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ALGORITHM OF OBJECTIVE EXAMINATION OF A PATIENT WITH BLEPHAROPTOSIS

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✧ Meticulous objective examination of a patient with blepharoptosis allows determining the tactics of surgical treatment. It depends on many factors, but main ones are blepharoptosis etiology, upper eyelid's levator function, and ptosis degree. The estimation algorithm of objective examination of a patient with blepharoptosis is presented in this article.

✧ ***Keywords:*** blepharoptosis; estimation algorithm; surgical treatment.

АЛГОРИТМ ОБЪЕКТИВНОГО ОСМОТРА ПАЦИЕНТА С БЛЕФАРОПТОЗОМ

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✧ Тщательный объективный осмотр пациента с блефароптозом позволяет определить тактику хирургического лечения. Последняя зависит от множества факторов, основными из которых являются этиология блефароптоза, функция леватора верхнего века, степень птоза. В рамках данной статьи представлен подробный алгоритм объективного осмотра пациента с блефароптозом.

✧ ***Ключевые слова:*** блефароптоз; алгоритм оценки; хирургическое лечение.

Ptosis surgery is challenging even for the most experienced ophthalmologists and plastic surgeons. According to statistics, the prevalence of relapses ranges from 5% to 35% [4, 12, 15, 16, 23, 24]. In order to reduce the frequency of reoperations and improve postoperative symmetry, a thorough preoperative assessment of blepharoptosis is necessary.

EXAMINATION OF A PATIENT WITH PTOSIS

1. Complaints

Patients usually complain about heaviness in the eyelids, headaches caused by constant tension of the frontal muscle, difficulty in reading, narrowing of the upper half of the visual field, as well as constant fatigue associated with it [13, 14]. An important point in history taking is the ptosis duration. Congenital ptosis manifests itself very early; however, parents often do not notice it. Acquired types of ptosis progress slowly and are chronic in nature. Acute ptosis may be associated with aneurysm of *a. communicans posterior*, a reactive edema of the upper eyelid – with allergic diseases or acute infections [9, 20]. Ptosis may be the result of previous surgery or injury.

It is also necessary to ask a patient if the degree of ptosis changes during the day, and whether he has double vision. An increase in ptosis in the evening

may indicate myasthenia [18]. Diplopia is registered in patients with paralysis of the third pair of the cranial nerves (CN), as well as with myasthenia [17, 18].

2. Degree of ptosis

The difference between the measured uncovered size of the cornea and its normal size is considered as the degree of ptosis (Fig. 1).

3. Distance between the upper eyelid edge and the corneal reflex (MRD, marginal reflex distance)

MRD_1 is the distance from the corneal light reflex to the edge of the upper eyelid at the center while looking directly ahead (N is 4–4.5 mm, Fig. 2) [7].

MRD_2 is the distance from the corneal light reflex to the edge of the lower eyelid at the center when looking directly ahead (N is 5–5.5 mm, Fig. 2). With $MRD_2 > 5.5$ mm, there is either retraction or eversion of the lower eyelid. The patient may have ptosis of the upper eyelid and normal width of the palpebral fissure due to the low location of the lower eyelid [7].

MRD_3 is the distance between the corneal light reflex from the eyeball (at the 6 o'clock level of the limbus) and the edge of the upper eyelid at the center while looking up. A prerequisite for this measurement is fixing the eyebrow [7].

4. Function of the upper eyelid levator

This indicator is estimated using the magnitude of the upper eyelid excursion while changing the position of the look from the bottom upward with mandatory fixation of the eyebrow/frontal muscle. In the normal condition, the function of the upper eyelid levator should be > 12 mm (Fig. 3) [7, 8, 17].

Classification of the upper eyelid levator function according to Berke [8] is as follows: ≥13 mm is excellent; 8–12 mm is good; 5–7 mm is average; and ≤4 mm is poor.

5. Margin crease distance (MCD)

MCD is the distance from the lower edge of the upper eyelid to the palpebral fold. In the normal condition, it ranges from 7–9 mm in men and 8–10 mm in women (Fig. 4) [7, 8, 17]. The absence of a pronounced fold of the upper eyelid indicates the congenital nature of ptosis, while the high location of the fold indicates its aponeurotic nature.

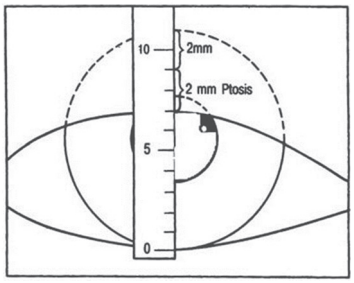


Fig. 1. Ptosis degree estimation (adapted from Collin J.R.O., 2006)

Рис. 1. Оценка степени птоза (Collin J.R.O., с измен., 2006)

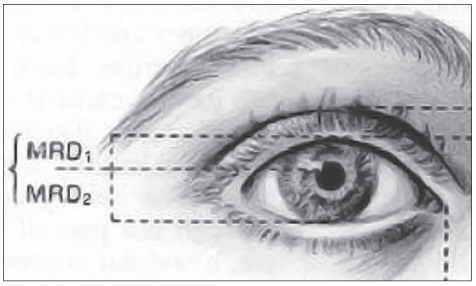


Fig. 2. MRD_1 and MRD_2 measurement (adapted from Collin J.R.O., 2006)

Рис. 2. Оценка MRD_1, MRD_2 (Collin J.R.O., с измен., 2006)

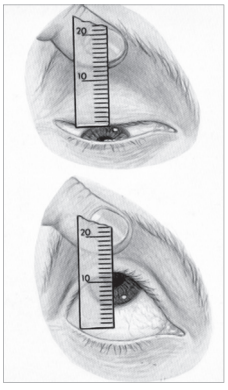


Fig. 3. Measurement of upper eyelid's levator function (adapted from Collin J.R.O., 2006)

Рис. 3. Оценка функции леватора верхнего века (Collin J.R.O., с измен., 2006)

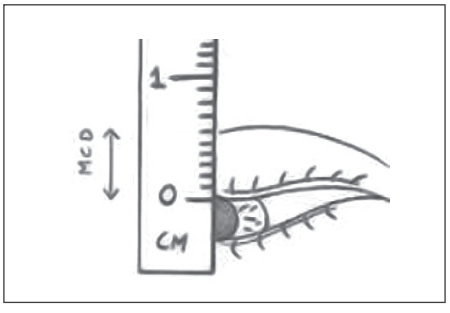


Fig. 4. Measurement of distance between the margin and the crease (adapted from Collin J.R.O., 2006)

Рис. 4. Оценка высоты складки верхнего века (Collin J.R.O., с измен., 2006)

6. Expressiveness of the upper eyelid fold: Degree 1 means that it is not expressed, degree 2 means it is poorly expressed, degree 3 means it is moderately expressed, and degree 4 means it is well expressed (Fig. 5).

7. Assessment of the upper eyelid fold mobility

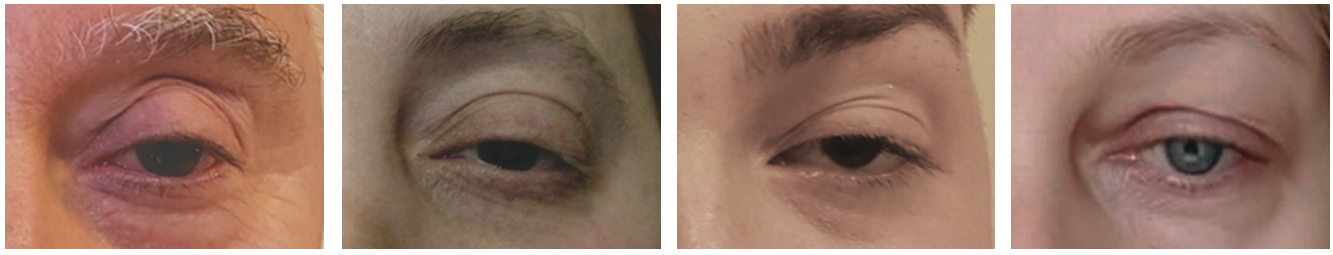
To determine the mobility of the upper eyelid fold, the patient is asked to look down and then up while fixing the eyebrow.

8. The width of the palpebral fissure is the distance between the lower edge of the upper eyelid to the top of the lower eyelid at the center (Fig. 6). In the normal condition, it is 8–10 mm [7, 8, 17]. To determine the uniformity of ptosis within the eyelid, we consider it appropriate to measure the width of the palpebral fissure not only at the center, but also in the lateral and medial limbus area.

9. The position of the eyelid when looking down: Increased ptosis indicates its aponeurotic nature (Fig. 7, *a*), and retraction indicates the myogenic nature (Fig. 7, *b*).

10. Phenylephrine test (α_2-adrenoceptor agonist)

The test involves instilling 2.5%-phenylephrine drops and evaluating the MRD_1 before and 5 min after the instillation of the drops. It enables to determine the surgical treatment tactics. If, after instilling the drops, the MRD_1 index increases by 2–3 mm, the test is considered positive, otherwise it is negative (Fig. 8).



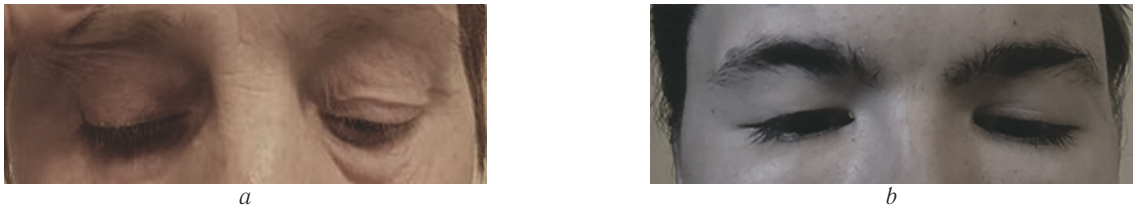
a *b* *c* *d*

Fig. 5. Types of upper eyelid creases (*a* – 1st degree, *b* – 2nd degree, *c* – 3rd degree, *d* – 4th degree)

Рис. 5. Выраженность складки верхнего века (*a* — 1-я степень, *b* — 2-я степень, *c* — 3-я степень, *d* — 4-я степень)

Fig. 6. Measurement of palpebral fissure height (adapted from Collin J.R.O., 2006)

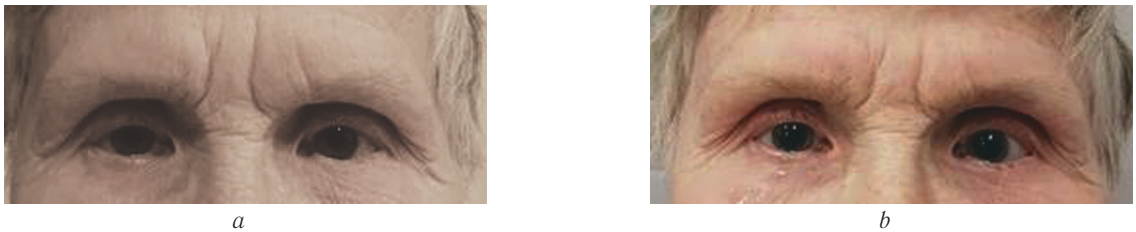
Рис. 6. Оценка ширины глазной щели (Collin J.R.O., с измен., 2006)



a *b*

Fig. 7. Aponeurotic ptosis, more pronounced in downgaze (*a*); Myogenic ptosis, retraction in downgaze (*b*)

Рис. 7. Апоневротический птоз, усиление птоза при взгляде книзу (*a*); миогенный птоз, ретракция век при взгляде книзу (*b*)



a *b*

Fig. 8. Mild ptosis before (*a*) and after (*b*) phenylephrine instillation

Рис. 8. Частичный птоз до (*a*) и после (*b*) закапывания 2,5 % фенилэфрина

With a positive test, a conjunctival mullerectomy is recommended, and with a negative test, resection of the levator aponeurosis is recommended [3, 8, 19]. However, recently, an increasing number of studies have analyzed the feasibility of conjunctival mullerectomy or tarsoconjunctival mullerectomy at a negative phenylephrine test [3, 8].

11. Bell's phenomenon

To evaluate Bell's phenomenon, the researcher holds the upper eyelids, while the subject tries to close them (Fig. 9). The phenomenon is a protective mechanism, the essence of which is the ability of the eyeball to rotate upward and outward while closing the eyelids; this test is evaluated using the following guidelines:

- pronounced: $>^2/_3$ of the cornea is hidden behind the raised upper eyelid
- moderate: $^1/_3$–$^2/_3$ of the cornea is hidden behind the raised upper eyelid
- poor: $<^1/_3$ of the cornea is hidden behind the raised upper eyelid

Poorly expressed Bell's phenomenon can cause exposure keratopathy in the postoperative period [8].

12. Ruling out ptosis on the opposite side with unilateral ptosis

According to Hering's law (the law of motor correspondence), synergistic muscles receive the same signal, and in the presence of ptosis, there may also be retraction on the other side. Usually, in this situation, the following test is performed: the lowered eyelid is raised, and the position of the eyelid on the contralateral side is observed (Fig. 10) [25].

13. Cold test

This test is performed in patients with suspected myasthenia. It is conducted to assess the position of the upper eyelid before and 5 min after applying ice to the upper eyelid [1, 5, 26].

14. Fatigue test

This test is performed as follows: the patient has to look up for 30 s without blinking. The lowering of one or both eyelids as well as the inability to look up indicates myasthenia [1, 5, 26].

15. The examination of the ocular surface state

The following tests are included in the basic ophthalmological examination and, to our mind do not require a description of the methodology: Schirmer test, tear break-up time test, staining of the conjunctiva and cornea with vital stains, and corneal sensitivity assessment.

16. Assessment of eyeball motility

Motility impairment can be observed in myasthenia, lesion of the 3rd pair of CN, as well as in chronic progressive external ophthalmoplegia [17, 18].

17. Evaluation of eyebrow motility

This test is especially relevant when planning surgeries of suspension type.

In addition to the above methods, some authors propose to evaluate the angle of the slope of the eyelashes and the strength of the levator [2, 3]. An intraoperative assessment of the state of the complex of tarsoorbital fascia and aponeurosis of the upper eyelid levator and Whitnall's ligament is also crucial. Particular attention should be paid to their structure, elasticity, and mobility [3].

Ptosis of the upper eyelid can be congenital or acquired. Acquired ptosis in turn can be involutional (aponeurotic), myogenic, neurogenic, or mechanical. The category of pseudoptoses is distinguished and includes retraction of the eyelids and exophthalmos on the opposite side, enophthalmos, prolapse of the lower eyelid, as well as floppy eyelid syndrome [17, 23, 24].

Aponeurotic ptosis

The most common form of aponeurotic ptosis is the involutional type that occurs due to stretching of the upper eyelid levator and weakening or impairment of its attachment to the cartilaginous plate [17, 18, 23]. This type of ptosis is characterized by normal function of the upper eyelid levator and a highly located fold of the upper eyelid (Fig. 11) [17, 18]. Ptosis can be either bilateral or unilateral. Patients with aponeurotic ptosis are not characterized by impaired mobility of the eyeball. Aponeurotic ptosis is often registered after various surgical interventions. Thus, according to the literature, on an average, 8% of the patients who undergo cataract surgery develop aponeurotic ptosis [21, 22, 24]. This may be attributable to the damage to the levator aponeurosis in isolation or in combination with the superior rectus muscle in connection with the installation of an eyelid speculum [10].

Neurogenic ptosis

This category includes ptosis in myasthenia, paralysis of the pair III of CN, and with Horner's syndrome [18].

Ptosis in myasthenia occurs due to a disorder of neuromuscular conduction; therefore, it can be

Fig. 9. Poor Bell's phenomenon

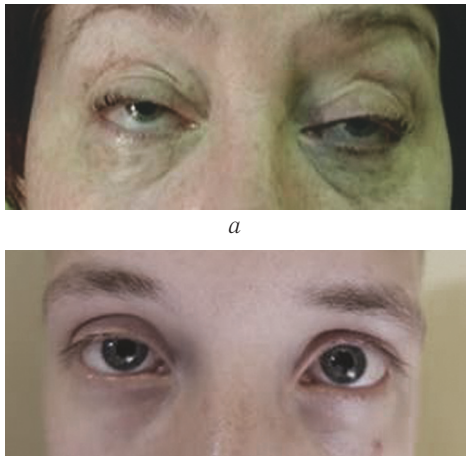
Рис. 9. Плохо выраженный феномен Белла

Fig. 10. Illustration of Hering's law

Рис. 10. Иллюстрация закона Геринга

Fig. 11. Aponeurotic ptosis

Рис. 11. Апоневротический птоз



a

b

Fig. 12. Neurogenic ptosis: *a* — in a patient with myasthenia gravis; *b* — in a patient with Horner's syndrome

Рис. 12. Нейрогенный птоз: *a* — при миастении; *b* — при синдроме Горнера

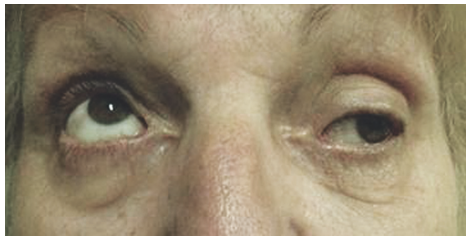


Fig. 13. Ptosis in a patient with 3rd cranial nerve palsy

Рис. 13. Птоз при параличе III пары черепно-мозговых нервов

attributed to both myogenic and neurogenic disorders [17, 18]. Ptosis can be unilateral or bilateral and can be asymmetric or expressed equally on both the sides. The severity of ptosis varies from complete to invisible to the patient and others. With ptosis, the extraocular muscles are usually involved in the pathological process. Extraocular muscle involvement is also typical for the pathological process (Fig. 12).

The ocular form of myasthenia, characterized only by damage to the eye muscles, is the most prevalent of all local forms in adults. Local ocular myasthenia is less common in children than in adults. Isolated ocular symptoms that persist for two years, and sometimes longer, may be the initial manifestations of a generalized form of the disease [26]. A distinctive feature of this type of ptosis is its variability. Ptosis increases in the evening and disappears when exposed to cold. Additional studies that include analyses of blood serum for the level of autoantibodies to the muscle acetylcholine receptor, proserin test, and electromyographic study are necessary [5].

Paralysis of the 3rd pair of CN can be a consequence of tumors, vascular lesions, as well as inflammatory diseases [18] and is clinically manifested by ptosis, impaired mobility of the eyeball, and its deviation outward (due to the action of *m. rectus lateralis* and *m. obliquus superior* not encountering resistance) (Fig. 13) [17, 23]. Pupillary involvement, manifested by mydriasis, more often indicates aneurysm of the *a. communicans posterior* [26].

The patient management approach may vary. In the presence of mydriasis, magnetic resonance imaging or magnetic resonance angiography must be performed to rule out aneurysm of *a. communicans posterior* [20]. The levator function can be either normal or absent [17]. The latter is much more common. The main correction method is suspension-type surgery. If the patient has strabismus, it should be adressed first [28].

Ptosis in Horner's syndrome develops because of an impairment of sympathetic innervation in the tissues of the orbit due to tumors, aneurysms, or inflammatory changes. The main manifestations are ptosis, myosis, enophthalmos, and dyshydrosis of the affected half of the face [18, 23]. In this case, ptosis is

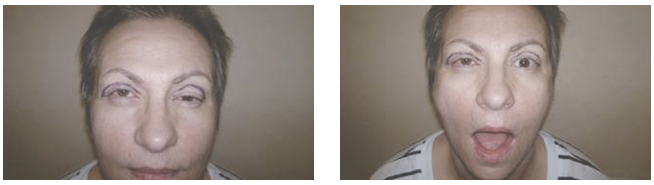


Fig. 14. Marcus Gunn Jaw winking phenomenon

Рис. 14. Синдром Маркуса Гунна

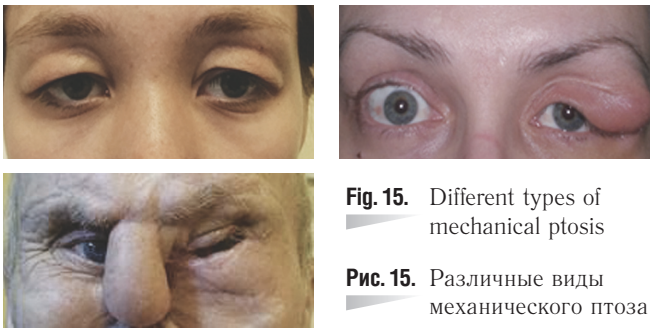


Fig. 15. Different types of mechanical ptosis

Рис. 15. Различные виды механического птоза

not pronounced and averages 2–2.5 mm with normal levator function. Several neurological tests, such as cocaine test, Minor test, hydroxyamphetamine test, and Apraclonidine test, are available for the confirmation of Horner's syndrome. The implementation methods are not described in this article because the studies are included in the complex of neurological examination.

Myogenic ptosis

The cause of myogenic ptosis is weakening of the upper eyelid levator [1]. Myogenic ptosis is predominantly congenital [18]. This type of ptosis is caused by the underdevelopment of the upper eyelid levator. Approximately 30% of the patients with congenital ptosis have a limitation in the upward mobility of eyeballs. This is mainly because of the weakening of the ipsilateral superior rectus muscle [17, 18, 28]. Congenital myogenic ptosis is mainly unilateral and is not associated with other anomalies of the face structure [18]. The levator function can be diverse. The decrease in function is mainly caused by fibrosis of the upper eyelid levator.

We should also mention the connection of congenital ptoses with craniofacial syndromes. The Marcus Gunn syndrome is the most common [17, 18, 23]. The reason for the development of this syndrome is a violation of the connection between the 3rd pair of CN innervating the upper eyelid levator and the 5th pair of CN innervating the masticatory muscles. This syndrome is manifested with unilateral ptosis associated with synkinetic retraction of the lowered upper eyelid during stimulation of the masticatory muscles on the ptosis side. The involuntary ascent of the lowered upper eyelid occurs when chewing, opening the mouth or yawning, and moving the lower jaw to the side opposite to that of the ptosis (Fig. 14) [18].

In adults, myogenic ptosis can cause traumatic damage to the upper eyelid levator. However, more often, there is either damage to the muscle aponeurosis, or the 3rd pair of CN. In case of injury of the bones of the orbit, a spiral computed tomography of the orbits is necessary [17].

It is necessary to mention other causes of myogenic ptosis in adults, such as oculopharyngeal muscular dystrophy and chronic progressive external ophthalmoplegy [17, 28].

Mechanical ptosis

In most cases, this type of ptosis develops due to excess skin hanging over the upper eyelid that causes narrowing of the visual field [17, 18]. Other causes include neoplasms and cicatricial changes in the eyelids (Fig. 15) [17, 18, 23]. The main treatment in this case is elimination of the ptosis cause.

The clear algorithm for examining patients with blepharoptosis, presented within this article, can help determining the right approach while planning surgical treatment while being aware of the potential hazards to reduce the chances of hypocorrection, hypercorrection, and relapse.

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