A preliminary study on the treatment of amblyopia with Haidinger’s brushes

Churawan Lal Sahu, R. Muralidhar, D. Ramamurthy

Introduction: A number of treatment options for amblyopia have been reported in the recent years. Haidinger’s brushes have also been used to treat amblyopia and correct fixation abnormalities in amblyopia though there is no study that addresses visual acuity to the best of our knowledge. Type of Study: This is a nonrandomized prospective case series. Materials and Methods: Patients between the age groups of 5 and 15 years with strabismic/anisometropic/mixed/ametropic amblyopia were enrolled for the study. All patients wore their refractive correction for a month prior to the study. All patients were made to view the Haidinger’s brushes through the amblyopic eye for 15 min/day for a total of 10 consecutive days. Part-time occlusion was commenced thereafter. The vision was recorded prior to the commencement of the exercise, after conclusion of the same and at 2-month review. Results: Thirty-seven eyes of 30 patients were enrolled for the study. The mean age of the patients was 8.7 ± 3.4 years. The mean number of lines of improvement was 1.2 ± 0.9 at completion of 10 days of exercise and 1.36 ± 0.9 at 2 months with patching. None of the patients had a loss of visual acuity at 2-month review. The series included patients with anisometropic, ametropic, and strabismic amblyopia though the numbers did not permit a subgroup comparison. Overall, eight eyes did not respond to exercises. Conclusions: 10 days of exercises with Haidinger brushes produces substantial visual gain in patients with strabismic, anisometropic and mixed amblyopia. The improvement is sustained at 2-month review. The results of this study need to be validated in a larger series of patients.

Key words: Amblyopia, Haidinger’s brushes, patching

Materials and Methods

The study was a nonrandomized prospective study conducted at our hospital from January 2015 to August 2015. The study was approved by the Institutional Review Board of our hospital. Patients with ametropic/strabismic/anisometropic/mixed amblyopia with age between 5 and 15 years were recruited from the Pediatric Ophthalmology and Strabismus Clinic of our hospital after informed consent. Strabismic amblyopia was defined as amblyopia in the presence of a manifest heterotropia at distance and/or near fixation or a history of strabismus surgery (or botulinum toxin) or a history of manifest strabismus with a two-line visual acuity difference between the two eyes. Anisometropic amblyopia

Although patching remains the gold standard therapy of amblyopia, a number of new treatment options have emerged over the years. These include refractive adaptation, atropine penalization, and a number of binocular activities with varying success rates. A recent study reported that binocular iPad treatment improved vision by 1–1.5 lines with just 1 h of play per day over 4 weeks. The improvement plateaued thereafter. Another study reported that dichoptic movie viewing improved vision by two lines at a 2-week review.[1,6] While these techniques may not replace patching as a therapy for amblyopia, they could certainly supplement efforts of patching by providing a head start improvement in the visual acuity. This may make it easier for the child to patch as he or she would have a better visual acuity in the amblyopic eye.

Haidinger’s brushes have also been tried for amblyopia treatment and are readily available as part of the synoptophore. Haidinger’s brushes refer to an entoptic phenomenon that appears as an hourglass or a double brush subtending an angle of 3°, while viewing a uniform blue field through a polarized filter. The image fades away quickly unless the filter is rotated. They can only be perceived by the most central part of the macular field.[6] They have been shown to correct eccentric fixation in patients with strabismus.[7] Another study showed that vision improves with active vision therapy in pediatric patients with amblyopia. The study mentioned many methods of vision stimulation, though it was not clear as to how many patients improved with Haidinger’s brushes.[8] To the best of our knowledge, there is no study that focuses on the improvement of visual acuity with the use of Haidinger’s brushes in amblyopic patients. Our study aimed to assess the improvement in visual acuity with 10 days of exercise with Haidinger's brushes in patients with strabismic/mixed/anisometropic/ametropic amblyopia.

Department of Pediatric Ophthalmology and Strabismus, The Eye Foundation, Coimbatore, Tamil Nadu, India

Address for correspondence: Dr. R. Muralidhar, Department of Pediatric Ophthalmology and Strabismus, The Eye Foundation, 582A, D. B. Road, R. S. Puram, Coimbatore - 641 002, Tamil Nadu, India.

E-mail: rajamanimurali@hotmail.com

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was defined as amblyopia in the presence of a difference in refractive error of +1.0 diopter (D) of hyperopia/−3.0 D of myopia/1.5 D difference of astigmatism in any meridian. Mixed amblyopia was defined as the presence of both strabismus and anisometropic amblyopia as per the definitions above. In addition, the best-corrected visual acuity in the fellow eye was required to be ≥20/40 with a two-line difference in visual acuity between the two eyes. Ambroptic amblyopia was defined as amblyopia in the presence of hyperopia >5.0 D, myopia >3.0 D, and astigmatism ≥2.5 D in any meridian. All patients wore their refractive correction for 1 month prior to participation in the study. Patients who had a history of previous part-time/full-time occlusion were excluded from the study.

The good eye was patched, and the patient wore his or her refractive correction. All exercises were administered in the hospital on the department synoptophore. A synoptophore (serial no. 2010/111 Baliwalla and Homi Pvt. Ltd., Mumbai, India) was used for the study. Corrective lenses were used in trial frame if the patient failed to bring the prescribed spectacles. The head, chin, and forehead rest were adjusted to maximize patient comfort. A blue filter was placed in front of the exercising eye, and the Haidinger’s brushes were placed in the slot. In cases where the exercise was needed for both the eyes, the good eye was subjected first. The wheel of the Haidinger’s brushes was rotated clockwise for 3 min and anticlockwise for 2 min. This was repeated for a total of three times, and the speed was increased each time. The reversal in direction was primarily to engage the attention of the child on the brushes. Further, the attending optometrist also ensured that the child’s attention was focused on the rotating brushes. The exercises were administered for 10 consecutive days (except Sundays). For patients with ametropic amblyopia, exercises were administered for both the eyes one after the other after a gap of around 1 h. The visual acuity with the Early Treatment Diabetic Retinopathy Study chart was checked with the refractive correction before and completion of the exercise and it was recorded in decimal notation. Patients were then advised to continue wearing glasses after completion. Part-time occlusion of the good eye was advised when appropriate (2 h/d for moderate amblyopia and 6 h/d for severe amblyopia) after the completion of exercises. Patching was not advised for ametropic amblyopia.

The visual acuity improvement in terms of decimal visual acuity and number of letters read before and after the completion of the exercise and at 2 months was compared. The two-sample paired t-test was used to assess the significance of visual improvement.

## Results

Thirty-seven eyes of thirty patients were enrolled for the study. Patient characteristics are mentioned in Table 1. The mean age of the patients was 8.7 ± 3.4 years. Fourteen eyes (seven patients) had ametropic amblyopia, 6 eyes had mixed amblyopia, 12 eyes had anisometropic amblyopia, and 5 eyes had strabismic amblyopia. All patients completed 10 days of exercises with Haidinger’s Brushes in the amblyopic eye. The mean decimal visual acuity prior to the exercises was 0.35 ± 0.16, which increased to 0.47 ± 0.17 after 10 days of exercise ($P = 0.007$). The mean decimal visual acuity at the end of 2 months was 0.769 ± 1.328. The mean number of letters read prior to the exercise was 21.08 ± 8.8, which increased to 27.4 ± 8.7 ($P = 0.007$) at completion. The mean number of letters at 2 months was 28.5 ± 8.7. The mean number of letters gained was 6.3 ± 5.1 at completion of 10 days of exercise and 6.8 ± 4.5 at 2-month review. The mean number of lines improved after 10 sittings of exercises was 1.2 ± 0.9. The number of lines improved after 2 months of therapy was 1.36 ± 0.9. None of the patients had a worsening of visual acuity at 2-month review. Overall, eight eyes (one – anisometropic, two – strabismic, and five – ametropic) did not have any improvement (<2 letters of improvement was taken as no improvement) with 10 days of exercises (Table 2). Only two eyes had further improvement with patching. Interestingly, one eye of patient no. 5 (ametropic amblyopia) responded to exercises while the fellow eye did not.

## Discussion

Our study shows that a short course of exercises with Haidinger’s brushes (100 min/patient) results in a substantial and rapid visual gain in the amblyopic eye. This improvement is sustained at 2-month review. This bears significance in giving a head start to the vision in amblyopia therapy that may translate into better cooperation of the patient for patching. In comparison, a study using an iPad app reported an improvement of 1.5 lines after 8 h of gameplay over 4 weeks. Atropine penalization has been reported to improve visual acuity by 1.4 lines after 5 weeks of treatment. In one of the Pediatric Eye Disease Investigator Group studies, 2 h of patching yielded an improvement of 1.1 lines over 5 weeks. Hence, an average of 1.2-line improvement after 10 days of exercise assumes a great potential significance. All patients had worn glasses for a month prior to the exercise, and none of the patients had started patching. This argues for the beneficial effects of viewing Haidinger’s brushes alone. The improvement was sustained in these patients at 2-month review though a further substantial improvement was not noted by 2 months.

The limitations of our study include the small number of patients and limited follow-up. Our study did not have a control arm. The small number of patients in our study did not permit an intergroup comparison. Most of the nonresponders in our series had ametropic amblyopia or were in an older age group. This is not entirely unexpected as ametropic amblyopia responds slowly to therapy. An older age group is also associated with a poor response to therapy. It would be interesting to note how the vision improves with patching for a longer duration. The synoptophore is a low-cost equipment and is available in most pediatric ophthalmology
Sahu, et al.: Amblyopia treatment, Haidinger brushes

Only one patient in our study improved to 20/20 vision. This stresses the need to continue patching after the exercise session. Further studies with larger number of patients, longer follow-ups, diverse conditions such as eccentric fixation, refractive amblyopia, and a control arm are needed before recommending this treatment for the general use.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

### Table 1: Study patient details

| Number | Serial number | Age | Etiology of amblyopia | Refractive error | Preexercise vision | Postexercise vision | Final vision after 2-month follow-up |
|--------|---------------|-----|-----------------------|------------------|--------------------|---------------------|--------------------------------------|
| 1      | 1             | 12  | Mixed                 | −0.75/−2.25×165  | 0.16               | 0.4                 |                                      |
| 2      | 2             | 11  | Mixed                 | +1.00            | 0.4                | 0.5                 | 0.5                                  |
| 3      | 3             | 4   | Mixed                 | +3.00            | 0.16               | 0.32                | 0.32                                 |
| 4      | 4             | 5   | Ametropic             | −3.50/−2.00×5    | 0.16               | 0.32                | 0.32                                 |
| 5      | 4f            |     | Ametropic             | −4.50/−2.00×180  | 0.25               | 0.32                | 0.4                                  |
| 6      | 5             | 6   | Ametropic             | −4.00/−2.00×180  | 0.32               | 0.32                | 0.32                                 |
| 7      | 5f            |     | Ametropic             | −5.00/−2.00×170  | 0.4                | 0.63                | 0.63                                 |
| 8      | 6             | 14  | Anisometropic         | −4.50/−0.75×115  | 0.5                | 0.8                 | 0.8                                  |
| 9      | 7             | 5   | Mixed                 | +1.50/−1.50×30   | 0.32               | 0.4                 | 0.5                                  |
| 10     | 8             | 5   | Ametropic             | +12.00/−1.00×20  | 0.16               | 0.4                 | 0.4                                  |
| 11     | 8f            |     | Ametropic             | +12.00/−0.75×160 | 0.16               | 0.4                 | 0.4                                  |
| 12     | 9             | 9   | Strabismic            | +2.50/−1.50×180  | 0.4                | 0.5                 | 0.5                                  |
| 13     | 10            | 10  | Anisometropic         | −8.50/−1.5×180   | 0.16               | 0.32                | 0.32                                 |
| 14     | 11            | 9   | Mixed                 | +1.75/−1.00×65   | 0.5                | 0.63                | 0.63                                 |
| 15     | 12            | 8   | Anisometropic         | +6.50/−2.25×10   | 0.25               | 0.32                | 0.4                                  |
| 16     | 13            | 5   | Ametropic             | +0.00/−2.50×10   | 0.5                | 0.63                | 0.63                                 |
| 17     | 13f           |     | Ametropic             | +0.00/−2.75×175  | 0.5                | 0.63                | 0.63                                 |
| 18     | 14            | 9   | Anisometropic         | −4.75/−1.0×60    | 0.4                | 1.0                 | 1.0                                  |
| 19     | 15            | 15  | Anisometropic         | +1.00/−0.75×70   | 0.63               | 0.63                | 0.8                                  |
| 20     | 16            | 7   | Strabismic            | +1.50/−1.50×30   | 0.25               | 0.4                 | 0.5                                  |
| 21     | 17            | 12  | Anisometropic         | +2.00            | 0.32               | 0.5                 | 0.5                                  |
| 22     | 18            | 15  | Strabismic            | +2.00            | 0.16               | 0.16                | 0.16                                 |
| 23     | 19            | 5   | Ametropic             | −3.00/−2.50×10   | 0.16               | 0.16                | 0.16                                 |
| 24     | 19f           |     | Ametropic             | −3.50/−2.75×165  | 0.16               | 0.16                | 0.16                                 |
| 25     | 20            | 5   | Ametropic             | +3.75/−1.25×180  | 0.5                | 0.63                | 0.63                                 |
| 26     | 20f           |     | Ametropic             | +4.00/−1.25×180  | 0.16               | 0.4                 | 0.4                                  |
| 27     | 21            | 5   | Anisometropic         | +0.00/−3.00×165  | 0.4                | 0.5                 | 0.5                                  |
| 28     | 22            | 10  | Anisometropic         | +1.75/−1.00×165  | 0.5                | 0.63                | 0.63                                 |
| 29     | 23            | 13  | Anisometropic         | −8.00/−2.00×140  | 0.63               | 0.8                 | 0.8                                  |
| 30     | 24            | 7   | Anisometropic         | +0.00/−2.00×175  | 0.63               | 0.8                 | 0.8                                  |
| 31     | 25            | 9   | Strabismic            | +4.50/−2.25×180  | 0.4                | 0.5                 | 0.5                                  |
| 32     | 26            | 11  | Mixed                 | +3.00/−0.75×15   | 0.5                | 0.63                | 0.63                                 |
| 33     | 27            | 7   | Ametropic             | −2.00/−1.75×20   | 0.5                | 0.5                 | 0.5                                  |
| 34     | 27f           |     | Ametropic             | −4.00/−1.75×160  | 0.4                | 0.4                 | 0.4                                  |
| 35     | 28            | 8   | Strabismic            | +3.00/−1.00×40   | 0.4                | 0.4                 | 0.4                                  |
| 36     | 29            | 6   | Anisometropic         | −0.75/−3.50×180  | 0.16               | 0.25                | 0.32                                 |
| 37     | 30            | 15  | Anisometropic         | −9.00/−0.75×20   | 0.32               | 0.4                 | 0.4                                  |

Patients highlighted in red did not have any improvement with Haidinger’s brushes after the completion of 10 days of exercise. f: Fellow eye

### Table 2: Vision status of amblyopic eye after ten days of exercise and at 2 months review

| After 10 days of exercise | After 2-month follow-up |
|---------------------------|-------------------------|
| Eight eyes have not improved | Two eyes improved with patching |
| Seventeen eyes have improved one line | Five eyes had shown further improvement of at least one line |
| Eight eyes have improved two lines | One eye improved further with patching |
| Four eyes have improved three lines | No further improvement was noted on patching |

One patient was lost to follow-up at 2 months

units in the country. Only one patient in our study improved to 20/20 vision. This stresses the need to continue patching after the exercise session. Further studies with larger number of patients, longer follow-ups, diverse conditions such as eccentric fixation, refractive amblyopia, and a control arm are needed before recommending this treatment for the general use.

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Conflicts of interest
There are no conflicts of interest.
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