

# Reversal of cupping in juvenile glaucoma treated with topical prostaglandin analogue

## *Reversal of cupping em glaucoma juvenil tratado com análogo de prostaglandina tópica*

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### ABSTRACT

*Reversal of cupping is a rare entity, characterized by the reduction of optical disc cupping in response to sustained decrease in intraocular pressure (IOP) levels by 25% of the basal IOP. The occurrence of this phenomenon with clinical treatment is rarely reported in the literature. This study reports a case of a patient with juvenile glaucoma with augmented cupping, significant decrease in the retinal nerve fiber layer in both eyes and altered topographic measures in optical coherence tomography (OCT). After one year using topical prostaglandin analog and keeping low IOP levels, a decrease in optic nerve cupping was detected in rethinography, confirmed by the improvement of OCT topographic measures. Reversal of cupping is a sign of decreased tension at the level of the lamina cribosa and is probably associated with a reduced risk for long-term progression of glaucoma without improvement of visual function.*

**Keywords:** Optic nerve; Glaucoma; Intraocular pressure

### RESUMO

A reversão da escavação é uma entidade rara que se refere à redução da escavação do disco óptico em resposta à diminuição sustentada dos níveis de pressão intra-ocular (PIO), em cerca de 25% da PIO basal. A ocorrência deste fenômeno apenas com o tratamento clínico é pouco relatada na literatura. Este estudo relata um caso de um paciente com glaucoma juvenil, que apresentou à gonioscopia ângulo aberto e tomografia de coerência óptica (OCT) com uma diminuição significativa na camada de fibras nervosas retinianas em ambos os olhos. Após um ano utilizando análogos de prostaglandina tópica e manutenção de níveis baixos de PIO, ocorreu diminuição da escavação do nervo óptico, que foi confirmada pelos padrões topográficos da OCT. O “reversal of cupping” é um sinal da diminuição da tensão ao nível da lâmina crivosa e está provavelmente associada a uma redução do risco para a progressão do glaucoma a longo prazo, sem melhora da função visual.

**Descritores:** Nervo óptico; Glaucoma; Pressão intraocular

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### INTRODUCTION

Reversal of cupping refers to optic disc cup size reduction in response to intraocular pressure (IOP) decrease equal to, or higher than, 25%.<sup>(1)</sup> This phenomenon is mainly described after antiglaucomatous surgeries, mainly in cases of primary congenital and juvenile glaucoma.<sup>(2)</sup> Reversal of cupping rates range from 40% to 70% due to adequate IOP control after surgical treatment in patients with congenital glaucoma.<sup>(3)</sup> The incidence of this phenomenon after clinical treatment is rarely reported in the literature, so no epidemiological data were found to suggest reversal of cupping incidence after the application of topical medication in cases of primary congenital and juvenile glaucoma. The aim of the current study is to report a reversal of cupping case in a patient with juvenile glaucoma who presented sustained intraocular pressure (IOP) reduction after topical prostaglandin analogue use for 1 year.

### CASE REPORT

S.L.B., male, 19 years old, healthy, with no previous history of eye surgery or family history of glaucoma. Routine ophthalmologic examination has shown visual acuity of 20/20 (Snellen table), whereas biomicroscopic examination has shown normal results for both eyes (BE). Fundoscopy revealed 0.7 and 0.6 concentric optical disc cupping (C/D ratio - cup-to-disc) in the right (RE) and left (LE) eyes, respectively. Goldmann applanation tonometry recorded 22 mmHg and 16 mmHg for RE and LE, respectively. Diurnal intraocular pressure curve (DIOPC) peaked at 22 mmHg and 23 mmHg in RE and LE, respectively. Gonioscopy has evidenced wide open cameralar sinus and no pigmentation (0) based on Scheie's classification; pachymetry reached 495 micron; reliable computerized visual field (CVF) did not show significant focal losses in BE. Optical coherence tomography (OCT - CIRRUS 4000 Carl Zeiss Inc.) presented decrease in the superior, temporal and inferior retinal nerve fiber layer (RNFL) in RE, as well as in the superior nasal and temporal RNFL in LE. Treatment with timolol maleate (0.5%) was implemented in BE, and it enabled reducing IOP by more than 20%. Retinography presented increased C/D ratio (Figures 1 and 2) after two years of follow-up, whereas OCT presented lower RNFL reduction in RE and stability in LE. DIOPC peaked at 26 mmHg in BE.

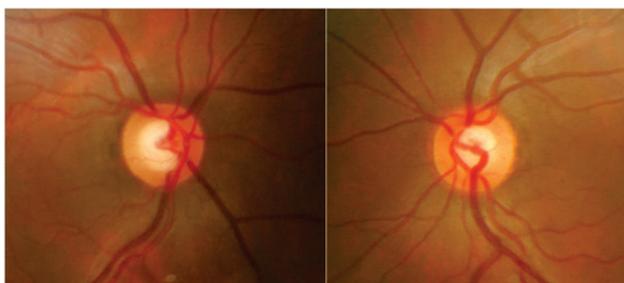


Figure 1: Retinography performed in 2015

### DISCUSSION

“Reversal of cupping” identification is a sign of decreased stress at cribriform plate level; it is likely associated with reduced risk of long-term glaucoma progression without visual function improvement.<sup>(4)</sup> Some hypotheses suggested to justify this phenomenon include proliferation of the astroglial tissue filling

the cup, restoration of intra and extracellular fluid in the optic disc, and narrowed scleral canal due to scleral elasticity. This hypothesis explains the higher narrowed scleral canal incidence in children, since the rigidity of this structure in adult individuals does not allow scleral canal size to change so rapidly.<sup>(5)</sup>

Studies have shown changes in optic nerve topography and in RNFL thickness after IOP decrease in pediatric patients with congenital and juvenile glaucoma, as well as in adult individuals with primary open-angle glaucoma (POAG), who were subjected to surgery.



Figure 2: Retinography performed in 2017, after the patient had used timolol maleate (0.5%) for 2 years. Increased C/D ratio in both eyes; it was worse in RE.



Figure 3: Retinography performed in 2018, after one year of Tafluprost (0.0015%) use. There was C/D ratio decrease in comparison to 2016.

	OD	OS		OD	OS
Average RNFL Thickness	83 µm	88 µm	Average RNFL Thickness	81 µm	84 µm
RNFL Symmetry	63%		RNFL Symmetry	74%	
Rim Area	0.82 mm²	0.92 mm²	Rim Area	0.99 mm²	1.11 mm²
Disc Area	2.07 mm²	1.96 mm²	Disc Area	2.07 mm²	1.94 mm²
Average C/D Ratio	0.78	0.73	Average C/D Ratio	0.72	0.65
Vertical C/D Ratio	0.79	0.68	Vertical C/D Ratio	0.70	0.57
Cup Volume	0.815 mm³	0.537 mm³	Cup Volume	0.591 mm³	0.363 mm³

Figure 4: OCT topographic patterns recorded in 2017 (on the left) and 2018 (on the right).

Shin et al. assessed adult patients with chronic POAG, before and after trabeculectomy (TREC). They found IOP reduction by approximately 50%, 3 months after the procedure. Decreased optic disc cup and volume, as well as increased neural rim, were observed - these changes were directly proportional to IOP reduction rate.<sup>(6)</sup> The study by Leske et al. focused on identifying and quantifying changes in the optic nerve of patients subjected to TREC. Individuals whose IOP reduced by over 40% have shown improvement in the following optic nerve parameters: cupped area, rim area and cup/disc area ratio.<sup>(7)</sup>

Yamada et al.<sup>(8)</sup> have conducted a study focused on evaluating RNFL thickness in POAG patients before and after

TREC. Patients whose IOP decreased by more than 30% have also presented increased RNFL thickness, mainly in the superior and inferior temporal regions of the optic nerve.<sup>(8)</sup> Similar to the aforementioned study, Figs et al. have analyzed the effects of IOP reduction after TREC on patients with poor drug control. They observed increased mean RNFL thickness, which was also associated with reduced IOP levels.<sup>(9)</sup>

Meirelles et al. have conducted a prospective study focused on evaluating the reversal of cupping in the optic disc of patients with congenital and juvenile glaucoma who were subjected to surgical procedures.<sup>(10)</sup> The association between reduced C/D ratio and the analyzed variables has shown that patients' age at surgery time and IOP reduction after surgery were the only variables recording statistically significant reversal of cupping.<sup>(10)</sup> The younger the patient at surgery time, the higher the reversal of cupping rate.<sup>(10)</sup>

Few studies available in the literature have analyzed changes in optic nerve topography and in RNFL thickness resulting from hypotensive drug therapy.

Similar to the patient described in the current study, Parrow et al. observed increased optic nerve cupping in patients with non-controlled IOP, which was followed by cupping reduction after therapeutic replacement and IOP control.<sup>(11)</sup> Avelino et al. have observed increased RNFL thickness after IOP reduced by at least 25% due to drug therapy.<sup>(12)</sup>

Bowd et al. observed statistically significant decrease in cupping area and volume, and in C/D ratio, as well as increased neural rim in patients whose IOP decreased by approximately 36% after topical prostaglandin introduction.<sup>(13)</sup>

Tan et al. performed a case-control study and found IOP reduction by 25% in the case and control groups; however, cupping reduction was only observed in the group of eyes with glaucoma or ocular hypertension. This change was identified in 1/5 of treated eyes and it persisted for at least 1 year.<sup>(1)</sup>

The patient assessed in the present study has shown stability in propaedeutic exams such as tonometry, retinography, computerized visual field and OCT, after reversal of cupping. Further studies should be conducted to help better understanding the pathophysiology of this phenomenon, as well as its correlation to glaucoma progression.

## REFERENCES

1. Tan JC, Hitchings RA. Reversal of disc cupping after intraocular pressure reduction in topographic image series. *J Glaucoma*. 2004;13(5):351-5.
2. Harju M, Saari J, Kurvinen L, Vesti E. Reversal of optic disc cupping in glaucoma. *Br J Ophthalmol*. 2008;92(7):901-5.
3. Wu SC, Huang SC, Kuo CL, Lin KK, Lin SM. Reversal of optic disc cupping after trabeculotomy in primary congenital glaucoma. *Can J Ophthalmol*. 2002;37(6):337-41.
4. De Araújo CC. Efeito da redução da pressão intraocular sobre a camada de fibras nervosas retinianas e nervo óptico medido pela tomografia de coerência óptica. [dissertação]. Brasília: Universidade de Brasília; 2013.
5. Gietzelt C, Lemke J, Schaub F, Hermann MM, Dietlein TS, Cursiefen C, et al. Structural Reversal of Disc Cupping After Trabeculectomy Alters Bruch Membrane Opening-Based Parameters to Assess Neuroretinal Rim. *Am J Ophthalmol*. 2018;194:143-52.
6. Shin DH, Bielik M, Hong YJ, Briggs KS, Shi DX. Reversal of glaucomatous optic disc cupping in adult patients. *Arch Ophthalmol*. 1989;107(11):1599-603.
7. Lesk MR, Spaeth GL, Azuara-Blanco A, Araujo SV, Katz LJ, Terebuh AK, et al. Reversal of optic disc cupping after glaucoma surgery analyzed with a scanning laser tomograph. *Ophthalmology*. 1999;106(5):1013-8.
8. Yamada N, Tomita G, Yamamoto T, Kitazawa Y. Changes in the nerve fiber layer thickness following a reduction of intraocular pressure after trabeculectomy. *J Glaucoma*. 2000;9(5):371-5.
9. Figs M, Lazzeri S, Nardi M, Bartolomei MP, Ferreras A, Fogagnolo P. Short-term changes in the optic nerve head and visual field after trabeculectomy. *Eye (Lond)*. 2011;25(8):1057-63.
10. Meirelles SH, Mathias CR, Bloise RR, Stohler NS, Liporaci SD, Frota AC, et al. Evaluation of the factors associated with the reversal of the disc cupping after surgical treatment of childhood glaucoma. *J Glaucoma*. 2008;17(6):470-3.
11. Parrow KA, Shin DH, Tsai CS, Hong YJ, Juzych MS, Shi DX. Intraocular pressure-dependent dynamic changes of optic disc cupping in adult glaucoma patients. *Ophthalmology*. 1992;99(1):36-40.
12. Avelino RR, Luis PA, Medeiros M, Costa VP. Influência da redução medicamentosa da pressão intra-ocular na medida da espessura da camada de fibras nervosas da retina de olhos hipertensos e glaucomatosos pela polarimetria de varredura a laser. *Arq Bras Oftalmol*. 2006;69(5):655-9.
13. Bowd C, Weinreb RN, Lee B, Emdadi A, Zangwill LM. Optic disk topography after medical treatment to reduce intraocular pressure. *Am J Ophthalmol*. 2000;130(3):280-6.

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