

# Research Summary & Evidence Base for Strabismus & Amblyopia

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There are many valid academic papers and scientific studies supporting the behavioural optometry approach to treating both amblyopia and strabismus. A recent literature search found 130+ articles on behavioural vision therapy for strabismus and another 240+ articles on behavioural vision therapy for amblyopia in the literature prior 2009!

The following are some examples from the literature. Wick (1987)<sup>1</sup> wrote that a retrospective examination was performed on the records of 54 patients who had undergone vision therapy for accommodative esotropia. Over 90% of the patients achieved total restoration of normal binocular function with vision therapy, which would now be called behavioural vision therapy.

Zeigler, Huff and Rouse<sup>2</sup> found sufficient published literature to perform a review of strabismus therapy in 1982, and although the reporting basis was not consistent in many, they showed cure rates based on Flom's functional cure or equivalent of up to 73% from behavioural vision therapy.

A review of ophthalmology surgical and non-surgical interventions for intermittent exotropia conducted for the Cochrane Database (Hatt and Gnanaraj, 2006)<sup>3</sup> concluded that the available medical literature consists mainly of retrospective case reviews which are difficult to reliably interpret and analyse. The one randomised trial included found unilateral surgery more effective than bilateral surgery for basic intermittent exotropia. However, across all identified studies, measures of severity and thus criteria for intervention are poorly validated, and there appear to be no reliable natural history data. There is therefore a pressing need for improved measures of severity, a better understanding of the natural history and carefully planned clinical trials of treatment to improve the evidence base for the management of this condition<sup>4</sup>.

It should be noted in passing that standards for successful optometric treatment of strabismus typically relate to a functional result of binocular vision, whereas ophthalmological standards for strabismus surgery only aim for a cosmetic result, which can mean a remaining strabismus deviation within 10 prism dioptres of alignment, and no significant binocular vision function.

Also of note are the dramatically different criteria for success used by optometry and ophthalmology. As detailed above, ophthalmology seeks orthotropia after a surgery, the definition

of which is that the eyes are now within plus or minus 10 prism diopters of being straight. Optometry has a much higher standard level of “functional cure”, looking to achieve the highest level of Flom’s criteria which includes binocular vision function and stereo acuity.

A similar conclusion was reached in another Cochrane report by Elliott and Shafiq in 2005 concerning interventions for infantile esotropia (IE). “The main body of literature on interventions for IE are either retrospective studies or prospective cohort studies. It has not been possible through this review to resolve the controversies regarding type of surgery, non-surgical intervention and age of intervention. There is clearly a need for good quality trials to be conducted in these areas to improve the evidence base for the management of IE.”<sup>5</sup>.

Laboratory research studies show that, with extensive practice, performance on positional tasks (which is particularly poor in amblyopes) can be improved substantially in children with amblyopia (Li et al.,2005). In addition to results in children, there are laboratory (Li and Levi, 2004) and clinical (Wick et al.,1992) studies suggesting that vision therapy and/or extensive task repetition in adults with amblyopia can also produce significant improvements in visual acuity, binocular function and positional acuity measures.”

Refractive correction alone, or in combination with patching/penalisation is frequently associated with a high level of treatment success. This is very consistent with a behavioral view, as evidenced in the textbook *Applied Concepts in Vision Therapy* which states: “The judicious application of prescriptive lenses is always the initial step in amblyopia therapy”. The fact that this is frequently associated with a high level of treatment success with some patients does not obviate the need for additional intervention with other patients <sup>6</sup>.

Wick & Wingard (1992) concluded from a study of 19 patients that “following a sequential management plan for treatment of anisometropic amblyopia can yield substantial long-lasting improvement in visual acuity and binocular function for patients of any age. But there is plenty more evidence.”

As early as 1978 Flax and Duckman<sup>7</sup> reviewed several papers and showed orthoptic therapy produced a combined functional cure rate of 72.4% in patients with strabismus. NOTE: the “orthoptic therapy” as it was called then, is indeed nearly identical to that which the optometry field now calls behavioural vision therapy, except for the evolutionary changes which have improved the treatment.

In 1980, Goldrich studied the outcomes of 28 patients treated at the State University of New York, State College of Optometry and found that 71% attained a functional cure following sequential therapy procedures used in-office as well as home.

The 1999 paper of Krumholtz and Fitzgerald<sup>8</sup> studied patients with refractive amblyopia and found that, although patching alone may be sufficient for improvement of visual acuity, binocular performance is significantly better when vision therapy is included in the treatment regimen.

Cotter et al. in 1992<sup>9</sup> showed a 59% success rate for vision therapy, which exceeded the success of surgery.

A review of Perceptual Learning (otherwise known as vision therapy) as a treatment for amblyopia by Levi et al (2009)<sup>10</sup> showed that extant studies made it clear that practising a visual task resulted in a long-lasting improvement in performance in an amblyopic eye.

Alotaibi et al. (2012)<sup>11</sup> demonstrated that patients with both moderate and severe amblyopia improved significantly when near therapy activities were included in treatment compared with the group without near therapy activities.

Gaishi et al. (2015) showed that deficits in motion-defined form perception were still present in 55% of patients at the end of patching treatment and identified the need for new approaches to amblyopia treatment.

A very significant development in amblyopia therapy has more recently evolved in mainstream optometric and ophthalmologic literature. This is the thrust toward treating amblyopia as a binocular vision problem treated primarily through binocular integrative therapy as opposed to occlusion/patching and/or penalisation. This approach has been championed by Hess in optometric circles in Canada, and supported by Wong and ophthalmologic colleagues in Canada based on newer understandings of brain processes in amblyopia and neuroplasticity. In a 2012 research paper on the subject, Hess and colleagues credit this approach in part to a paper published by Press in a journal that espouses a behavioural optometric approach<sup>12 13</sup>.

There are now a growing number of publications demonstrating the usefulness of display technology including virtual reality in treating these conditions. Hess (2012)<sup>14</sup> and subsequent follow up studies recorded positive results for therapy using iPad stereoscopic devices. Australian researchers have recently shown improvements in fine motor skills using IPod based therapy to improve binocular vision function in children with amblyopia<sup>15</sup>

The Consensus Panel on Care of the Patient with Strabismus, published by the American Optometric Association in 1995 and most recently reviewed in 2010, the Optometric Clinical Practice Guideline (CPG) on Care of the Patient with Strabismus includes 170 references supporting the role of vision therapy. One need not advance a “purely behavioral approach” to advocate for the application of behavioral principles in strabismus therapy. As this CPG demonstrates, surgical and non-surgical approaches can be synergistic in some cases <sup>16</sup>.

In many cases, the specific treatment plan for an individual involves a number of modalities. However, most would agree that the conservative options should be applied first. From an optometric viewpoint this means that if a case can be cured with lenses alone then this is the best option. If it requires the addition of behavioural vision therapy this is the next best option. Some cases require surgery, but even in those cases, the patient benefits from some therapy being done before the surgery and therapy being done after the surgery. The debate about the proper sequencing and combinations of treatments for particular individuals imposes a responsibility on all clinicians to continue their efforts to find the best way forward.

### **Conclusion**

We do not need to enter into the debate about which therapy or treatment option(s) are the ideal. Our purpose is to illustrate that there was, is, and continues to be valid and numerous academic papers and scientific studies supporting the behavioural optometry approach.

Optometric treatment of amblyopia and strabismus with lenses and patching, and in some cases vision therapy, is effective in many cases in achieving improved visual function to the high Flom criteria. More research is needed to evaluate the individual benefits of all modes of delivery of treatment for amblyopia and strabismus, including optometric vision therapy and ophthalmological strabismus surgery.

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<sup>1</sup> Wick B. Accommodative esotropia: efficacy of therapy. *J Am Optom Assoc.* 1987 Jul;58(7):562-6

<sup>2</sup> Ziegler D, Huff D, Rouse MW. Success in strabismus therapy: a literature review. *J Am Optom Assoc.* 1982 Dec;53(12):979-83.

<sup>3</sup> Hatt, S. and Gnanaraj, L. (2006) Interventions for Intermittent Exotropia. *Cochrane Database Syst. Rev., Art. No.:CD003737.* doi: 10.1002/14651858.CD003737.pub2.

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- <sup>4</sup> Hatt SR, Gnanaraj L. Interventions for intermittent exotropia. Cochrane Database Syst Rev 2013 May 31;(5):CD003737. doi: 10.1002/14651858.CD003737.pub3.
- <sup>5</sup> Elliott S, Shafiq A. [Interventions for infantile esotropia](#). Cochrane Database Syst Rev. 2013 Jul 29;(7):CD004917.
- <sup>6</sup> Press LJ. Applied Concepts in Vision Therapy. 2nd ed. Santa Ana: Optometric Extension Program, 2008. pp.191-2
- <sup>7</sup> Flax N, Duckman RH. Orthoptic treatment of strabismus. Journal of the American Optometric Association, 49: 1353-1361, 1978.
- <sup>8</sup> Krumholtz I, FitzGerald D. Efficacy of treatment modalities in refractive amblyopia. Journal of the American Optometric Association, June; 70(6):399-404, 1999.
- <sup>9</sup> Coffey B, Wick B, Cotter S, et al. Treatment options in intermittent exotropia: a critical appraisal. Optometry and Vision Science, 69: 386-404, 1992
- <sup>10</sup> Levi DM , Li RW Perceptual learning as a potential treatment for amblyopia: A mini-review. Vision Research. 49 (2009) 2535–2549
- <sup>11</sup> Alotaibi AG, Fawazi SM, Alenazy BR, Abu-Amro KK. Outcomes of 3 hours part-time occlusion treatment combined with near activities among children with unilateral amblyopia. Saudi Med J. 2012 Apr;33(4):395-8.
- <sup>12</sup> Wong AM. New concepts concerning the neural mechanisms of amblyopia and their clinical implications. Can J Ophthalmol 2012,Oct;47(5):399-409.
- <sup>13</sup> Press LJ. Electronic games and strabismus therapy. J Optom Vis Dev 1981;12:35-9.
- <sup>14</sup> Hess RF, Thompson B, Black JM, Machara G, Zhang P, Bobier WR, An iPod treatment of amblyopia: an updated binocular approach. Cooperstock J.Optomety. 2012 Feb 15;83(2):87-94.
- <sup>15</sup> Webber A , L, Wood JM, Thompson B. Fine motor skills of children with amblyopia improve following binocular treatment. Invest Ophthalmol Vis Sci 2016;57:4713-4720
- <sup>16</sup> Rutstein RP, Cotter SA, Daum KM, Molzlin RL, Ryan JM. Optometric Clinical Practice Guideline - Care of the Patient with Strabismus: Esotropia and Exotropia. St. Louis, MO: American Optometric Association 2011