THE EFFECT OF THE AC/A RATIO ON THE DIFFERENCE BETWEEN DISTANCE AND NEAR MEASUREMENTS OF DEVIATION

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Abstract
The influence of the AC/A ratio on the difference between the distance and near deviation is investigated in 248 cases. It is found that the AC/A ratio provides a moderately accurate predictor of the near deviation (± 10Δ) in cases who are orthophoric at 6m. For all other cases it is of no value. The near deviation in most cases was more convergent than that predicted by the AC/A ratio.

Key words
AC/A ratio, near deviation.

Introduction

It is commonly noted in literature and in clinical practice that the AC/A ratio can be determined by observing the change in deviation from distance fixation to near fixation. For example, it has been stated that "when the measurement for distance and near is equal, the AC/A ratio is normal, when it is greater for distance than near the AC/A ratio is low, and when it is greater for near than distance the AC/A ratio is high".[1]

In the following paper 248 cases were investigated to evaluate the significance the AC/A ratio has upon the variation in angle of deviation from distance to near fixation.

Method

On all patients seen the AC/A ratio was calculated at the synoptophore by the gradient method. This method was chosen as it gives an accurate estimation of the AC/A ratio[2]. Being done at a set distance, the method eliminates any additional effect of proximal convergence on the simulated near deviation and the synoptophore enables the eyes to be kept fully dissociated to eliminate any effect of fusional convergence.

An angle of deviation was first recorded (B) and repeated using –3.00 DS lenses (A) with the better eye fixing in each case. To ensure that the maximum amount of accommodation was exerted the smallest detailed simultaneous perception slides suitable were used, accompanied by constant questioning about fine detail. The AC/A ratio was calculated by the formula $\frac{B - A}{3}$.

The deviations at 6 metres, and 1/3 metre were recorded by means of the alternate prism cover test. The difference between these two measurements was noted with a positive sign indicating a relatively more convergent deviation for near than distance and a negative sign indicating a relatively more divergent deviation for near than distance. For each distance, again to ensure maximum and accurate accommodation, constant questioning about a detailed fixation object was undertaken.

Since all information was obtained from clinical orthoptic assignments, done by students, only 135 of the 248 patients have been recorded with cover tests revealing whether the deviation was latent, intermittent or constant.

In all patients the recordings were taken with the patient wearing the appropriate spectacle correction.

On each graph a line has been drawn showing the predicted values of the difference between the distance and near deviations according to the value of the AC/A ratio alone.

Six centimetres is a convenient average IPD for the general population so that if the subject had an AC/A ratio of only 1, then, for near fixation (1/3m), only 3 dioptres of accommodation is exerted. This then is 15 prism dioptres less than the "ideal" of 18Δ at this distance in a subject

with an IPD of 6cms. Therefore, the difference in deviation from distance to near fixation should be −15 if the AC/A ratio was determined on the near deviation alone.

In Figure 1, it can be seen that there is no distinct correlation existing between the AC/A ratio and the difference between near and distance measurements. However, a general trend is evident revealing a positive correlation within a difference of fixation measurement range of approximately 20△ or more which tends to be a lot higher than the 10△ accepted as within normal limits by Lyle and Wybar (1970)[1]. As the AC/A ratio moves from low to high most of the patient distribution moves from a relatively more divergent deviation for near than distance to a relatively more convergent deviation for near than distance respectively. The patient distribution also tends to be higher than the theoretical line, suggesting that the factors which are causing the variation are causing a relatively more eso deviation for near.

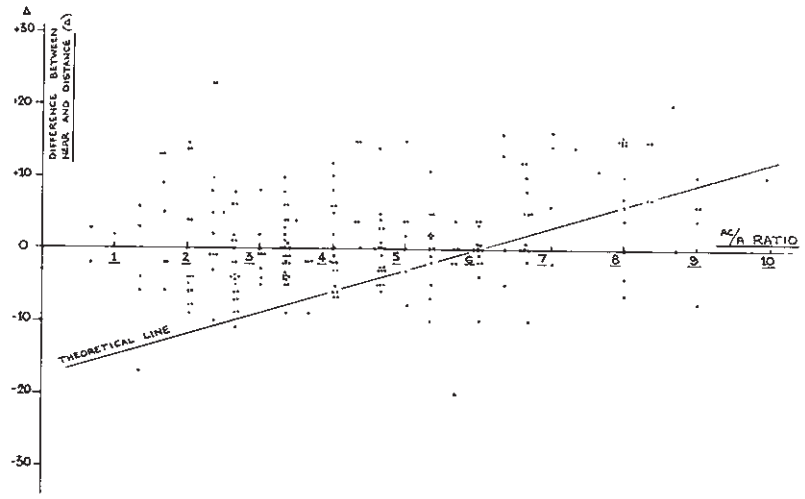

FIGURE 1 ALL CASES (i.e. 248)

Figure 2, evaluating exophoria, shows that 87% of exophoric patients have a more divergent deviation for near than distance. The AC/A ratio ranges from 1 to 7. Only 8% of the exophoric patients were less divergent for near than distance which was unexpected in these particular patients as their AC/A ratios were low. The remaining 5% of patients had no difference between near and distance measurement and had a moderate AC/A ratio.

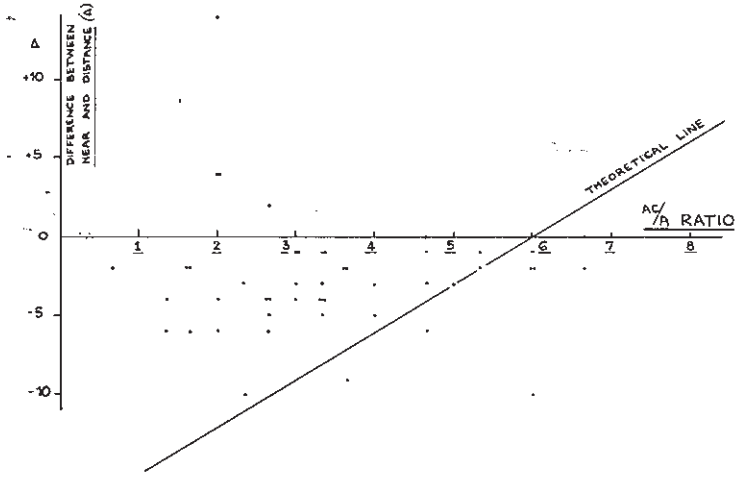

FIGURE 2 EXOPHORIA (47 CASES)

In Figure 3, 5 and 6 no correlation exists at all between the AC/A ratio and the difference between near and distance measurements. All three figures reveal a majority of patients with a more convergent deviation for near than distance, although the AC/A ratio ranged from 1 to 9. In the esophoric and constant squint patients 34% of patients who have a more convergent deviation for near than distance also have a low AC/A ratio. Again, this presents as an unusual finding as one would expect that the majority of this large percentage would have a high AC/A ratio or, conversely, a more divergent angle for near.

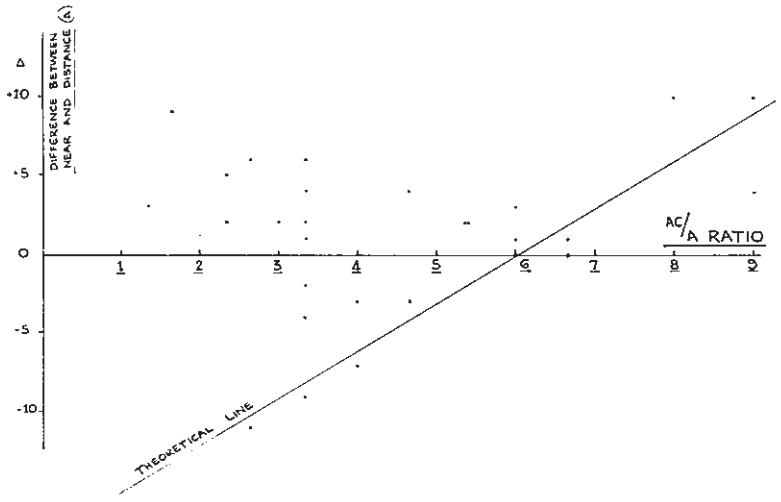

FIGURE 3 ESPHORIA (29 CASES)

In Figure 4 we find the closest correlation between the AC/A ratio and the difference between near and distance measurement. This illustrates those patients who were orthophoric at distance, although they may have had an exophoria or esophoria for near fixation. The range, in expected deviation, does fall within the limits of 10 prism dioptres as predicted by Lyle and Wybar (1970) and the distribution does fall close to the theoretical AC/A ratio line. As the AC/A ratio moves from low to high, the patient distribution moves from a relatively more divergent deviation to a relatively more convergent deviation for near fixation.

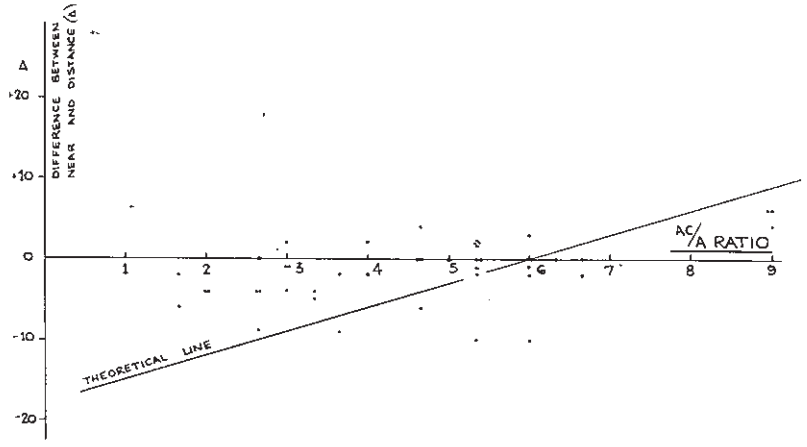

FIGURE 4 ORTHOPHIA AT 6 METRES (45 CASES)
(i.e.) Basic deviation obtained from prism cover test at 6 metres)

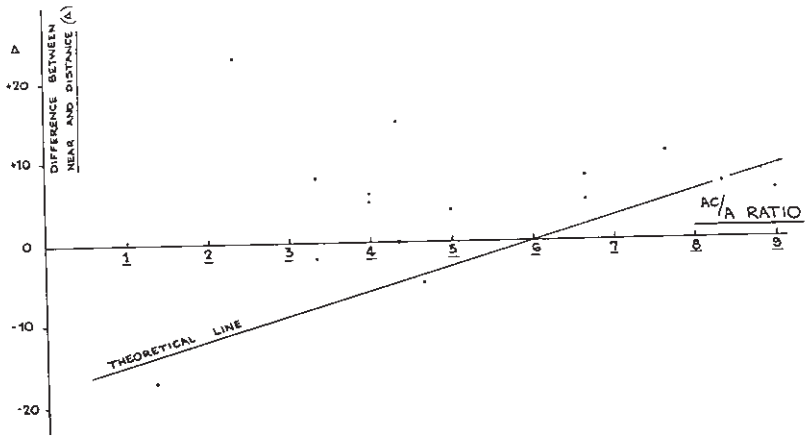

FIGURE 5 INTERMITTENT DEVIATIONS (15 CASES)

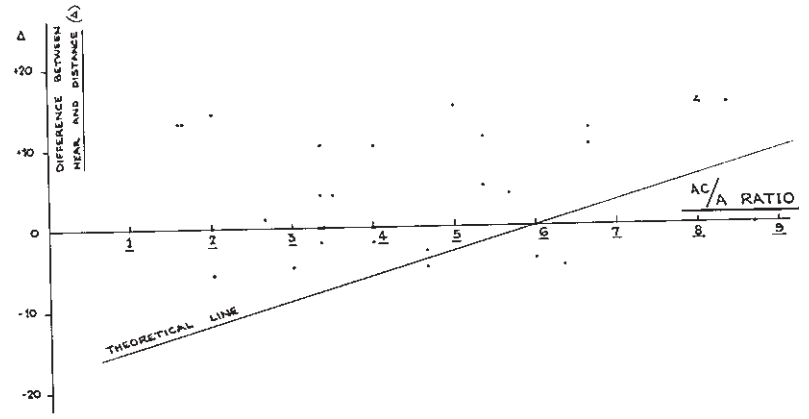

FIGURE 6 CONSTANT DEVIATIONS (33 CASES)

Discussion

This study has been centred around the theoretical AC/A ratio derived from an IPD of 6. It has been frequently noted in literature that the "normal" AC/A ratio is about 3.5[3]. But it must also be noted that about 80% of people who have a heterophoria, have an exophoria for near[4]. This would account for the moderately low AC/A ratio of 3.5 (in comparison to the ideal AC/A ratio of 6) as being the average, and thus being called the normal.

It is interesting to note that 36% of the sample in Figure 1 fell within an AC/A ratio of 3 to 5 and with a difference in measurements of +10Δ (i.e. 20Δ range). This suggests that an AC/A ratio of 3 to 5, although being expressed as the normal, is not really the ideal ratio to have.

Duke Elder[4] states that the AC/A ratio "applies only to patients with binocular single vision when used in its true sense", (e.g. in latent and intermittent deviations) "even in its absence, however, as in a manifest squint, it is of value to assess any anomaly of the ratio which may have determined the deviation".

However, the figures presented suggested that for esophoric, intermittent and constant squint patients there appears to be no correlation between the AC/A ratio and the difference between near and distance fixation measurements. In exophoric patients and for all cases combined (Figure 1), only an indefinite general trend to a positive correlation exists. However, in Figure 4, we see that orthophoric patients (i.e. basic deviation obtained from prism cover test done at 6 metres) did fall close to the theoretical line which then agrees with Duke Elder's statement.

The observation that, in Figure 1 the patient distribution appears to be higher than the theoretical line rather than centred around it is probably due to the fact that the theoretical line does not take into account the patient's proximal conver-

gence, which would tend to increase the near deviation.

CONCLUSION

From the above findings the AC/A ratio does not appear to present as an accurate predictor of near deviation measurement compared with distance deviation measurement. The findings also contradict Bredmeyer and Bullock's statement[5] that, "regardless of whether a phoria or a tropia is present, the AC/A ratio is a primary factor responsible for the difference in the angle of deviation during distance and near fixation". It appears that the only occasion when one can predict the near deviation from the AC/A ratio is when the patient is orthophoric for distance fixation (i.e. 6 metres). But for heterophorias (for near and distance), intermittent or manifest squints it appears to be of value only to assess any anomaly of the ratio as a factor which may have determined the deviation.

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