CASE REPORTS

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Optic nerve head recovery following the IOP – lowering surgery in the eye with early juvenile glaucoma – nine-year follow-up

Oporavak vidnog živca posle filtracione antiglaukomne operacije u oku sa ranim juvenilnim glaukomom tokom perioda praćenja od devet godina

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Abstract

Introduction. Congenital uveal ectropion (CEU) is a rare, non-progressive condition often accompanied with eyelid ptosis, anterior insertion of the iris, disgenesis of the irido-corneal angle and glaucoma. **Case report.** We present a case of a seven-year-old girl with a congential unilateral uveal ectropion and a secondary glaucoma which had daily variations from 13 up to 50 mm Hg. The patient had no other abnormalities of the iris or underlying systemic diseases. Introduced local anti-glaucomatous therapy initially normalized intraocular pressure (IOP), but failed to provide long term normalisation. Trabeculectomy normalized the IOP which resulted in the reduction of the cup/disc ratio and restitution of neuroretinal rim. The rim area increased to 1.716 mm^2 (0.958 mm^2 preoperative) rim volume, was 0.666 mm^3 (0.195 mm^3 preoperative) while cup-disc (C/D) ratio decreased to 0.330 (0.626 preoperative) as well as linear C/D=0.574 (0.791 preoperative). Neuroretinal rim (NR) was preoperatively preserved in the Ti segment, damaged in T, Ts, N, Ns segments, and borderline in the Ni segment. Postoperatively, neuroretinal rim was preserved in all segments. **Conclusion.** In the presented case trabeculectomy induced recovery of the nerve tissue of the optic nerve head which was confirmed by Haidelberg Retina Tomograph II (HRT II). The treatment results have been maintained during the follow-up period of nine years without topical or systemic antiglaucomatous therapy. Although CEU is a non-progressive and benign eye disease, associated glaucoma can cause severe optic nerve damage if not detected early and treated properly. As can be seen in the presented case, an adequate treatment can prevent and even reverse optic disc neuropathy.

Key words:
ectropion; uvea; congenital abnormalities; glaucoma; trabeculectomy; treatment outcome; child.

Apstrakt

Uvod. Kongenitalni ektropijum uvee je retko, neprogresivno stanje često praćeno ptozom, prednjom insercijom dužice, disgenezom irido-kornealnog ugla i glaukomom. **Prikaz bolesnika.** U radu je prikazana sedmogodišnja devojčica sa kongenitalnim ektropijumom uvee i sekundarnim glaukomom sa dnevnim skokovima pritiska do 50 mmHg. Bolesnica nije imala druge abnormalnosti dužice niti pridružene sistemske bolesti. Uvedena lokalna antiglaukomna terapija iako je dovela do početnog pada, nije dovela i do trajne normalizacije očnog pritiska (IOP). Filtraciona antiglaukomna operacija je dovela do trajne normalizacije IOP što je rezultovalo smanjenjem ekskavacije optičkog diska i opo-ravkom neuroretinalnog oboda. Površina oboda se uvećala na 1,716 mm^2 sa preoperativnih 0,958 mm^2, zapremnina na 0,666 mm^3 sa preoperativnih 0,195 mm^3, dok se ekskavacija smanjila sa 0,791 na 0,574. Neuroretinalni obod je preoperativno bio sačuvan samo u donjem temporalnom segment. Postoperativno, neuroretinalni segment je bio normalan u svim segmentima. **Zaključak.** Kod prikazane bolesnice trabekulektomija je dovela do oporavka optičkog nerva što je potvrđeno uz pomoć Haidelber Retina Tomograph II (HRT II) softvera. Tokom devetogodišnjeg perioda praćenja bolesnice nije koristila antiglaukomnu terapiju, pritisak je bio normalan, bez oštećenja optičkog nerva. Iako je kongenitalni ektropijum uvee neprogresivno i benigno oboljenje, pridruženi glaukom može da izazove ozbiljno

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oštećenje očnog nerva ukoliko se ne otkrije i ne leči na vreme. Kao što može da se zaključi iz ovog prikaz bolesnika adekvatanim tretmanom može se sprečiti nastanak oštećenja, a čak i dovesti do oporavka vidnog živca.

Ključne reči:
ektropijum; uvea; anomalije; glaukom; trabekulektomija; lečenje, ishod; deca.

Introduction

Congenital ectropion uveae (CEU) is a rare, nonprogressive condition insufficiently mentioned in the ophthalmologic literature.

Etiologically, uveal ectropion can be classified into two groups: acquired and congenital.

CEU is characterised by the ectropionated pigment epithelium layer on the front surface of the iris from the pupillary ruff, anterior insertion of the iris, dysgenesis of the iridocorneal angle and glaucoma.

Some studies have also found CEU joined with congenital anomalies and hereditary diseases.

Case report

In April 2007 a 6-year-old girl was referred to the Institute for Eye Diseases of Clinical Center of Serbia by a pediatric ophthalmologist for clinical examination due to an elevated intraocular pressure (IOP) in her right eye. Mother reported that about 3–4 ago, she started noticing wider right pupil, enlargement of the right eye and slightly lowered upper eyelid. The patient also had eye tenderness and pain with occasional and moderate redness and "bulging".

Best corrected visual acuity (correction -1.25 Dsph = -1.75 Dcyl ax 14 degrees) on her right eye was 20/20. Her left eye visual acuity was 20/20. IOP measured by Goldmann Applanation Tonometer was 36 mmHg on the right, and 18 mmHg on her left eye. Horizontal corneal diameters were 11.5 mm on the right and 10.5 mm on the left eye. Ptosis of the right upper eyelid was evident as well as anisocoria with wider and slowly responsive right pupil. Slit lamp examination showed 2–3 mm wide zone of the uveal pigmented layer ectropion on the anterior iris surface which affected 360 degrees of the pupil margin. There were no signs of the newly formed blood vessels, tumors or other congenital anomalies (Figure 1).

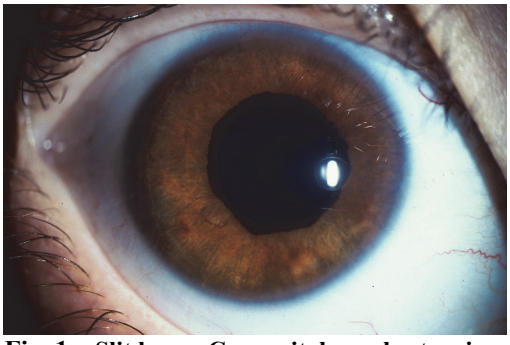


Fig. 1 – Slit lamp: Congenital uveal ectropion.

Gonioscopic findings on her right eye show a wide anterior chamber angle with anterior insertion of the iris of medium pigmentation – aplasio ligamentum pectinatum (Figure 2). Left eye gonioscopy showed open, free and moderately pigmented iridocorneal angle.

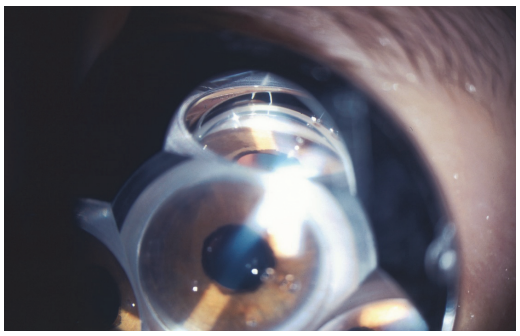


Fig. 2 – Gonioscopic findings of the congenital uveal ectropion.

Red reflex was present in both eyes, without defects. Fundus examination showed excavation of the optic head with cup/disc (C/D) ratio 0.7/I, while left was C/D 0.2/I.

Ultrasound biomicroscopy (UBM) confirmed the results of the gonioscopy (Figure 3).

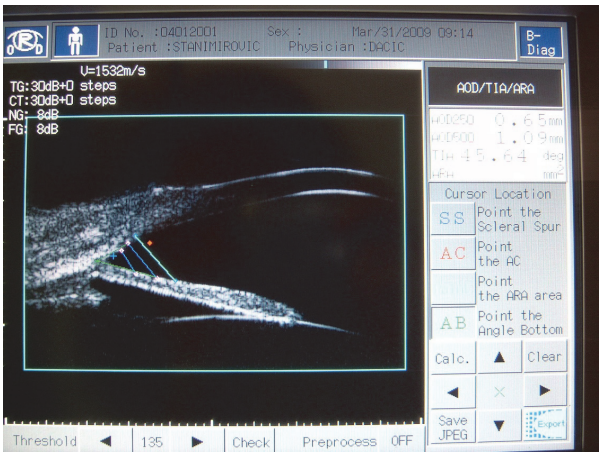
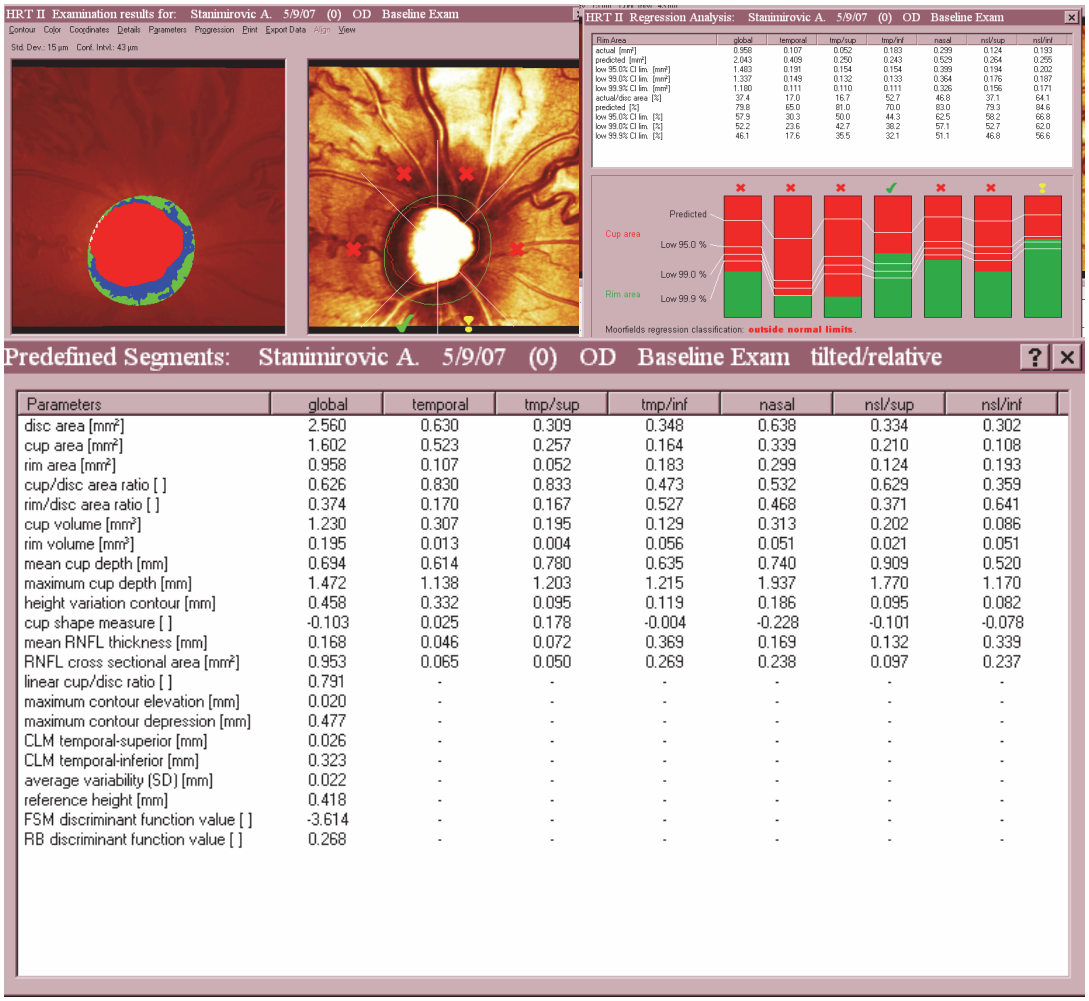


Fig. 3 – Ultrasound biomicroscopy (UBM) of the affected eye: trabecular iris angle 45.64°, angle opening distance 0.65 mm at 250 µm and 1.09 mm at 500 µm, trabecular-ciliary process distance 0.788 mm, iris-ciliary process distance 0.240 mm, anterior chamber depth 3.12 mm and iris thickness 0.322 mm.

Humphrey computerized perimetry was performed, but the results were invalid due to poor cooperation. As shown on the Figure 4 neuroretinal rim (NR) was damaged in nearly all segments. Disc area was 2.560 mm^2, rim area 0.958 mm^2 and rim volume = 0.195 mm^3, C/D ratio was = 0.626, linear cup C/D = 0.791. Moorfields regression analysis was classified as "outside normal limits". HRT II of the left eye showed no abnormalities.



Parameters	global	temporal	tmp/sup	tmp/inf	nasal	nsl/sup	nsl/inf
disc area [mm²]	2.560	0.630	0.309	0.348	0.638	0.334	0.302
cup area [mm²]	1.602	0.523	0.257	0.164	0.339	0.210	0.108
rim area [mm²]	0.958	0.107	0.052	0.183	0.299	0.124	0.193
cup/disc area ratio [ ]	0.626	0.830	0.833	0.473	0.532	0.629	0.359
rim/disc area ratio [ ]	0.374	0.170	0.167	0.527	0.468	0.371	0.641
cup volume [mm³]	1.230	0.307	0.195	0.129	0.313	0.202	0.086
rim volume [mm³]	0.195	0.013	0.004	0.056	0.051	0.021	0.051
mean cup depth [mm]	0.694	0.614	0.780	0.635	0.740	0.909	0.520
maximum cup depth [mm]	1.472	1.138	1.203	1.215	1.937	1.770	1.170
height variation contour [mm]	0.458	0.332	0.095	0.119	0.186	0.095	0.082
cup shape measure [ ]	-0.103	0.025	0.178	-0.004	-0.228	-0.101	-0.078
mean RNFL thickness [mm]	0.168	0.046	0.072	0.369	0.169	0.132	0.339
RNFL cross sectional area [mm²]	0.953	0.065	0.050	0.269	0.238	0.097	0.237
linear cup/disc ratio [ ]	0.791	-	-	-	-	-	-
maximum contour elevation [mm]	0.020	-	-	-	-	-	-
maximum contour depression [mm]	0.477	-	-	-	-	-	-
CLM temporal-superior [mm]	0.026	-	-	-	-	-	-
CLM temporal-inferior [mm]	0.323	-	-	-	-	-	-
average variability (SD) [mm]	0.022	-	-	-	-	-	-
reference height [mm]	0.418	-	-	-	-	-	-
FSM discriminant function value [ ]	-3.614	-	-	-	-	-	-
RB discriminant function value [ ]	0.268	-	-	-	-	-	-

Fig. 4 – Hajdelberg Retina Tomograph II (HRT) initial report of the right eye (OD), neuroretinal rim (NR) was preserved in the Ti segment; NR was damaged in T, Ts, N, Ns segments, and borderline parameters of NR were found in the Ni segment, disc area = 2.560 mm^2, cup volume 1.230 mm^3, cup area = 1.602 mm^2, mean cup depth = 0.694 mm, max. cup depth = 1.472 mm, rim area 0.958 mm^2 and rim volume = 0.195 mm^3, cup/disc (C/D) ratio = 0.626, linear C/D ratio = 0.791. RNGL – retinal nerve fiber layer; CLM – contour line modulation; FSM – Mikelberg discriminant function; RB – right bank.

Local antiglaucomatous therapy was introduced and during the hospitalisation intraocular pressure normalized. The patient was discharged with the IOP values 16 mmHg in the right eye and 15 mmHg in the left eye without therapy.

On the regular monthly check-ups the right eye IOP varied from 13–30 mmHg in the morning, reaching values up to 50 mmHg in the afternoon in spite of prescribed therapy so the patient was hospitalised again. IOP in *oculi sinstri* (S) was 13–16 mmHg without therapy. HRT II results during the second hospitalization showed progression and decompensation of glaucoma. Since IOP in *oculi dextri* (OD) was not normalized under further therapy, antiglaucomatous surgery (trabeculectomy – TTR), in general anesthesia, was performed during the third hospitalization (Figure 5). Mitomycin C was not used in the procedure in order to avoid postoperative hypotonia because IOP showed significant daily variations.

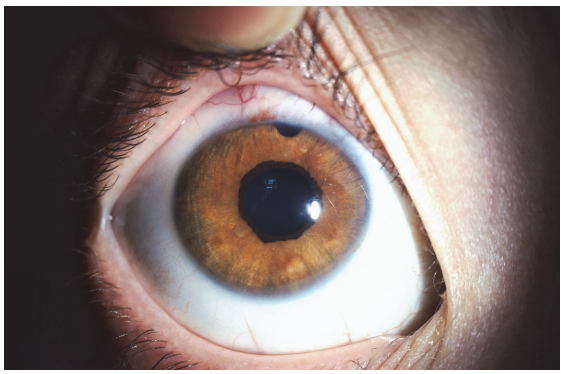
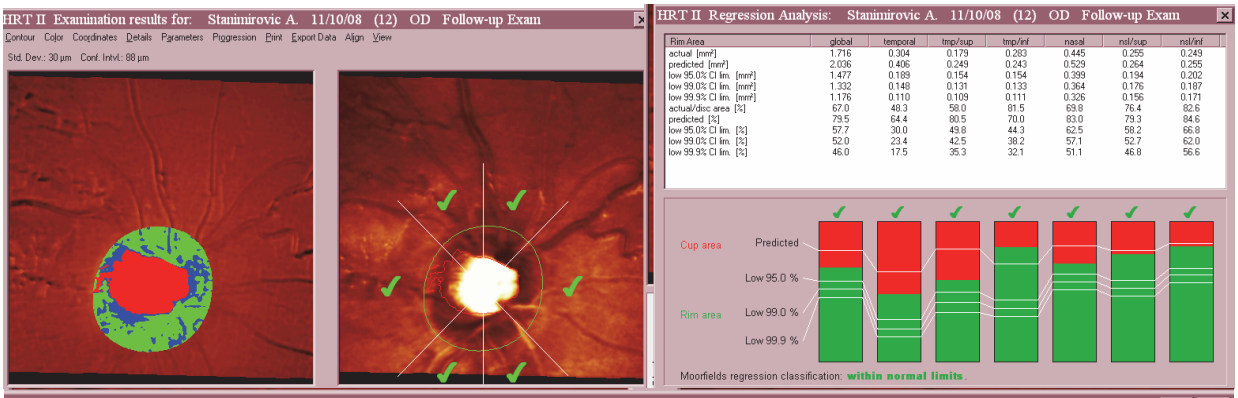


Fig. 5 – Anterior segment of the right eye after the performed antiglaucomatous surgery (trabeculectomy – TTR).

Upon discharge, IOP on the right eye was 8 mmHg with a somewhat enlarged filtration bleb, and 9 mmHg on the left eye.



Parameters	global	temporal	tmp/sup	tmp/inf	nasal	nsl/sup	nsl/inf
disc area [mm²]	2.560	0.630	0.309	0.348	0.638	0.334	0.302
cup area [mm²]	0.844	0.326	0.130	0.064	0.192	0.079	0.053
rim area [mm²]	1.716	0.304	0.179	0.283	0.445	0.255	0.249
cup/disc area ratio [ ]	0.330	0.517	0.420	0.185	0.302	0.236	0.174
rim/disc area ratio [ ]	0.670	0.483	0.580	0.815	0.698	0.764	0.826
cup volume [mm³]	0.436	0.149	0.067	0.031	0.116	0.048	0.026
rim volume [mm³]	0.666	0.062	0.046	0.143	0.189	0.096	0.130
mean cup depth [mm]	0.518	0.471	0.569	0.490	0.542	0.635	0.460
maximum cup depth [mm]	1.144	1.101	1.026	0.986	1.347	1.011	1.009
height variation contour [mm]	0.531	0.410	0.110	0.112	0.196	0.178	0.060
cup shape measure [ ]	-0.146	-0.157	0.023	-0.001	-0.259	0.162	-0.148
mean RNFL thickness [mm]	0.303	0.129	0.182	0.476	0.408	0.207	0.491
RNFL cross sectional area [mm²]	1.722	0.182	0.127	0.347	0.575	0.152	0.344
linear cup/disc ratio [ ]	0.574	-	-	-	-	-	-
maximum contour elevation [mm]	0.118	-	-	-	-	-	-
maximum contour depression [mm]	0.649	-	-	-	-	-	-
CLM temporal-superior [mm]	0.053	-	-	-	-	-	-
CLM temporal-inferior [mm]	0.347	-	-	-	-	-	-
average variability (SD) [mm]	0.031	-	-	-	-	-	-
reference height [mm]	0.638	-	-	-	-	-	-
FSM discriminant function value [ ]	1.636	-	-	-	-	-	-
RB discriminant function value [ ]	1.115	-	-	-	-	-	-

Fig. 6 – Hajdelberg Retina Tomograph II (HRT II) findings 18 months after the trabeculectomy. Values of stereometric parameters were: disc area: 2.560, rim area = 1.716 mm^2, cup volume = 0.436 mm^3, rim volume = 0.666 mm^3 mean cup depth = 0.518 mm, max. cup depth = 1.144 mm and cup/disc (C/D) ratio = 0.330 and linear C/D = 0.574. Neuroretinal rim (NR) was preserved in all its segments. Moorfields regression analysis were classified as "within normal limits".
RNFL – retinal nerve fiber layer; CLM – contour line modulation;
FSM – Mikelberg discrimination function; RB – right bone.

On the regular check-up 3 months later, IOP values were 10 mmHg on the right, and 11 mmHg on the left eye. Horizontal corneal diameter in OD was 10.5 mm and in OS 10 mm, with no Haab striae. Best corrected visual acuity (BCVA) was 20/20 on both eyes. Three months after the procedure, HRT II examination results were: cup area = 1.156 mm2, cup volume = 0.717 mm^3, rim area = 1.403 mm^2, rim volume = 0.495 mm^3 and C/D = 0.452, which is evidently lower C/D compared to the initial report.

Figure 6 shows the HRT II results 18 months after the trabeculectomy. The rim area increased to 1.716 mm^2 (0.958 mm^2 preoperatively) as well as rim volume which was 0.666 mm^3 (0.195 mm^3 preoperatively) while C/D decreased to 0.330 (0,626 preoperatively) as well as linear C/D =0.574 (0.791 preoperatively) (Figure 6). NR rim was found to be preserved in all its segments so the findings of Moorfields regression analysis were classified as "within normal limits". All this undoubtedly demonstrates the recovery of the NR rim on the optic disc.

Since the patient was without any therapy she had regular check-ups, first on 3, then on 6 months and then once a year. Last check-up was 6 months ago.

BCVA was 20/20 on both eyes, intraocular pressure was 14 mm Hg on the right, and 15 mm Hg on the left eye. Axial length of the right eye was 25 mm and of the left 23.5 mm.

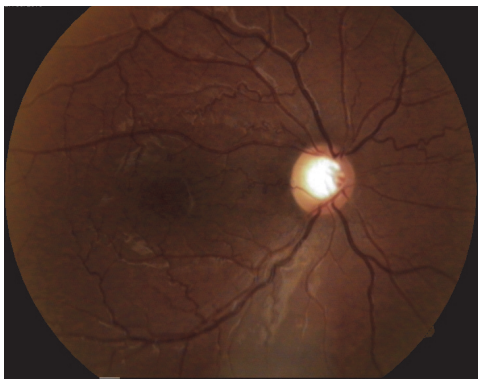


Fig. 7 – Foto fundus right eye – preserved neuroretinal rim (NR), cup/disc (C/D) ratio 0.4.

Foto fundus of the right eye showed preserved rim of the optic head with cup/disc ratio 0.4 and no pathology on the posterior segment of the eye (Figure 7).

Figure 8a presents HRT II of the right eye 9 years after the trabeculectomy. All the findings were within normal limits: HRT II left eye findings (6/1/2016) were C/D = 0.356, linear C/D = 0.597, rim area = 2.164, rim volume = 0.380 mm^3, disc area = 3.361 mm^2. Computerised visual field of the right eye showed generalised reduction of sensitivity MD-3.9 db; Bebie curve cumulative defect curve: diffuse loss of sensitivity under normal curve, but paralleled with displayed normale curve; left eye: normal sensitivity (Figure 8b).

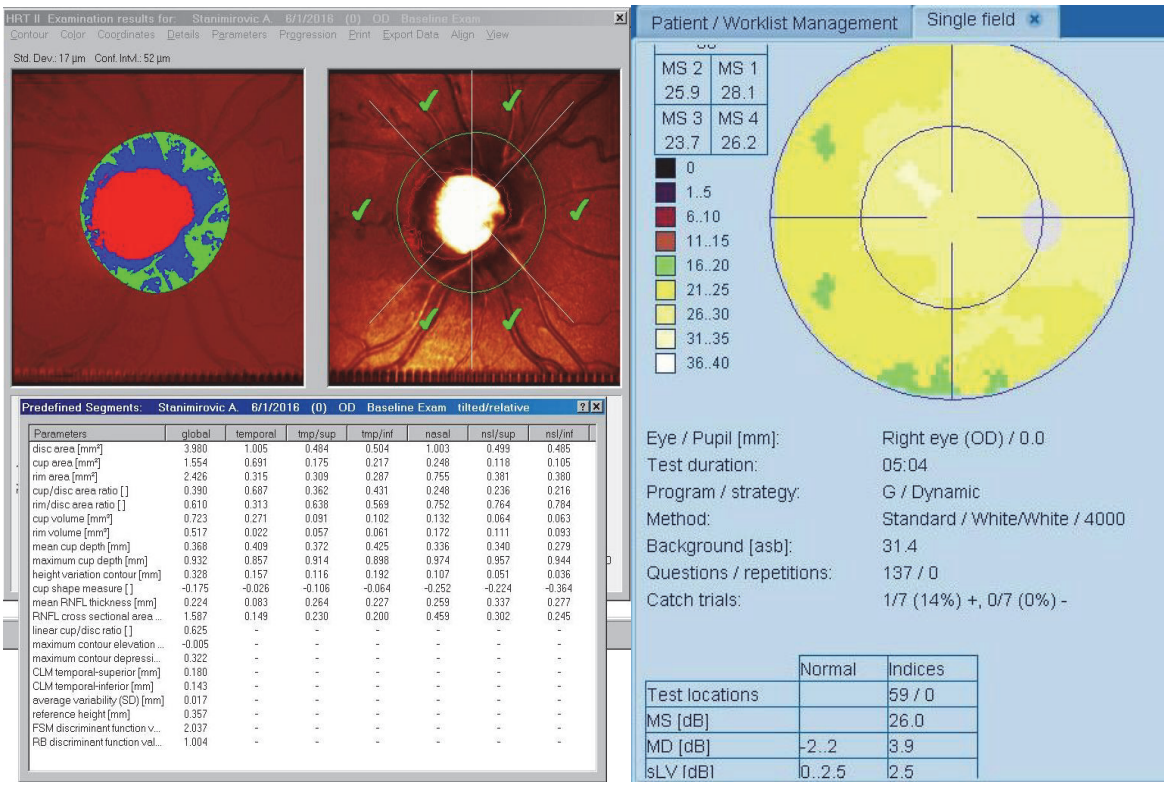


Fig. 8 – a) Haiedelberg Retina Tomograph II (HRTII) cup/disc (C/D) ratio: 0.390, linear C/D = 0.625, rim area = 2.426 mm^2, rim volume = 0.517 mm^3, disc area: 3.980 mm^2; b) Computerized visual field of the right eye showed generalised reduction of sensitivity MD-3.9 db, Bebie curve (cumulative defect curve): diffuse loss of sensitivity under normal curve, but paralleled with displayed normal curve.
RNFL – retinal nerve fiber layer; CLM – controur line modulation;
FSM – Mikelberg discrimination function; RB – right bank.

Discussion

In the majority of cases from the available literature CEU is associated with glaucoma. Typically, there is an initial drop of IOP following the induction of the topical therapy, like in the case presented, but eventually most cases require filtration surgery.

The origin of the CEU is not certain. Dowling et al. [1] suggested that abnormal migration of neural crest cells might be the reason for the development of the CEU, while Ritch et al. [2] suggested the possibility of a neural crest cell disorder. Some authors describe bilateral CEU with late onset primary glaucoma and bilateral prominent corneal nerves [3,4]. Wilson [5] concluded that, due to its embryological origin, this trinity supports the neural crest cell theory of the anterior segment dysgenesis.

Harasymowycz et al. [6] analysed a sample of an iris taken from the eye with CEU and glaucoma and found a fibro vascular membrane on the front surface of the iris. Its traction might be responsible for pulling the posterior pigmented epithelium and CEU formation. Embryonal heart studies [7] suggest the vascular factor being primary insult that leads to the secondary disorder of the neural crest cell migration.

The recovery of the optic nerve is widely discussed. Tavares et al. [8] found no significant change in anatomic and functional glaucoma evaluation 5–6 months after glaucoma surgery. Wright et al. [9] suggested that IOP lowering surgery enhances visual field (VF) sensitivity while Ventura et al. [10] found that the progressive loss of retinal ganglion cell function in early glaucoma may be alleviated after IOP lowering, as measured by pattern electroretinograms.

Lesk et al. [11] concluded that lowering of the IOP by 40% after glaucoma surgery had improved optic nerve morphology correlating highly with the percent reduction of IOP. Waisbourd et al. [12] also reported cupping reversal and visual field (VF) improvement, but results did not correlate to the amount of the IOP lowering.

Emery et al. [13] suggested that increased IOP causes bulging of the cribrous lamina posteriorly, rearrangement of the openings on it, strangulation of axons and stagnation of axoplasmatic transport. Quigley [14] demonstrated that decrease of the IOP induced cupping reversal and recovery of the optic nerve head. Mochizuki et al. [15] reported cupping reversal accompanied by the shrinkage of the scleral canal after successful IOP-lowering surgery. If the cupping reversal had not been observed, the scleral ring enlargement and ongoing stress on the optic nerve would have been continued. The cupping reversal is more frequent in children due to a larger number of elastic fibres in the fibrous layer of the globe.

Conclusion

In the presented case, normalisation of IOP induced a cupping reversal and normalized axoplasmatic transport resulting in the recovery of neuroretinal rim and the decrease of C/D ratio.

Even in the case of the secondary juvenile glaucoma due to congenital uveal ectropion, early detection and adequate treatment can prevent and reverse optic disc neuropathy.

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