

# Long-term Follow-up of Acute Isolated Accommodation Insufficiency

Jung Jin Lee<sup>1</sup>, Seung-Hee Baek<sup>1</sup>, Ungsoo Samuel Kim<sup>1,2</sup>

<sup>1</sup>Department of Ophthalmology, Kim's Eye Hospital, Konyang University College of Medicine, Seoul, Korea

<sup>2</sup>Department of Ophthalmology, Konyang University Hospital, Konyang University College of Medicine, Daejeon, Korea

**Purpose:** To define the long-term results of accommodation insufficiency and to investigate the correlation between accommodation insufficiency and other factors including near point of convergence (NPC), age, and refractive errors.

**Methods:** From January 2008 to December 2009, 11 patients with acute near vision disturbance and remote near point of accommodation (NPA) were evaluated. Full ophthalmologic examinations, including best corrected visual acuity, manifest refraction and prism cover tests were performed. Accommodation ability was measured by NPA using the push-up method. We compared accommodation insufficiency and factors including age, refractive errors and NPC. We also investigated the recovery from loss of accommodation in patients.

**Results:** Mean age of patients was 20 years (range, 9 to 34 years). Five of the 11 patients were female. Mean refractive error was -0.6 diopters (range, -3.5 to +0.25 diopters) and 8 of 11 patients (73%) had emmetropia (+0.50 to -0.50 diopters). No abnormalities were found in brain imaging tests. Refractive errors were not correlated with NPA or NPC ( $\rho = 0.148, p = 0.511$ ;  $\rho = 0.319, p = 0.339$ ; respectively). The correlation between age and NPA was not significant ( $\rho = -0.395, p = 0.069$ ). However, the correlation between age and NPC was negative ( $\rho = -0.508, p = 0.016$ ). Three of 11 patients were lost to follow-up, and 6 of 8 patients had permanent insufficiency of accommodation.

**Conclusions:** Accommodation insufficiency is most common in emmetropia, however, refractive errors and age are not correlated with accommodation insufficiency. Dysfunction of accommodation can be permanent in the isolated accommodation insufficiency.

**Key Words:** Accommodation, Convergence, Diplopia

Accommodation, convergence and miosis are the synergistic movements that occur when viewing a near point. Accommodation is a dynamic, optical change in the dioptric power of the eye and is achieved through increased anterior and posterior lens surface curvatures and increased thickness of the lens by contraction of the ciliary muscles. Deficiency of accommodation may result in fatigue with near work, diplopia, headache and decreased concentration [1]. Although accommodation insufficiency can occur when conjugate movement is normal with decreased contraction of both medial rectus muscles, most causes are

still unknown. Ophthalmic problems such as oculomotor paralysis, tonic pupil, uveitis and cataracts might lead to accommodation insufficiency [2]. Head trauma, meningitis, encephalitis and diseases involving the midbrain may also cause accommodation insufficiency [3]. Variable causes include systemic, neurologic and ocular diseases [4]. These diseases affect the lens, ciliary body, short ciliary nerve, ciliary ganglion, oculomotor nerve and third nerve nucleus and lead to accommodative loss [5,6]. However, accommodation insufficiency can develop without any precipitating factors. Almog [3] reported 5 young patients with transient loss of accommodation. The patients had an isolated transient loss of accommodation unrelated to any other ocular or systemic manifestations. Chrousos et al. [1] reported 10 healthy patients with accommodation insufficiency. However, they did not mention recovery after loss of accommodation or the correlation between loss of ac-

Received: March 19, 2012 Accepted: July 18, 2012

Corresponding Author: Ungsoo Samuel Kim, MD. Department of Ophthalmology, Kim's Eye Hospital, Konyang University College of Medicine, #136 Yeongsin-ro, Yeongdeungpo-gu, Seoul 150-034, Korea. Tel: 82-1577-2639, Fax: 82-2- 2677-9214, E-mail: ungsokim@kimye.com

© 2013 The Korean Ophthalmological Society

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

accommodation and relating factors such as age and refractive errors.

Accommodation insufficiency can be combined with convergence insufficiency. Matsuo and Ohtsuki [7] reported that 9 out of 16 patients who had accommodative insufficiency with convergence insufficiency did not show any precipitating factors such as head trauma, febrile illness, encephalitis or drug use.

Thus, the aim of the present study was to define the recovery from loss of accommodation and investigate the correlation between the degree of accommodation deficiency and factors that affect accommodation, including refractive error and age.

**Materials and Methods**

A retrospective study was conducted between January 2008 and December 2009 on 11 patients at Kim’s Eye Hospital with acute accommodation dysfunction. Acute accommodation dysfunction is defined as an acute tiredness from near work, remote near point of accommodation (NPA) and relief of patient difficulty with near glasses correction. In order to eliminate the possibility of early presbyopia, only patients under the age of 35 were considered. Other neurological and systemic complaints, abnormal pupil reaction and patients with previous ocular surgery and trauma history were also excluded. Magnetic resonance imaging was performed to identify brain lesions.

All patients were evaluated with a detailed history taking and a complete ophthalmologic examination, including best corrected visual acuity, manifest refraction, cycloplegic refraction, pupil examination, slit lamp examination, ocular motility and alternate cover tests.

To evaluate accommodative function, the NPA of each

eye was measured under full refractive correction. NPA was measured with a 20 / 40 target that was slowly brought closer to the eye and the patient was instructed to signal the point of first sustained blur. Near points of convergence (NPC) were determined by subjective methods. To evaluate the correlations with parameters affecting NPA, we compared age, refractive errors and NPC to NPA. We also investigated recovery from loss of accommodation in the same patients. All examinations were performed by one author (USK).

All analyses were performed with SPSS ver. 14.0 (SPSS Inc., Chicago, IL, USA). The correlation between age and near point of accommodation and convergence was analyzed using Spearman’s nonparametric correlation. The differences in age, refractive errors and NPA between males and females were evaluated using Student’s *t*-test.

**Results**

The 11 patients (6 males and 5 females) ranged from 9 to 34 years of age with a mean age of 20 (Table 1). Mean refractive error was -0.62 diopters (-3.5 to +0.5 diopters). There were no hyperopic patients with >+0.50 diopters, and 8 of 11 patients (73%) had emmetropia (+0.50 to -0.50 diopters, spherical equivalent). Four patients underwent magnetic resonance imaging of the brain. However, all results were interpreted as normal. No cases showed an abnormal pupillary reflex, anterior chamber inflammation or vitreous inflammation. The alternate cover test noted that all patients showed under 4 prism diopters at far distance and five of 11 patients showed more than 10 prism diopters at near distance.

The mean NPA and NPC were 30.19 cm (16 to 50 cm) and 30.82 cm (20 to 40 cm), respectively. Age, refractive

**Table 1.** The clinical characteristics of 11 patients with insufficiency of accommodation

	Sex	Age (yr)	Refractive errors* (diopters)		NPA (cm)		NPC (cm)	Mean follow-up (mon)	Exodeviation (prism diopters)		Recovery
			Right	Left	Right	Left			Near	Far	
1	Female	29	+0.25	+0.375	45	30	40	39	16	4	No
2	Male	34	-3.5	-3.5	30	31	25	36	Ortho	Ortho	No
3	Male	20	-1.75	-1.25	26	30	32	33	Ortho	Ortho	After 18 mon
4	Male	18	Plano	+0.25	24	26	26	24	6	4	After 1 mon
5	Female	9	+0.50	-0.50	36	45	40	-	12	Ortho	-
6	Male	10	+0.25	Plano	32	38	35	33	14	Ortho	No
7	Female	23	Plano	Plano	16	18	24	-	12	Ortho	-
8	Female	27	-1.75	-1.50	20	20	20	34	Ortho	Ortho	No
9	Male	22	Plano	Plano	35	35	32	-	10	Ortho	-
10	Female	15	-0.25	-0.25	25	25	25	33	Ortho	Ortho	No
11	Male	12	-0.50	-0.50	50	42	40	32	6	Ortho	No

NPA = near point of accommodation; NPC = near point of convergence.  
\*Spherical equivalent.

**Table 2.** The differences in age, refractive errors and near point of accommodation (NPA) between males and females

	Age (yr)	Refractive errors (diopters)	NPA (cm)
Male	19.3	-0.875	33.1
Female	20.6	-0.31	28.0
<i>p</i> -value*	0.717	0.239	0.221

\*Student's *t*-test.

errors and NPA showed no differences between males and females (Table 2). Only one 29 year-old female showed a difference of NPA that was >10 cm between the two eyes. The correlation between age and NPA was not significant ( $\rho = -0.395$ ,  $p = 0.069$ ). However, the relationship of age and NPC showed a negative correlation ( $\rho = -0.508$ ,  $p = 0.016$ ). Refractive error was not correlated with NPA or NPC ( $\rho = 0.148$ ,  $p = 0.511$ ;  $\rho = 0.319$ ,  $p = 0.339$ ; respectively). There was a strong correlation between NPA and NPC ( $\rho = 0.875$ ,  $p < 0.000$ ).

Three patients were lost to follow-up. The mean follow-up was 32.9 months (24 to 39 months) for 8 patients. One case showed recovery of accommodation in one month. However, only 2 patients had recovered from loss of accommodation at final follow-up.

## Discussion

The possible causes of accommodation insufficiency are numerous, including head or orbital trauma, encephalitis and meningitis, midbrain disease, tonic pupil and pharmacological and toxic agents [3]. In other instances, there have been cases of abrupt accommodation insufficiency without any apparent systemic, neurological or other causes [8,9]. Therefore, the present study investigated the characteristics of patients with isolated accommodation insufficiency without any ocular or systemic manifestation.

There were no gender differences and a wide range in age distribution (9 to 34 years). Five of the 11 patients (46%) showed a discrepancy of exodeviation between far and near distance in the present study. This result is similar with a previous report and Von Noorden et al. [10] reported nine patients with a combined accommodative insufficiency and convergence insufficiency, and five of nine patients (55%) had exophoria. All cases but one showed a symmetric decrease of accommodation. Although the mechanism of accommodation insufficiency is not certain, the symmetric decrease in both eyes perhaps implies an abnormality of the central nervous system or psychogenic disease [11].

Von Noorden et al. [10] proposed that accommodation insufficiency can occur in hyperopia without correction and in myopic patients. In the present study, emmetropia

was the most common type of refractive error and three myopic patients were noted. In spite of the high prevalence of myopia in Asians [12], there were only three low myopia patients. The low incidence of accommodation insufficiency in myopia may result from the amplitude of accommodation which is higher in myopes than in emmetropes and hypermetropes [13]. However, the amount of refractive error was not correlated with NPA or NPC in the present study ( $\rho = 0.148$ ,  $p = 0.511$ ;  $\rho = 0.319$ ,  $p = 0.339$ ; respectively). Thus, the loss of NPA and NPC may depend on individual ability for accommodation.

We performed imaging tests in four cases to search for the cause of accommodation insufficiency. Accommodation is neuronally coupled through the preganglionic parasympathetic innervation extending from the Edinger-Westphal nucleus in the brain [14]. In the present study, 4 cases with an imaging study had no abnormal findings. Almog [3] also posited that accommodation insufficiency is a benign medical entity. Although accommodation insufficiency is considered a self-limited disease, 6 of 8 patients showed permanent accommodation insufficiency in the present study. Permanent accommodation insufficiency is common when it is accompanied by convergence insufficiency. Our results also showed a high rate of permanent damage in accommodation insufficiency. Patients who showed no recovery were in no specific age group and had no refractive errors.

Although this study was conducted on a small number of cases, it found that accommodation insufficiency can be permanent. Accommodation insufficiency is most common in emmetropia, and refractive errors and age are not correlated with the intensity of accommodation insufficiency.

## Conflict of Interest

No potential conflict of interest relevant to this article was reported.

## References

1. Chrousos GA, O'Neill JF, Lueth BD, Parks MM. Accommodation deficiency in healthy young individuals. *J Pediatr Ophthalmol Strabismus* 1988;25:176-9.
2. Bell RA, Thompson HS. Ciliary muscle dysfunction in Adie's syndrome. *Arch Ophthalmol* 1978;96:638-42.
3. Almog Y. A benign syndrome of transient loss of accommodation in young patients. *Arch Ophthalmol* 2008;126:1643-6.
4. Mahto RS. Eye strain from convergence insufficiency. *Br Med J* 1972;2:564-5.
5. Ohtsuka K, Maeda S, Oguri N. Accommodation and convergence palsy caused by lesions in the bilateral rostral superior colliculus. *Am J Ophthalmol* 2002;133:425-7.
6. Lesser RL, Simon RM, Leon H, Siegel N. Cryptococcal meningitis and internal ophthalmoplegia. *Am J Ophthalmol* 1979;87:682-7.
7. Matsuo T, Ohtsuki H. Follow-up results of a combination of

- accommodation and convergence insufficiency in school-age children and adolescents. *Graefes Arch Clin Exp Ophthalmol* 1992;230:166-70.
8. Stephenson RW. Paralysis of accommodation with recovery after 5 years. *Br J Ophthalmol* 1960;44:51.
  9. Tornqvist G. Paralysis of accommodation. *Acta Ophthalmol (Copenh)* 1971;49:702-6.
  10. Von Noorden GK, Brown DJ, Parks M. Associated convergence and accommodative insufficiency. *Doc Ophthalmol* 1973;34:393-403.
  11. Miller NR. Neuro-ophthalmologic manifestations of psychogenic disease. *Semin Neurol* 2006;26:310-20.
  12. Kleinstein RN, Jones LA, Hullett S, et al. Refractive error and ethnicity in children. *Arch Ophthalmol* 2003;121:1141-7.
  13. Abraham LM, Kuriakose T, Sivanandam V, et al. Amplitude of accommodation and its relation to refractive errors. *Indian J Ophthalmol* 2005;53:105-8.
  14. Jampel RS, Mindel J. The nucleus for accommodation in the midbrain of the macaque. *Invest Ophthalmol* 1967;6:40-50.