# SURGICAL TREATMENT OF DIPLOPIA IN PATIENTS WITH ENDOCRINE ORBITOPATHY

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## SUMMARY

Purpose: To evaluate the results of surgical treatment of diplopia in patients with endocrine orbitopathy.
Materials and Methods: Retrospective evaluation of the results of patients with diplopia associated with endocrine orbitopathy operation at the Department of Ophthalmology in Kolin Hospital during the period 2008–2013. All the patients included in the study group were exposed to retroposition of inferior rectus and moreover, 11 of them underwent retroposition of medial rectus. Five patients were not taken into consideration at all during the statistical analysis because of other surgical operations of extraocular muscles, which were indispensable for proper removal of diplopia in primary gaze position.
All the patients underwent overall eye and orthoptic examination as well as objectification of the eye movement disorder and diplopia by Hess test preoperatively and 1 month after surgery. Deviation of the eye with worse mobility was chosen for assessment. Subjective perception of the diplopia became another criterion.
Results: There were 72 patients without diplopia in primary gaze position. In 4 patients correction with prismatic glasses (3 pdpt) was necessary for residual vertical deviation. Thirty six patients reached functional binocular vision half a year after surgery proved by ortoptic assessment. Compensatory head position disappeared in all patients in this group.
Conclusion: The treatment of endocrine orbitopathy should be complex. Proper indication and timing of the surgery is mandatory for the successful results.
**Key words**: endocrine orbitopathy, diplopia, surgery of strabismus

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## INTRODUCTION

Endocrine orbitopathy is a serious autoimmune disorder with a crossed immune reaction against the orbital tissues and to thyrocyte. Antibodies have been identified which bind to the same epitopes in the orbital tissues and to thyrocyte [1, 10]. Further documentation of the linkage between the pathology of the orbit and the thyroid gland has been provided by ultrasound examination of the extraocular muscles, in which changes in these muscles were identified in patients with Graves-Basedow disease without clinical symptoms of orbitopathy.

On a laboratory level, a protein has been detected with a high incidence in patients with endocrine orbitopathy and with thyropathy of the Graves-Basedow type. This protein is shared by both thyreoglobulin and the extraocular muscles, and is further documentation of the linkage between the thyroid gland and these muscles. In afflicted orbital tissues, as well as the pretibial hypodermis and in the area of the glabella an increased accumulation of glycosaminoglycans takes place, with an increase in the volume of afflicted tissues and swellings [14, 16]. In patients with Graves-Basedow thyropathy and orbitopathy there is also a significantly increased amount of antibodies of the type HLA - DR [3, 17, 18].

We very often observe the first symptoms of the disease as ocular mobility defects, though as stated above, we can sonographically observe minimal changes on the extraocular muscles in the case of Graves-Basedow thyrotoxicosis in 80 – 92% of cases [4, 2, 15]. The most common clinically afflicted muscle is the inferior rectus (60 % - 70 %), followed by the medial rectus (25 %) and superior rectus (10 %), whilst affliction of the lateral rectus is rare [7, 12, 20].

The intensity of affliction is usually asymmetrical, and thus there is also an asymmetrical malfunction of the mobility of the eyes, which leads to diplopia. Long-term mobility malfunction and diplopia thus becomes the most significant disabling factor for patients with endocrine orbitopathy. Patients with this disorder eliminate diplopia by means of a compensatory head position, most frequently by tilting the head backwards, as corresponds to the most common affliction of the inferior rectus [8]. Long-term compensatory head position leads to contractures of groups of the neck muscles and cervicocranial complaints.

Disorder of the function of the extraocular muscles occurs on the basis of scarring of the muscle tissue and impairment of the contractility of microfibrils whilst retaining full innervation of the muscles [4, 20]. Strabismus in endocrine orbitopathy does not behave like typical paralytic strabismus precisely due to the multiple affliction of muscles with impaired function, with fully retained innervation. On the basis of Sherington's and Hering's laws, however, the secondary deviation is larger than the primary, which may then lead to a paradoxical fixation more by the afflicted eye (with worse mobility), mostly due to better visual acuity, whilst the more mobile, less afflicted eye veers enormously in se-

condary deviation [5, 6, 20].

Thyropathy, usually Graves-Basedow thyrotoxicosis, and acute orbital condition are usually resolved within a period of months, but immune reactions, the state of antibodies, primarily against TSH receptor (TRAK) and the actual inflammation reaction in the muscles persist for years. On the basis of long-term experience with the treatment of diplopia we can wait for years before the immune reaction subsides completely (normalisation of TRAK), but mainly sonographic examination of the extraocular muscles shows full scarring. In the opposite case a dramatic reaction takes place, with activation of the process and subsequent scarring. Accretions are formed, rendering re-operation practically impossible [20]. This is the main reason for long-term incapacity and potentially subsequent invalidity of patients with endocrine orbitopathy.

For examination of diplopia and the condition of the extraocular muscles we perform a standard orthoptic analysis using regular facilities such as a Worth four lights test, Maddox test and synoptophore. Disorders of motility of the eyeballs are usually large enough to be visible upon first sight, for more detailed analysis we use a Hess test or Lancaster screen.

Conservative therapy of diplopia in patients with endocrine orbitopathy usually fails due to the specific affliction of the extraocular muscles. Correction of refractive error has no influence on the position of the eyeballs, on the contrary a well corrected error on the non-dominant eye may lead to subjectively worse tolerance of diplopia [20]. Prismatic correction is practically impossible in the acute stage, primarily due to the pronounced instability of the deviation [11], the size of the deviation and above all due to the combined affliction of the muscles and thus also the combination of a vertical, horizontal and often also rotational deviation. Prisms may be used only for applicable supplementary correction of small residual deviations after surgery.

From this it ensues that the sole effective method for permanent removal or alleviation of diplopia in patients with endocrine orbitopathy is a surgical procedure on the extraocular muscles of the eye with worse mobility. The objective of this study is to evaluate the results of the surgical technique which we use at our centre in order to treat diplopia in patients with endocrine orbitopathy.

## METHOD

During the observation period of 2008 – 2013 we operated on a total of 76 patients at our ophthalmology department, aged from 36 to 64 years (52 women with an average age of 48 years and 24 men with an average age of 51 years). All the patients had undergone total thyroidectomy and had completed immunosuppression by corticosteroids, and some had undergone radiotherapy. Diplopia, position of the eyeballs and motility were entirely stable in all patients for at least six months before surgery. The quality of the extraocular muscles was also examined sonographically, and complete pacification of activity in all extraocular muscles was confirmed. The patients had a TRAK level within the norm for a period of at least 3-6 months before surgery. In no case did we operate earlier than one year after the removal of the thyroid gland. The patients underwent a complete orthoptic examination and examination by a Hess test, both preoperatively and one month after surgery. For evaluation we chose the size of the deviation in the eye with worse mobility before surgery, and after surgery objectified on a troposcope and prisms. A further criterion was the patient's subjective perception of diplopia and its verification by orthoptic analysis. The baseline deviation was considered 100% of the value, and improvement was stipulated as reduction of the baseline deviation in percentage points. We set the target result as removal of diplopia in primary gaze position without the need for compensatory head position. We evaluated the results of surgery after one week at a postoperative follow-up examination, after one month by means of an orthoptic examination and examination with prisms, and subsequently after six months. The patients were able to determine their subjective perception of diplopia on the second day after the operation.

Surgery was performed under general anaesthesia on the basis of a strabological analysis, by means of a procedure on the most afflicted muscle. Primarily we operated always only upon one muscle in one eye, in which it was demonstrated that a less radical procedure was effective, with subsequent supplementing if applicable. In the operating theatre we examined motility of the eyeballs bilaterally by means of a passive duction test, by which we further verified the actual condition of muscle traction. In table 1 below we present the distribution of the cohort of patients according to the size of the baseline deviation.

Retropositioning of the inferior rectus was performed on all 76 patients. We stipulated the scope of the procedure on the basis of the degree of strabismus at the preoperative examination (evaluated in prismatic correction) and the orthoptic analysis. In 11 patients it was necessary to supplement retropositioning of the medial rectus within six months due to persistent diplopia in the primary gaze position (graph no. 1). Table no. 2 illustrates the residual deviation in 11 patients following retropositioning of the inferior rectus, in whom it was necessary to supplement retropositioning of the medial rectus. In 5 patients it was necessary to perform a supplementary surgical procedure in a primary gaze position in order to remove diplopia. These 5 patients were not included in the overall statistical evaluation and were evaluated separately.

Surgery for retropositioning of the relevant muscle was performed in such a manner that the muscle was released from its original tendon, retro-inserted and fixed to the sclera using the suturing material PGA 6/0.

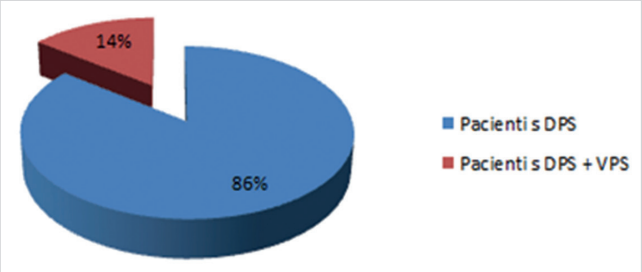
The scope of retropositioning of the operated muscle was indicated according to the preoperative orthoptic examina-

**Table 1 presents the distribution of the entire cohort of patients according to the preoperative deviation in angle degrees.**

| Degree of preoperative deviation in angles | < 20 | 20–30 | > 30 |
|---|---|---|---|
| Number of patients | 11 | 44 | 21 |

**Table 2 presents the residual deviation following surgery of the inferior rectus in 11 patients from the cohort in whom it was necessary to supplement retropositioning of the medial rectus.**

| Degree of residual deviation in angles | < 10 | 10 – 20 | > 20 |
|---|---|---|---|
| Number of patients | 4 | 6 | 1 |




**Graph no. 1: Division of patients according to operated muscle in entire cohort (IR – inferior rectus, MR – medial rectus).**

tion using classic recommended normograms.

Decompression of the orbit was not performed on 65 patients. By contrast, 11 patients underwent preoperative decompression of the orbit either at our centre or previously during supervision at other centres. Decompression of the orbits did not have any influence on the position or motility of the eyeballs in any of our patients.

## RESULTS

At the final evaluation 6 months after surgery, 72 patients were entirely without diplopia in the primary gaze position. In four patients it was necessary to perform supplementary correction of residual vertical diplopia by prismatic correction at the level of 3 pdtp in front of each eye. These patients belonged to the group in which retropositioning of both the inferior rectus and medial rectus was performed. According to the orthoptic analysis, functional binocular vision was established in 36 patients within six months. Patients were recommended exercises for physiological diplopia in order to ensure more rapid renewal of simple binocular vision in the period after surgery. Compensatory head position disappeared in all our patients.

**Table 3: Improvement of deviation in patients following retropositioning of inferior rectus (IR) and in patients following retropositioning of inferior rectus with supplementary retropositioning of medial rectus (IR + MR)**

| Type of patients | Number of patients / representation | Average improvement |
|---|---|---|
| Total patients | 76 / 100 % | 83 % |
| Patients with IR | 65 / 86 % | 84 % |
| Patients with IR and MR | 11 / 14 % | 74 % |

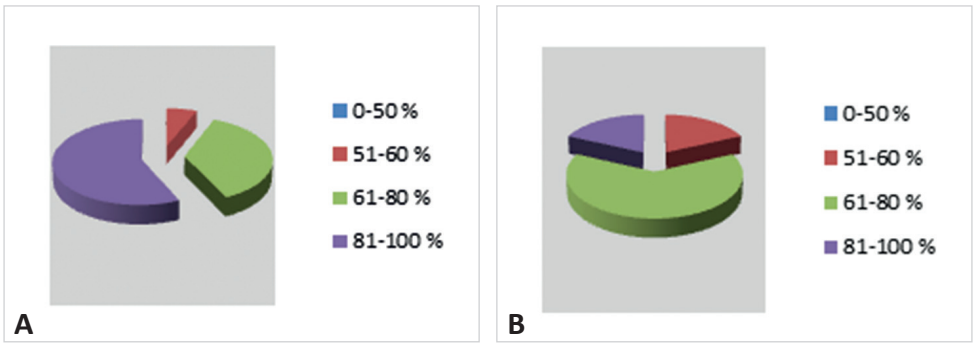
According to table no. 3 it is possible to evaluate the representation of surgical procedures in patients and the improvement of diplopia:

- 65 patients (86 %) – retropositioning of only inferior rectus in one eye with improvement of 84 %.
- 11 patients (14 %) – retropositioning of inferior rectus and supplementary retropositioning of medial rectus in one eye with improvement of 74 %.

The improvement of the deviation in patients following retropositioning of the inferior rectus and in patients following retropositioning of the inferior rectus with subsequent supplementary retropositioning of the medial rectus is presented in table no. 4 and graph no. 2. An improvement of the deviation of less than 50% was not recorded in any patient from our cohort. In the group of patients who

**Table no. 4: Distribution of patients according to improvement of deviation on the eye with worse mobility as against the baseline value in percentage points. (IR – inferior rectus, MR – medial rectus)**

| Improvement / no. of patients | 0 – 50 % | 51 – 60 % | 61 – 80 % | 81 – 100 % |
|---|---|---|---|---|
| IR | --- | 4 | 24 | 37 |
| IR + MR | --- | 2 | 7 | 2 |




**Graph no. 2: Graphic illustration of distribution of patients according to improvement of deviation on the eye with worse mobility as against the baseline value (graph 2A – patients after retropositioning of inferior rectus, graph 2B – patients after retropositioning of inferior rectus with supplementary retropositioning of medial rectus)**

underwent retropositioning of the inferior rectus the improvement of the deviation was on average by 81-100% as against the baseline value. In the group of patients who additionally underwent retropositioning of the medial rectus the deviation of the position of the eyeball was improved by 61-80% in comparison with the baseline value.

Only the two above-described surgical procedures were indicated for all of the above-stated patients used in the statistical processing, and it was not necessary to supplement operations on other muscles.

In the case of two of the patients on whom retropositioning of the inferior rectus was performed, complete removal of diplopia in the primary gaze position was not achieved within the observation period, and it was necessary to perform a revision of the inferior rectus. Diplopia persisted due to accretions of the muscle with the tenon fascia, and we therefore supplemented elongation of the relevant muscle.

In three patients on whom retropositioning of the inferior rectus was performed it was also necessary to supplement not only retropositioning of the medial rectus, but after a time interval (six months) also retropositioning of the lateral rectus. Only by this method was it possible to remove subjectively perceived diplopia in the primary gaze position.

These five patients were not included in our cohort of 76 patients. Even despite the strict inclusion criteria, we did not succeed in averting re-operation in these five patients.

## DISCUSSION

With regard to the clear criteria which we set for indication of strabismus surgery, in our evaluated cohort of 76 patients we did not record any more serious postoperative complications.

In the case of endocrine orbitopathy, affliction of the extraocular muscles is sufficiently complex that it is not possible even despite every endeavour to entirely avert the necessity to indicate a revision or re-operation on the extraocular muscles. We were forced to supplement these procedures in the case of 5 patients in order to remove diplopia in the primary gaze position. Due to their small number they were excluded from the statistical processing of the study cohort.

72 patients were entirely without diplopia in the primary gaze position. In four patients it was necessary to perform supplementary correction of residual vertical diplopia by prescribing prismatic correction.

For evaluation of the improvement of the deviation, a percentage reduction against the baseline value in the primary gaze position was used (in angle degrees and prismatic dioptres) for clear and simple statistical processing. It is evident that sometimes the same resulting percentage reduction of the deviation may produce a different subjective impression for patients with a different baseline deviation, and a somewhat different result upon orthoptic examination.

However, of fundamental significance in the evaluation is the patient's subjective impression of the condition. Postoperatively 95% of patients stated complete removal of diplopia in the primary gaze position. In the remaining 5% of patients subjectively perceived diplopia in the primary gaze position was removed using prismatic correction.

For the purpose of evaluation it is important to be aware of the specifics of strabismus, and the thus ensuing diplopia with endocrine orbitopathy. Above all it is necessary to realise that this concerns an affliction of the contractility of the muscles due to scarring following an inflammatory disease, and therefore a chronic condition. The original characteristics of the muscle cannot be returned, and as a result we also evaluate the disappearance of diplopia only in the primary gaze position, since in other gaze positions diplopia may yet appear.

According to our experiences and foreign studies [19, 22], in the case of strabismus surgery it is essential to wait until the complete disappearance of activity of endocrine orbitopathy. As stated above, we usually begin to consider indication for strabismus surgery approximately one year after the removal of the thyroid gland, and after complete pacification of the autoimmune process, which we verify by means of the stability of diplopia, normalisation of antibodies against the TSH receptor (TRAK) and complete scarring of the extraocular muscles according to sonography [20]. If these criteria are not adhered to this may result in activation of the process and finally deterioration of the condition, minimising the possibility of correction.

As the procedure of first choice we use retropositioning of the muscles, even though this is a very arduous approach to the muscle tendon on the sclera due to scarring of the muscle and the surrounding tissue and dislocation of the eyeball. We no longer use free tenotomy, which was used previously, due to the subsequent large retraction of the lower eyelid upon accretion of the Lockwood's ligament. Upon retropositioning of the muscle with fixed anchoring and if applicable reconstruction of the tenon fascia the retraction of the eyelid is not so pronounced, although this is also arduous due to the fragility of the conjunctiva.

We observed an increase of retraction of the lower eyelid following retropositioning of the inferior rectus on average by 0.9 mm, which can be considered cosmetically acceptable. In the case of previously performed free tenotomies, retractions of up to 2 mm and more are stated [9, 20].

Another option for surgical treatment of diplopia in patients with endocrine orbitopathy is the method of adjustable sutures. In the Czech literature we have recorded only one original study on this theme to date, which confirmed the potential benefit of this technique. Two methods were used on a cohort of 14 patients observed in the period from June 2010 to March 2012 at the Department of Ophthalmology of the Faculty of Medicine of Palacký University and the University Hospital in Olomouc, namely: fixed scleral sutures modified by the "hang-back" technique, and the technique of adjustable sutures. According to this study, strabismus surgery on patients with endocrine orbitopathy using the method of adjustable sutures was demonstrated to be highly beneficial [13]. We do not use this method on patients with endocrine orbitopathy at our centre.

## ZÁVĚR

Endocrine orbitopathy is a very serious chronic disease, the treatment of which requires a multi-disciplinary approach and considerable patience on the part of both the pa-

tients and the medical team. The disorder afflicts internal secretion, psychological condition, sight and overall appearance of the patient. The combination of these conditions may then lead to very severe illness with severe impairment of vision to blindness, followed by deep depression. The treatment of endocrine orbitopathy must be complex and above all must be precisely controlled, in which the individual steps must be linked in a logical sequence, since each breach of the sequence may have negative consequences.

From the entire range of medical procedures which we perform on our patients, we selected one of the final phases of therapy for this publication, which is also one of the most difficult phases.

The patient is now in a relatively healthy condition and feels good, but is limited in his or her activity by diplopia. In this stage we must resist pressure from the patient and ensure correct timing of the final treatment, we must prepare the patient for the fact that this shall be the final state, which may not be ideal according to the patient's expectations. In this phase we have mostly been in contact with the patient for a longer period of time, which somewhat alleviates the situation.

It is a fact that diplopia in patients with endocrine orbitopathy is a key factor which substantially prolongs the period of treatment and is a fundamental problem due to which our patients are disabled due to the length of inability to work. For precisely this reason, sufficient attention must be devoted to endocrine orbitopathy, and all the criteria for the treatment of this disorder must be carefully adhered to.

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