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Guidelines for the management of strabismus in children

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ABSTRACT

The treatment of strabismus is an area of ophthalmology which is overshadowed by other more common eye conditions. Consequently, a lot of controversy and misunderstanding still surrounds the issue. With a view to improving the standards of ophthalmic care for young patients, the Section of Pediatric Ophthalmology and Strabismus Treatment of the Polish Ophthalmological Society presents guidelines and recommendations on the basic principles of strabismus management in children.

KEY WORDS: strabismus, guidelines, pediatric ophthalmology.

INTRODUCTION

Strabismus affects between 1.3 and 5.7% of the pediatric population [1]. Temporary deviation of the eyes is common in healthy newborns and should not cause concern. Correct binocular coordination of eye movements develops already at around 2 months of age, while motor fusion should be fully established in all infants from 4 months of age. As a consequence, strabismus found in children over this age should raise concern and prompt a complete ophthalmologic examination [2].

Most cases of strabismus in children have a developmental (congenital) background or result from an accompanying error of refraction. However, it needs to be noted strabismus can also be secondary to ocular diseases such as congenital cataract, retinoblastoma or retinopathy of prematurity. It can also have an acquired paralytic origin associated with a pathology within the central nervous system. Correct diagnosis is key to determining patient management and further prognosis.

DIAGNOSTIC WORK-UP AND DIAGNOSIS

The presence of manifest and latent strabismus is easy to confirm using the cover test. However, establishing a diagnosis requires the application of various diagnostic tools. In each patient, general ophthalmic examination, complete with the assessment of visual acuity, and anterior and posterior ocular segments, should precede the orthoptic diagnostic work-up.

Determining the refractive error in a child with strabismus requires the use of cycloplegic agents regardless of the child's age. These include atropine at 1% in children over 6 years of age, 0.5% in children between 1.5 and 6 years of age, and 0.25% in children between 9 and 18 months of age; cyclopentolate at 1% in children from 1 year of age; and tropicamide at 1%. The agents listed above should be

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used in a manner that brings about complete cycloplegia, while taking into account the patient's age.

Basic orthoptic examination in a child with suspected strabismus should include an assessment of distance and near visual acuity, ocular motility, and phoria and tropia (using a distance and near cover test) as well as a sensory examination of simultaneous perception, fusion and stereoscopy. In young children, the Brückner test or the prism fusion test.

Correct diagnosis and initiation of treatment in patients with strabismus require additional orthoptic examinations:

1) Measurements of strabismus angles using alternate prism cover test for distance, gaze upward, downward, to the sides and at head tilt, and for near. AC/A ratio measurement with a +3.0 Dsph lens. Identification of phoria and tropia by prism cover test or another method. In patients with sensory strabismus, assessment of the strabismus angle based on corneal reflections.

2) Assessment of ocular motility in 9 diagnostic directions of gaze, including duction and vergence movements, evaluation of fixation preferences and the width of the palpebral apertures.

3) Assessment of compensatory head posture, its direction and magnitude.

4) Assessment of the status of binocular vision (simultaneous perception, range of fusion, stereoscopy) and the presence and type of sensory adaptation (abnormal retinal correspondence, diplopia, suppression) with the use of prism bars, Worth and Bagolini tests, stereotests (e.g. Randot, Titmus fly, TNO) and/or synoptophore.

Complementary tests to facilitate a complete diagnosis and treatment planning include:

1) Measurement of ocular torsion using subjective (e.g. synoptophore) and objective methods (eye fundus examination), Hess or Harms screen tests, 9 positions of gaze on the synoptophore, Parks-Bielschowsky three-step test. Assessment of the field of binocular single vision performed with Goldmann perimeter or Harms screen.

2) Examination after prolonged monocular occlusion (Marlowe's patch test).

3) Prism adaptation test to determine the risk of postoperative diplopia and reveal the full angle of strabismus.

AIM OF TREATMENT

Regardless of the type of ocular motility disorder detected in a patient, there are four indications for undertaking strabismus treatment. They include:

- manifest strabismus presenting with esthetic and psychosocial challenges;
- compensatory head posture in view of its effects on body posture;
- diplopia, constant or intermittent, because of functional effects;
- asthenopic symptoms (fatigue), because of functional effects.

The above indications can be extended to include yet another one, namely the attempt to improve the quality of binocular vision. Certain occupations require a high level of stereoscopy, which can be decreased in patients with considerable latent strabismus. However, these are exceptional situations.

The goals listed above can be achieved through appropriate conservative and surgical treatment modalities.

CONSERVATIVE TREATMENT

Refractive error correction

It is recognized that correction of refractive error is the first step in the treatment of strabismus, regardless of its type. The aim is to eliminate the accommodative component and prevent secondary amblyopia. In cases of fully accommodative strabismus, correction of the refractive error alone may lead to a cure [2, 3].

Principles of refractive error correction in strabismic children [4]:

1) for hyperopia, full refractive error correction to the value obtained after cycloplegia (except for cases of intermittent exotropia, where undercorrection of up to 1.5 Dsph is acceptable);

2) for myopia, full refractive error correction to the value obtained after cycloplegia or lower, but ensuring full distance visual acuity;

3) for with-the-rule astigmatism, full correction is recommended, but undercorrection of 0.5 Dcyl is acceptable; otherwise full correction to the value obtained after cycloplegia;

4) for anisometropia, full refractive error correction to the value obtained after cycloplegia. Spectacle power in the eye with higher refractive error should not be reduced, regardless of the magnitude of anisometropia. Where high differences (over 4.0 Dsph) are found, a contact lens is recommended.

Modifications of spectacle correction to induce a change in strabismus angle by means of accommodative effects (e.g. hypercorrection of hyperopia in patients with esotropia or undercorrection in exotropia) are not a recognized method of therapy. Exceptions include cases of intermittent exotropia, where a minus overcorrection may decrease the duration of the manifest phase, as long as it does not induce asthenopic symptoms [5].

In children with accommodative esotropia and convergence excess, bifocal or progressive spectacles with an addition of up to + 3.0 Dsph are prescribed. Regardless of the type, such spectacles should have a large lower segment (division through the center of the pupil). The success of therapy depends on reducing the angle of strabismus for near below 8 Dpt and obtaining binocular vision [6].

Amblyopia treatment

The principles of amblyopia treatment in children with strabismus are described in detail in separate guidelines (Polish Ophthalmological Society, 2021). The timing of surgical treatment for strabismus in amblyopic children is at the discretion of the treating physician [7]. The basic principles in this area should be followed:

1) In children with early-onset strabismus with a doubtful potential for binocular vision, an alternation of fixation should be sought (by patching the less frequently deviating eye) prior to undertaking a surgical intervention.

2) In cases of moderate to severe amblyopia, intensive efforts should be made to improve visual acuity prior to strabismus surgery.

3) If the treatment of strabismic amblyopia fails (following the exclusion of other causes – see below), surgical restoration of orthotropia may be conducive to therapeutic progress and, in such situations, should not be delayed.

Orthoptic exercises

Orthoptic exercises are used in the treatment of convergence insufficiency and latent strabismus in situations where they cause asthenopic symptoms [8]. They comprise exercises that extend the range of fusion, strengthen binocular vision, and enhance convergence. Fusion range exercises may also be helpful to maintain orthotropia after strabismus surgery with a small residual angle [9]. There is currently no scientific evidence for the therapeutic efficacy of orthoptic exercises in other types of strabismus than those listed. Consequently, recommending them outside these indications does not comply with the requirements of evidence-based medicine.

Prisms [1, 9]

Prism correction is used in the following clinical situations:

1) in partially accommodative strabismus with a good potential for binocular vision and small angle of strabismus;

2) in intermittent exotropia of the convergence insufficiency type in order to assess the possibilities for surgical correction or reduction of asthenopic symptoms;

3) in paralytic and post-traumatic strabismus with diplopia, with no torsion of the image, as an alternative to surgery;

4) in esotropia for distance;

5) in acute non-accommodative concomitant esotropia to ensure continuity of binocular vision and eliminate diplopia while waiting for surgery;

6) in decompensated latent strabismus as an alternative to surgery;

7) to reduce residual angle or secondary strabismus after surgical procedure in patients with strabismus and binocular vision;

8) in nystagmus to stimulate convergence or reduce compensatory head posture;

9) to perform extended preoperative prism adaptation test.

It needs to be emphasized that, with the exception of the situations listed above, prism correction is not an established treatment modality for strabismus, and does not represent an alternative to surgery.

Patching therapy

Patching (alternate or unilateral) is not a treatment for strabismus *sensu stricto* but is used as an adjunctive therapy in the following clinical situations [2, 9, 6, 10]:

a) infantile esotropia – patching of the less frequently deviating eye is performed to achieve alternating fixation. There is no evidence that it might improve the apparent abduction deficit;

b) intermittent exotropia – alternate patching in young children with this form of strabismus reduces the duration of the manifest phase;

c) paralytic strabismus – to eliminate diplopia while waiting for surgery;

d) as a method to treat strabismic amblyopia – as a result of improved visual acuity, manifest strabismus may become latent.

Patching part of the spectacle lenses, either completely unilaterally or alternately, for the purpose of normalization of eye alignment, is not grounded in or validated by scientific research as an effective therapeutic method.

SURGICAL TREATMENT

Based on the current state of knowledge, surgical treatment is the primary therapeutic modality in patients with strabismus [2, 6]. In cases where conservative treatment options have been exhausted, the decision to refer the patient for surgery is made by the ophthalmologist. Depending on the diagnosis, the following principles should be followed:

1) Surgical procedures in children with infantile strabismus (esotropia as well as exotropia) should be performed in early childhood (though views on this issue vary) [11].

2) Intermittent exotropia, unless it becomes constant, does not require surgical intervention before the ages of 6 and 8 years [12, 13].

3) Partially accommodative esotropia requires surgical intervention as promptly as possible in view of the concern for stabilization of binocular vision [2, 6].

4) Acute acquired concomitant esotropia requires urgent surgery as soon as neurological causes are excluded [14].

5) Congenital paralytic and mechanical strabismus with compensatory head posture should be provided as early as possible, preferably before the age of 4 [1].

6) The treatment of compensatory head posture in children with nystagmus (unless it is extremely severe) should be considered as late as possible, preferably after 8-9 years of age [15].

Surgical treatment should be preceded by an extended orthoptic diagnostic assessment (see above). When planning the procedure, the presence of all horizontal, vertical and torsional components, spread of concomitance in 9 gaze directions, and the A or V syndrome must be considered.

The goal of surgical treatment should be achieved with as few procedures as possible, preferably during a single operative session. The need to schedule surgery over more than one session arises only in exceptional circumstances. These include such situations as the risk of anterior segment ischemia resulting from a large number of muscles operated on in one eye, complex paralytic and post-traumatic strabismus, and cases where the effect of the procedure is difficult to pre-

dict or there is no standard relationship between the scope of the procedure and its outcome.

It needs to be highlighted that surgical therapy does not mark the end of treatment. The patient requires continued amblyopia treatment, and periodic follow-up checks of refractive error and ocular alignment. The frequency of follow-up visits depends on a range of factors, such as the child's age and treatment outcomes.

BOTULINUM TOXIN

Botulinum toxin is used as an alternative to surgical intervention in the following clinical situations [2]:

a) small to moderate angle (up to 40 Dpt) esotropia and exotropia;

b) residual small-angle strabismus persisting after surgery, in patients with binocular vision;

c) acute paralytic strabismus (e.g. paralysis of the abducens nerve);

d) as adjuvant therapy in surgical treatment of large-angle strabismus (e.g. in infantile strabismus).

DISCLOSURE

The authors declare no conflict of interest.

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