

## CLINICAL SCIENCE

## Disease laterality, eye dominance, and visual handicap in patients with unilateral full thickness macular holes

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**Aim:** To investigate the association between visual handicap, laterality, and historical eye dominance in patients presenting with unilateral full thickness macular holes (FTMH).

**Methods:** Consecutive patients presenting with unilateral FTMH and no other visually significant ocular pathology including abnormalities of binocular vision were included. A questionnaire and case note review were performed to determine the mode of presentation, presence of symptomatic binocular interference, historically dominant eye, and whether they elected to undergo surgery.

**Results:** 44 eyes of 44 patients fulfilled the inclusion criteria. 21 (48%) affected eyes were right sided and 56% of FTMH were in the historically dominant eye. 76% of FTMH in historically dominant eyes presented symptomatically compared to 36% in non-dominant eyes ( $p=0.003$ ). 72% of patients with FTMH affecting their historically dominant eye were aware of binocular interference in day to day binocular viewing compared with 21% when the FTMH was in the non-dominant eye ( $p=0.001$ ). 23 (52%) patients elected to undergo surgery, of whom 18/23 (78%) had FTMH in their historically dominant eye ( $p=0.0003$ ).

**Conclusion:** This study suggests that eye dominance may be an important determinant of the visual handicap suffered by patients with unilateral FTMH.

The clinical impression was gained that patients with full thickness macular holes (FTMH) affecting their historically dominant eye suffer greater visual handicap and elect to undergo surgery more frequently than patients with disease in their historically non-dominant eye. The aim of this study was to investigate associations between laterality, eye dominance, and visual handicap in patients with unilateral FTMH. We are not aware of any previous studies relating symptomatic visual handicap to disease laterality and/or ocular dominance.

## PATIENTS AND METHODS

## Inclusion criteria

Consecutive patients with unilateral FTMH and no other significant ocular pathology (including abnormalities of binocular vision or amblyopia) presenting to one clinic over a 28 month period were included. Patients were offered surgery on the basis of the severity of their day to day binocular visual handicap and their willingness to undergo surgery with post-operative prone posturing.

Data were derived from a case note review and postal questionnaire (Table 1) to determine:

- (1) demographic data
- (2) the patients' historically dominant eye (Table 1 question 1)

- (3) whether the initial presentation was symptomatic on the part of the patient or resulted from an asymptomatic screening finding (Table 1 question 2)
- (4) whether the patient was aware of binocular interference (that is, that the eye with the FTMH interfered with the vision of the fellow eye during day to day binocular viewing)<sup>1-3</sup>
- (5) whether the patient elected to undergo surgery.

All data were collected before surgery. Descriptive statistics,  $\chi^2$  and Mann Whitney U tests were employed. Ethical approval was not required.

## RESULTS

Fifty four patients with 66 eyes affected by FTMH presented between October 1998 and March 2001. Forty four patients fulfilled the inclusion criteria; 33 (75%) were female. The age of the patients ranged from 62 years to 88 years (mean 74 years). Twenty one affected eyes were right sided and 25 (56%) were considered historically dominant. The median Snellen acuities of affected eyes were 6/36 (range 6/18 to 3/60) in the historically dominant group and 6/60 (range 6/9 to 3/60) in the historically non-dominant group (Mann-Whitney U test:  $U=182.5$ ,  $p=0.18$ ). No patients considered themselves co-dominant.

Twenty five (56%) patients presented symptomatically. In 19 patients the macular hole was detected as an asymptomatic

**Table 1** Questionnaire designed to determine the patients' historically dominant eye and mode of presentation

(1) To determine ocular dominance	(2) To determine mode of presentation
Before you developed your eye problem, which eye would you have used for a one eyed task such as using a camera or a telescope? (i) Right (ii) Left (iii) Either	Please specify whether: (i) You noticed a visual problem and sought attention from your doctor/optician (ii) Your problem was found during an eye test at a time that you were not aware of it. (iii) Others (please give details)

**Table 2** To compare the prevalence of symptomatic presentation, interference, and listing for surgery on the basis of eye dominance in patients with unilateral full thickness macular holes

	Dominant	Non-dominant	Df	$\chi^2$	p Value
Symptomatic presentation	19/25 (76%)	6/19 (36%)	1	8.68	0.003
Interference	18/25 (72%)	4/19 (21%)	1	11.2	0.001
Listing	19/25 (76%)	4/19 (21%)	1	13.06	0.0003

**Table 3** To compare the prevalence of symptomatic presentation, interference, and listing for surgery on the basis of disease laterality in patients with unilateral full thickness macular holes

	Right	Left	df	$\chi^2$	p Value
Symptomatic presentation	14/21 (67%)	11/23 (47%)	1	1.59	0.21
Interference	12/21 (57%)	9/23 (40%)	1	1.43	0.23
Listing	13/21 (61%)	10/23 (43%)	1	1.49	0.22

finding during a routine ocular examination. Twenty two patients (50%) were aware of binocular interference (that is, that the affected eye interfered with its normal fellow in day to day binocular viewing). Twenty three (52%) patients elected to undergo surgery.

These data were analysed separately on the basis of laterality and ocular dominance. The results of this analysis are presented in Table 2.

Twenty one right eyes were referred; 13 of these were scheduled for surgery, of which 11 (85%) were historically dominant. Of 23 left eyes referred 10 were scheduled and seven (70%) were historically dominant.

## DISCUSSION

We are not aware of any previous publications that have investigated for associations between the laterality of uniocular eye disease and visual symptomatology. Several functional tests to determine eye dominance have been described.<sup>4-6</sup> Unilateral eye disease as encountered in this study might however bias the results of such tests. We therefore elected to determine dominance on the basis of the patients' recollection of their premorbid ocular preference when performing a one eyed task.

The patient population included in this study was 75% female and in their 7th to 9th decade. The overall median visual acuity was 6/60 Snellen with a range of 6/9 to 3/60. In this respect our population appears demographically similar to other reported populations with FTMH.<sup>7-12</sup>

Seventy six per cent of patients with a FTMH in their historically dominant eye presented symptomatically. Symptomatic presentation was however half as frequent (36%) when the macular hole was in the historically non-dominant eye (Table 2,  $p = 0.003$ ).

Awareness of binocular interference—that is, awareness of the diseased eye interfering with the vision of its normal fellow during day to day binocular viewing, is a clinically prevalent ophthalmic symptom.<sup>13 14</sup> Some patients with this symptom will cover or close the affected eye.<sup>15</sup> The routine clinical consultation included inquiry into symptoms consistent with binocular interference. Binocular interference was perceived by 72% of patients with a FTMH in their dominant eye but in only 21% of those with a diseased non-dominant eye (Table 2,  $p = 0.001$ ).

All patients were offered surgery on the basis of the severity of their visual handicap and their willingness to undergo a procedure with 7 days of postoperative prone positioning. The

decision to undergo or forego surgery was used as a surrogate measure for the severity of their handicap. Seventy six per cent of those with a FTMH in their dominant eye elected to undergo surgery as opposed to only 21% of those where the disease was on the non-dominant side (Table 2,  $p = 0.0003$ ).

It may be seen from Table 3 that no significant associations between laterality and symptoms/handicap could be demonstrated when the data were analysed on a right/left rather than a dominant/non-dominant basis.

The numbers in this study are relatively small but the observed effect size was sufficiently great for statistically significant results to be found for each of outcome measure. The dominant and non-dominant groups appeared comparable on the basis of acuity. A potential bias is that the patients' decision to undergo surgery and data regarding binocular interference may have been influenced by the interviewing surgeon. Repeating this study in a naive surgeon/patient group would validate the results.

Eye dominance is defined as “the eye controlling binocular function” and represents the tendency to prefer visual input from one eye to the other.<sup>16</sup> Eye dominance has been found to correspond to handedness in 65% of American individuals.<sup>17</sup> “Crossed dominance” occurs in 18% and co-dominance 17%; 80% of the general population is right handed.<sup>18</sup> Our results were broadly comparable to these data, with 88% being right handed and 75% right eye dominant. Dominance may determine the deviating eye in strabismus,<sup>19</sup> is thought to be important in the development and control of reading,<sup>20</sup> and may have a role in the aetiology of dyslexia.<sup>21</sup> Beyond this however the role and/or associations of eye dominance in disease states are poorly understood.

An association between eye dominance and binocular rivalry has been demonstrated.<sup>1</sup> Binocular rivalry occurs when corresponding points in each eye view images that are sufficiently dissimilar to prevent fusion. The observer experiences alternating dominance and suppression of each uniocular image. Harrad *et al* have shown that symptoms of binocular rivalry like transient blanking out of vision, intermittent fuzziness, and blurring were much more common when the dominant eye is patched in comparison with the non-dominant eye.<sup>1</sup> We hypothesise that the impaired and distorted image presented by an eye with a macular hole might result in rivalry.

The results of this study suggest that the visual handicap perceived by patients suffering from uniocular FTMH may be

strongly influenced by disease laterality and ocular dominance. These findings might apply to other unocular or asymmetrical eye diseases. The importance of eye dominance in the aetiology of visual handicap may be under-recognised.

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