TESTING ACCOMMODATION IN CHILDREN

There are a number of accommodative functions and it is often difficult to decide which of these functions are most applicable when testing accommodation in children.

The amplitude of accommodation is perhaps one of the most frequently measured visual functions to clinically determine the accommodative function of patients presenting with symptoms of binocular dysfunctions. Other tests of accommodative functions include lead/lag of accommodation, accommodative facility and a cycloplegic refraction (Wick & Hall, 1987). The lag/lead of accommodation represents the discrepancy between the accommodative stimulus and the response (Cooper, 1987; Saladin, 2006; Barret & Elliot, 2007). The lag of accommodation is believed to be due to the effect of the depth of focus of the eye (Flom, 1955; Rouse, et al., 1984; Cooper, 1987). Accommodative facility is the ability to alter accommodation with a change in the fixation distance (Wick & Hall, 1987) or lens induced blur (flipper lens test) (Saladin, 2006). These tests are necessary in order to diagnose accommodative anomalies such as accommodative insufficiency, accommodative excess as well as accommodative infacility (Scheiman & Wick, 2008).

Accommodative insufficiency is a clinical condition in which the patient has difficulty stimulating accommodation. It is characterized by amplitude of accommodation that is below the minimum expected amplitude for the patient’s age (Scheiman & Wick, 2008). Conversely, accommodative excess, also known as accommodative spasm, is defined as a condition in which the accommodative response exceeds the accommodative stimulus (Rustein, et al., 1988). Accommodative infacility is a condition in which the patient experiences difficulty changing the accommodative response level and represents an abnormal dynamics of the response (Scheiman & Wick, 2008).

In determining whether a patient has accommodative insufficiency, age dependent norms of amplitude of accommodation are used (Morgan, 1944; Daum, 1983). The three main categories commonly used for classification are:

a. Accommodative insufficiency (AI): describes the clinical condition in which the amplitude of accommodation is persistently lower than expected for the patient’s age. Clinically, when a patient’s amplitude of accommodation is 2.00 D or more less than the minimum amplitude of accommodation, the individual is said to have AI (Morgan, 1944; Daum, 1983; Cacho, et al., 2002).

b. Accommodative excess: traditionally defined as accommodation higher than age expected value. It can also refer to an inability to relax accommodation readily leading to spasm of accommodation (Rustein, et al., 1988).

c. Accommodative infacility: accommodative dynamics, including latency, time constant and peak velocity are slowed, and manifests in the individual having difficulty changing focus from near to far or far to near (Scheiman & Wick, 2008).

Other accommodative anomalies include ill-sustained accommodation which is similar to accommodative insufficiency except that the deficiency is revealed after a period during which the accommodation has been active. Accommodative inertia in which the subject has difficulty changing from one accommodative state to another.

Facility of accommodation

Accommodative facility is the ability to change accommodation with a change in the fixation distance (Wick & Hall, 1987) without changing vergence (Barret & Elliot, 2007). The purpose of the accommodative facility test is to assess the ability of the accommodative system to respond to changing fixation distance (near-far test) or to lens-induced blur with monocular stimulus presentation (flipper lens test) (Saladin, 2006) and can be performed monocularly or binocularly. Clinically, the test involves the use of the ± 2.00D flipper test to alternately stimulate (minus lens) and relax (plus lens) accommodation. The number of cycles of accommodative shift within a time period is the measure of the accommodative facility (Barret & Elliot, 2007; Cooper, 1987; Saladin, 2006). The test could be performed monocularly or binocularly.

Lag of accommodation

The dioptric difference between the stimulus to accommodation and the corresponding accommodative response is known as the lag of the accommodation (Cooper, 1987; Barret & Elliot, 2007; Saladin, 2006). This results from the fact that when there is an accommodative stimulus, the minimum accommodative response is elicited to obtain a clear retinal image of the fixated object. This is thought to serve as a buffer zone for the accommodative system (Cooper, 1987). The lag of accommodation can be measured subjectively with the cross-cylinder test or objectively with dynamic retinoscopy but several authors reported poor results with the use of this technique in children. It seems to only work when used with presbyopes. (Barret & Elliot, 2007; Cooper, 1987; Saladin, 2006). The dynamic retinoscopic methods that have been employed include the monocular estimation method (MEM), and the Nott method amongst others. The Nott dynamic retinoscopy has been reported to be a more appropriate technique in measuring the lag of accommodation in young adults (del Pilar Cacho, et al., 1999; Rosenfield, et al., 1996). McClelland and Saunders (2004) used the Nott dynamic technique to determine age norms of lag of accommodation for school age children.

Relative accommodation (Positive and negative)

The relative accommodation is the amount of accommodation that can be elicited while maintaining convergence at a given fixation distance (Morgan, 1944). The positive relative accommodation (PRA) is measured by placing minus lenses in 0.25D steps before the eye while the subject maintains fixation at an accommodative target at a given distance, usually 40 cm. The total amount of minus lenses placed before the eye for the subject to report blur is the measure of PRA. Conversely, the negative relative accommodation (NRA) is measured by the total amount of plus lenses placed before the subject to report blur (Barret & Elliot, 2007; Saladin, 2006).

The blur finding during prism vergence tests.

The blur point in the prism vergence tests (BI to blur-break-recovery and BO to blur-break-recovery) at near is thought to represent the point at which accommodation is no longer able to maintain clear vision. It is therefore a measure of accommodative response (Barret & Elliot, 2007).

AC/A ratio

The AC/A ratio shows the mathematical relationship that demonstrates the synkinetic association between accommodation and convergence. It is the amount of convergence associated with a unit diopter of accommodation. The AC/A ratio is determined from the relationship (Barret & Elliot, 2007) given below which uses the physiological phoria finding as well as the accommodative demand at near distance:

AC/A = IPD + (near phoria – distance phoria) divided by D - Where IPD = interpupillary distance measured in cm and D = accommodation in diopters. In using this expression, exophoria is assigned a negative sign while esophoria is assigned a positive sign. This method of measuring the stimulus AC/A ratio is believed to be contaminated by the influence of proximal vergence on the near phoria (Saladin, 2006). The AC/A ratio may also be measured using the so-called gradient method (Barret & Elliot, 2007) in which the phoria is measured at 40 cm and repeated while a plus lens is used to relax accommodation or a while a minus lens is used to stimulate accommodation. The difference between the phoria findings with and without the plus or minus lens per unit diopter of lens power gives the gradient AC/A ratio. If a plus lens is used, the measure is referred to positive gradient AC/A, and if a minus lens is used it is referred to as negative AC/A ratio.

Measurement of amplitude of accommodation. The amplitude of accommodation can be measured subjectively using the patient’s response and perception of blur as the criteria for measurement, or objectively using instruments such as the infrared optometer (Rustein, 1993; Saladin, 2006). The subjective method includes the push-up technique and the minus-lens to blur technique in which minus spherical lenses are used as the stimulus for accommodation. Millodot and Newton (1981) proposed the use of visually evoked potentials as an objective method for measuring the amplitude of accommodation. Several factors are reported to affect the measured amplitude of accommodation. Subjective amplitude of accommodation varies with spherical ametropia with myopes reported to have a higher amplitude of accommodation compared to emmetropes and hyperopes (Abraham, et al., 2005; Iyamu, et al., 2012). The level of illumination during the

I am not surprised that you are getting an increase of claims for children younger than 10 years old. If you look at my report then you will find that research is showing that 50% of children will now become myopic by the age of 10 [Study done in Sweden and also similar studies out of Far East]

I have recently spoke on a conference and warned against the impact of technology on the visual systems of our children. It was widely reported in the press and I also did several radio interviews. The point I am trying to make is that Medical Aids will have to take note of this because it is going to have a major effect on claims received.

This was attributed to the finding by previous authors that amplitude of accommodation in children does not decline in a linear but a curvilinear function.

Comparison of the push-up and minus lens to blur techniques indicated that the former gave significantly higher amplitude of accommodation than the letter, with a bias of as much as 5.36 D between the two techniques. This finding was consistent with previous studies on the subject matter, indicating the need to be careful not to substitute the values obtained using one method for the other.

it is evident that Hofstetter’s equations cannot accurately predict the amplitude of accommodation

Table 6.51: Mean amplitude of accommodation for different age groups using the push-up and minus lens to blur methods. Age (years) Amplitude of accommodation (PU) Amplitude of accommodation (MLB) 6 – 15 14.54 ± 3.70 8.62 ± 2.28 16 – 25 12.09 ± 2.15 8.41 ± 1.65

When dealing with children we are looking at 2 issues that can be regards as two sides of the same coin.

1. Because of the continuous close -up demands in and outside the school due to the latest technologies children will develop Nearwork Induced Transient Myopia [NITM]at much earlier age. I have seen 4 year olds that spend up to 3 hours per day on I pads. In dealing with these patients you have 2 options. Currently the most popular approach is to simply correct the myopia, resulting in children returning every year for stronger glasses. By the way I should not allow any script less than -0.75 or astigmatism below -.075. Children can comfortably deal with without negative consequences. I am amazed as to the number of -0.25 or + 0.25 glasses that I find in children. The second approach - which I prefer is to profide strain relieving lenses [not less that +1.00] and my research a success rate of 90% with this approach. You also don't have to change the power every year.

2. The other side of the coin is children [more so boys] that refuse to read or battle with reading simply because their visual systems cannot cope with these demands. They will then most likely be labelled as Attention Deficit - put on medication that keeps them "under control" but not improve their reading or learning significantly. With them the solution is the same - reduce the nearpoint strain! by giving them strain relieving lenses. 1. Because of the continuous close -up demands in and outside the school due to the latest technologies children will develop Nearwork Induced Transient Myopia [NITM]at much earlier age. I have seen 4 year olds that spend up to 3 hours per day on I pads. In dealing with these patients you have 2 options. Currently the most popular approach is to simply correct the myopia, resulting in children returning every year for stronger glasses. By the way I should not allow any script less than -0.75 or astigmatism below -.075. Children can comfortably deal with without negative consequences. I am amazed as to the number of -0.25 or + 0.25 glasses that I find in children. The second approach - which I prefer is to profide strain relieving lenses [not less that +1.00] and my research a success rate of 90% with this approach. You also don't have to change the power every year.

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