 (0.8-4.0)	1.4 ([-2.3]-4.8)	1.5 ([-2.3]-4.8)	0.85

* calculated by Mann-Whitney U test

Abbreviations: AC/A, accommodative convergence to accommodation

[a] measured by lens gradient method

3. The ratio of Change of AC/A ratio in both groups

The AC/A ratio decreased with age in both groups, but the initially higher AC/A ratio of BCG remained higher than that of BSG until last visit. The change of AC/A ratio with age is very slow. As the graphs depicting change in AC/A ratio over time for two groups show, decrease ratio of the AC/A ratio with age are 0.01 per 1 month in both groups (Figure 1).

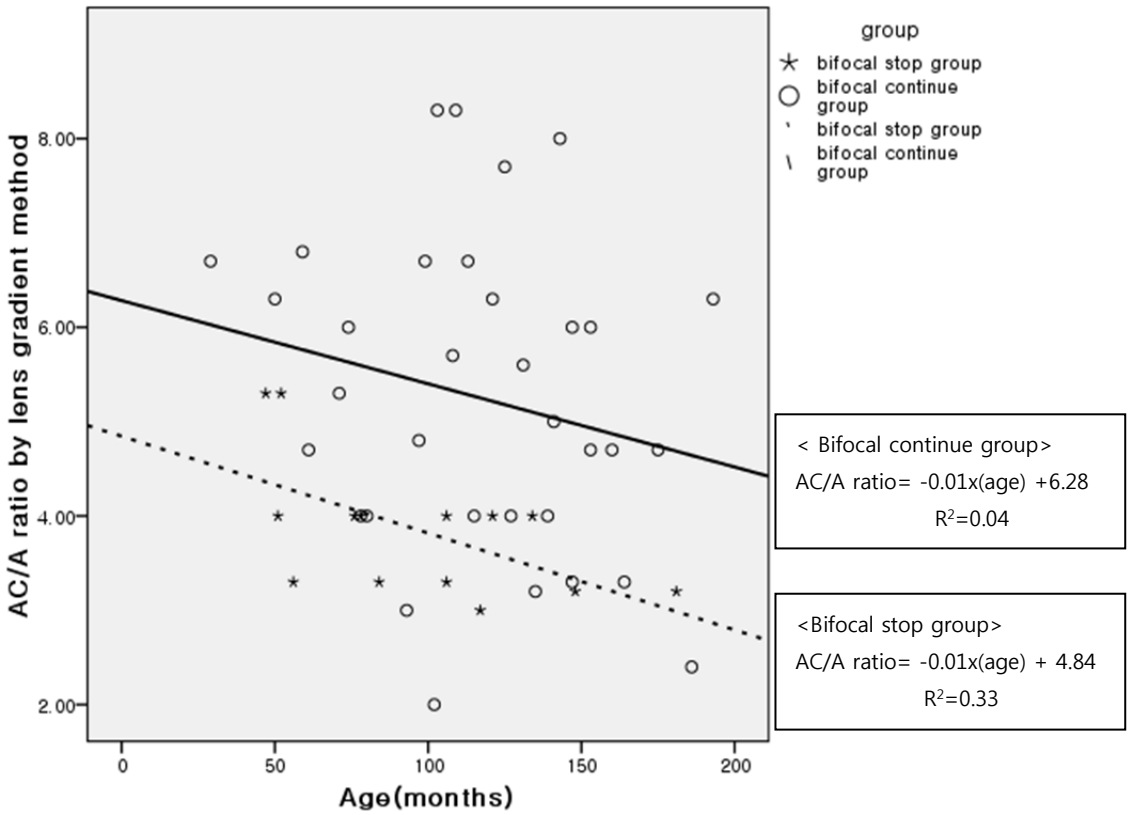

Figure 1. Regression graph of the Change of AC/A Ratio according to age in the Bifocal Stop Group Compared with the Bifocal Continue Group. Graphs depicting change in AC/A ratio over time for the two groups show a decrease in the AC/A ratio with age, -0.01 x (age) + 4.84 in Bifocal Stop group and -0.01 x (age) + 6.28 in Bifocal Continue Group.

Abbreviation: AC/A, accommodative convergence to accommodation.

4. Initial AC/A ratio at bifocal prescription in both groups

All AC/A ratio of BSG at bifocal prescription were less than 5.5, but the AC/A ratio of BCG were distributed all range from 4.0 to above 7.0. There was no patient in BSG whose AC/A ratio were more than 5.5 at bifocal prescription time (Table 7).

Table 7. The AC/A ratio of two groups at bifocal prescription.

AC/A ratio at bifocal prescription	Bifocal Stop Group (number)	Bifocal Continue Group (number)	Total (number)
4.0≤ AC/A ratio<4.5	4	2	6
4.5≤ AC/A ratio<5.0	0	1	1
5.0≤ AC/A ratio<5.5	2	1	3
5.5≤ AC/A ratio<6.0	0	0	0
6.0≤ AC/A ratio<6.5	0	2	2
6.5≤ AC/A ratio<7.0	0	3	3
7.0≤ AC/A ratio	0	1	1
total	**6**	**10**	**16**

IV. DISCUSSION

Treatment with bifocals to correct residual near esodeviation is a well-established and popular method for patients with nonrefractive accommodative esotropia[12,20]. In this study, about one-third of patients with nonrefractive accommodative esotropia

were able to stop using bifocal glasses during follow-up without surgery. The AC/A ratio of these patients, measured by the lens gradient method, decreased with age and normalized. Binocular fusion was made by a spontaneous decrease of esodeviation at near fixation[21]. A previous study reported that 37.0% (31/84) of patients were either cured or improved with bifocals[21]. Another study reported that 61.5% (40/65) of patients were able to stop using bifocals at an average age of 9.7 years[12].

Differences in success rate of bifocal glasses treatment might be due to different inclusion and exclusion criteria and different follow-up durations. In this study, the follow-up duration of included patients was at least 5 years which is thought to be enough to analyze the change of accommodative convergence to accommodation (AC/A) ratio.

The average age at bifocal discontinuation in this study was 10.8 years, which is older than that in a previous study[12], in which the average age was 9.7 years. This difference may be explained by the different races of subjects in the studies or by the small number of patients. The average age at bifocal discontinuation of 10.8 years in this study may indicate that surgical treatment of nonrefractive accommodative esotropia can be delayed until this age. Other reports revealed good postoperative outcomes following strabismus surgery even in younger age, but second surgery was required more frequently in younger patients[12,13]. The results of this study do not imply that when deterioration in binocular function is noted with bifocal glasses, surgical correction should be postponed. Instead, we suggest that patients who are well controlled with bifocal glasses can delay surgery until this age. However, if deterioration in binocular function is confirmed, even with bifocal glasses, the

nonaccommodative component of partially accommodative esotropia should be corrected surgically without delay, because bifocal glasses can correct only the accommodative component.

In this study, there were six patients who received strabismus surgery because of uncontrolled esotropia, even with bifocal glasses, during follow-up. We excluded these patients to avoid the possible effect of surgery on the AC/A ratio[22-24].

Differences of esodeviation between at near and distant are used in calculating the AC/A ratio by the heterophoria method and also deciding clinically whether to stop the bifocal glasses or not. Therefore, if bifocal glasses were stopped, it can be inferred that the AC/A ratio by the heterophoria method became normalized. But, the AC/A ratio by the lens gradient method may not be consistent with that measured by the heterophoria method and may not correlate well with discontinuation of bifocal glasses.

The unique benefit of this study is that AC/A ratio were computed by lens gradient method, which gives a true estimate of the AC/A ratio. The gradual decrease of AC/A ratio with age in nonrefractive accommodative esotropia was revealed in this study, which corresponds well with observations from previous studies[10,12].

The AC/A ratio in the normal population is thought to remain stable without change before presbyopia. In contrast to that of the normal population, the AC/A ratio decreased with age in high AC/A ratio accommodative esotropia. The rates of decrease were 0.01 per 1 month, which were similar in both groups in this study.

In this study, the factor that determined whether the final AC/A ratio became normal was the initial AC/A ratio at bifocal prescription. The initial AC/A ratio of

BSG were significantly lower than that of BCG. This finding is in contrast to a previous report that found that the higher the initial AC/A ratio, the higher the chance of bifocal discontinuation[21]. However, in our study, the relatively low AC/A ratio by the lens gradient method at the age of bifocal prescription was a good prognostic factor.

All the patients in BSG had AC/A ratio less than 5.5 at their bifocal prescription. So, we can conclude that the AC/A ratio at bifocal prescription could be a very important factor that could predict the response to bifocal treatment. And, AC/A ratio more than 5.5 at bifocal prescription could be a factor that predicts poor response to bifocal treatment.

In addition to relatively low AC/A ratio, a smaller angle of esodeviation with near fixation at the age of bifocal prescription could be prognostic factors of treatment with bifocals in high AC/A ratio accommodative esotropia. This result differs from that of another study that did not determine any factors that were predictive of the outcome in nonsurgical patients who were treated with bifocals.

Some limitations of this study are the small sample size and the lack of a sensory test of fusion. Only the motor examination results were considered in determining whether to discontinue the use of bifocals. Another limitation is that only plus lenses were added at near fixation in this study, but a report suggested that the AC/A ratio could vary with plus lenses near fixation, compared with minus lenses at a farther distance from fixation when the lens gradient method was used.

V. CONCLUSION

In this study, about 40% of patients with nonrefractive accommodative esotropia could stop using bifocal glasses spontaneously during follow up. The AC/A ratio of these patients were spontaneously decreased with age and finally normalized. The average age at bifocal discontinuation in this study was 10.8 years. This may indicate that surgical treatment of nonrefractive accommodative esotropia to eliminate the need for bifocal glasses should be deferred until patients are at least this age.

The AC/A ratio decreased with age in all nonrefractive accommodative esotropia, but initially higher AC/A ratio remained higher at last. The AC/A ratio at bifocal prescription could be a factor that determines whether the patient can stop using glasses spontaneously. Furthermore, low AC/A ratio less than 5.5 at bifocal prescription could be good prognostic factor in bifocal treatment.

REFERENCES

1. Bhoola H, Atchison DA, Bruce AS(1995) Accommodation-convergence relationships and age. Investigative ophthalmology & visual science 36:406-13.
2. Chen HW, Rosenfield M, Ciuffreda KJ(1997) The AC/A ratio, age and presbyopia. Ophthalmic & physiological optics 17: 307-15.
3. M A(1962) Movement of the eyes. The Eye. Academic Press: New York, pp 130.
4. Zadnik K, Moeschberger ML, Jones LA, Mutti DO(2000) AC/A ratio, age, and refractive error in children. Investigative ophthalmology & vision science 41: 2469-78.
5. Esser J, Fischer M, Eckstein AK(1998) Normal accommodative convergence excess--long-term follow-up of conservative therapy with bifocal eyeglasses. Klinische Monatsblatter fur Augenheilkunde 212: 218-25.
6. Yu G(1993) The correction of high AC/A ratio non-accommodative esotropia with straight-top bifocals. Zhong hua Yan Ke Za Zhi 29: 343-5.
7. Glusman M, Rich LS(1992) Tangent Streak RGP bifocal contact lenses in the treatment of accommodative esotropia with high AC/A ratio. The CLAO Journal 18: 56-8.
8. Justo DM, Procianoy E(1991) Results of unilateral medial rectus recession in high AC/A ratio esotropia. Journal of Pediatric Ophthalmology and Strabismus 28: 212-4.

9. Tillson G, Pratt-Johnson JA(1985) The management of esotropia with high AC/A ratio (convergence excess). Journal of Pediatric Ophthalmology and Strabismus 22: 238-42.

10. Tillson G, Pratt-Johnson JA(1984) Sensory outcome with nonsurgical management of esotropia with convergence excess (a high accommodative convergence/accommodation ratio). Canadian Journal of ophthalmology 19: 220-3.

11. Mims III JL, Wood RC(1993) Isoflurophate(Floropryl®) ointment as the initial treatment of various esotropias: A survey and review of 279 cases. Binocular Vision & Eye Muscle Surgery Qtrly 8:11-20.

12. Ludwig IH, Parks MM, Getson PR(1989) Long-term results of bifocal therapy for accommodative esotropia. Journal of Pediatric Ophthalmology and Strabismus 26: 264-70.

13. Norman A, Lueder GT(2006) Strabismus surgery for elimination of bifocals in accommodative esotropia. American Journal of Ophthalmology 142: 632-5.

14. Kushner BJ(2001) Fifteen-year outcome of surgery for the near angle in patients with accommodative esotropia and a high accommodative convergence to accommodation ratio. Archives of Ophthalmology 119: 1150-3.

15. Arnoldi KA, Tychsen L(1996) Surgery for esotropia with a high accommodative convergence/accommodation ratio: effects on accommodative vergence and binocularity. Ophthalmic Surgery and Lasers

27: 342-8.

16. Clark RA, Ariyasu R, Demer JL(2004) Medial rectus pulley posterior fixation is as effective as scleral posterior fixation for acquired esotropia with a high AC/A ratio. American Journal of Ophthalmology. 137:1026-33.

17. Gharabaghi D, Zanjani LK(2006) Comparison of results of medial rectus muscle recession using augmentation, Faden procedure, and slanted recession in the treatment of high accommodative convergence/accommodation ratio esotropia. Journal of Pediatric Ophthalmology and Strabismus. 43:91-4.

18. Burian HM, Franceschetti AT(1970) Gradient accommodative convergence-accommodative ratio in families with and without esotropia. American Journal of Ophthalmology 70: 558-62.

19. Havertape S, Cruz O, Miyazaki E(1999) Comparison of methods for determining the AC/A ratio in accommodative esotropia. Journal of Pediatric Ophthalmology and Strabismus 36: 178-83.

20. Risovic D(2003) Treatment of esotropia with a high AC/A ratio. Srp Arh Celok Lek 2003; 131(1-2): 36-9.

21. von Noorden GK, Morris J, Edelman P(1978) Efficacy of bifocals in the treatment of accommodative esotropia. American Journal of Ophthalmology 85: 830-4.

22. Brard PV, Gauther G, Vercher JL, Putteman A, Semmlow J(2000) Surgical modification of the AC/A ratio and the binocular alignment ("Phoria") at distance; its influence on accommodative esotropia: a study of 21 cases. Binocular vision & strabismus quarterly 15: 121-30.

23. Lucas E, Bentley C, Aclimandos W(1994) The effect of surgery on the AC/A ratio. Eye 8: 109-14.

24. Morton GV, Preslan MW, Kushner BJ(1987) Treatment of partly accommodative esotropia with a high accommodative convergence-accommodation ratio. Archives of Ophthalmology 105: 815-8.

ABSTRACT (IN KOREAN)

이중초점안경으로 치료받은 비굴절성 조절내사시 환자의
조절 눈모음비 분석

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김욱겸

목적 : 비굴절 조절내사시 환자에서 이중초점안경 치료의 장기 결과를 알아보고 치료결과에 따른 조절눈모음비의 변화를 알아본다. 또한, 이중초점안경 치료 결과를 예측할 수 있는 인자가 무엇인지도 알아본다.

방법 : 이중초점안경 치료를 받으며 5년 이상 경과 관찰된 환자 16명을 후향적으로 조사하였다. 이중초점안경을 처방한 시점을 포함하여 내원시 시행한 사시각, 조절마비 굴절 검사 결과, 시력, 계단적 검사법(lens gradient method)에 의한 조절눈모음비, 이중초점안경 지속착용여부 등의 자료를 수집하였다. 치료 결과에 따라 이중초점안경을 벗은 군과 이중초점안경을 지속한 군으로 나누어서 각각의 요소를 비교 분석하였다.

결과 : 6명의 환자(38%, 이중초점안경 벗은 군)는 경과 관찰 중 평균 10.8세의 나이에(범위, 6.5-15.4세) 이중초점안경을 벗었다. 하지만, 나머지 10명의 환자(62%, 이중초점안경 지속한 군)는 마지막 내원시까지 이중초점안경을 착용하였으며 그 나이는 평균 13.8세였다(범위, 11.3-

18.5세). 조절눈모음비는 이중초점안경을 벗은 군과 지속한 군 모두에서 시간에 따라서 감소하였는데 전자는 이중초점안경 처방 시에 4.4이었고 마지막 내원시에는 2.7으로 감소하였으며 후자는 5.9에서 4.5로 감소하였다. 이중초점안경을 처방한 시점부터 이중초점안경 벗은 군의 조절눈모음비가 이중초점안경 지속한 군에 비해서 통계적으로 유의하게 낮았으며,(p=0.03) 이 차이는 마지막 방문시까지 지속되었다. (p=0.03)

결론 : 이중초점안경으로 치료받은 비굴절조절내사시 환자의 약 40%에서 경과관찰 중에 이중초점안경을 벗을 수 있었다. 이들의 평균 나이는 10.8세였으며 이것은 이중초점안경을 벗기 위한 수술적 치료는 이 나이까지는 미루는 것이 안전할 것이라는 것을 의미한다고 볼 수 있다. 두 군 모두에서 조절눈모음비가 나이가 듦에 따라서 감소하였지만 이중초점안경을 지속한 군에서의 처방시 높았던 조절눈모음비는 마지막 관찰 때까지도 이중초점안경을 벗은 군에 비해서 높은 것을 알 수 있었다. 본 연구에서 이중초점안경을 벗은 군에서는 처방시 조절눈모음비가 5.5 미만이었으며 이것은 처음 처방시 조절눈모음비가 이중초점안경 치료에 대한 반응을 예측할 수 있는 인자라고 생각된다.

핵심되는 말 : 조절눈모음비, 연령, 이중초점안경, 계단식검사법,
비굴절조절내사시