

# The use of choline in association with the Bangerter filters for the treatment of amblyopia

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## Abstract

The study investigated the effects of choline combined with Bangerter filter in the treatment of amblyopia. All amblyopic subjects used a Bangerter filter on the corrective spectacle lens (1d over the left eye, 1d over the right eye). Choline was then administered orally to 39 patients once daily, five days per week for the entire study period. Subjects treated with the Bangerter filter showed a mean visual acuity of 0.27 logMAR; at 12mo of treatment, the mean visual acuity reached 0.09 logMAR. Patients treated with the Bangerter filter and citicoline showed a mean visual acuity of 0.35 logMAR; at 12mo of treatment, the mean visual acuity reached 0.01 logMAR. No significant changes in the angle of deviation were observed in both groups. Subjects in both forms of amblyopia therapies demonstrated an increase in visual acuity. However, these effects were markedly enhanced when coupled with the administration of choline. Findings suggest that the effects are particularly relevant in the more severe amblyopic cases.

**KEYWORDS:** choline; amblyopia; Bangerter filter; visual acuity; ocular motility

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## INTRODUCTION

Amblyopia is a condition of reduced visual acuity, generally unilateral, caused by an obstacle in the normal sensory input occurring during a critical moment, and allowing for the full or partial recovery through the appropriate and timely rehabilitative treatment<sup>[1]</sup>. However, the prevalence of amblyopia is often underestimated<sup>[2]</sup>. According to a research study conducted in 1983, it involves at least 5% of the population and, specifically, during childhood it affects

between 1.5% and 2.5% of population<sup>[3-4]</sup>. Common modalities treatment are: patching, penalization with filter, lens or atropine eye drops. The purpose of this study was to assess and compare the effectiveness of Bangerter filters, when used alone and combined with the intake of choline, in amblyopia therapy.

## METHODS

The study was conducted in accordance with the Declaration of Helsinki of 2008. A total of 80 amblyopic patients were included in the study, 42 females and 38 males, at an average of 4.5y and follow-up at 12mo. Forty-eight subjects with exodeviation and thirty-two subjects with esodeviation. Their initial mean visual acuity value measured 0.31 logMAR. Treatment was administered orally once daily, 5d per week, and continued to the end of the 12mo follow-up period. Informed consent was obtained from all individual participants included in the study.

Based on the amblyopia treatment, they were divided randomly as follows: 41 subjects underwent amblyopia therapy with the Bangerter 0.8 filter on alternate days; 39 subjects underwent amblyopia therapy with the Bangerter filter coupled with choline (citicoline). Choline was administered orally once daily, 5d per week for the entire study period.

Subjects received a comprehensive ophthalmic examination in order to exclude any dioptric media opacities or ocular and retinal pathologies, either initial or during the follow-up period, that could compromise visual function. Visual assessment with the best visual correction was measured in logMAR at baseline and 3, 6, 9 and 12mo after treatment. Moreover, they received an orthoptic examination including: Extrinsic Ocular Motility (EOM) Study, Hirschberg test, Krimsky test, alternate prism cover testing, fusional amplitudes, and Bagolini red filter test. The orthoptic screening is necessary in order to determine, at the beginning of the study and during follow-up, the presence of strabismus and the binocular cooperation and the possible variations.

## RESULTS AND DISCUSSION

Subjects with exodeviation who underwent amblyopia therapy with the Bangerter filters showed a mean visual acuity of 0.25 logMAR in both eyes; and at 12mo of treatment, the mean visual acuity reached 0.15 logMAR in both eyes, with a 40% increase in the visual acuity. Subjects with exodeviation who underwent amblyopia with both the Bangerter filter and citicoline, showed a mean visual acuity of 0.4 logMAR in both eyes; and at 12mo of treatment, the mean visual acuity reached 0.1 logMAR in both eyes with a 75% increase in the

visual acuity. No significant changes in the angle of deviation were observed. Subjects with esodeviation treated with the Bangerter filter showed a mean visual acuity of 0.3 logMAR in both eyes; and at 12mo of treatment, the mean visual acuity reached 0.15 logMAR in both eyes with a 50% increase in the visual acuity. Subjects with esodeviation treated with the Bangerter filter and citicoline showed a mean visual acuity of 0.3 logMAR in both eyes; and at 12mo of treatment, the mean visual acuity reached 0.15 logMAR in both eyes with a 50% increase in the visual acuity. There were no significant changes in the angle of deviation. The analysis of variance (ANOVA) model was statistically significant ( $F=11.26$ ,  $P<0.05$ ), providing an  $R^2=0.75$ .

The Pediatric Eye Disease Investigator Group Writing Committee reported that the Bangerter filter treatment is a viable option to consider when initiating treatment of moderate amblyopia<sup>[5]</sup>, and is an effective technique as: 1) it increases patient compliance; 2) fusion (sensory and motor) is not interrupted; 3) it does not cause any significant changes in the angle of vision; 4) it may be used for long periods of time.

Chen *et al*<sup>[6]</sup> in 2015 reported that “Bangerter filters can immediately reduce suppression and promote binocular summation for mild/low spatial frequencies in observers with amblyopia”. Furthermore, Schiavi *et al*<sup>[7]</sup> suggested that “In the amblyopic and sound eyes Bangerter filters seem not to alter the retinal sensitivity”. Miyata *et al*<sup>[8]</sup> highlighted that “the degree of stereopsis was not degraded by the reduced visual acuity induced by the use of 0.3 Bangerter filters. In this regard, the use of 0.3 Bangerter filters may be considered safer than occlusion eye patches for the patients with normal binocular vision”. Even when amblyopia is caused by strabismus or anisometropia, Bangerter filters seem to be useful for the treatment of mild or moderate cases<sup>[9-10]</sup>. The authors should consider these explanations/results from different studies in context of their own results.

The sample used in our study affected by a mild to moderate amblyopia caused by strabismus responded positively to the treatments. The combination of the Filters with citicoline shows a further significant improvement after approximately 5mo, with an increase in visual acuity, which appears to be more rapid and effective, and also statistically significant ( $F=11.26$ ,  $P<0.05$ ), these data are confirmed by other studies, indeed Fresina *et al*<sup>[11]</sup> reported that, in amblyopic patients, cytidine diphosphate-choline combined with patching treatment contributes to obtaining more stable effects than with patching alone. Pawar *et al*<sup>[12]</sup> argued that visual acuity improvement with citicoline coupled with patching therapy was significantly higher than with patching alone at one year of treatment. Mendonça and Ferreira<sup>[13]</sup> reached the same conclusion and reported that “the visual acuity and the visual evoked potential latency improvement demonstrated that the citicoline enhanced the transmission of the electric impulse from retina to visual cortex”.

Choline indeed: 1) has minor adverse effects; 2) causes a rapid increase in visual acuity; 3) shortens the recovery time; 4) allows visual acuity improvement to be sustained effectively. Although the Bangerter filter is a valid amblyopia treatment, its therapeutic effects are considerably enhanced when combined with the administration of citicoline.

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**Conflicts of Interest:** Sabetti L, None; Masedu F, None; Tresca C, None; Bianchi F, None; Valenti M, None.

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