# Perceptual learning for adults with astigmatism-related amblyopia: abridged secondary publication

**TW Leung *, CS Kee, RWH Li**

**KEY MESSAGES**

1. Perceptual learning to detect gratings at near cut-off spatial frequencies can improve grating acuity, visual acuity, and stereoacuity while alleviating meridional visual deficits in adults with amblyopia.
2. Occlusion therapy provided minimal visual benefits for adults with amblyopia.
3. Perceptual learning did not improve visual function in normally sighted adults.

Hong Kong Med J 2024;30(Suppl 1):S39
HMRF project number: 02160117

[1] **TW Leung,** [1] **CS Kee,** [2] **RWH Li**

[1] *School of Optometry, The Hong Kong Polytechnic University, Hong Kong SAR, China*
[2] *School of Optometry, University of California Berkeley, United States*

* Principal applicant and corresponding author: jeffrey.tw.leung@polyu.edu.hk

## Introduction

Uncorrected astigmatism during critical periods in children can disrupt normal visual development, potentially leading to persistent visual impairment known as meridional amblyopia or astigmatism-related amblyopia. The traditional first-line intervention for this condition involves the prescription of corrective spectacles. However, optical correction alone or in combination with occlusion therapy is not always sufficient to fully restore vision,[1] particularly in young children of kindergarten age. Consequently, there is a pressing need for more effective treatment modalities.

Traditional approaches to amblyopia treatment typically target individuals before the age of 8 years, which is considered the critical period for visual development. Nevertheless, recent research indicates that intensive vision therapy can induce neural plasticity in adults with strabismic and anisometropic amblyopia.[2-4] In light of these findings, we propose a treatment strategy for the specific visual deficits associated with astigmatism to correct this type of brain-related visual disorder. Our study aims to establish a training regimen to enhance grating acuity along the most impaired meridian in individuals with astigmatism-related amblyopia.

## Methods

A cohort of 35 patients diagnosed with amblyopia was randomly allocated to receive either perceptual learning therapy (n=19) or occlusion therapy (n=16). Perceptual learning to detect gratings at near cut-off spatial frequencies was used to treat adults with astigmatism-related amblyopia.

## Results

After 20 hours of training over 4 weeks, participants showed 24% improvement in grating acuity, 65% improvement in meridional anisotropy, 38% improvement in visual acuity, and 16% improvement in stereoacuity. In contrast, patients receiving occlusion therapy did not exhibit significant improvement in any of these visual functions. Perceptual learning did not improve visual function in normally sighted adults.

## Discussion

These findings highlight the potential for perceptual learning to activate neural plasticity and ameliorate visual deficits in adults with amblyopia who have exceeded the age window corresponding to the critical period of visual development. The ability of targeted learning therapy (rather than optical correction of refractive errors) to treat the underlying astigmatism-related functional impairment represents a promising direction for amblyopia care.

## Funding

This study was supported by the Health and Medical Research Fund, Health Bureau, Hong Kong SAR Government (#02160117). The full report is available from the Health and Medical Research Fund website (https://rfs2.healthbureau.gov.hk).

### References

1. Harvey EM. Development and treatment of astigmatism-related amblyopia. Optom Vis Sci 2009;86:634-9.
2. Li RW, Levi DM. Characterizing the mechanisms of improvement for position discrimination in adult amblyopia. J Vis 2004;4:476-87.
3. Li RW, Klein SA, Levi DM. Prolonged perceptual learning of positional acuity in adult amblyopia: perceptual template retuning dynamics. J Neurosci 2008;28:14223-9.
4. Li RW, Ngo C, Nguyen J, Levi DM. Video-game play induces plasticity in the visual system of adults with amblyopia. PLoS Biol 2011;9:e1001135.