OBSERVATIONS ON COMPENSATORY ADJUSTMENTS IN ONE-EYED PERSONS*

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The most significant neuro-ophthalmological changes which take place after the loss of vision in one eye may be summarized as follows:

(a) All impulses to binocular unitary perception are immediately lost and, if the blind eye has not been enucleated, the eyes assume the fusion-free or dissociated position.

(b) The infra- and supra-gennari layers of the visual cortex are subject to atrophy, if the receptors connected with them are removed. For instance, in the visual cortex of a person who has lost the left eye some time before, the right infra-gennari laminae and the left supra-gennari laminae of layer 4 will undergo atrophy (Walls, 1941).

(c) The practical importance of the range of fixation of the remaining eye increases considerably.

(d) The remaining eye perceives depth by making use of various clues (parallax, shadows, etc.).

The present investigation has shown, however, that in order to adjust themselves to the new visual conditions after the loss of one eye many persons tend to assume a persistent compensatory head posture which may be called "uniocular torticollis". The abnormal head postures adopted by one-eyed people may be classified as:

(a) Tilting the head.
(b) Turning the face.
(c) Depressing the chin.

(a) Persistent tilting of the head towards the shoulder on the side of the remaining eye with depression of the chin towards the chest represents an attempt to extend the relative field of vision (although the field remains restricted by the area of the retina), especially in the lower nasal quadrant, where the margin often recedes to 50° or 45° on account of the prominence of the nose (Fig. 1a, b, opposite).

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596
Fig. 1.—Compensatory head-tilting towards the side of the remaining eye (the right conjunctival socket contains a prosthesis), with depression of the chin both for distant vision (a) and near vision (b).
(b) The face is usually turned towards the side of the lost eye (Fig. 2). This has two advantages:

(i) The nasal half of the visual field of the remaining eye is extended.

(ii) The remaining eye assumes temporarily the mid-position of a single frontal visual organ. This alignment can give the one-eyed person information on the position of objects in space in relation to the median vertical plane through the body, and so helps him to undertake work in which symmetrical exactitude is important (Fig. 3).

Fig. 2.—Compensatory face-turning towards the side of the lost eye (the right conjunctival socket contains a prosthesis). This is one of the less frequent types of posture, in which the head is tilted towards the side of the lost eye.

(c) Lowering the chin extends the field of vision of the remaining eye, especially in the lower nasal quadrant. Depressing the chin towards the chest causes the remaining eye to become slightly elevated in the orbit.

It is generally agreed that there are several clinical types of torticollis, the most commonly encountered being two non-ocular types (neurological and orthopaedic), and one ocular type. The last represents an attempt by the individual to compensate for an abnormality involving both the vertical and torsional components of the extra-ocular musculature.

The fourth type, "uniocular" torticollis, may escape observation when present in slight degree, and the significance of a habitual head-tilt or face-turn is given insufficient consideration. One-eyed people sometimes exhibit head-tilting in connexion with tasks requiring near vision rather than with those requiring efficient distance vision (Zagora, 1953).
A marked uniocular torticollis may be mistaken for torticollis due to unilateral contracture of the sternomastoid muscle, and in such cases the differential diagnosis should be considered:

(1) In orthopaedic torticollis the deformity is present from birth and the sternomastoid muscle is taut on the side to which the head is tilted so that bending the neck in the opposite direction is often impossible. Uniocular torticollis, on the other hand, follows the loss of vision in one eye. Moreover, no contracture of sternomastoid muscle is present and the head-tilt or face-turn can be controlled voluntarily.

(2) In orthopaedic torticollis the chin is raised and face is always turned away from the direction of the head-tilt. In uniocular torticollis the chin is depressed and face is usually turned away from the direction of the head-tilt, though in some instances the face-turn and head-tilt may both be in the same direction.

Uniocular torticollis appears in some cases during the first few weeks after the loss of an eye. Children who have lost an eye as the result of injury show initially a tendency to marked compensatory face-rotation towards the side of the lost eye, especially when doing school work. In many cases this form of face-rotation seems to be capable of spontaneous correction at a later period.

The practical importance of the uniocular range of fixation increases considerably after the loss of one eye. The limitations of the visual field, particularly towards the nasal side, constitute a significant handicap in everyday life, and persistent compensatory head-tilting and face-turning will help to enlarge the range of vision, chiefly towards the nasal side.

When the one-eyed person tilts his head to one side, the remaining eye undergoes torsion on its antero-posterior axis in the opposite direction (under the influence of tonic stimuli from the otolith apparatus) to compensate for the changed position of the head, and the vertical meridian of the cornea remains vertical in respect to gravity. For example, in the case of a person who has lost his right eye, when the head is tilted sideways towards the left shoulder, the remaining eye becomes intorted and somewhat elevated, through contraction of the left superior oblique and left superior rectus, and in this way the vertical meridian of the cornea remains vertical (Fig. 4, overleaf).

In a period of 8 years, 140 uniocular cases have been seen, in all of which the patients had normal or approximately normal vision in the remaining eye and no anomalies of the ocular movements. They were mostly one-eyed people who had lost one eye in childhood or in adult life through injury and were wearing a prosthesis. Patients with one amblyopic eye were not studied in the present series since the depth of amblyopia and its recoverability varies so much in individual cases. The type and incidence of compensatory postural adjustments are set out in the Table (overleaf), which also shows the side of the lost eye.
The chief problems of adjustment to the new visual conditions which confront the patient after the loss of an eye concern also the acquisition of the skills necessary for orientation with respect to the space-time relationship. The superiority of binocular over uniconcular distance discrimination is most pronounced at short distances, and it is the closest objects which are of utmost importance visually, as any sightless person has experienced. For example, the speed of spatial orientation in relation to the high speed of motor vehicles is important to one-eyed cyclists in dense traffic. The additional time required by a one-eyed cyclist for the recognition of an approaching vehicle may become a contributory cause of accidents.

### Table

**Compensatory Adjustments in 140 Cases**

<table>
<thead>
<tr>
<th>Compensatory Adjustment</th>
<th>Side of Lost Eye</th>
<th>Total Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right</td>
<td>Left</td>
</tr>
<tr>
<td>Present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head-tilting*</td>
<td>No.</td>
<td>Per cent.</td>
</tr>
<tr>
<td></td>
<td>82·2</td>
<td>17·8</td>
</tr>
<tr>
<td>Face-turning†</td>
<td>No.</td>
<td>Per cent.</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>75</td>
</tr>
<tr>
<td>Total</td>
<td>No.</td>
<td>Per cent.</td>
</tr>
<tr>
<td></td>
<td>66·4</td>
<td>33·6</td>
</tr>
<tr>
<td>Absent</td>
<td>No.</td>
<td>Per cent.</td>
</tr>
<tr>
<td></td>
<td>54·1</td>
<td>45·8</td>
</tr>
<tr>
<td>Total Cases</td>
<td>No.</td>
<td>Per cent.</td>
</tr>
<tr>
<td></td>
<td>64·2</td>
<td>35·8</td>
</tr>
</tbody>
</table>

* Towards the side of the remaining eye with face turning towards the side of the lost eye and depression of the chin.
† Towards the side of the lost eye, either without head tilting or with a slight head tilt in the same direction.

### Treatment

This should be directed to the avoidance of inclination of the head, but this is not easy to achieve, as the position is not taken up by the one-eyed person as a result of a bad habit, but because it helps to adjust himself to the new visual conditions after the loss of an eye. In fitting a one-eyed
person with spectacles for the correction of refractive errors, care must be taken that the bridge, frames, and side-pieces are so designed as not to restrict any part of the nasal field of vision of the remaining eye. These measures will help the one-eyed person to hold his head straighter. If the nose is large a plastic operation may improve both the cosmetic effect and the visual field, so that the compensatory head-tilt and face-turn become less pronounced.

A few one-eyed people (especially those who have been left with the dominant eye) have reported that they find it necessary to close the lids of the lost eye when looking at very distant objects or in difficult visual conditions such as in fog, rain, and reduced illumination. The lid closure appears to be carried out involuntarily but involves the mediation of consciousness.

Summary and Conclusions

(1) The majority of one-eyed people show a tendency to assume compensatory postural adjustments in an attempt to enlarge the nasal field of vision.

(2) When the face is turned to the side of the lost eye, an alignment of the remaining eye takes place in relation to the median vertical plane through the body, and this helps to regain confidence in the judgment of symmetry.

(3) The practical importance of the uniocular field of fixation increases if one eye is lost.

(4) From the study of 140 one-eyed persons the following conclusions have been drawn:

(a) The loss of the right eye was followed in the majority of cases by the development of a tendency to compensatory head-tilting towards the left shoulder, face-turning towards the right, and depression of the chin towards the chest.

(b) The loss of the left eye was most commonly followed by face-turning to the left, either without head-tilting or with a slight head-tilt to the same side.

An explanation of these facts would require further studies and especially a determination of the relationship between these various compensatory postures and lateral dominance.

(5) Compensatory head postures help to shorten the time required by one-eyed people for spatial orientation.

(6) Prophylactic measures may help to correct the abnormal head posture.

(7) In some cases the closure of the lids of the lost eye appears to act as a psycho-physiological stimulus to the visual acuity of the remaining eye.

REFERENCES
