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Rehabilitation after surgical treatment of retrobulbar tumors

Authors' Contribution:
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection

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ABSTRACT: The authors propose a set of rehabilitation exercises concerning the muscles which are responsible for movement of the eyeball. After surgical treatments of retrobulbar tumors, the function of the eyeball muscles is often inadequate. Some compensation should be created at the level of the central nervous system, which means trigging adaptation, substitution and habituation. The exercises should be started just after the patient is awakened: first in the horizontal position, then sitting position and finally standing position. The highest number of exercises should be done in the direction of extreme diplopia

KEYWORDS: diplopia, orbit's tumors, rehabilitation of the muscles which are responsible for the movement of the eyeball, surgery of the orbit

The orbital cavity is where primary, secondary or metastatic tumors can develop. Within the eye socket benign tumors, malignant tumors, vascular lesions, inflammatory diseases, birth defects are observed.

The prevalence of all orbital tumors is 1 in 100,000 and accounts for around 1% of all cancers.

Primary cancers of the orbit account for 0.4% of all human cancers, of which 15–25% occur in childhood. 2–8% of orbital tumors are a result of metastases, most often lung and breast adenocarcinoma. Orbital changes can occur as a result of systemic diseases such as: sarcoidosis, tuberculosis, Wegener's granulomatosis, Sjögren's syndrome, endocrine disorders, and hematological diseases.

Another group of orbital abnormalities are pseudotumors, also known as idiopathic inflammatory lesions in the orbital tissues. The prevalence of these lesions in childhood is around 8.5%, and up to 18% in adults. Intraorbital tumors are more frequent in the eyeball, less often retrobular.

The initial orbital tumor may be asymptomatic, with exophthalmos and perceived pressure from patients or increased orbital tension only after certain dimensions are reached (most often around 1 cm). External access is the most common choice in the diagnosis and treatment of orbital tumors. In the Clinical Ward of the SU Otolaryngology Clinic, we use our own classification to facilitate the selection of surgical techniques. We apply modifications to the orbital space criteria according to Duke-Elder and Benedict. This classification includes two real surgical spaces:

- the first peripheral space between the periosteum of the orbital bones and the ocular muscles,
- the second central space inside the muscle cone, behind the eye.

In contrast, two further areas – Tenon's space and periosteal space are potential spaces in surgical oncology.

Another criterion for division are the vertical planes that divide the eye socket into zones:

- at the maximum width of the eyeball, also called the equator of the eyeball,
- 1.5 cm behind the eyeball (not coinciding with the place of exit from the orbit by the anterior ethmoid artery).

The last criterion is the assessment of the relation of the tumor to the optic nerve, i.e. determination of the wall and nerve II between which the tumor is located.

The overall objective of treating orbital retrobulbar tumors is oncological radical resection of the tumor, followed by preservation of vision in the operated orbit without loss of color or double vision. The combination of radicality and preservation of the functions of eyes forces optimal access to the tumor and the operational methodology:

1. such opening of the orbital cavity allowing the easiest access to the tumor while passing the equator of the eyeball (the widest dimension);

2. as little muscle trauma as possible;

3. the lacrimal gland should not be removed, and if the tumor is located in the lacrimal gland, some fragment must necessarily remain in the orbit;

4. excision of the tumor should always be followed by repositioning of tissues and fitting of a suction tube; however, it cannot touch the optic nerve and muscles;

5. layered sutures of closed tissues must not be in contact with oculomotor muscles.

The above assumptions are associated with the possibility of binocular vision.

Otolaryngologists and ophthalmologists have been cooperating closely for several years in the diagnostic, therapeutic and rehabilitative management of patients with orbital tumors localized behind the eye but inside the orbit. Rehabilitation is aimed at preventing double vision.

Double vision stems from the risk of surgical access to the tumor – the need to dissect the oculomotor muscle, its stretching during preparation, compressing with hooks, etc., the need for cutting and anastomosis after tumor excision, or the healing process depending on the individual type of wound healing, when adhesions that may limit the mobility of the oculomotor muscles can form. Naturally, reoperation to improve the mobility of the eyeball and to break up adhesions within muscles is a last resort and in the presence of such indications and after consultation with ophthalmologists, 9 such operations have been performed in the Department of Otolaryngology of the Jagiellonian University in the last 5 years.

The authors outline how to rehabilitate the patient when surgery to remove the orbital tumor is followed by double vision which was not caused by impaction of the periorbital muscle, but by its stretching during the procedure, or by the necessity of cutting and suturing (end-to-end anastomosis).

This rehabilitation is also necessary if the healing process leads to limited mobility of the muscle or muscles.

Independently of the rehabilitation exercises brought forward, patients receive pharmacological treatment.

The essence of rehabilitation is to achieve a state of central compensation, i.e. compensation of double vision disorders at the level of the central nervous system. It shall aim at restoring the patient's binocular vision to the clinical condition before the start of tumor development and surgery. The foundation of this treatment is the creation of compensation between the oculomotor muscles of both eye sockets and the initiation of habituation, adaptation and substitution. Habituation is understood as a gradual extinction of pathological reactions to head and body movements, adaptation is the attunement of the central nervous system to the asymmetrical information reaching from the oculomotor muscles and the retina (i.e. from the perimeter). Substitution is the replacement of the function of one of the muscles with compensatory action of the other. Altogether, the adaptability of a single muscle or several muscles and the central nervous system allow for creating such a "balance of gaze" so that binocular vision returns and the seen image is single and "projected" centrally on the retina. Compensation begins several dozen minutes after the patient is awakened after surgery and opens his eyelids, while adaptation is stimulated by head movements and visual stimuli, and substitution is a greater use of visual oculomotor reflexes and visual "information" to supplement the vision deficit.

The idea of habituation exercises is to silence various pathological eyeball responses affecting head and body movements. They consist on eye movements in extreme positions. Substitution exercises consist in strengthening the visual system when moving the head or standing on a moving ground while, for example, moving the ball from one hand to another.

Rehabilitation is always advisable when double vision has occurred after surgery to remove the orbital tumor, but it was not due to impaction of the oculomotor muscle, which often occurs with, e.g. endoscopic opening of the orbit from the nasal cavity with, e.g. Graves' disease.

The set of exercises consists in movements of both eyeballs immediately after surgery, regaining consciousness by the operated person. They are performed under supervision in a lying position and, as the operation begins, in sitting, standing or walking positions, finally tracking a ball thrown from one hand to another by the patient.

If double vision is intensified with sudden head movements, patients have a tendency to stiffen their neck. This causes tension in the neck muscles, neck pain and the tendency to move the entire torso so that the operated body positions itself when the patient sees one image with both eyes. Some patients manage to cover the operated eye in order to avoid neck pain and tendency to move the entire body. Such individuals are given analgesics and explained the necessity of exercising with both eyes.

SPECIFIC RECOMMENDATIONS

During the exercises, the patient is to look at a moving point with both the healthy and the operated eye (e.g. at his finger or the finger of the supervisor of the exercise) located at a distance of about 30–40 cm in front of the exercising person's eyes. From this position he begins each eye movement in specific directions; that is, from the position "straight" sideways to the right and left, left and up, left and down, in a diagonal direction to the right and up, left and up, left and down or right and down.

A minimum of 20 repetitions should be done in each of these directions several times a day. The head should remain still at first. The eyes should be moved to the greatest extent possible.

The general rule is that during exercise most movements should be made towards the largest double vision = in those directions where there is the greatest restriction of eye movement.

All exercises should be done with caution, slowly and precisely over several weeks (about a month); then the movements should be faster.

The first lying exercises: the head remains still, the patient looks up and down, from side to side, the eye moves smoothly from the side downwards in a straight position and smoothly upwards to the other side.

The second set of exercises is in a sitting position from the 4th day after surgery, prior to this we recommend it before removal of suction

drain. Exercises such as lying down, adding lifting objects lying on the floor.

The third exercise set is similar to the second one, but performed in lying, sitting and standing positions. We add throwing of the ball from hand to hand at eye level. The patient is to walk in an illuminated apartment and an illuminated staircase. He is asked to lift objects from the floor from a standing position (provided that the operated person performed such movements before the surgery). He is to wear shoes without high heels. There must be no obstacles on the floor when walking.

Improvement should be expected after a few to several weeks of exercise. If pain occurs during exercise, the exercise time or eye angle should be reduced to prevent pain.

In patients after orbital surgery, we start exercises on the day of surgery after the patient regains consciousness.

Every few weeks (4–8) a check-up should be performed by the doctor, including an assessment of the range of eye movements and double vision. Exercises are carried out for about 3–6 months and longer if further improvement is observed. If these exercises and pharmacological treatment do not produce improved eye movement, it is necessary to consider ocular muscle surgery after 6–12 months and, of course, ENT and ophthalmological follow-up care regardless of oncological follow-up or the absence of recurrence of the underlying disease.

Failure to perform the described rehabilitation is followed by insufficiency of the non-operated healthy orbital muscles by forcing an incorrect, adaptive adjustment of the eyeball in this orbit and, as a consequence, decay of vision.

Rehabilitation is the last part of treating every disease. "Movement can replace many drugs, but no drug can replace movement" is a statement by Dr. Oczko who lived in 1537–1599.

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