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Review Article

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Convergence Insufficiency - Perception Error: A Review Article

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Background

Ocular asthenopia associated with headaches and visual discomfort are the major complaints, clients have these days. Intensive near and digital works have brought many non-strabismic binocular vision disorders (NSBVD) in the clients. Convergence insufficiency (CI) is one of the most prevalent NSBVD. CI is a binocular vision dysfunction, characterized by the patient's inability to accurately converge, or sustain accurate convergence when focusing on near objects. Apart from visual symptoms, CI is known to have effects on a children's academics and a person's daily life. In addition to visual discomfort, children with CI report symptoms affecting reading performance, such as loss of pace, loss of concentration, reading slowly, and trouble remembering what was read. Proper diagnosis of convergence insufficiency is simple, but it has been complicated by the unavailability of essential orthoptic tools; the attitude of practitioner and their knowledge adds to the hurdle. Why don't we introduce term "CI Suspect" like "Glaucoma-Suspect" so that every individual if matches one or more criteria for CI diagnosis is subjected undergo a complete binocular single vision assessment? This will properly diagnose and manage the case and also make orthoptics as a proper sub-specialty for eye care practitioners.

Keywords: Binocular single vision screening, Convergence insufficiency, Convergence insufficiency suspect, Eyestrain, Vision therapy

Introduction

The assessment of convergence is an integral part of the ophthalmic assessment, with the responses used to conform clinical management decisions. With convergence insufficiency being one of the leading causes of non- strabismic binocular vision anomalies, the thorough/detail assessment of convergence becomes crucial for every symptomatic patient. Convergence Insufficiency (CI) is a binocular vision dysfunction, characterized by the patient's inability to accurately converge, or sustain accurate convergence when focusing on near objects. Scheiman, et al. (1996) defined Convergence Insufficiency (CI) as a condition characterized by exophoria greater at near than at distance, a receded near point of convergence (NPC), and reduced positive fusional vergence (PFV) at near and a low AC/A ratio [1]. The proper diagnosis of CI is important because, the underdiagnoses not just have effects on individual's ocular health but also on his academics and daily lifestyle.

The prevalence of CI and AI in the general population is not known due to an absence of population based epidemiological studies [2,3]. However, various investigators have reported a prevalence of 4.2-6% for convergence insufficiency [4-7]. On a research conducted by BAND, Convergence insufficiency was the most prevalent (16.5 and 17.6 percent in the urban and rural arms, respectively) among all the types of non-strabismic anomalies of binocular vision [8]. Among the various studies published, the data related to the prevalence of this condition range from 1.7 to 33% [3,9]. An average in the order of 5% has been taken as the rate of prevalence of CI in the general population [8,9]. Studies in children have higher rates, and the frequency is reduced with the increase in criteria for diagnosis of CI [9-12]. In a study done by Dahal M & Khatri B in optometry students, the prevalence of CI was found to be 17.5% [13].

The symptoms of CI are highly variable and does not reflect the status of convergence. The symptoms are attributed to difficulty in maintaining binocular single vision following a prolonged near work. Von Graefe pointed out that a patient with CI complain about eyestrain and a sensation of tension in and about the globes [14]. After a brief period of reading, the letters appear blur and run together. Cross diplopia may occur occasionally during prolonged near work. Ocular headaches are another frequent complains. In short, symptoms of CI can include significant asthenopia during near vision oriented tasks: headache, diplopia, words appearing to move or jump, lack of concentration, visual fatigue, reading problems, blurred vision, and sore eyes [15].

The Signs of CI Include

- Moderate to high exophoria or intermittent exophoria at near or greater exophoria at near than distance
- Reduced PFV at near if orthophoric for distance
- Reduced PFV at distance and near if exophoric for both near and distance
- Reduced vergence facility at near with BO prism
- Intermittent suppression at near
- Receded NPC
- Low AC/A ratio
- Fails BAF testing with +2.50 D
- Low MEM and fused cross cylinder findings
- Low NRA
- Exo-fixation disparity
- Frequently associated with accommodation insufficiency

Different authors have given different criteria for diagnosis of convergence insufficiency. According to Convergence Insufficiency Treatment Trial [CITT], the diagnostic criteria for CI are [16]:

- Exodeviation at near >4 pd than distance
- Receded NPC break ≥6cm
- Insufficient PFV at near (failing of Sheard's criteria)
- Reduced PFV ≤15pd BO blur or break point
- CI Symptom Survey Score ≥16
- Appreciation of 500" stereopsis

Apart from visual symptoms, CI is known to have effects on a children's academics and a person's daily life. In addition to visual discomfort, children with CI report symptoms affecting reading performance, such as loss of pace, loss of concentration, reading slowly, and trouble remembering what was read [17-20]. Parents of children with CI report a high frequency of adverse academic behaviors (e.g., inattention, avoidance, difficulty completing homework) [21]. Suppression of vision in one eye causes loss of binocularity and depth perception. Poor binocular vision can have a negative impact on many areas of life, such as coordination, sports, judgment of distances, eye contact, motion sickness, etc. Consequently, a person with convergence insufficiency who is suppressing one eye are adversely affected. They are reluctant to perform jobs that require precise depth perception or eye-hand co-ordinations: which might affect their economy. Besides, if their subject of interest were any of those which requires prolonged near work or sharp binocularity, these patients are at disadvantage due to frequent symptomatic encounter. Due to misjudgment of distances, patients may be subjected to frequent mishaps like: trips and stumbles on uneven surfaces, stairs, and curbs, etc., frequent spilling or knocking over of objects, bumping into doors, furniture and other stationary objects, sports and/or car parking accidents. To avoid their level of discomfort, an individual may adapt positions like: frequent head tilt, one shoulder noticeably higher than another, poor postures and many more. Lack of eye- contact and awkward body posture may decrease their self- confidence and social interactions. Besides, undiagnosed CI or untreated CI may lead to intermittent exotropia, adding a cosmetic concern.

Furthermore, Convergence insufficiency is known to affect attention. Studies have shown that children with attention deficit hyperactivity disorder (ADHD) have a higher percentage (nearly 10%) of CI than normal children. An apparent three-fold greater incidence of Attention Deficit Hyperactivity Disorder among patients with CI has been reported with three-fold greater incidence of CI in the ADHD population [22]. The symptoms of CI can make it difficult for a patient to concentrate. Also, some of the symptoms of ADHD overlap with symptoms of CI. Therefore, it is recommended that any child with CI be assessed for attention problems and any child with attention problems be assessed for the presence of convergence insufficiency. It is also associated with other types of NSBVD, most commonly AI and with amblyopia [23].

The treatment modalities for convergence insufficiency can be grouped into two: Active Therapy and Passive Therapy. The treatment is designed for five objectives:

- To relieve symptoms
- To break suppression
- To improve convergence
- To appreciate physiological diplopia and
- Lastly to induce voluntary convergence

The treatment always begins with correction of any ametropia, if present as it likely to account for the patient's symptoms or result in compensation of the convergence defect. The passive therapy comprises exercise with Base In prisms and bifocals while the active therapy comprises home based pencil push up exercise and office-based exercise i.e. Vision therapy. The passive therapy somehow helps to accentuate the symptoms but is not the first line of treatment, it is well established that Vision therapy is the primary treatment for convergence insufficiency [24]. The scientific study showed that children responded quickly to this treatment protocol: 75% achieved either full correction of their vision or saw marked improvements within 12 weeks [20]. The vision therapy procedures to improve convergence includes the following:

Anaglyphs and Polaroid

- Variable tranaglyphs
- Variable vectograms
- Nonvariable tranaglyphs
- Computer orthoptics
- Random dot stereopsis program

Lenses, Prisms and Mirrors

- Loose prism jumps

Septums and Apertures

- Aperture rule
- Remy separator

Paper, Pencil and Miscellaneous Tasks

- Eccentric circles
- Free space fusion cards A
- Lifesaver cards
- Free space fusion cards B

Stereoscopes

- Brewster stereoscopes
- cheiroscope
- Wheatstone cheiroscope

Recent studies surveying eye care providers suggest that home-based pencil push-up therapy and base-in prism reading glasses are the most commonly prescribed treatments by both optometrists and ophthalmologists, with 87% prescribing these two treatment modalities fairly often, often or always for young patients with symptoms [25,26]. Office-based vision therapy was found to be the most effective treatment, many will feel that this form of therapy should be the first-line treatment. We recognize that this creates challenges for many clinicians because only about 15% of optometrists and 3% of ophthalmologists currently offer office-based vision therapy for CI [25].

Although, there are list of diagnostic methods and criteria to properly diagnose CI, why have we been limiting its diagnosis with a receded NPC? Most of the optometrist and ophthalmologist are known to diagnose CI with a mere pencil on Out Patient Department (OPD) and manage it with a pencil push up exercise, without any follow-ups and referrals. These patients are not even referred for further assessment of binocular single vision in to the orthoptic department. Is it because we perform diagnosis traditionally, or do we lack enough time, place and resource for its proper diagnosis? Managing every receded NPC as CI may misdiagnose the case and thus its

management. Misdiagnosing and mismanagement of CI means underdiagnoses of disease underlying CI like: Parkinson's, Graves Orbitopathy, Internuclear Ophthalmoplegia or life-threatening conditions like sub-dural hematoma [27]. So, eye care practitioner should refrain themselves from performing a diagnosis merely on a receded NPC basis. Further, it has also been practiced that, if no ocular morbidities are found for ocular headaches, the presumed diagnosis is convergence insufficiency. Yes, it is true that CI is the most common cause of ocular headache and asthenopia, but this is nevertheless the truth. Ocular headache is frequently, but not always associated with CI. This has been over-shadowing the diagnosis of other non- strabismic binocular vision anomalies like accommodation insufficiency.

Despite of its common occurrence, many patients especially children are unaware that they have convergence insufficiency. Proper screening for convergence insufficiency may allow identification and prompt referral for its management. However, school screenings often focus on detection of reduced visual acuity, rather than binocular vision dysfunction such as convergence insufficiency, and the best test to screen for the presence of convergence insufficiency is not known. Furthermore, the level of awareness regarding non-strabismic binocular vision is not enough among general public to realize the essence of its treatment. So, these are the hurdles in path of both the practitioner and the patient that preclude the proper CI diagnosis.

Proper diagnosis of convergence insufficiency is simple, but it has been complicated by the unavailability of essential orthoptic tools; the attitude of practitioner and their knowledge adds to the hurdle. The underdiagnoses of CI not just have visual impacts, but on every aspects of an individual's life as stated earlier. So, like any other ocular disease (Glaucoma, Diabetic Retinopathy, etc.), convergence must be thoroughly assessed. Why don't we introduce term "CI Suspect" like "Glaucoma-Suspect" so that every individual if matches one or more criteria for CI diagnosis is subjected undergo a complete binocular single vision assessment. For referring the suspects, it is important to carry out CI screening effectively. This necessitates the importance of conducting "Binocular Vision Dysfunction" Screening camps. This can be done on the same way as a vision- screening procedure. All screeners should be trained prior to the screenings and adhered to protocols and scripts for each procedure. CI suspects should be referred from the clinical settings and CI screening camps to the tertiary hospital where a designated optometrist can perform a complete examination, diagnosis and offer its management. These strategies ensure that both the symptomatic and symptomatic CI patients receives their appropriate treatment. Besides, these referrals will not just help patients to get appropriate treatment, but to us as a practitioner, will help to flourish our sub-specialty, rendering the other eye care professional to learn and understand the importance of our profession, while also educating them about the particular binocular vision dysfunction and their special tests.

Conclusion

It is necessary to diagnose CI beyond the pencil use in the OPD settings and to treat it like any other ocular disease with follow ups and designated referrals. The idea of CI management to be only the home-based pencil push-up exercise should be completely discarded. More studies and researches should be conducted on related topics. Practitioners should be motivated, and timely updated. These measures should be taken as soon as possible. If not now, when? Well there can be no better time than today.

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