Microtropia - A challenge to conventional treatment strategies

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ABSTRACT

A sample of members of the Orthoptic Association of Australia, practicing within Sydney was surveyed. The members surveyed were selected at random and represent a cross section of the Sydney metropolitan Orthoptic 'workforce'. The survey pertained to occlusion management of primary microtropia. The survey aimed at examining modes of current Orthoptic practice and pinpointing Orthoptic opinion regarding the outcome of visual acuity standards achieved in primary microtropia. This paper includes reference to both past and present literature sources and documented research. Multiple authors, each with their specifically defined classifications are cited in the literature dating back to the 1950's, as having identified a unique non paralytic strabismus "phenomenon", which is now termed Microtropia. In conclusion, this paper aims at provoking a renewed interest in a well established phenomenon; in addition to providing an altered view of management protocols and treatment outcomes in primary microtropia.

INTRODUCTION

Multiple authors, each with their specifically defined classifications are cited in the literature dating back to the 1950's, as having identified a unique non paralytic strabismus 'phenomenon', which is now termed microtropia.[1,2,3] Indeed, the phenomenon of microtropia has been defined with great diversity over the years and has been referred to with a variety of names over the decades. Small angle deviations characterised by central suppression of the deviating eye and normal or near normal fusion amplitudes were first identified by Pugh in 1936, and were referred to as 'retinal slip.[3,4] Following this time a multitude of names prevailed including among others the terms "fixation disparity, fusion disparity, retinal flicker, monofixational esophoria, monofixational syndrome, strabismus spurius, microtropia unilateralis anomalo-fusionalis, microstrabismus and minisquint".[4] Many authors have grouped 'like' criteria pertaining to the strabismus but have often distinguished, and separated individual characteristics specific to their definition.

Lang coined the term microtropia in 1966 to describe a "monolateral squint of less than five degrees"[5] associated with harmonious abnormal retinal correspondence (ARC) which allows for abnormal binocular single vision (ABSV), fusion and reduced stereopsis.[6] According to Lang's clinical description, a foveal suppression scotoma and amblyopia are frequent findings accompanying microtropia. Eccentric fixation may or may not exist.[5,6] It is also widely recognised that microtropia is associated with the presence of anisometropia.[3] In 1984 Lang distinguished four groups of microtropia according to their fixation and refractive state. These groups consisted of central and eccentric fixation each occurring with either isometropia or anisometropia.[7]

Halveston and von Noorden (1967) originally restricted their definition of microtropia to include very small angle strabismus with eccentric fixation and ARC, with the cover-uncover test revealing no manifest deviation; the uniocular angle of eccentric fixation and the angle of anomaly therefore being coincident.[6,8] Parks (1969) used the term 'monofixation syndrome' to describe the phenomenon of small angle strabismus (a manifest strabismus of eight prism dioptres or less), and was the only author to propose that the patients have normal retinal correspondence (NRC).[6]

In general, the literature points toward an agreement of microtropia having the common characteristics of a central suppression scotoma and the presence of ABSV. Amblyopia and anisometropia are frequently reported findings accompanying the phenomenon.[6] There is however, disagreement amongst authors on what is observed on cover testing, the size of the manifest deviation and the form of retinal correspondence.[6]

The literature reports a consensus that the condition may occur as a primary entity or be secondary to optical or surgical correction of a larger angle strabismus. Secondary microtropia is rarely associated with ocular pathology.[3,4,6] Lang qualifies the use of the term 'secondary' microtropia stating that "since secondary has not only a temporal but also a causative meaning, we prefer now to speak in these cases of 'consecutive' microtropia which means: Microtropia resulting after treatment".[2] Lang believes that the term 'secondary' may be reserved for microtropia when a condition can be attributed to it's cause. For example, secondary microtropia due to anisometropia.[2] Lang reported that in a group of 805 microtropes, 388 (48%) were of the primary form.[2]

The term microtropia 'with identity' is used by most authorities to describe cases with no manifest movement on cover test, the eccentric fixation point coinciding with the angle of ARC. Microtropia 'without identity' describes cases where a small manifest movement is determined on the cover-uncover test, the angle of anomaly exceeding the angle of eccentricity.[9,10] In 1998 Houston, Cleary, Dutton

and McFadzean reported on a series of patients with microtropia. They found microtropia with identity in 30% of the cases and microtropia without identity in 70%.[8]

As previously indicated, there is wide recognition of microtropia being associated with anisometropia. A review of primary microtropia conducted by Lang in 1974 showed that 70% of cases were isometropic; the remaining 30% anisometropic.[3] Amblyopia has been reported to be denser in cases with eccentric fixation and more pronounced with higher anisometropia.[5]

The aetiology of microtropia is not fully understood, although there are several hypotheses documented in the literature.[2,5,11] Typically in strabismus, suppression develops in order to alleviate confusion and diplopia in response to a motor anomaly. However, unlike other forms of strabismus primary microtropia is considered essentially sensorial in nature.[10] A summary of the proposed aetiological factors documented in the literature include "an inherent inability or loss of ability for bifoveal fusion, anisometropia producing a habitually defocused image in one eye and a subsequent foveal scotoma, a 'statistical variant' in the fixation reflex feedback mechanism, and a genetic/hereditary component with a particular familial disposition to ARC".[10] Keiner (1978) proposed an abstract argument that it is a dynamic impediment of uncontrolled accommodation in the amblyopic eye which maintains the microtropia and the amblyopia.[12] Lang (1983) described the aetiology as "a primary sensorial defect, which predisposes to ARC".[2] Lang qualifies that microtropia is "an inherited primary congenital defect, rather than an acquired anomaly".[13] Cleary, Houston, McFadzean and Dutton in 1998, hypothesized an alternative process for a 'subset' of microtropic patients having responded well to occlusion therapy. The process included a period of normal visual development preceding the onset of microtropia, during which the retinocortical 'foundations' for NRC were established. Precise pairing of foveo-foveal receptive fields was not abolished by the presence of amblyopia and a central scotoma, but this relation was "temporarily suspended" and binocular single vision was sustained via the neural substrate of paired receptive fields over a wide retinocoritcal area.[10]

Lang has stated that microtropia is "by no means a rare condition".[2] Lang acknowledges early practitioners Javal, Worth, Duane and Bielschowsky had not mentioned small angle strabismus. However, Maddox in 1898 believed that, "very small angles were extremely rare because the natural tendency to fusion was much too strong as to allow small angles to exist"[2]! Lang estimates that one per cent of the general population has a microstrabismus. With this statistic in mind and with knowledge of the resulting amblyopia described by Everhard-Halm and Maillette de buy Wenniger-Pick as "the most important aspect of microstrabismus",[7] a sample of thirty members of the Orthoptic Association of Australia practicing within Sydney was surveyed.

THE SURVEY

The members surveyed were selected at random, representing a cross section and included approximately 40% of the Sydney metropolitan 'OAA workforce'. The principal author carried out a telephone interview survey of four questions. Each respondent was informed of the purpose of the survey which was to collect information related to the current modes of Orthoptic practice with regard to management of microtropia. The respondents were also informed that anonymity with regard to their name would be observed. Respondents were encouraged to give complete answers and were allowed to make qualifying statements and comments related to each question. The survey questions were designed to provoke clinical comments and pinpoint Orthoptic opinions regarding visual acuity standard outcomes in microtropia. The questions were as follows:

Question 1. In the case of primary microtropia what form of occlusion would you recommend? (i.e. with what would you patch the non-amblyopic eye?)
Question 2. What patching regime would you recommend? (i.e. for how long?)
Question 3. What final standard of visual acuity in the microtropic eye would you aim for?
Question 4. What clinical tests would you use to monitor the primary microtrope during occlusion therapy?

RESULTS & DISCUSSION

The results were collated and summarised. The following table reports the responses for Question 1. of the survey.

TABLE 1
Question 1. In the case of primary microtropia **what form of occlusion** would you recommend? (i.e. with what would you patch the non-amblyopic eye?)

Form of Occlusion Recommended	Frequency
Total to light/ 'Opticlude' direct to the face	4/30
'Micropore' direct to the face	7/30
'Micropore' or 'Opticlude' direct to the face	3/30
'Leucosilk' or 'Leucopore' direct to the face	2/30
'Micropore', 'Leucosilk', "whatever" direct to the face	1/30
Sticky patch direct to the face	1/30
Total to light/ 'Opticlude' direct to the face reducing to, or partial occlusion (filter/ tape) on glasses	6/30
Partial occlusion (filter/ tape) on glasses; if fails total to light/ 'Opticlude' direct to the face	2/30
'Micropore' on glasses reducing to filter occlusion on glasses	1/30
Sticky patch on glasses	1/30
No occlusion at all or 'Opticlude' direct to the face with VA of less than 6/12	1/30
No occlusion at all or 'Micropore' on glasses or direct to the face	1/30

Respondents in clarification made several statements in addition to their answers for Question 1. A number of respondents commented that:

- "The selection of the form of occlusion in microtropia is dependent upon the patient's age, compliance and previous history/ experience with patching. It is also dependent upon the level of visual acuity."
- "An added heterophoria should be considered when selecting the form of occlusion in microtropia".

One individual commented that:

- "The selection of the form of occlusion is important in management of microtropia, as the Orthoptist does not want to interfere with patient's binocularity".

Another respondent added that:

- "Binocular function should be considered prior to selecting the form of occlusion for a patient with microtropia".

Microtropic amblyopia is viewed by Lang as responding well to simple, full time direct occlusion.[3] Furthermore, Lang made reference to the use of partial occlusion with "graduated occlusion of the sound eye with Bangerter filters until the age of 10 years"[5,7]. The initial use of total occlusion followed by partial occlusion once visual acuity improves, is noted by several authors in the literature.[8,11] Houston et al included an initial period of total to light occlusion. When visual acuity failed or ceased to improve, or with waning compliance, the substitution of full time, partial (total to form) 'Blenderm' (tape) occlusion was made.[8] Lithander and Sjostrand made use of atropine penalisation as an alternative when compliance with direct occlusion was unsatisfactory.[14]

The authors mentioned have considered the level of visual acuity and the compliance of the patient as factors in determining the form of occlusion prescribed. The literature makes no apparent reference to the age of the patient being a significant consideration in selection of the form of occlusion. The issue of establishing the stability of binocular function in microtropia prior to occlusion therapy shall be discussed later.

The information gathered from the survey reflects a general assumption that the various forms of occlusion 'tape' and 'patches' available allow for what is referred to as total ('total to light') occlusion. Of the Orthoptists choosing to apply occlusion direct to the face, 39% recommended the option of the use of either 'tape' (usually 'Micropore') or 'Opticlude' occlusion. It was also interesting that 20% of the Orthoptists surveyed made direct reference to the use of either 'Micropore' or 'Leucopore' acting as a form of total occlusion.

Electrophysiology Experiment

With these figures in mind, a preliminary mini-experiment was set-up to observe the difference in retinal activity between eyes patched with 'Opticlude' and those occluded with 'Micropore'. Photopic electroreintogram (ERG) traces were recorded for a series of 7 subjects. The subjects included for the ERG were caucasian adult volunteers with a mean age of 36 years. There was a remarkable consistent finding of the eyes patched with 'Opticlude', providing an approximate 60-85% reduction in the amplitude of the ERG signal with delayed latency noted. Whereas, for eyes patched with 'Micropore' the consistent finding showed virtually no, or an upper limit of 20% reduction in the amplitude of the ERG trace with no delay in the latency noted. These preliminary experimental results showed that under photopic conditions, there was a difference in the amount of visual stimulus received by the retina, when subjects wore the two different forms of occlusion. It appears that neither of the patches totally 'block out' a stimulus and certainly the 'Micropore' does not appear to impede the light source dramatically. This preliminary evidence would suggest that 'Micropore' is not able to provide total, i.e. ('total to light') occlusion. The clinical significance of the result of using various occlusion patches for the treatment of amblyopia requires further study.

It was interesting that a couple of the group surveyed often chose to recommend no occlusion for patients with microtropia. The literature identifies reports of insuperable diplopia having resulted as a consequence of occlusion therapy. We however, along with others, could find no information related specifically to this complication in microtropia, a phenomenon recognised as having normal or near normal fusion amplitudes.[3,4,8]

The following table reports the responses for Question 2. of the survey.

Table 2

Question 2. What patching regime would you recommend? (i.e. For how long?)

Occlusion regime recommended (hours/day)	Frequency
3hrs to full time	6/30
2hrs to 8hrs	4/30
6hrs	1/30
4hrs to 6hrs	3/30
1hr to 6hrs	2/30
4hrs to 5hrs	4/30
2hrs to 4hrs	3/30
3hrs to 4hrs	3/30
2hrs to 3hrs	2/30
1hr	1/30
1hr per line of difference	1/30

Note: When partial occlusion was recommended, it was placed on the glasses for full time wear.

Respondents provided the following points of clarification when providing answers to Question 2.

- 27/30 (90%) of the respondents made direct reference to the degree of amblyopia being a 'key element' in formulating a suitable patching regime.
- 10/30 (33%) of the respondents also stated that the patient's age is an important consideration when recommending an occlusion regime.

A number of respondents stated that:

- "Part time occlusion is best carried out with the child doing close work."

- "Less occlusion time is recommended for younger children, whereas with the older child there is less time to gain an improvement in vision and thus a more vigorous approach is required."

Individuals provided the following statements:

- "With an older child there is little expectation for improvement. A token regime of occlusion is all that is required."
- "It is important to warn parents of an increased size of deviation with the use of occlusion therapy."
- "Limited occlusion time would be recommended should the child have an added heterophoria."

The Orthoptists surveyed have reported diverse 'patching' regimes. A similar variety of opinions for full time versus part-time occlusion therapy is documented in the literature.[3,7]

Lang (1974) found part-time patching to be a non-effective regime and preferred the use of simple, full time direct occlusion followed by partial occlusion until the amblyopia was remedied.[3]

Houston et al (1998) studied the visual acuity outcomes of thirty microtropes managed with a specific occlusion therapy protocol. The regime included an initial period of 6-8 weeks of spectacle wear alone. Total to light occlusion was then introduced for 4-8 hours daily, with a greater number of hours for patients with poor visual acuity. Close work was encouraged during the patching. As the visual acuity improved the occlusion was reduced to a minimum of 2 hours daily. When no improvement was evident or waning compliance occurred, full time, partial (total to form) 'Blenderm' occlusion was substituted.[8]

The following table reports the responses for Question 3. of the survey.

Table 3

Question 3. What final standard of visual acuity in the microtropic eye would you **aim** for?

Final standard of visual acuity (VA) in microtropic eye - The Aim	**Frequency**
6/5part	1/30
6/6	2/30
'Equal VA or close to equal VA'	3/30
'One line difference between the microtropic eye and the "good" eye'	8/30
6/9 to 6/6	2/30
6/9	7/30
6/12 to 6/9	5/30
6/12	1/30
Some improvement	1/30

The above results to survey Question 3 indicate that 50% of Sydney Orthoptists are aiming for a final visual acuity standard of 6/9 or 'one line of difference' in the microtropic eye following occlusion therapy. Respondents in clarification made several statements in addition to their answers for Question 3. Several of the respondents commented that:

- "The final standard of visual acuity is dependent upon several factors, the age of the patient at the time of diagnosis, the level of the visual acuity at the commencement of occlusion therapy, the degree of refractive error and eccentric fixation."
- "VA will never be equal, it will regress once occlusion is ceased."
- "The aim is for stable vision."
- "Patching should be pursued whist improvement is gained."

One respondent made an additional comment that:

- "With microtropia, sometimes it is better to settle for less improvement."

An individual also provided anther statement that:

- "Near VA is a most important factor, aim for N6 to N8."

The literature makes little mention of the achievable visual outcomes in microtropia. Visual acuity is thought to be responsive to occlusion therapy, but the result limited by the presence of eccentric fixation.[10] Like 50% of the Orthoptists surveyed, Lithander and Sjostrand (1991) agree that a residual one line difference in visual acuity to be the best endpoint for treatment in microtropia.[14] Whereas approximately 20% of the group surveyed would agree with Parks and Eustis (1961) who stated "that amblyopia has to be treated by occlusion until equal vision of both eyes has been reached"[7]. Everhard-Halm et al, however, believed that amblyopia treatment in microstrabismus was successful when a visual acuity of 6/12 or better was achieved.[7]

Houston et al (1998) comment that "following occlusion it is generally accepted that levels of visual acuity greater than 6/12 or 6/9 Snellen are rarely achieved, despite the lack of literature evidence to support this view."[8] Houston et al report their findings of equal 6/5 vision being attainable in microtropia, with 43% of the microtropic group studied having achieved this visual acuity outcome.[8] The authors suggest it is the full time use of 'Blenderm' (total to form) occlusion on the glasses, when visual acuity levels reach 6/9 Snellen in the amblyopic eye, which is a major factor in improving the visual outcome.[8]

The literature recognises that the standard of visual acuity may regress once occlusion is ceased and that periods of patching or 'form occlusion' on the glasses, may have to be reinstated to achieve optimal stable vision.[7,8] Parks commented that "intermittent occlusion is the treatment of choice until it is finally terminated at 9 years of age".[3]

It is noteworthy that Houston et al reported that older patients in their study (i.e. 5-7year olds) were often able to achieve 6/5 visual acuity and most often 6/9.[8] Lithander and Sjostrand also found "no crucial age related differences in the final outcome of treatment".[14] Furthermore, these authors and others report that "initial poor visual acuity did not predispose to a poor visual outcome".[7,8] The degree of anisometropia was also reported as having no relationship to the final visual acuity achieved.[8]

Lang recognises near vision as an important factor. Poor reading faculty with the microtropic eye is often demonstrated in spite of seemingly good distant and near vision with optotypes. This discrepancy is referred to as 'reading amblyopia'.[2]

The following table reports the responses for Question 4. of the survey.

Table 4
Question 4. What clinical tests would you use to **monitor** the primary microtrope **during occlusion** therapy?

Clinical tests used for monitoring microtropia during therapy	Frequency
Visual acuity near	12/30
Visual acuity distance	28/30
Refraction	3/30
Cover test near and distance	24/30
Measurement of deviation	10/30
Visuscope	21/30
Sbisa Bar	1/30
4^ Prism Test	3/30
Worth's Lights	2/30
CNP	2/30
Fusion ranges	1/30
Synoptophore assessment	4/30
*Stereoacuity assessment	26/30

*It was of interest that there were a variety of stereoacuity tests selected for use. The following is a breakdown of the tests selected.

Table 5 Stereo Tests

Stereoacuity test(s) selected	Frequency
Titmus	10/30
TNO	5/30
Langs	2/30
Titmus or TNO	4/30
Titmus or Langs	2/30
TNO or Frisby	1/30
Unspecified stereoacuity test	2/30

Respondents in clarification made several statements in addition to their answers for Question 4. Several respondents made mention that:

- "Linear visual acuity testing should be attempted whenever possible in order to highlight the presence of the 'crowding phenomenon'."

One individual commented that:

- "Near visual acuity is most necessary at every visit"

Another responded added that:

- "Measurement of the deviation is of importance, particularly with patients having an added heterophoria."

Many of the respondents included that:

- "The visuscope is used throughout the occlusion therapy, although no change in fixation would be expected"

One respondent stated that:

- "The visuscope is only to be used during therapy when there is a poor result with the occlusion."

Another clarified that:

- "The visuscope is only used at the commencement of treatment in order to establish the effect of occlusion on fixation."

A couple of respondents added that:

- "Stereoacuity would only be attempted as visual acuity improved with treatment."

The Orthoptists surveyed have included a variety of practice protocols. Near visual acuity was included by 40% of the group surveyed. Lang reports that reading difficulties exist in microtropia due to a monocular temporal scotoma, creating a 'crowding phenomenon'. The fixation point scotoma corresponds to the area where in microesotropia the centre of the ARC lies, causing separation difficulties and thus reading amblyopia. This explains why in microtropia of the right eye the final letters of a word seem blurred, whereas in microtropia of the left eye the initial letters seem blurred. In order to monitor this form of amblyopia it is essential that monocular near vision be assessed with text rather than single optotypes when possible.[2,3,5,12]

Houston et al suggest that the "risk of insuperable diplopia can be monitored by measuring fusional reserves".[8] It is also recommended that the stability of the ABSV for older patients having full time occlusion be measured with the Sbisa bar.[8] It is noteworthy that there was very little mention of examination of fusion ranges or the stability of ABSV among Sydney Orthoptists. Several comments were however made with regard to the importance of measuring the size of the total deviation throughout occlusion therapy. The underlying heterophoria determined by alternate cover test is ultimately compensated by fusion.[4 cited in 15] Thus emphasizing the importance of continued assessment of fusional reserves during occlusion therapy.

The literature documents the importance of monitoring stereopsis throughout occlusion therapy.[8] Houston et al state that after patching, all of the microtropic patients in their series showed improved stereoacuity, with a third of patients achieving better than 60" of arc. It was of clinical significance that for half of these patients the improved stereopsis preceded the improvement in visual acuity.[8] The results to the survey indicate that 87% of the Sydney Orthoptists would routinely assess stereoacuity. The specific choice of stereoacuity test does however, vary amongst the group. It is interesting to note that Hahn, Cadera and Orton reported no relationship being found between the presence or absence of anisometropia and the level of stereoacuity attained.[6] Two studies cited in the literature comment that microtropes with identity achieve better stereoacuity levels.[6,8]

The results to the survey indicate that 70% of the Sydney Orthoptists would monitor fixation during occlusion therapy. The qualifying statements however, made in reference to the use of visuscopy would suggest many Orthoptists are not predicting a change in fixation to occur. Everhard-Halm et al (1989) had a similar impression "that the fixation pattern was not greatly influenced by therapy".[7] The literature however, reports that primary microtropia is not a static condition.[8] Houston et al (1998) detected an alteration in the point of fixation in 50% of the microtropes studied following their protocol of occlusion therapy. The authors qualify that one third of the subjects acquired foveal fixation.[8]

As discussed, 87% of the Sydney Orthoptists surveyed indicated they would monitor stereoacuity. Lang acknowledges that binocular function spontaneously improves as a result of 'end stage' partial occlusion therapy.[3] To achieve stereopsis better than 60" of arc, bifoveal fixation must exist.[16] The literature includes evidence of recovery in microtropia. The amblyopia is documented as having resolved, with equal 6/5 Snellen vision resulting, central fixation and stereoacuity of 60"of arc or better.[8]

Von Norden and Cantolino like Houston et al acknowledged the potential for recovery in microtropia following occlusion therapy.[3,8,13] Indeed if microtropia has the potential to be 'cured', it refutes the concept of it being an underlying primary congenital defect of retinal correspondence as proposed by Holland, Richter and Lang.[4] Cleary et al (1998) hypothesise that "the perceived change from ARC to NRC support a plasticity in the retinocortical relation and the existence of ARC on the basis of normally existing retinocortical connections, facilitated by flexibility of paring of receptive fields over a relatively wide cortical area"[10]. The authors state it is likely that high grade stereoacuity and bifoveal fixation are restored in response to occlusion therapy only in patients when "a period of normal retinocortical architecture development preceded the onset of microtropia".[10]

SUMMARY

The survey of Sydney metropolitan Orthoptists has provided insight to the current modes of Orthoptic practice and pinpointed Orthoptic opinion regarding the outcome of visual acuity standards achieved in primary microtropia. In part the literature would suggest that microtropia is a dynamic rather than a static condition, in which it is possible to gain a substantial improvement in visual acuity and stereoacuity. With the included use of full time partial ('total to form') occlusion at the end stage of treatment, equal visual acuities rather than 'one line of difference' or '6/9' should be the aim of therapy. During treatment monitoring patients with microtropia should include the assessment of stereoacuity and fixation, as positive changes in these may precede an improvement in vision.[8] Near reading visual acuity should also be monitored to elicit the 'crowding phenomenon' associated with microtropic 'reading amblyopia' which as discussed may persist in the presence of 'normal' distance visual acuity.[2,3,5,12]

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