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THE IMPORTANCE OF EARLY TREATMENT OF CONGENITAL VISUAL DISORDERS IN CHILDREN AND THE CONSEQUENCES OF UNTREATED CONDITIONS

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Abstract: This article is dedicated to highlighting the importance of early detection and timely treatment of congenital visual disorders in children, as well as explaining, on a scientific basis, the negative consequences that may arise if no interventions are undertaken. Congenital visual disorders directly affect the development of the visual system in children, disrupting the normal maturation of the visual analyzer. In particular, if these pathologies are not identified or adequately treated during the early years of life, profound and irreversible functional changes may occur in the visual system.

Research indicates that congenital visual disorders can lead to the development of amblyopia (lazy eye), impaired binocular vision, decreased visual acuity, and strabismus. Furthermore, insufficient visual stimulation may result in inadequate formation of neural connections in the visual areas of the cerebral cortex or irreversible neuronal changes. This not only limits visual function but also negatively impacts the child’s cognitive development, academic performance, and social adaptation.

According to scientific sources, early diagnosis and treatment during the neuroplastic period of the visual system, id est, in the initial stages of childhood, are highly effective and can significantly improve visual functions. Therefore, widespread implementation of visual screening in children, early identification of congenital visual disorders, and development of individualized treatment strategies for each child are considered among the top priorities in pediatric ophthalmology.

Keywords: ptosis, cataract, astigmatism, strabismus, amblyopia

Аннотация: Данная статья посвящена освещению важности раннего выявления и своевременного лечения врожденных нарушений зрения у детей, а также научному объяснению негативных последствий, которые могут возникнуть при отсутствии вмешательства. Врожденные нарушения зрения напрямую влияют на развитие зрительной системы у детей, нарушая нормальное созревание зрительного анализатора. В частности, если эти патологии не выявляются или не адекватно лечатся в ранние годы жизни, в зрительной системе могут произойти глубокие и необратимые функциональные изменения.

Исследования показывают, что врожденные нарушения зрения могут приводить к развитию амблиопии (ленивого глаза), нарушению бинокулярного зрения, снижению остроты зрения и косоглазию. Более того, недостаточная визуальная стимуляция может привести к неполноценному формированию нейронных связей в зрительных областях коры головного мозга или к необратимым нейронным изменениям. Это не только ограничивает функции зрения, но и отрицательно влияет на когнитивное развитие ребенка, успеваемость в учебе и социальную адаптацию.

Согласно научным источникам, ранняя диагностика и лечение в период нейропластичности зрительной системы, т.е. на ранних стадиях детства, являются высокоэффективными и могут значительно улучшить зрительные функции. Поэтому широкое внедрение визуального скрининга у детей, раннее выявление врожденных нарушений зрения и разработка индивидуальных стратегий лечения для каждого ребенка считаются одними из приоритетных задач детской офтальмологии.

Ключевые слова: птоз, катаракта, астигматизм, косоглазие, амблиопия

Annotatsiya: Ushbu maqola bolalarda tug‘ma ko‘rish nuqsonlarini erta aniqlash va o‘z vaqtida davolashning ahamiyatini yoritishga, shuningdek, davolash choralari ko‘rilmagan taqdirda yuzaga kelishi mumkin bo‘lgan salbiy oqibatlarni ilmiy asosda tushuntirishga bag‘ishlangan. Tug‘ma ko‘rish nuqsonlari bolalarda ko‘rish tizimining rivojlanishiga bevosita ta’sir ko‘rsatib, ko‘rish analizatorining normal yetilishini buzadi. Xususan, ushbu patologiyalar hayotning dastlabki yillarida aniqlanmasa yoki

yetarli darajada davolanmasa, ko‘rish tizimida chuqur va qaytarilmas funksional o‘zgarishlar yuzaga kelishi mumkin.

Ilmiy tadqiqotlar shuni ko‘rsatadiki, tug‘ma ko‘rish nuqsonlari ambliopiya (dangasa ko‘z), binokulyar ko‘rishning buzilishi, ko‘rish o‘tkirligining pasayishi va g‘ilaylik rivojlanishiga olib kelishi mumkin. Bundan tashqari, yetarli vizual stimulyatsiyaning yo‘qligi bosh miya po‘stlog‘ining ko‘rish sohalarida neyron aloqalarning to‘liq shakllanmasligiga yoki qaytarilmas neyron o‘zgarishlarga sabab bo‘lishi mumkin. Bu holat nafaqat ko‘rish funksiyalarini cheklaydi, balki bolaning kognitiv rivojlanishiga, o‘quv faoliyatiga va ijtimoiy moslashuviga ham salbiy ta’sir ko‘rsatadi.

Ilmiy manbalarga ko‘ra, ko‘rish tizimining neyroplastik davrida, ya’ni bolalikning dastlabki bosqichlarida, erta tashxis qo‘yish va davolash juda samarali bo‘lib, ko‘rish funksiyalarini sezilarli darajada yaxshilashi mumkin. Shu sababli bolalarda ko‘rishni skriningdan o‘tkazishni keng joriy etish, tug‘ma ko‘rish nuqsonlarini erta aniqlash va har bir bola uchun individual davolash strategiyalarini ishlab chiqish bolalar oftalmologiyasining ustuvor yo‘nalishlaridan biri hisoblanadi.

Kalit so‘zlar: ptoz, katarakta, astigmatizm, g‘ilaylik, ambliopiya.

Introduction

The visual system is one of the complex sensory systems that plays a crucial role in a child’s overall development, with its complete and healthy formation occurring during the early years of life. During this period, functional connections between the eyes and the central nervous system develop actively, and a high degree of adaptability to external visual stimuli is exhibited. Any disruption in this process can hinder the full development of the child’s visual abilities.

Congenital visual disorders in children often remain unnoticed in the early stages of life because they may not be clinically apparent. As a result, these conditions are diagnosed late, and appropriate treatment is delayed. This can lead to incomplete development of visual function, impairment of sensorimotor integration, and subsequent functional limitations. Reduced visual input significantly affects a child’s perception of the environment, spatial awareness, reading and writing skills, and social activities.

Modern scientific approaches emphasize that the detection of visual problems in children should not rely solely on clinical signs but also include the importance of regular screening and preventive examinations. Early diagnostic measures allow the identification of latent functional impairments in the visual system, creating opportunities for timely initiation of effective treatment and rehabilitation interventions. From this perspective, early detection and comprehensive management of congenital visual disorders in children represent a critical issue in pediatric ophthalmology and pediatrics.

Methods

The aim of this study was to scientifically analyze the importance of early detection and treatment of congenital visual disorders in children, as well as the consequences of untreated conditions.

The study primarily employed literature analysis, including scientific articles, systematic reviews, and meta-analyses published over the past 10 years. This approach allowed for the assessment of both clinical and functional outcomes of congenital visual disorders in children, such as ptosis, cataract, astigmatism, myopia, and anisometropia.

The benefits of early diagnosis and treatment for each type of congenital visual disorder were identified, along with the negative consequences of delayed or insufficient treatment, and their impact on the quality of life of affected children was evaluated.

Results and Discussion

Congenital Cataract in Children

Ptosis — the drooping of the upper eyelid — is a condition in which the eyelid rests lower than normal. In some cases, it may partially or completely cover the pupil. Ptosis can affect one eye (unilateral) or both eyes (bilateral).

Causes of ptosis in children:

1. Congenital ptosis occurs when the levator palpebrae superioris muscle, which elevates the upper eyelid, is underdeveloped or nonfunctional. It is usually unilateral but can sometimes be bilateral. Congenital ptosis is generally associated with myogenic developmental abnormalities of the levator palpebrae superioris muscle.

2. Marcus Gunn Jaw-Winking Syndrome is a neurological condition in which the upper eyelid elevates involuntarily during jaw movement. This phenomenon occurs due to aberrant connections between the trigeminal nerve (cranial nerve V) and the oculomotor nerve (cranial nerve III), causing the eyelid to move synchronously with jaw activity.

3. Neurogenic ptosis results from impaired innervation, such as in Horner syndrome or damage to the oculomotor nerve. Horner syndrome arises from disruption of the sympathetic pathway, which extends from the brain to the eye. Lesions along this pathway can cause mild drooping of the upper eyelid, constriction of the pupil (miosis) on the affected side, absence of sweating on the corresponding side of the face (anhidrosis), and the appearance of the eyeball being recessed (enophthalmos).

Treatment of ptosis in children preserves vision. If left untreated, ptosis may lead to amblyopia (lazy eye), astigmatism (due to eyelid pressure causing deformation of the cornea), compensatory head posture (tilting the head backward), as well as aesthetic and psychological issues.

Management strategies for congenital ptosis:

1. Observation: If ptosis is mild, the pupil is not occluded, and vision is not at risk, the child is regularly monitored by an ophthalmologist.

2. Surgical intervention (primary treatment). The type of surgery is selected based on the functional status of the levator muscle:

a) Levator resection — If the levator muscle has partial function, it is shortened to increase eyelid elevation.

b) Frontalis suspension — If the levator muscle is poorly functional or inactive, the eyelid is connected to the frontalis muscle. The child can raise the eyelid by lifting the eyebrow. Materials used include autogenous fascia, silicone rods, or specialized synthetic materials [1,2,3,4].

Congenital Cataract in Children

Congenital cataract in children is usually identified at birth or during the first few months of life. The condition can result from genetic mutations (30–50% of cases), maternal infections during pregnancy (such as measles, herpes, or cytomegalovirus), metabolic disorders (galactosemia, hypoglycemia), or hereditary syndromes (e.g., Down syndrome, Marfan syndrome).

In children, congenital cataract is characterized by clouding of the natural lens of the eye, which significantly impairs the normal development of the visual system. Treatment is exclusively surgical, as medications or exercises cannot eliminate the cataract. The timing of surgery is crucial to prevent the development of amblyopia (“lazy eye”). Typically, unilateral cataracts are operated on at 4–6 weeks of age, while bilateral cataracts are treated at 6–8 weeks.

Cataract surgery in children involves several steps. First, the child is safely anesthetized, and a clinical eye examination is performed. During surgery, the opaque lens is removed (lensectomy). In some cases, microinstruments or ultrasound are used for lens emulsification; however, in children, the lens is relatively soft, so simple extraction is often sufficient. Additionally, a posterior capsulotomy and, if necessary, an anterior vitrectomy are performed to prevent rapid opacification of the posterior capsule, ensuring better visual outcomes.

Intraocular lens (IOL) implantation is performed depending on the child’s age. Generally, IOL implantation is delayed in children aged 0–2 years, with visual correction initially achieved using contact lenses or glasses. After the age of 2, an artificial lens may be implanted. Following surgery, appropriate optical correction (contact lenses or glasses) is provided to restore vision and prevent amblyopia. If surgery is performed on one eye and there is a significant difference in visual acuity between the eyes, temporary occlusion (patching) of the healthy eye is applied to stimulate the amblyopic eye, promoting improved visual function. Additionally, specialized visual exercises and instrumental visual stimulation techniques help develop binocular vision.

Postoperative follow-up is essential. During the first month, the child’s eyes are examined weekly; subsequently, assessments are conducted every 1–3 months to evaluate eye movement, visual acuity, and binocular vision. Antibiotic and anti-inflammatory eye drops are administered, and intraocular pressure is monitored if necessary.

Delayed surgery increases the risk of amblyopia and permanent visual impairment; therefore, congenital cataracts should be removed surgically as early as possible. Timely diagnosis and treatment are critical because insufficient visual input during the early months of life prevents the proper formation of the visual cortex and disrupts the development of the visual system.

One of the most severe consequences of untreated congenital cataract is deprivation amblyopia. In this condition, the brain fails to process signals from the affected eye due to poor-quality retinal images, resulting in significant loss of visual acuity. Amblyopia develops particularly in early life and may not be fully reversible even after surgical correction. Furthermore, congenital cataract adversely affects the development of binocular vision, disrupting the coordinated function of both eyes and preventing the formation of depth perception.

If left untreated for an extended period, cataract may lead to functional asymmetry between the eyes, predisposing the child to strabismus. Misalignment of the eyes not only causes aesthetic concerns but also further limits visual function. Additionally, insufficient visual stimulation can result in irreversible neural changes in the visual cortex, which can significantly restrict vision throughout life. Visual impairment also negatively affects psychomotor and cognitive development, including environmental perception, motor activity, speech, and learning. Therefore, early detection and timely surgical management of congenital cataracts are essential to preserve visual function and support normal overall development in children [5,6,7,8,9].

Astigmatism in Children

Astigmatism is a refractive error caused by irregular curvature of the cornea or lens, resulting in images not being sharply focused on the retina. It can be congenital and is often detected during early childhood. Timely and appropriate correction of astigmatism in children is crucial for normal development of the visual system, prevention of amblyopia, and ensuring stable visual function later in life.

The need for astigmatism correction depends on the child’s age and the degree of astigmatism. In the first year of life, astigmatism up to 1.0 diopter is generally considered physiological and only requires observation. However, astigmatism of 1.5–2.0 diopters or higher necessitates early optical correction. In children aged 1–3 years, astigmatism greater than 1.0 diopter, and in those aged 3–6 years, astigmatism above 0.75 diopter requires mandatory correction. Even in school-aged children, astigmatism of 0.5 diopter may require correction if accompanied by clinical symptoms.

The primary and most effective method for correcting astigmatism is optical correction, typically achieved using eyeglasses equipped with cylindrical lenses. Full cylindrical correction is recommended in most cases, as partial or insufficient correction may slow visual development. Prescription glasses are particularly important in cases of unilateral or high-degree astigmatism. In older children, usually from 8–10 years of age, toric contact lenses may be used, especially in cases of high astigmatism or anisometropia.

Failure to detect or adequately correct astigmatism early may lead to amblyopia (“lazy eye”). In such cases, optical correction alone may be insufficient, and additional pleoptic treatments may be applied. These include temporary occlusion of the healthy eye, penalization techniques, and specialized visual exercises aimed at stimulating vision. Instrumental and computer-based visual training may also serve as supportive tools, but they can never replace eyeglasses.

Astigmatism cannot be corrected with medications or eye exercises, and laser refractive surgeries are not performed in children; such interventions are only considered after the age of 18, once refraction has stabilized. Therefore, during childhood, the focus must remain on appropriate optical correction and regular ophthalmologic monitoring [10,11,12].

Congenital Strabismus in Children

Congenital strabismus is a visual system disorder characterized by the inability of a child to maintain proper ocular alignment from birth or within the first six months of life. In this condition, the eyes do not point to the same target, and their movements are uncoordinated. Congenital strabismus arises from disruptions in the complex connections between the central and peripheral components of the visual analyzer.

Several factors play a key role in the development of congenital strabismus. Major causes include congenital deficiencies of the extraocular muscles or the cranial nerves (III, IV, and VI) that innervate them, developmental abnormalities of the central nervous system, perinatal hypoxia, intrauterine infections, and hereditary predisposition. In addition, congenital refractive errors — high hyperopia, astigmatism, or anisometropia — can disrupt ocular balance and contribute to strabismus. Congenital cataract or other visual obstacles can also reduce visual stimulation, leading to secondary strabismus.

Timely treatment of congenital strabismus is critical for the development of binocular vision. The visual system exhibits high plasticity during the early years of life, making interventions during this period most effective. Treatment primarily targets the underlying causative factors. If refractive errors are present, appropriate optical correction is provided using glasses or contact lenses. To prevent and treat amblyopia, temporary occlusion (patching) of the healthy eye or penalization techniques may be applied. Orthoptic and pleoptic exercises are used to enhance extraocular muscle function and improve binocular coordination. In some cases, surgical intervention on the eye muscles is required, typically in conjunction with or following conservative treatment.

Failure to treat congenital strabismus can lead to serious and long-term consequences. The most common complication is amblyopia, in which the visual acuity of the strabismic eye gradually decreases

as the brain “ignores” signals from that eye. Consequently, binocular vision does not develop, and the child lacks depth perception. Prolonged untreated strabismus can also result in irreversible functional changes in the visual cortex, so that even after surgical correction of ocular alignment, full visual function may not be restored. Moreover, aesthetic concerns negatively affect the child’s psychological well-being, social adaptation, and self-confidence. Therefore, early detection and comprehensive management of congenital strabismus are essential to preserve visual health and support normal overall development in children [13,14,15].

Table 1. Early Intervention and Consequences of Untreated Congenital Visual Disorders in Children

Congenital Visual Disorder	Causes	Recommended Early Treatment	Consequences if Untreated
Ptosis (drooping upper eyelid)	Underdevelopment of levator palpebrae superioris muscle; Marcus-Gunn Jaw-Winking Syndrome; Neurogenic (Horner syndrome, oculomotor nerve damage)	Observation (for mild cases); Surgical intervention (levator resection or frontalis suspension)	Amblyopia (lazy eye); astigmatism; compensatory head posture; aesthetic and psychological issues
Congenital Cataract	Genetic mutations (30–50%); maternal infections during pregnancy (measles, herpes, cytomegalovirus); metabolic disorders (galactosemia, hypoglycemia); hereditary syndromes (Down, Marfan)	Early surgery (lensectomy) at 4–8 weeks; optical correction with glasses or contact lenses; patching of healthy eye to prevent amblyopia	Deprivation amblyopia; impaired binocular vision; strabismus; irreversible neural changes; delayed cognitive and psychomotor development
Astigmatism	Irregular curvature of the cornea or lens; can be congenital	Early optical correction (glasses with cylindrical lenses); pleoptic therapy if amblyopia develops	Amblyopia; slowed visual development; impaired binocular vision; long-term visual limitations
Congenital Strabismus	Congenital deficiency of extraocular muscles or cranial nerves (III, IV, VI); CNS developmental abnormalities; perinatal hypoxia; intrauterine infections; hereditary predisposition; refractive errors; congenital cataract	Optical correction for refractive errors; temporary occlusion of healthy eye; orthoptic/pleoptic exercises; surgery if necessary	Amblyopia; impaired binocular vision; loss of depth perception; irreversible functional changes; aesthetic and psychological issues

Conclusion

Early detection and treatment of congenital visual disorders are critical for ensuring high-quality visual function throughout a child’s life. The neuroplastic period of the visual system is most active in the first years of life, and interventions during this time can significantly improve visual outcomes. Therefore, public awareness, healthcare professionals, and parents must prioritize early screening, timely diagnosis, and comprehensive treatment strategies to safeguard children’s vision and overall development.

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