

THE EFFECT OF PERIPHERAL FUSION ON THE 4 Δ TEST

Judith Sparke Assoc. Dip. O. (Cumb.) D.O.B.A.

This paper was written whilst the author was a third year student in orthoptics at the Cumberland College of Health Sciences, Lidcombe, N.S.W.

Abstract

Fifty subjects were examined to assess whether peripheral fusion affects the response to the 4 Δ test to determine the presence of a central scotoma. The test was performed both with and without peripheral fusion stimuli. It was found that in 23% of cases with a significant heterophoria, or a small angle squint, the presence of a scotoma was only demonstratable when peripheral fusion is eliminated. In the light of the results it is suggested that the usual method of performing the test be modified.

Key Words

Peripheral fusion, four prism dioptré test.

The 4 Δ test is clinically used to confirm an area of central suppression. The most effective use of this test, therefore, is limited to cases of small angle squint where a suppression scotoma of the foveal region of the squinting eye exists and no deviation has been found on cover test because the angles of eccentricity and anomaly coincide.

A 4 Δ prism causes sudden displacement of the foveal image to the parafoveal retina in one eye. Two binocular reflexes are thereby evoked. One is the refixation reflex which brings the image back to the fovea and the second is the fusional reflex which overcomes the diplopia induced by the monocular image displacement. Romano and von Noorden¹ state that both reflexes are probably initiated at the same time but because the velocity of the saccadic movement is 10 times that of the tonic movement, the fixation movement appears to precede the fusion movement.

In the event of central suppression the second fusion reflex is not elicited as the image is displaced into the scotomatous area, diplopia is not recognised and the fusional response fails to occur. This is described, for the purpose of this study, as a monocular response. However, Duke Elder² states that there is a form of peripheral fusion that occurs in the presence of a central suppression scotoma which may be demonstrated even if the deviation is gross.

Thus, the purpose of this study was to investigate whether peripheral fusion plays any part in

eliciting the second fusional response to the 4 Δ test in subjects with central suppression. If so, then peripheral fusion is affecting responses of this test previously used to note the presence of central fusion.

To do this, the test was carried out by two different methods:

- i) In free space – A fixation stick with a small dark spot drawn on it was used for fixation and held at 1/3 m from the subject at eye level. A 4 Δ prism was brought down over the dominant eye (i.e. the suspected fixing eye or the eye with the best VA) from above. The responses of the eyes were observed closely. This procedure was usually carried out 3 or 4 times to ensure consistency of results. In this condition peripheral and central fusion were allowed to act.
- ii) When peripheral fusion was eliminated – to eliminate peripheral fusion surrounding objects that would stimulate peripheral retina while fixing a spot target had to be eliminated. Initially, it was decided to instruct the subject to fix a small coloured spot on to a blank wall or to fix the small spot on the Bjerrum screen 1/3 m from the subject. This proved unsatisfactory as it was very difficult to observe the subject's eyes and clues to peripheral fusion were presented when placing the prism over the subject's eyes as this could only be done by standing beside and in front of the subject. Therefore, another method of eliminating peripheral fusion was devised.

A large white card with a spot in the centre was made up. The size of the card was determined by the area of the binocular field when fixing a spot at 1/3 m, this area was calculated as 34 cm up; 72 cm down and 48 cm either side of the fixation spot. By using this card stimulation of peripheral retina could be eliminated effectively.

The subject was instructed to fix the spot on the card which was held at 1/3 m at eye level. The eyes were observed through a hole in this spot. Another person would stand behind the subject, placing the prism over the suspected fixing eye while the responses were noted. To ensure consistency of responses this procedure was also performed 3 or 4 times. This test was performed with the prism base in, in the presence of an exo deviation.

For obvious reasons the 4 Δ test was not performed for 6 m as it would mean that a completely blank room would be needed to eliminate the peripheral fusion response.

Of the total 50 subjects tested:

- 10 (20%) were controls, having only a small latent deviation present (9 exophorias/1 esophoria)
- 24 (48%) had a moderate to large latent deviation > 5 Δ (7 esophorias/17 exophorias)
- 16 (32%) had a small angle squint (14 esodeviations/2 exodeviations)

Visual acuity of 6/18 or better in the less dominant eye and a positive response to the Wirt-Titmus test were necessary criteria for all groups.

Peripheral fusion was considered to be playing a significant part if a different response was observed when the test was performed under each of the two conditions. If peripheral fusion was being used it would be reasonable to suspect that there would be a binocular response in free space and a unioocular response when using the large white card.

RESULTS

Control Group

In the control group all subjects showed a binocular response under both testing conditions, signifying that no central scotoma was present and central fusion was being used to elicit the second fusional reflex.

Heterophoria Group

In the second group of 24 moderate to large latent deviations it was found that 15 (approx.

63%) of the subjects seen showed a binocular response under both testing conditions, i.e. central fusion was being used to elicit the second fusional response even when peripheral fusion had been eliminated.

7 of the subjects (approx. 29%) showed a change in response, i.e. a binocular response was observed in free space and a unioocular response observed when peripheral fusion had been eliminated, suggesting that there was a significant amount of central suppression present and the deviation was being controlled by peripheral fusion.

All these 7 subjects had a good VA (better than 6/9), had stereoacuity of 80 seconds of arc or better on the Titmus test and all except one showed good recovery movements to cover test. These patients had a mean heterophoria measurement of 29 Δ which is considerably larger than the mean measurement of 15 Δ of those showing a binocular response under both conditions.

2 subjects (approx. 8%) in this group showed a unioocular response to the 4 Δ prism under both testing conditions. This confirmation of central suppression suggests that these 2 subjects had a small microtropia that was previously undetected.

Small Angle Squint

In the third group of 16 small angle squints, 3 subjects (approx. 19%) showed a binocular response in free space and a unioocular response when peripheral fusion was eliminated, i.e. these subjects would not have been diagnosed as a microtropia by this test under the conditions usually used.

It was noted that all three cases had a large super-imposed heterophoria.

These findings are summarised in figure 1.

Response	Control Group	Heterophoria	Small Angle Squint
Binocular response under both conditions	10	15	-
Binocular response in free space. Unioocular response when peripheral fusion is eliminated	-	7	3
Unioocular response under both conditions	-	2	13
Total	10	24	16

Figure 1 Responses of each group to the 4 Δ test when performed with and without peripheral fusion stimuli.

CLINICAL SIGNIFICANCE

Of the 44 patients with a squint or significant heterophoria, 10 (23%) showed a uniocular response to the test only when performed in the absence of a stimulus to peripheral fusion. This suggests that the presence of a central scotoma may be overlooked when this test is carried out in the conventional manner. In order to be entirely accurate it is suggested that the usual method of performing the test be modified to reduce the effects of peripheral fusion.

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References

1. ROMANO, P.E. & VON NOORDEN, G. Atypical responses to the four dioptre prism test, *Am. J. of Ophthal.* Vol 67, 1969 pp. 935 - 941.
2. DUKE-ELDER, SIR STEWART. "System of Ophthalmology" Vol. VI Ocular Motility and Strabismus. Henry Kimpton, London, 1973, 406 - 407.