Potential of the quality of life (QoL) tool for patient profiling in paralytical strabismus

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Backup: *To the best of our knowledge, there is no ocular motility disorder (OMD)-specific quality of life (QoL) tool, OMD-specific scale or method for patient profiling during treatment.*
Purpose: *To develop an OMD-specific QoL assessment method in an effort to objectify treatment outcomes and to perform patient profiling during treatment.*
Material and Methods: We retrospectively analyzed outcomes among 240 patients (109 women and 131 men; aged 18 to 78 years; mean age, 36 ± 4.2 years) with OMD who received inpatient treatment at the Romodanov Neurosurgery Institute between 2004 and 2016. Out of these patients, 108 underwent surgeries for ruptured saccular supraclinoid internal carotid artery aneurysm, 65 underwent tumor removal (including: acoustic neurinoma, n = 23; pituitary adenoma, n = 26; and meningioma, n = 16) and 67 were treated non-surgically for craniocerebral trauma. Rehabilitative treatment was done in all patients (in operated-on patients, it was done early after surgery).
Results and Discussion: *We developed OMD-specific score assessment method and QoL scale involving a number of indices related to neurological symptoms, as well as to physical, psychic and social status of patients. A total OMD-specific QoL score of 0–15 is considered a poor (or low) QoL; 16–30, a moderate (or good) QoL; and 31–45, a high QoL. Not only the extent of damage to cranial nerves III, IV, and VI, but also the impact of physical handicap on the patient's activities and on his functional abilities is assessed.*
Conclusion: *Application of the OMD-specific QoL assessment method involving the QoL scale in clinical practice makes it possible to objectify treatment outcomes and facilitates patient profiling during treatment.*

Key words: rehabilitative treatment, ocular motility disorders, paralytical strabismus, quality of life

Introduction

Paralytic strabismus (PS) occurs after injury to nuclei and trunks of cranial nerves III, IV, and VI, as well as after injury to extraocular muscles and their nerves. Cranial nerve injuries and resulting ocular motility disorders (OMD) are common in neurological and neurosurgical patients with craniocerebral trauma, vascular disorders, brain tumors, and central nervous system inflammation [1-6].

In these cases, management of PS involves therapy of the underlying disorder, as well as combination treatment (including electric neuromuscular stimulation, other physiotherapeutics, and therapeutic physical training). One cannot express the limitations in home and social activities caused by PS using well known physical units. This calls for the development of a disease-specific instrument (a test, a questionnaire or a scoring system) to assess not only the extent of pathological changes, but also the above mentioned limitations in PS. Specific quality of life (QoL) assessment methods and treatment outcome profile tools are already used in craniocerebral trauma, stroke and cerebral vascular disorders, as well as spinal injuries, making it possible to collect data on the functional status of patients with a variety of neurological manifestations in order to assess muscle spasticity, tone and strength, pain level, local functional abnormalities (e.g., those of hand function), etc [7-8]. To the best of our knowledge, there is no OMD-specific QoL assessment method or scale that can be used as a QoL assessment and treatment outcome profile tool for patients with dysfunction of cranial nerves III, IV, and VI.

The study purpose was to develop a comprehensive OMD-specific QoL assessment method involving the indices related to neurological and ophthalmological symptoms, as well as to physical, psychic and social status of patients.

Materials and Methods

We retrospectively analyzed outcomes among 240 patients (109 women and 131 men; aged 18 to 78 years; mean age, 36 ± 4.2 years) with OMD who received inpatient treatment at the Romodanov Neurosurgery Institute between 2004 and 2016. Out of these patients, 108 underwent surgeries for ruptured saccular supraclinoid internal carotid artery aneurysm, 65 underwent tumor removal (including: acoustic neurinoma, n = 23; pituitary adenoma, n = 26; and meningioma, n = 16) and 67 were treated non-surgically for craniocerebral trauma. Rehabilitative treatment was done in all patients (in operated-on patients, it was done early after surgery).

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Ocular motility disorder (OMD)-specific Quality of Life (QoL) Scale
Subscale A (with the questions to be answered by the patient)

No.	Question	2 points	1 point	0 points
1	Do you experience double vision?	No	Mild	Apparent
2	Do you have vertical or horizontal strabismus?	No	Mild	Apparent
3	Are your eye movements impaired?	No	Restricted eye movements	Eye movements are almost or totally impossible
4	Do you have ptosis?	No	Partial	Complete
5	Can you read with both eyes open?	Yes (it is my usual way of reading)	I can, but it is difficult due to double vision.	I cannot, because of double vision
6	Can you write with both eyes open?	Yes (it is my usual way of writing)	I can, but it is difficult due to double vision	I cannot, because of double vision
7	Is your movement coordination impaired?	No	Partially	Yes
8	Does your double vision interfere with your everyday activities?	No	Partially	Significantly
9	Are you suffering from concomitant neurological symptoms (headache, unsteadiness, dizziness)	No	Yes, under visual load	Yes, constantly
10	Do you need help from other people?	No	Sometimes	Yes, constantly
11	Do you communicate with your friends and acquaintances?	Yes	With one or two	No
12	Has your lifestyle changed after the onset of disease?	No	Partially	Significantly
13	Is your visual orientation in your usual environment (room or apartment) unimpaired?	Yes	Somewhat impaired	Significantly impaired
14	Can you go outdoors?	Yes	Only when accompanied by another person	No
15	Do you feel apathy? Do you feel anxious, irritable, or depressed?	No symptoms	Seldom	I feel these symptoms often often

We developed OMD-specific scoring method and QoL scale (involving a selected number of OMD-specific indices related to neurological symptoms, as well as to physical, psychic and social status of patients) using the Rehabilitation Activities Profile [9] and the National Institutes of Health Stroke Scale (NIHSS) [10] as prototypes. The Rehabilitation Activities Profile is a clinical assessment tool which can be used as a checklist with a 0-3 point severity rating. Besides the patient's self-assessment, the NIHSS considers the assessment made by medical personnel [7-8]. The authors of this paper have been granted patent No.43940 "A technique to assess the quality of life in patients with ocular motility disorders" in Ukraine [11].

Results

Patients and medical personnel (doctors) had been asked to answer the questions of the QoL Scale prior to, just after and 2-3 months following rehabilitative treatment. Points were assigned to each item, total scores were calculated, and post-treatment total scores were compared with pretreatment total scores.

The QoL scale has two subscales, subscale A (15 questions with each question having three possible responses) and subscale B (5 questions with each question having four possible responses), with the questions answered by the patient and the doctor, respectively. As per WHO guidelines, the patient's status assessment is based on not only the intensity of pathological process but also influence of the disease or of the trauma on the patient's self-care ability, home and social activities. Comparison of physician's assessment scores with patient-reported scores makes it possible to deepen understanding of the functional handicap and of the patient's adaptation to this condition.

With the testing completed, total scores are calculated. A total OMD-special QOL score of 0–15 is considered a poor (or low) QoL; 16–30, a moderate (or good) QoL; and 31–45, a high QoL. OMD-specific assessment of treatment outcomes and QoL over time is performed by comparison of total pre-treatment and post-treatment scores. Not only the extent of damage to cranial nerves III, IV, and VI, but also the impact of physical handicap on the patient's activities and on his functional abilities is assessed. The extent of neurological manifestations and the patient's QoL are identified at different time points.

Example

Ms. O.P. M-k, aged 29 years, was operated for left cerebellopontine angle neurinoma. Postoperatively, a left cranial nerve VI palsy was observed. A paralytic esotropia was present, with a left eye turned inward, and no eye movements outward, toward the central axis and away from the central axis. Soon after operation, the patient was discharged from the inpatient unit for family reasons. Her neurological symptoms persisted, and, 2 months later, she came back to the unit to undergo a course of rehabilitative therapy for OMD. The patient and the doctor were asked to answer the questions of the QoL Scale prior to treatment (i.e., at baseline).

The patient's baseline present total QOL score was 8, reflecting "poor" (or low) QoL. After she underwent the course of rehabilitative therapy for OMD, positive ocular motility changes were observed in her left eye, and eye movements (outward, toward the central axis and away

Subscale B (examination data, to be filled in by the doctor)

No.	Parameters	3 points	2 points	1 point	0 points
1	Amount of horizontal eye movement (by Golovin [12])	normal (43˚ outward, away from the central axis, and 46˚ inward, away from the central axis)	slightly restricted (21˚to 42˚ outward, away from the central axis, and 21˚to 45˚ inward, away from the central axis)	√ significantly restricted (6˚to 20˚ outward or inward, away from the central axis)	No or almost no (0˚ to 5˚) eye movement
2	Amount of horizontal eye movement (by Golovin [12])	√ normal (37˚ upward, away from the central axis and 53˚ downward, away from the central axis)	slightly restricted (19˚ to 36˚ upward, away from the central axis and 26˚to 52˚ downward, away from the central axis)	significantly restricted (6˚ to 18˚ upward, away from the central axis and 27˚ to 52˚ downward, away from the central axis)	No or almost no (0˚ to 5˚) eye movement
3	Angle of strabismus (measured with the Hirschberg test [13-14])	0˚ - 5˚	≤ 15˚ (light reflex is at the pupillary margin of the iris)	√ ≤ 45˚ (light reflex is at the corneal margin)	≤ 60˚ (light reflex is beyond the limbus, on the sclera)
4	Ptosis, if any [15-16]	√ no ptosis	Grade I, mild ptosis (with the upper eyelid margin being 1-3 mm lower than normal)	Grade II, moderate ptosis (with the upper eyelid occluding up to half the pupil)	Grade III, severe ptosis (with the upper eyelid obscuring the pupil completely)
5	Mydriasis, if any	√ no mydriasis (pupils S=D; pupil diameter, 3-4 mm), normal direct pupillary light response, no loss of accommodation (as per the Donders formula [17])	anisocoria (pupil diameter, 4-5 mm), the difference in pupil size is mild, normal direct pupillary light response, no loss of accommodation (as per the Donders formula)	anisocoria (pupil diameter, 5-7 mm), the difference in pupil size is mild, the direct pupillary light response is weak, partial loss of accommodation (as per the Donders formula)	pupil diameter, ≥7 mm, the difference in pupil size is significant), complete loss of light responses and accommodation, the extent of the absolute accommodation is indeterminable, the extent of the relative accommodation is zero.

Subscale A (prior to treatment)

No.	**Question**	**2 points**	**1 point**	**0 points**
1	Do you experience double vision?	No	Mild	√ Apparent
2	Do you have vertical or horizontal strabismus?	No	Mild	√ Apparent
3	Are your eye movements impaired?	No	Restricted eye movements	√ Eye movements are almost or totally impossible
4	Do you have ptosis?	√ No	Partial	Complete
5	Can you read with both eyes open?	Yes (it is my usual way of reading)	I can, but it is difficult due to double vision.	√ I cannot, because of double vision
6	Can you write with both eyes open?	Yes (it is my usual way of writing)	I can, but it is difficult due to double vision	√ I cannot, because of double vision
7	Is your movement coordination impaired?	No	Partially	√ Yes
8	Does your double vision interfere with your everyday activities?	No	Partially	√ Significantly
9	Are you suffering from concomitant neurological symptoms (headache, unsteadiness, dizziness)	No	Yes, under visual load	√ Yes, constantly
10	Do you need help from other people?	No	Sometimes	√ Yes, constantly
11	Do you communicate with your friends and acquaintances?	Yes	With one or two	√ No
12	Has your lifestyle changed after the onset of disease?	No	Partially	√ Significantly
13	Is your visual orientation in your usual environment (room or apartment) unimpaired?	Yes	Somewhat impaired	√ Significantly impaired
14	Can you go outdoors?	Yes	Only when accompanied by another person	√ No
15	Do you feel apathy? Do you feel anxious, irritable, or depressed?	No symptoms	Seldom	√ I feel these symptoms often often

from the central axis) were restored. The patient was re-examined, and her QoL was re-assessed with the QoL Scale.

Just after the course of rehabilitative therapy for OMD, the patient's total QOL score was 27, reflecting "good" (or moderate) QoL. During the follow-up, she maintained the positive functional changes. At the 3 month follow-up visit, the function of the specific nerve was restored completely, and the patient had no OMD-related complaints. She was re-examined, and her QoL was re-assessed with the QoL Scale.

Subscale B (prior to treatment)

No.	Parameters	3 points	2 points	1 point	0 points
1	Amount of horizontal eye movement (by Golovin [12])	normal (43˚ outward, away from the central axis of the globe, and 46˚ inward, away from the central axis)	slightly restricted (21˚to 42˚ outward, away from the central axis, and 21˚to 45˚ inward, away from the central axis)	significantly restricted (6˚to 20˚ outward or inward, away from the central axis)	√ No or almost no (0˚ to 5˚) eye movement
2	Amount of horizontal eye movement (by Golovin [12])	normal (37˚ upward, away from the central axis and 53˚ downward, away from the central axis)	slightly restricted (19˚ to 36˚ upward, away from the central axis and 26˚to 52˚ downward, away from the central axis)	significantly restricted (6˚ to 18˚ upward, away from the central axis and 27˚ to 52˚ downward, away from the central axis)	√ No or almost no (0˚ to 5˚) eye movement
3	Angle of strabismus (measured with the Hirschberg test [13-14])	0˚ - 5˚	≤ 15˚ (light reflex is at the pupillary margin of the iris)	≤ 45˚ (light reflex is at the corneal margin	√ ≤ 60˚ (light reflex is beyond the limbus, on the sclera)
4	Ptosis, if any [15-16]	√ no ptosis	Grade I, mild ptosis (with the upper eyelid margin being 1-3 mm lower than normal)	Grade II, moderate ptosis (with the upper eyelid occluding up to half the pupil)	Grade III, severe ptosis (with the upper eyelid obscuring the pupil completely)
5	Mydriasis, if any	√ no mydriasis (pupils S=D; pupil diameter, 3-4 mm), normal direct pupillary light response, no loss of accommodation (as per the Donders formula [17])	anisocoria (pupil diameter, 4-5 mm), the difference in pupil size is mild, normal direct pupillary light response, no loss of accommodation (as per the Donders formula)	anisocoria (pupil diameter, 5-7 mm), the difference in pupil size is mild, the direct pupillary light response is weak, partial loss of accommodation (as per the Donders formula)	pupil diameter, ≥7 mm, the difference in pupil size is significant), complete loss of light responses and accommodation, the extent of the absolute accommodation is indeterminable, the extent of the relative accommodation is zero.

Subscale A (just after the course of rehabilitative therapy for OMD)

No.	Question	2 points	1 point	0 points
1	Do you experience double vision?	No	√ Mild	Apparent
2	Do you have vertical or horizontal strabismus?	No	√ Mild	Apparent
3	Are your eye movements impaired?	No	√ Restricted eye movements	Eye movements are almost or totally impossible
4	Do you have ptosis?	√ No	√ Partial	Complete
5	Can you read with both eyes open?	Yes (it is my usual way of reading)	√ I can, but it is difficult due to double vision.	I cannot, because of double vision
6	Can you write with both eyes open?	Yes (it is my usual way of writing)	√ I can, but it is difficult due to double vision	I cannot, because of double vision
7	Is your movement coordination impaired?	No	√ Partially	Yes
8	Does your double vision interfere with your everyday activities?	No	√ Partially	Significantly
9	Are you suffering from concomitant neurological symptoms (headache, unsteadiness, dizziness)	No	√ Yes, under visual load	Yes, constantly
10	Do you need help from other people?	No	√ Sometimes	Yes, constantly
11	Do you communicate with your friends and acquaintances?	Yes	√ With one or two	No
12	Has your lifestyle changed after the onset of disease?	No	√ Partially	Significantly
13	Is your visual orientation in your usual environment (room or apartment) unimpaired?	Yes	√ Somewhat impaired	Significantly impaired
14	Can you go outdoors?	Yes	√ Only when accompanied by another person	No
15	Do you feel apathy? Do you feel anxious, irritable, or depressed?	No symptoms	√ Seldom	I feel these symptoms often often

Subscale B (just after the course of rehabilitative therapy for OMD)

No.	Parameters	3 points	2 points	1 point	0 points
1	Amount of horizontal eye movement (by Golovin [12])	normal (43˚ outward, away from the central axis, and 46˚ inward, away from the central axis)	slightly restricted (21˚to 42˚ outward, away from the central axis, and 21˚to 45˚ inward, away from the central axis)	√ significantly restricted (6˚to 20˚ outward or inward, away from the central axis)	No or almost no (0˚ to 5˚) eye movement
2	Amount of horizontal eye movement (by Golovin [12])	√ normal (37˚ upward, away from the central axis and 53˚ downward, away from the central axis)	slightly restricted (19˚ to 36˚ upward, away from the central axis and 26˚to 52˚ downward, away from the central axis)	significantly restricted (6˚ to 18˚ upward, away from the central axis and 27˚ to 52˚ downward, away from the central axis)	No or almost no (0˚ to 5˚) eye movement
3	Angle of strabismus (measured with the Hirschberg test [13-14])	0˚ - 5˚	≤ 15˚ (light reflex is at the pupillary margin of the iris)	√ ≤ 45˚ (light reflex is at the corneal margin)	≤ 60˚ (light reflex is beyond the limbus, on the sclera)
4	Ptosis, if any [15-16]	√ no ptosis	Grade I, mild ptosis (with the upper eyelid margin being 1-3 mm lower than normal)	Grade II, moderate ptosis (with the upper eyelid occluding up to half the pupil)	Grade III, severe ptosis (with the upper eyelid obscuring the pupil completely)
5	Mydriasis, if any	√ no mydriasis (pupils S=D; pupil diameter, 3-4 mm), normal direct pupillary light response, no loss of accommodation (as per the Donders formula [17])	anisocoria (pupil diameter, 4-5 mm), the difference in pupil size is mild, normal direct pupillary light response, no loss of accommodation (as per the Donders formula)	anisocoria (pupil diameter, 5-7 mm), the difference in pupil size is mild, the direct pupillary light response is weak, partial loss of accommodation (as per the Donders formula)	pupil diameter, ≥7 mm, the difference in pupil size is significant), complete loss of light responses and accommodation, the extent of the absolute accommodation is indeterminable, the extent of the relative accommodation is zero.

Subscale A (3 months after the course of rehabilitative therapy for OMD)

No.	**Question**	**2 points**	**1 point**	**0 points**
1	Do you experience double vision?	√ No	Mild	Apparent
2	Do you have vertical or horizontal strabismus?	√ No	Mild	Apparent
3	Are your eye movements impaired?	√ No	Restricted eye movements	Eye movements are almost or totally impossible
4	Do you have ptosis?	√ No	Partial	Complete
5	Can you read with both eyes open?	√ Yes (it is my usual way of reading)	I can, but it is difficult due to double vision.	I cannot, because of double vision
6	Can you write with both eyes open?	√ Yes (it is my usual way of writing)	I can, but it is difficult due to double vision	I cannot, because of double vision
7	Is your movement coordination impaired?	√ No	Partially	Yes
8	Does your double vision interfere with your everyday activities?	√ No	Partially	Significantly
9	Are you suffering from concomitant neurological symptoms (headache, unsteadiness, dizziness)	No	√ Yes, under visual load	Yes, constantly
10	Do you need help from other people?	√ No	Sometimes	Yes, constantly
11	Do you communicate with your friends and acquaintances?	√ Yes	With one or two	No
12	Has your lifestyle changed after the onset of disease?	√ No	Partially	Significantly
13	Is your visual orientation in your usual environment (room or apartment) unimpaired?	√ Yes	Somewhat impaired	Significantly impaired
14	Can you go outdoors?	√ Yes	Only when accompanied by another person	No
15	Do you feel apathy? Do you feel anxious, irritable, or depressed?	√ No symptoms	Seldom	I feel these symptoms often often

Three months after the course of rehabilitative therapy for OMD, the patient's total QOL score was 44, reflecting "high" QoL.

Conclusion

Application of the OMD-specific QoL assessment method involving the QoL scale in clinical practice makes it possible to objectify treatment outcomes and facilitates patient profiling during treatment.

Subscale B (3 months after the course of rehabilitative therapy for OMD)

No.	Parameters	3 points	2 points	1 point	0 points
1	Amount of horizontal eye movement (by Golovin [12])	√ normal (43˚ outward, away from the central axis, and 46˚ inward, away from the central axis)	slightly restricted (21˚to 42˚ outward, away from the central axis, and 21˚to 45˚ inward, away from the central axis)	significantly restricted (6˚to 20˚ outward or inward, away from the central axis)	No or almost no (0˚ to 5˚) eye movement
2	Amount of horizontal eye movement (by Golovin [12])	√ normal (37˚ upward, away from the central axis and 53˚ downward, away from the central axis)	slightly restricted (19˚ to 36˚ upward, away from the central axis and 26˚to 52˚ downward, away from the central axis)	significantly restricted (6˚ to 18˚ upward, away from the central axis and 27˚ to 52˚ downward, away from the central axis)	No or almost no (0˚ to 5˚) eye movement
3	Angle of strabismus (measured with the Hirschberg test [13-14])	√ 0˚ - 5˚	≤ 15˚ (light reflex is at the pupillary margin of the iris)	≤ 45˚ (light reflex is at the corneal margin)	≤ 60˚ (light reflex is beyond the limbus, on the sclera)
4	Ptosis, if any [15-16]	√ no ptosis	Grade I, mild ptosis (with the upper eyelid margin being 1-3 mm lower than normal)	Grade II, moderate ptosis (with the upper eyelid occluding up to half the pupil)	Grade III, severe ptosis (with the upper eyelid obscuring the pupil completely)
5	Mydriasis, if any	√ no mydriasis (pupils S=D; pupil diameter, 3-4 mm), normal direct pupillary light response, no loss of accommodation (as per the Donders formula [17])	anisocoria (pupil diameter, 4-5 mm), the difference in pupil size is mild, normal direct pupillary light response, no loss of accommodation (as per the Donders formula)	anisocoria (pupil diameter, 5-7 mm), the difference in pupil size is mild, the direct pupillary light response is weak, partial loss of accommodation (as per the Donders formula)	pupil diameter, ≥7 mm, the difference in pupil size is significant), complete loss of light responses and accommodation, the extent of the absolute accommodation is indeterminable, the extent of the relative accommodation is zero.

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