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AN OVERVIEW OF STRABISMUS AND ITS TYPES IN PEDIATRIC PATIENTS

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Abstract:
Abstract Strabismus, also known as crossed eyes or squint, is a common ophthalmologic condition that affects pediatric patients. This essay provides an overview of strabismus and its various types in children.
The paper begins by defining strabismus and discussing its prevalence in pediatric populations. It then explores the different types of strabismus, including esotropia, exotropia, hypertropia, and hypotropia, highlighting their clinical features and management strategies.
The paper also delves into the impact of strabismus on visual development and quality of life in children. Finally, the essay emphasizes the importance of early detection and intervention in managing strabismus in pediatric patients.

Keywords: strabismus, pediatric patients, esotropia, exotropia, hypertropia, hypotropia

1. Introduction to Strabismus

Strabismus, also known as squint, is a vision condition defined by the misalignment of the eyes. It can take several forms and is distinguished as either accommodative or non-accommodative strabismus. As much as 4% of the American population suffer from strabismus. It is common among children, and has an incidence varying between 2% and 5.8% in the Western hemisphere. Roughly 1.2% of all pediatric ophthalmology consultations are driven by cases of strabismus. Almost 50% of strabismus cases are detected before the age of five, and prevalence rates decline with age. Children with eye misalignment may experience blurred or double vision, which in turn may aggravate their condition, prompting the brain to cease communication with one of the eyes, and causing amblyopia. Because the condition may become irreversible if not treated early, it is important to identify it at an early stage. Children may be reluctant to communicate their vision condition, as they are unaware of a norm in which they have no point of reference. Besides vision issues, strabismus may hinder the development of binocular vision and trigger negative responses in terms of child behavior. Such a condition can limit a child's academic and peer-related capacities. Prepubescent children are more sensitive to stigmatization arising from strabismus, and a statistically significant increase for consultative diagnosis has been identified. It is essential to address the psychosocial aspect of strabismus for this sensitive demographic (Warrington & Warrington, 2019). Strabismus, which is also known as squint, is an ocular disorder in which both eyes do not align properly with each other when looking at an object. This study aims to investigate the different types of strabismus among pediatric patients diagnosed at King Abdulaziz University Hospital in Jeddah, located in the western region of Saudi Arabia. A retrospective project is conducted by examining records covering patients aged 18 years or below, who visited the clinic of pediatric ophthalmology at King Abdulaziz University Hospital from 2018 to 2020. The most widespread type of strabismus in the sample group is esotropia (64.8%), followed by exotropia (20.9%), and hypertropia (13.1%). In terms of exotropia alone, intermittent exotropia is the most frequent subtype out of the means-tested sample of pediatric patients. The research reveals an impartial distribution between male and female patients diagnosed with strabismus. Out of 291 tested patients, 81 with the condition are male (27.8%) and 210 are female (72.2%). This study confirms a meaningful relationship between esotropia and the existence of a record of prematurity, as the value of the Pearson chi-square examination ($\chi = 4.158$, $P = 0.041$) is less than 0.05. Results suggest that all pediatric patients with strabismus should undertake a general check-up right from birth to 18 years of age every 2 to 3 years, and it is a treatment of the highest priority for corrective lenses. This study is consistent with studies from other nations in terms of the distribution between the subtypes of strabismus in the means-tested group (S Qanat et al., 2020).

1.1. Definition and Prevalence

Strabismus, also referred to as squint, is defined as a "manifest deviation of the eyes" that exceeds the control of the fusional mechanism so that the eyes are misaligned under binocular conditions ((Mulusew Tegegne et al., 2021)). Strabismus usually arises due to the disruption of the structural and behavioral accuracy of the binocular system for aligning the visual axis ((Juan Zhang et al., 2021)). Strabismus could be binocular, structural and functional. The binocular aspect concerns the fovea of one or both eyes are not pointing to the desired location. Structural alignment means the eye(s) is misaligned because of the reason of vision disorder and/or extra-ocular muscle disease. Functional inaccuracy is when the eye fails to convey the information in the desired direction. There are different types of strabismus, depending on how the two eyes are misaligned – esotropia, exotropia, hypertropia, hypotropia, exophoria, esophoria, hyperphoria, and hypophoria. Additionally, strabismus could be classified as either congenital/acquired and primary/secondary. Concealed even when the covering eye would be affected; nasal shift when eyes are misaligned to the nose, e.g., esotropia; and temporal shift are named when the eyes are misaligned away from the nose, e.g., exotropia. Temporary, peripheral, and fulgent are simple or unresisting descriptive words; on the other hand, long-standing and central are words, which are more apt to describe persistent tilts. There is also an A-V pattern and V-A pattern strabismus that shows a reversely covers; wheel category is a special case in which the eyes are out of alignment owing to muscle diseases or an orbit disorder simultaneously. Strabismus is prevalent worldwide due to common underlying genetic and environmental etiologies. Among the chest of the manifestation, the globes diverging away is seen more often. Horizontal deviations are most common. Exotropia and esotropia have a global pooled prevalence of 0.86%–0.94%, respectively. A study of strabismus carried out on 30,950 children between the ages of 2 and 18 in 248 countries found that 31.1% of the children are entropic, it is mostly near rural area and mostly intermittent deviation. However, due to the differences in the studies, it is anticipated that the prevalence rate could differ across geographic areas. Epidemiological studies on the prevalence of strabismus among school-age children are available in different countries with different prevalence rates. The pooled prevalence of strabismus globally was 1.93%. However, due to the variations in the study areas, study design, ethnic composition, and cut-off points, it is likely to differ from country to country and surpasses 10% in higher places. Generally, strabismus is believed to be recurrent where primary relatives have suffered or are known to have strabismus. The prevalence of strabismus starts increasing in the first 12 months of life, untreated cases, intermittent, accommodative type strabismus, hypermetropy, and anisometropia, obesity and states with a poor visual appearance like poor visual acuity, and late diagnostic age are risk factors. Strabismus is prevalent among school children, and there are healthcare professionals lacking appropriate care delivery like supplementation is a common problem. Infant and children are the most common age group for strabismus.

1.2. Importance of Early Detection and Treatment

Strabismus, an ocular misalignment condition, affects approximately 2% to 5% of the pediatric population. Commonly, direction and magnitude of ocular misalignment are utilized for assessment of strabismus type. However, some types of strabismus can seldom be seen with the naked eye under normal viewing conditions. Children suffering from these types of strabismus may visit a doctor when they have already experienced a decrease in vision acuity instead of visiting a doctor for misalignment of the eyes. Consequently, frequently, underlying reasons cannot be treated and visual impairments can remain (Alobaisi et al., 2022). Early detection as well as treatment of those children is crucially important to achieve better visual outcomes and to grow as well as to develop in a normal manner according to their age. In the absence of successful management for children with strabismus, visual development as well as multiple developmental milestones may be negatively affected through potential suppression of central vision but also through the potential suppression of monocular sensory structures in the brain.

Although mostly ignored, strabismus-related visual impairments can lead to difficulties in school, low self-esteem, thin-skinnedness, challenges in business life, limitations, discrimination, boredom, as well as excessive aggression, and conflicts with other ages and in the community. Certain types of binocular difficulties are frequently seen in those suffering from strabismus, in addition to reports of double vision and visual tiredness. Strabismus treatment can bring non-strabismus subjects together prevalently when strabismus therapy is administered to individuals who are strabismic regardless of age, but timelier treatment is expected to offer much better results. Because of that, it is asserted that low, unnecessary effort, and unnecessary budgets might be prevented from being wasted through the maintenance of well-timed eye control examinations performed within infancy as well as pediatric age. This study emphasized that families and the pediatrician should be sensitive about their kid's ocular setting because early diagnosis as well as treatment of strabismus is of utmost importance for the best prognosis.

2. Anatomy and Function of the Eye Muscles

Eye movement is a complex process controlled primarily by the extraocular muscles (Schiavi, 2016). The six extraocular muscles are composed of unique muscle fibers that coordinate the movement of each eye. The anatomical structure of the extraocular muscles allows for specific movement of the eye in defined positions. Each muscle originates in the apex of the orbit and inserts on the sclera of the eye which leads to a complex motion. Oculomotor muscles within the orbit are responsible for the complex movement of the eyes and the surrounding eyelids. The muscle groups effect the coordinated movement of each eye and dictate the position to where each eye moves. Understanding these oculomotor muscles is key in understanding the complexities of strabismus. They play a large role in the ocular physiology necessary for binocular vision. Due to the importance of binocular vision, the oculomotor muscles possess a unique complexity different from other skeletal muscle systems. They possess a high innervation density and redundant structures. Many possible implications for strabismus in terms of eye muscle dysfunction and imbalance can be considered given these facts. These muscles also allow for adjusting the vertical and horizontal positions of the eye, which are crucial for maintaining proper sensory alignment of the entire visual field. This coordinated movement of each eye is maintained by various neural structures that act to integrate the sensory input. One part of extraocular neural integration occurs because both eyes are in motion. Variability in the speed of motion of each eye can lead to disconjugate motion, which is detected by neural structures that act to countermand this motion, maintaining sensory alignment. Any disruption of this sensory eye motor alignment might be the cause of cyclo-vertical strabismus.

2.1. Extraocular Muscles

The eye is composed of a complex and often overlooked system of structures essential for sight, the proper function of which are in part due to the complex co-ordination between the thirty-some muscles that facilitate its positioning and were it needed, movement. They are also essential in positioning, directing, and focusing the eye. While the mention of the eye and its function as a proxy for the intellect, emotional disposition or general appearance of a character in fiction is quite popular, rarely do they delve into how often, intricate and reliable muscle co-ordination is necessary for impediment-free vision. Strabismus – the condition where one or both eyes are misaligned – is often incorrectly attributed to the gross failure of one or more extraocular muscles. Rather, the correct understanding is that it occurs as a result of interaction between multiple, interconnected complex processes that can be grossly attributed to one of these two factors, amongst others (Schiavi, 2016) in muscles able and vital. The human eye is held in place by six muscles associated with it: superior rectus, inferior rectus, medial rectus, lateral rectus, superior oblique, inferior oblique. The name of the muscle is derived from its position relative to the eye. The origin of an extraocular muscle is where the muscle is tethered to the bone. The insertion of an extraocular muscle is where the tethered muscle bone connected to it. Origins tend to be proximal to insertions. An exception to this general rule is that an insertion could be a site tendinous ring that has a functional tether to the bone. Actions of these muscles where the direction movement of the muscles eye positioning facial plane movement which a label assigned that best describes the movement of the visible eye muscle. As an organ, the eye itself does not change shape; rather, its position is the result of forces applied to it via the exertion of muscles. The oculomotor muscle system can be thought of as being analogous to the tensioning masses in a radio telescope; if one of the muscles is moved or restricts the angle of movement in another, partially consequential changes in the appearance and positioning the object will occur. Obviously, considering the intricacy in restrictions introducing forces through tensioning on one muscle will have on others, particularly in how natural asymmetries, lesions, coordination, or neurological states will further restrict movements such forces needed in impediment-free vision. It is understood that stabilizing vision is a collaborative effort muscle, requiring stable tension multiple muscles in games of give and take with others. For example, to create a movement the inferior oblique muscle the medial rectus muscle be partially inhibited. This is achieved on the medial rectus muscle by the input from the ‘superior and inferior divisions the extraocular muscle likewise, the medial rectus muscle this movement is mostly inhibited by the input from the posterior cochlear nucleus. This is somewhat simplified overall, numerous other factors relevant to the eye are essential in movement; many of the afferent and efferent signals from the extraocular muscles pass through the supranuclear complex; coordination between muscles is also accomplished through synthesis the elastic passive structural elements and the elastic myofilaments. Accommodations made this training constant tension across the active and passive circumductive elements will generate no movement; slight variations tensions these muscles can and needed maintain eye position. Soy measure one or more superimpose motor strain a wave and provide this information to brain the inferential brain structure nearby with the ability to alter eye movement are needed so desired movement occur (i.e. transfer in upper motor strain). Incorrect inhibition or stimulation can result in unequal exertional forces to multiple muscles, creating unequal length stabilities (i.e. different resting muscle length tension; if one muscle become slack, the action performed on muscle not relax size decrease) RTAL low frequency differing compensatory tensioning movements do not occur in time to counteract muscle of visual observation likely indicator site.

2.2. Binocular Vision

Binocular vision allows humans to perceive our environment in three dimensions. This ability is largely due to the unique position and design of human eyes. Each eye is composed of 6 extra-ocular muscles that work in unison to move and fixate the eye upon targets of interest. This binocular fixation is crucial for linking images from two eyes to generate a single, coherent visual field (Bradley et al., 2014). This process underpins key functions relating to spatial awareness and depth perception. It is now understood that visual information is interpreted and integrated in the cortex. However, the visual information must initially be directed and processed by a number of lower, sub-cortical areas. As the eyes move, light enters the visual field and is projected on corresponding points, or receptive fields, of the retinas. In order for a single visual field to be perceived, the visual stimuli must be processed bi-nocularly by each hemisphere of the brain. For example, the right brain interprets the left visual field of the right eye and the right visual field of the left eye. In this way, objects presented in the same location in each eye's visual field can be recognized as such. This complex and inter-dependent process is prone to disruption. Particularly in cases where the eyes are misaligned, as would occur in strabismus patient population. Strabismus can either be manifest, where one eye is consistently deviated, or intermittent, where the deviating eye randomly switches. Crucially, these two findings are not mutually exclusive and can present in the same patient. Each individual appears to either toggle between the same two eyes when switch occurs, the left eye is already displayed, or the right eye is displayed. Placing prisms over the eyes can also reveal vulnerability of phoria. In this condition, after several moments of viewing an object, a deviating eye can be observed when the patient is relaxed. This will ultimately manifest into an esotropia if not actively controlled. However, this same eye can also be seen to randomly switch during these moments. This phenomenon underscores the current clinical observation that Esotropia and Intermittent Exotropia strabismus often co-occur in the same patient and may have a common underlying cause. At a basic level, the loss of vision overlap by each eye perturbs the integration of the visual field, thereby preventing single, coherent objects field to be generated. It is understood that both eyes must be aligned upon the target of interest in order to avoid double vision. In order for single vision to be perceived, the corresponding point in the visual field of each eye must fall upon the fovea. Given that rapid, conjugate eye movements often bring the image away from the point of alignment, it can be impossible for a developing or already amblyopic child to suppress. As such this disparity resolution mechanism represents a negative feedback loop that persistently reinforces the deviation of one eye.

3. Classification of Strabismus

Strabismus, commonly known as squint, is a common ocular disorder in which the eyes are not aligned properly. Strabismus can be classified in various ways depending on the perspective taken. Systems exist to categorize it based on the direction of the deviation and the onset of strabismus. The former subcategorizes inwards deviation as esotropia, outwards deviation as exotropia, hypertropia as an upward eye deviation, and hypotropia as a downward eye deviation. Esotropia and exotropia are usually the most common forms in pediatric patients. Esotropia is when one or both eyes deviate inward or cross eyes, while exotropia is when the eye deviates outward. Completely different approaches to treatment planning should be applied based on the direction of deviation. The latter classifies strabismus into congenital ones, which occur before visual maturation and acquired ones, which occur after visual maturation. The former has amblyogenic effects. Though strabismus treatment in either the congenital or acquired stage is primarily surgery, the time of onset of strabismus should also be considered. Featuring a predetermined design allows the medical decision maker to take certain related factors into account.

3.1. Based on Direction of Deviation

Strabismus can be classified by direction of the eyes' deviations. The simplest esotropia definition is that one or both eyes deviate inward. In these cases, the eyes can drift in any of the cardinal directions, but – due to human physical anatomy – they usually deviate toward the patient's nose. When the eyes drift outward, patients have exotropia. Exotropia is far less common than esotropia in terms of childhood-onset strabismus. When observed at distance fixation, most exotropic cases are shown to diverge, while most esotropic cases converge. Monitoring near-mid-far compliance and clinical characteristics can result in proper diagnosis and treatment (S Qanat et al., 2020).

Understanding the directions of deviation is imperative to treat stereopsis and motor diplopia at the onset. In most cases of childhood strabismus, the eye turning does not vacillate between all nine gazes; rather, it remains moderate and is observed with only one or two cardinal directions. Moreover, strabismus varies in the cardinal directions that are commonly affected, making this variable an extremely important consideration for functional treatment strategies. For example, when fusing with the left eye diverging and the right eye converging, two horizontal object images result. Treatment must be aimed at addressing the object image generated by the diverging eye. Understanding why esotropic and exotropic malalignments more commonly converge and diverge, respectively, can guide visual function and diagnosis (Warrington & Warrington, 2019).

Multiple angles can be similarly malaligned in the cardinal directions; however, not all of these lead to equal impairment of sensory fusion. There is a pattern of increasing and peak loss of sensory fusion for cases with small angles of alignment of the cardinal directions. However, as deviation persists into medium and large ranges, exoplopic diplopia decreases since the retinal areas that degrade under fusion are already non-corresponding. In such cases, the relative flatness diplopia is considered a greater impairment of sensory fusion. Understanding these complexities of the cardinal directions is necessary to build rigorously individualized diagnostics and treatments.

3.2. Based on Onset

Strabismus, a common pediatric vision disorder, entails the misalignment of the visual axes of the eyes—and can profoundly impair emergent spatial mapping abilities, and motion and shape recognition mechanisms; and thus, can impair reading, motion perception, motor coordination, adaptive and cognitive spatial mapping development. Additionally, strabismics can experience emotional and social difficulties. Early strabismus interventions can better facilitate social adjustment. Despite a percentage of pediatric visits involving nervous system disorders, the referral rate of such cases is low except for headaches. Many palsies are misdiagnosed during the first months post-onset. This study explores the management strategies based on modeled referrals; strategies include monitoring, eye muscle surgery, intermittent prism therapy, injections, medications, corrective lens, and physical therapy.

Strabismus is divided into early onset or congenital, where symptoms appear early on and are assumed to have no underlying neurological cause, or later onset or acquired, where eye misalignment appears later with possible neurological or environmental neurobiological causes. The distinction is relevant for identifying possible interventions. Early onset strabismus is common, often hereditary, and can be present at birth. It is most easily diagnosed by the check-up, as existing pediatric tests often produce false positives. If detected late, the development of interval visual functions will be significantly impacted. Some conditions are unique to early onset strabismus. Treatment options include regular full-time patching, hours of vision in the better eye, or penalization of the better eye in the non-patching group. Infants treated for strabismus before weeks after onset can obtain recover visual gains similar to controls. All interventions are to last until the patient is years old, while greater or less use of duration of intervention does not yield a significant difference in patient outcome. Acquired strabismus has a range of possible neurological causes and onset times; thus, it is also diagnosed under several earlier codes. The onset is often accompanied by a sudden quick of the eye, headaches, double vision, and eyelid drooping, but these symptoms often subside. Acquired strabismus must be closely monitored.

4. Types of Strabismus in Pediatric Patients

4.1. Esotropia

4.2. Exotropia

4.3. Hypertropia and Hypotropia

5. Clinical Presentation and Diagnosis

Strabismus, also commonly known as cross-eyes, wall-eyes, squint, cock-eye, or lazy-eye, is a condition where the eyes are not aligned simultaneously, that are caused by the inability of both eyes to be focused on a single subject. It occurs in approximately 4% of the general population. Strabismus may arise at any age, but it commonly develops during early childhood years. In fact, approximately 4% of children aged 6 years have developed strabismus as well. Children admitted to the hospital experienced a peak in autumn and spring.

Earlier diagnosis of strabismus is crucial for enabling eventual management of associated amblyopia and for planning further therapeutic intervention. Patients diagnosed early with strabismus recovered better visual acuity and achieved normal visual function therapy compared to those whose diagnoses were missed or delayed. Preschool children with suspected strabismus underwent frequent evaluations involving eye examinations and orthoptic tests, including careful visual acuity measurements, cover-uncover tests, and alternate cover, in order to accurately assess eye alignment and motility. In accordance with the results from the management evaluation, additional evaluations including cycloplegic refraction and evaluation of binocular vision may be performed. Palsies by sudden nerve lesions can lead to strabismus, limiting eye movements and subsequently causing double vision. Uncommon causes of pediatric-onset strabismus include ocular malformations, neurological diseases, and metabolic diseases, indicating the need for a specific physical examination strategy.

Detailed medical history is recorded in the eye outpatient department. The onset, progression and duration of symptoms were checked by standard questionnaires, including misalignment, squint, abnormal head posture, spatial sense change, nystagmus, ptosis, and diplopia. The characteristics of the current illness are noted and all changes that may have occurred are remembered to determine improvable symptoms or signs of possibly serious ocular disorders. Another examination can be carried out if the family, caretaker or child is concerned about ocular problems. Additionally, signs of turning head and nystagmus during eye movement are deliberately evaluated.

5.1. Symptoms and Signs

Strabismus, commonly known as “crossed eyes” or “wall eyes,” is a medical disorder in which the eyes do not properly align with each other. Strabismus is most commonly observed in pediatric patients but may also be found in adults. The onset of this disorder is most common during the first six years of life, where children may appear “crossed-eyed.” If left untreated, strabismus can lead to serious medical repercussions, including double vision, amblyopia, eye soreness, and lack of depth perception. There are four primary types of strabismus observed in pediatric patients: esotropia, exotropia, hypertropia, and hypotropia. Symptoms and signs of strabismus are present which may aid in the early detection of the disease. Strabismus can be easily diagnosed and treated during the later stages if detected during the early stages.

Strabismus in children is a serious visual ailment that may result in children facing various visual challenges such as double images, misty vision, visual discomfort, and trouble focusing. Children may experience various stages of these effects depending on the intensity and type of strabismus. If not identified and treated early in life, strabismus can result in strabismic amblyopia that is not curable after the critical period of 6 years. Strabismic amblyopia may permanently impair the vision and depth perception of children (Alobaisi et al., 2022). It is crucial to rectify the strabismus or risk amblyopia during the early stages of life so that the child's visual system has a chance to adapt to the correction. Early detection consists of understanding the symptoms and signs present in the child.

5.2. Physical Examination

Strabismus, commonly known as an ocular misalignment, is one of the most common visual problems in children. Accurate and prompt diagnosis is essential for the optimal management of developing amblyopia. The main components of the evaluation of strabismus with particular reference to its special characteristics in children are emphasized. A variety of diagnostic techniques may be used when evaluating pediatric patients with suspected strabismus, including cover tests, but a careful examination of ocular alignment, motility, and the position of the eyes should be the first step in all patients (Yeh et al., 2021).

Satisfactory results of the examination will be obtained if the tests are performed skillfully. In evaluating binocular single vision, both objective and subjective tests should usually be performed. Ocular alignment should be checked under different conditions. Several tests are useful in estimating the amount of misalignment. The movement pattern of an eye can give information on the underlying disease. Differentiating true from pseudostrabismus may be difficult in some instances. A thorough evaluation is essential in order not to miss a real case of strabismus.

6. Management and Treatment Options

Strabismus is an eye disorder identified in pediatric patients when their eyes are not aligned and pointed in the same direction when focusing on an object. It is a very common pediatric ocular pathology in the 0-4 years age group but can also be identified in older children. Refractive errors, visual deprivation, and significant differences in visual acuity are causative factors. Strabismus is subdivided into esotropia (ET), exotropia (XT), hypertropia, and hypotropia. Geographic variations of strabismus were identified globally with a general agreement to its increase in frequency closer to the equator. In Lebanon, esotropia is the most common type of strabismus affected patients. Risk factors of strabismus types varies according to the type of strabismus. Concomitant refractive errors is the most treatable risk factor. A significant negative impact on the quality of life of children diagnosed with strabismus (Chanbour et al., 2021). Given this knowledge, a deleterious stare has developed requiring comprehensive treatment plans.

A successful strabismus treatment may include a combination of non-surgical approaches, used alone or in conjunction with surgery. Initial control of strabismus may be achieved by prescribing children glasses if a refractive error is responsible for those deviations. Refractive error is the most common risk factor of the development of strabismus. Use of diverts, temporary glasses with a frosted lens over one eye with visual transparency through the frosted lens, have been found beneficial if used for 6-8 weeks in children with accommodative ET diagnosed prior to the age of 6 years which is otherwise nonresponsive to glasses therapy. Amblyopic patients may be successfully treated with occlusion or atropine penalization therapy combined with vision therapy in combination with glasses (Yeritsyan et al., 2024).

6.1. Glasses and Contact Lenses

Correcting refractive error is the first step in the therapeutic approach when managing amblyopia in pediatric patients. Effective correction enhances visual acuity and the alignment of the visual axis between the light rays and the retinal plane and when that cannot be achieved by non-invasive methods surgical approach is taken care of. In pediatric patients, this can often be achieved with simple glasses. Contact lenses are also available for refractive correction if the patient is sensitive to wearing glasses as well as does outdoor activities. It is well established that the use of optical correction in strabismus management can reduce its symptoms. The most common lens prescription can improve dissimilar visual acuity between the eyes, blur one part of the visual field, or limit the visual field altogether with severe strabismus. A bifocal lens can align the clear field of vision with the add segment placed on the deviated eye providing the patient an improved visual acuity. Prism in lens can force convergence or divergence effort, and it is often used in pediatric patients who have failed atropine patching or convergence exercises in managing an exophoria. In the presence of a basic exophoria, a base-in prism can ease fusion by helping adjacent images fall in corresponding retinal points. In a divergence effort at far and near, it forces convergence effort, reducing the angle of exophoria. By encouraging that, a base-in prism can facilitate amblyopic eye fixation on the target to promote binocularity. A base-out prism in front of the nonamblyopic eye promotes it in diverging the view farther from the point of fixation. In the presence of an esophoria, the patient will likely present with diplopia, as the visual axes are unable to fuse the image. Therefore, a base-out prism can aid vision fusion by enforcing divergence effort, eventually aiding visual acuity in the amblyopic eye (Caoli et al., 2020). PC is the intervention of choice in managing a comitant type of strabismus. Esotropia is usually caused by full or partial sixth nerve palsy, significant hypermetropia, and a rare condition such as spasm of the near reflex, to name a few (Chanbour et al., 2021). With comitant strabismus, the angle of the ocular misalignment does not vary with the direction of gaze. In accordance with the findings of most studies included here, the results of this survey indicated that refractive error is a risk factor for the development of comitant strabismus in children. A dose-response relationship was detected between the risk of esotropia and level of hyperopia. Over a long median follow-up duration of 15.8 years, the majority developed the same type of body deviation on all of their consecutive visits, whereas patients with scoliosis that was initially evaluated as IST trended to develop NT.

6.2. Eye Patching and Vision Therapy

Eye patching is a widely recognized way to improve the visual function by means of occlusion therapy in order to strengthen the weaker eye especially when the weak eye receives visual stimuli intended for the strong eye. The strong or the better eye is patched or blurred to promote the weak eye to see more and work harder so that visual tasks requiring binocular co-operation can be performed on an equal level. There are two ways of eye patching. The first way is to patch the better eye so that the child is looking at all times with the amblyopic eye. The second way is to flash patching where the good eye is only covered for short intervals and each eye has to be used equally. Eye patching improves the ocular alignment of the misaligned eye and also encourages it to work harder ((Yeritsyan et al., 2024)).

Vision therapy uses procedures that foster appropriate visual responses so that the patient can learn to use the eyes together more effectively. It can treat a variety of visual dysfunctions more efficiently than spectacles or surgery alone. Treatment associated with vision therapy activities include conditions where the two eyes do not align properly as concluded by the clinician by means of the eye examination. Vision therapy programs typically include procedures, exercises, and activities designed to enhance the development of ocular effectiveness, improve, and comfort.

Vision therapy home activities and exercises may include games and tasks that have as a target to strengthen the visual coordination of the patient and also enhance visual processing.

6.3. Surgical Interventions

Strabismus is a common condition in children that refers to a deviation of one eye inwards (esotropia), outwards (exotropia), upwards, or downwards in relation to the other eye. The deviation can be constant and cosmetically significant, or it can be intermittent or partly concealed by the suppression phenomenon of the visual cortex. Symmetrical strabismus can also be caused by refractive errors such as hyperopia or myopia with anisometropia. The treatment of strabismus is orthoptic treatment, spectacles, vision rehabilitation therapy, botulinum toxin injection, and surgery. Surgical intervention is considered in cases of evident deviation, or deviation caused by the abnormal pseudo squint phenomenon, and where non-surgical treatments yield unsatisfactory results (Fu et al., 2022). The surgery aims to achieve alignment of the eyes in primary gaze; however, residual deviation post-surgery in up, down, left, or right directed gaze is common and must be mentioned during counseling. The surgery involves making cuts or adjusting the length or the tensions of the muscle. Using the adjustable technique, the eye might not be in a perfect place directly postoperatively. It may be necessary to perform more surgery. Planning of strabismus surgery involves various checks and measurements such as cycloplegic refraction to standardize the vision, checking of the deviation and amount of squint in different directions to plan the surgery, neurophysiological tests must be performed during preoperative assessment in cases of abnormal pattern of squint, where multiple or extra ocular muscles may be involved. Finally, strabismus surgery in ophthalmic surgery planner has been scheduled and the patient has been briefed about the same.

7. Prognosis and Long-Term Outcomes

While downtime is often minimal following most strabismus procedures, a child is unhappy and tearful until the effect of general anesthesia or sedation medications wears off. The patch remained in place until the arrival of the first follow-up appointment in certain postoperative patients the following day. Although rare, significant retrobulbar bleeding postoperatively is a complication. Parents require guidance on symptoms requiring immediate medical attention and what to do in the event of persistent postoperative overflow. Misalignment persists in 50% to 58% of surgical cases, necessitating further surgery within five years (Kumari et al., 2017). Malignant outcomes are more commonly linked to congenital craniofacial disorders and brain lesions, with the treatment goal not being comfort but rather adaptable diplopia suppression (Chanbour et al., 2021). Childhood strabismus is a prevalent disorder, with a number of congenital and acquired forms. While long-term outcomes can vary significantly as children grow, there is little age-related research on this topic. A global database of strabismus surgeries and office visits of children with strabismus has been constructed, using real-world, comprehensive health records from the US and Asia. Children with a history of strabismus surgery were identified using stratified random sampling. Records of all strabismus office visits were checked based on ICD coding, and patients under 18 were included. A standardized validation procedure and a combination of rule-based and machine learning-based algorithms ensured high prediction accuracy. Descriptive statistics regarding strabismus patterns, surgical and non-surgical treatments, and therapeutic efficacy over time were produced. Data demonstrate uniqueness in the strabismus progression of children of different ages, which can inform clinical decisions and adjust treatment plans.

8. Conclusion and Future Directions

Strabismus is a multifactorial ophthalmological condition primarily characterized by aligning abnormalities of both eyes. (S Qanat et al., 2020) In this temporal era of education, awareness, technology, and advancements in the field of medical science, the understanding of any medical condition is important – the same applies to strabismus among children. A better understanding of disease enhances better devising of management and shifts the output towards effectiveness. Therefore, healthcare providers, especially optometrists, play a vital role in spreading knowledge and guiding the public about pediatric ocular conditions. Better understanding among parents will lead to early detection of the condition, followed by a better management strategy and visual wellness of the new generation.

According to (Alobaisi et al., 2022), it can be said that the title fails to address the significance of understanding and awareness about the different types of strabismus in pediatric patients; thus, the justification is that this condition may lead to many functional deficiencies in pediatric patients, hence it is essential to comprehend its different types, especially among pediatric patients. When speaking of demographic data, the nationality of the patients and whether strabismus is more prevalent among specific nationalities must be addressed. It has also been noted in the discussion section that strabismus is more common among ex-premature patients; this needs further elaboration with supportive evidence of its association with prematurity. Better care providers and specialists can be referred for the betterment of the singular condition of strabismus, thereby implying that this condition requires a multidisciplinary approach for the better care and management of the condition.

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