Article

Accommodative Insufficiency: A Literature and Record Review

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ABSTRACT

Background: Accommodative Insufficiency (AI) is a condition in which a patient has an inability to focus or sustain focus at near. Several management options are available including plus lenses for near, optometric vision therapy, and monitoring.

Methods: A database of patients evaluated at the Nova Southeastern University Eye Institute between 1/03 and 6/04 diagnosed with accommodative dysfunction was reviewed. A total of 504 charts were identified via an electronic database search. A manual chart review was performed of the identified charts.

Results: Fifty-four cases met the eligibility criteria for AI as defined in this paper. Myopia (56%) was most commonly found refractive condition in this group followed by emmetropia (37%), and hyperopia (7%). The most frequently encountered chief complaint was distance blur (n=20 subjects) followed by headaches (n=8), both distance and near blur (n=7) and near vision blur only (n=5). Optometric vision therapy was prescribed in 27.8 % of the cases, while plus at near was given in 74% of the cases. Of 40 patients issued plus at near, bifocals (40.7%) were most commonly prescribed, followed by reading glasses (29.6%) and progressive addition lenses (3.7%).

Conclusions: This study finds that the most common treatment of accommodative insufficiency in an academic health center is prescribing a near addition power lens. This article discusses the results of the record review, as well as the definition, diagnosis, and treatment of accommodative insufficiency.

Keywords: accommodation, accommodative insufficiency, optometric vision therapy, near plus add, bifocal

Introduction and Review

Accommodative insufficiency is an anomaly that is characterized by an inability to focus or sustain focus at near. This is shown clinically by an insufficient amplitude of accommodation based on age-expected norms.[1] The American Optometric Association defines accommodative insufficiency as occurring when the amplitude of accommodation is lower than expected for the patient's age and is not due to sclerosis of the crystalline lens.[2]

Symptoms begin almost simultaneously with an increase in near work demand.[3] The inability to focus on near targets or to sustain clear vision for a period of time, diplopia, asthenopia, and difficulty reading with headache are the most frequent patient complaints.[2,4] (Table 1)

In a recent study of patients diagnosed with accommodative insufficiency (n=96), the incidence of blur was 56%, headache (56%), asthenopia (45%), and diplopia (45%).[1] Sterner *et al.* found a prevalence of 42.4% of 59 patients had at least one subjective complaint including headache (28.8%), asthenopia (23.7%), floating text (18.6%), and facility problems (5.1%), indicating a significant relationship between different accommodative parameters and subjective symptoms. However, there were no symptoms reported in children younger than 7.5 years.[4] Even when a diagnosis of accommodative insufficiency is present some patients do not report any symptoms.[5]

Accommodative insufficiency incorporates ill-sustained accommodation, paralysis of accommodation, and unequal accommodation. Ill-sustained

1. Headache:	"Do you get a headache when you read or study?"
2. Asthenopia:	"Do you feel tiredness or itching in the eyes when you read or study?"
3. Floating text:	"Do you see the words appear to float on the page, swim, jump or wiggle when you read or study?"
4. Facility problems:	"Do you have difficulties in quickly changing focus from the board, to your textbook, and back to the board again?"

Table 1: *Some suggested questions to ask to help determine symptomology.[1] (Questionnaire)*

accommodation is described as an early stage of accommodative insufficiency, where the amplitude can start out as normal, but deteriorates over time. Paralysis of accommodation is very rare and is described as permanent or temporary loss of accommodation resulting from infections, glaucoma, trauma, lead poisoning, or diabetes.[5]

An understanding of the close association between accommodative function and convergence is also important. When patients accommodate, convergence occurs, and when they converge they also accommodate. This relationship can be quantified by the AC/A (Accommodative Convergence/Accommodation) and CA/C (Convergence Accommodative/Convergence) ratios, respectively. Accommodative and convergence insufficiency typically present at the same time, a likely result of a neurological link. The rate of co-morbidity has been shown to increase with the severity of the CI.[1]

Epidemiology

The most frequently encountered condition in optometry after refractive error is a binocular, accommodative or ocular motor anomaly. Two recent studies shed light on to the prevalence of these conditions. Scheiman *et al* in a study that included 2,023 pediatric patients found 19.7% to suffer from a binocular or accommodative dysfunction. This was broken down further into convergence excess (7.1%), convergence insufficiency (4.6%), accommodative insufficiency (2%) and accommodative excess (1.8%).[6] Lara *et al* found an overall prevalence of 22.3% in a study size of 265 subjects. The most common occurrence was multiple diagnoses (7.2%) followed by accommodative excess (6.4%), convergence excess (4.5%) accommodative insufficiency (3%) and convergence insufficiency (0.8%).[7]

Accommodative insufficiency can also be associated with other binocular vision problems.[5] As noted earlier, accommodative insufficiency and convergence insufficiency can be coincident in many cases. Children diagnosed with both are much more symptomatic than children with just convergence insufficiency or with normal binocular vision.[1,8] Both conditions can exist separately as well. Patients with accommodative insufficiency alone can have normal fusional capacities. When a 4.00D base-in prism is placed before the eyes when reading, a convergence insufficient will report the print as more clear, whereas those with accommodative insufficiency noted blur.[9] Eye tracking should be evaluated in patients that are suspected of having accommodative insufficiency, convergence insufficiency, or both.[1]

There are also several systemic findings associated with accommodative dysfunction. They can include neurasthenia (a condition characterized by general lassitude, irritability, lack of concentration, worry, and hypochondria), emotional factors, toxic conditions, dental caries or infection, as well as endocrine disturbances, anemia, and hypertension. Other conditions include nasal obstruction, decompression sickness, menopause, and arteriosclerosis.[3]

The relationship between accommodative dysfunction, CI and learning problems, such as attention deficit hyperactivity disorder (ADHD), are not well understood. A recent study by Borstig *et al.* attempted to clarify the relationship between a binocular vision problem (CI and/or AI) and the frequency of ADHD behaviors. The children's scores on the Conners Parent Rating Scale-Revised Short Form (CPRS-R:S) were compared with the normative samples. Twenty-four children (9 boys and 15 girls) participated in the study which suggested that school-aged children with symptomatic accommodative dysfunction or CI have a higher frequency of behaviors related to school performance and attention as measured by the CPRS-R:S.[10] The results of this study should support the need for all healthcare and education professionals including pediatricians to address vision problems prior to making a diagnosis of ADD/ADHD.

It may be typical to find a small degree of esophoria or exophoria in accommodative insufficiencients.

Esophoria can result from additional innervation being used by the patient to overcome the accommodative problem, stimulating accommodative convergence. In the case where the patient has difficulty stimulating accommodation and consequently under accommodates, less accommodative convergence is free and greater exophoria can occur. This last example can also be referred to as pseudo-convergence insufficiency.[5]

Etiology

Determining the etiology of an accommodative dysfunction is important prior to deciding on a treatment approach. This can generally be done during the comprehensive case history. Accommodative insufficiency can also be the result of various systemic conditions or many of the medications taken for those conditions.[5] Caution should be taken in all children that have been diagnosed with ADD/ADHD regardless of whether they are also taking medication. Granet *et al.* found a three times greater incidence of ADHD among patients with CI when compared to the general population. A three-fold greater incidence of CI in the ADHD population was also noted.[11] Accommodation can be altered significantly by medications such as Adderall, Ritalin, Concerta and Dexedrine. [1]

Diagnosis

Accommodative insufficiency is frequently encountered in young school children and is related to subjective symptoms noted by the child. Any decrease in accommodative function among school children can contribute to near-work related problems and therefore have a negative effect on a child's learning experience.[4] Even though there are various accommodative problems reported in the literature, accommodative insufficiency is the most common.[5]

Many examination findings can be used to assist in the diagnosis of AI. Scheiman and Wick separate these in to two categories: direct and indirect measures of accommodative stimulation (Table 2) Direct measures include reduced amplitude of accommodation, difficulty clearing -2.00 with monocular accommodative facility, high monocular estimation method finding, and high fused crossed-cylinder finding. Indirect measures of accommodative stimulation include reduced positive relative accommodation, difficulty clearing -2.00 with

binocular accommodative facility, and low base-out to blur finding at near.[5]

Having a patient that fails all or most of the tests as described above does not happen often. There is rarely a textbook case of AI that contains all of the signs. The patient may fail two direct measures and two indirect measures but pass the others. Convergence often plays an important role in the accommodative process.

While the gold standard for measuring accommodative problems is accommodative amplitude, the facility and response must also be addressed to properly diagnose these patients. When assessing accommodative facility, it is not only vital to focus on the end result of how many cycles per minute they complete, but also the quality of the patient response. Are they having difficulty with the plus, minus and/or both sides of the flipper? Does the duration of time it takes for clarity become longer during testing? Do the two eyes react in the same manner or measure the same cycles per minute? This type of information can

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Symptoms

These symptoms are generally related to reading or other near tasks:

- Blurred vision
- Headaches
- Eyestrain
- Reading problems
- Fatigue and sleepiness
- Loss of comprehension over time
- A pulling sensation around the eyes
- Movement of the print
- Avoidance of reading and other close work

Signs

Direct measures of accommodative stimulation

- Reduced amplitude of accommodation
- Difficulty clearing -2.00 with monocular accommodative facility
- High monocular estimation method finding
- High fused crossed-cylinder finding

Indirect measures of accommodative stimulation:

- Reduced positive relative accommodation
- Difficulty clearing -2.00 with binocular accommodative facility
- Low base-out to blur finding at near

Table 2: *Symptoms and signs of accommodative insufficiency.*[8 (Table 11.1)]

assist the practitioner in determining the best course of action.

Hofstetter's formula, which states that the lower limit of normal is equal to 15-1/3 X (age of patient) has been studied and has been found to be a valid measure of accommodation. The average value of accommodation can be determined by using a slightly different formula, 18-1/4 (age of patient). If the value measured is 2.00 D below the calculated lower limit of normal, it is considered abnormal.[5]

Accommodative lag is the difference between the accommodative stimulus and the patient's response to that stimulus. Lag can be measured several different ways including binocular cross-cylinders and near point retinoscopy, such as the Monocular Estimated Method (MEM). A measurement of lag equal to or greater than +1.00 can be expected in patients with accommodative insufficiency or infacility.[2] This also suggests that the patient could benefit from plus lenses.

Treatment

The sequential management recommended begins with correction of ametropia, added near lenses and then optometric vision therapy. Uncorrected refractive error can lead to accommodative fatigue, which can be easily remedied in many patients.[5] Once the ametropia has been fully corrected, retesting of the binocular and accommodative status should be considered.

Determination of an appropriate add power is made by analyzing data collected from facility testing, amplitude of accommodation, MEM retinoscopy, and balancing the PRA/NRA.[5] When prescribing some doctors prefer single-vision lenses (SVL) for near work while some use flat top bifocals. Daum in 1983[3] and more recently Abdi in 2005[12] reported success rates of 90% and 98% respectively in the reduction of symptoms in patients with accommodative insufficiency.

Progressive addition lenses (PAL) are another option, though many pediatric optometrists appear to shy away from their use in children. One fitting change that is often made involves fitting the bifocal or PAL segment height higher to increase the amount of time the patient is benefiting from the near prescription.

The Correction of Myopia Evaluation Trial (COMET) evaluated the adaptability of children to progressive addition lenses with a modified fitting protocol of setting the distance fitting cross 4 mm above the pupil center. COMET was a multicenter, randomized clinical trial to evaluate whether PALs vs. single-vision lenses slowed the rate of progression in children with juvenile-onset myopia over 3 years. Of the 469 children enrolled, 234 were assigned to SVLs and 235 were assigned to PALs (+2.00 D near addition). By 1 month, all differences in adaptability disappeared and the frequency of all visual symptoms remained low and similar for both treatment groups. Most (98%) of the 235 children assigned to PALs maintained the modified fitting protocol without any problems.[13]

As suggested by the AOA, optometric vision therapy to remediate accommodative amplitude and facility, is the most effective treatment for accommodative dysfunction.[5] While the exact procedures and the manner in which they are performed are at the doctors discretion, a three phase approach to vision therapy is recommended.

Phase one encourages the clinician to develop a working relationship with the patient. Teach the patient awareness of feedback mechanisms that will be used during therapy to help them stimulate accommodation and reach normal age-expected levels of amplitude. During this phase, magnitude of accommodation will be emphasized over speed and will be accomplished with minus lenses and balancing with plus and minus towards the end of therapy. Some therapy methods utilized in this phase include lens sorting, the Hart Chart, and loose lens rock. It is also beneficial to concurrently train vergence due to the close relationship between accommodation and vergence.[5]

During phase two of treatment, it is important to emphasize the speed of your patient's accommodative response. The therapy is balanced by using both plus and minus lenses during therapy, as used in phase one. At this point, biocular/binocular accommodative facility is also introduced, with activities such as red-red rock, and targets such as vectograms. Divergence and convergence therapy is again incorporated into this phase of therapy.[5]

Finally, the third phase emphasizes the integration of binocular, as well as accommodative therapy.[5] The use of homework is crucial to the management of these patients. Many of the techniques used during training can be sent home and performed in the same manner as in office or modified in some way. The willingness

of both the patient and the parent to participate in this process cannot be understated. With appropriate compliance from both the patient and parent, the outcomes and benefits of accommodative therapy are usually long-lasting.

Methods

A database of patients evaluated at the Nova Southeastern University Eye Institute between 1/03 and 6/04 diagnosed with accommodative dysfunction was reviewed. The following ICD9 codes were used to collect a list of patient charts for further investigation: accommodation disorder unspecified (367.9), accommodation paresis (367.51), and accommodation spasm (367.53). A total of 504 charts were identified via this electronic database search.

A manual chart review was performed of these identified charts. The diagnosis of AI was made using the criteria specified by Scheiman and Wick in Clinical Management of Binocular Vision. (These criteria can be found in table 2.) For the purpose of this study, AI was defined as 3 out of 4 direct measures of accommodative stimulation and/or 5 out 7 direct or indirect measures. Patient symptoms and recommended treatments were noted for patients that fit within this definition.

Results

Of the 504 charts reviewed, 54 cases met the eligibility criteria for AI. The male to female ratio was 1:1 with patient ages ranging from 6-27 years. The refractive error assessment noted 30 (56%) subjects with myopia, 20 (37%) with emmetropia, and 4 (7%) with hyperopia. (Figure 1)

The most common chief complaint found was distance blur (N=20 subjects) followed by headaches (N=8), both distance and near blur (N=7) and near vision blur only (n=5). (Figure 2) Other common complaints included routine exam/no complaint (n=4), reading avoidance (n=2), tracking/reading problems (n=2) and poor reading/perceptual skills (n=2).

The various treatment options included optometric vision therapy (27.8 %), plus at near (74%), monitor (9.3%). A concurrent prescription of plus at near was also given for 6 out of 15 patients that were treated with optometric vision therapy.

Of the 40 patients prescribed plus at near, bifocals (40.7%) were most commonly given, followed by reading glasses (29.6%) and progressive addition lenses (3.7%). The most frequently prescribed near
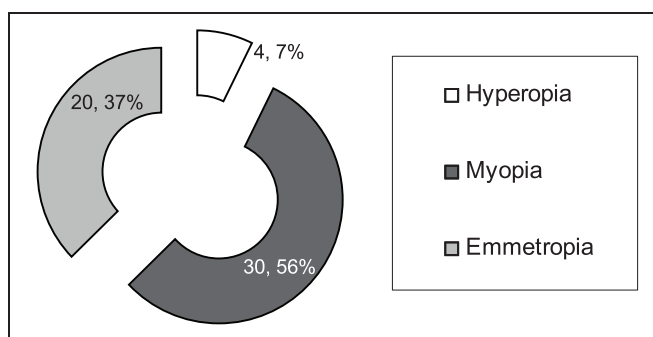

Figure 1

add powers were +0.75D and +1.00D, with a range from +0.50D to +2.25D. (Figure 3)

Conclusion

This paper has shown that the most common treatment of accommodative insufficiency in an academic health center is prescribing a near addition power lens. Even though there are many lens options available, practitioners appear to be hesitant to prescribe progression addition lenses. It is interesting to note that the most common symptom documented was distance vision blur and that 30 of the 54 patients (55.5%) were nearsighted, indicating that myopic patients may be at higher risk for developing accommodative symptoms or those with untreated accommodative disorders induce myopia progression. Since the patients with accommodative insufficiency do not routinely present with near complaints, appropriate near testing may reveal an accommodative problem. Perhaps further discussion of symptoms should be considered when the clinician suspects an accommodative problem in a seemingly asymptomatic patient. While the most common near add powers issued were on the lower end of the spectrum, some higher powers were prescribed. The exact mechanism for the determination of the add power was not addressed in this study.

Many parents note that the amount of near work that children perform on a daily basis has increased ten-fold from when the parents were young. Students are expected to do more near work and at a more demanding level than ever before. Care should be taken in identifying and treating patients not only with accommodative insufficiency but all binocular vision disorders to remove any obstacles to learning. Providing our patients with single, clear, comfortable, binocular vision will have significant and far reaching consequences during the child's school years.
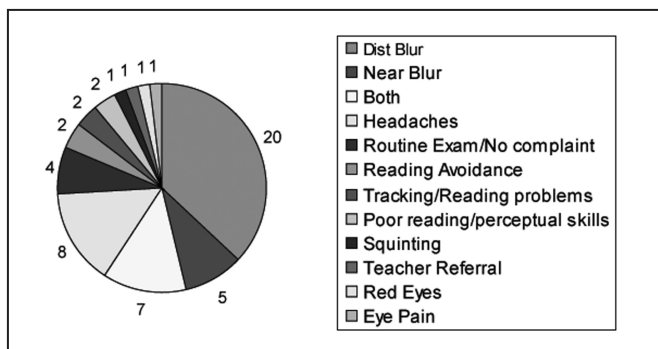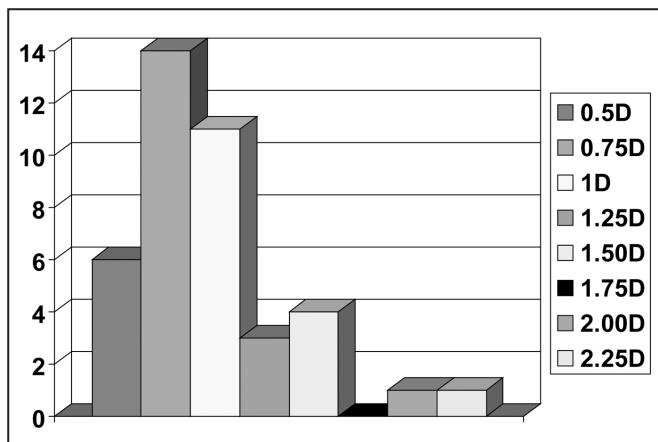
Figure 2

Figure 3

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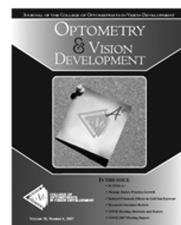View *Optometry & Vision Development* online at

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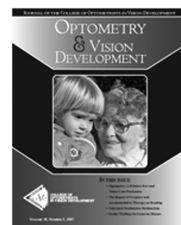**Optometry & Vision Development**

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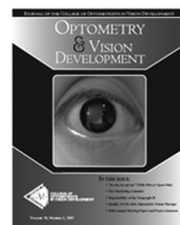
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