EYE MOVEMENTS IN ELECTRICAL SHOCK PROCEDURE.

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Two previous publications have been devoted to the behaviour of various reflex phenomena, and of the grasping phenomenon in particular, during the post-convulsive stage of the electrically produced seizures in man (1942, 1943).

This paper deals with eye movements in the shock procedure, and experiments planned to influence these movements.

The motor response of the electrically produced seizure can be subdivided into four phases: the paroxysm, the tonic cramp, the clonic convulsions and the post-convulsive stage.

The equal, symmetrical and synchronous stimulation of both frontal lobes in the shock procedure gives rise as a rule to a bilaterally equal response during each of the four stages. Occasional irregularities do occur, but they are minute and, what is more, do not show any constancy in their individual appearance.

From this general rule the eyeballs form a remarkable exception.

During the very short paroxysm the eyelids are forcibly screwed up and accurate observation of the position of the eyeballs is not possible. In the tonic stage the head is bent backwards, the eyelids widely opened and the eyeballs moved upwards to a maximal conjugate end-position. This triad of motor reaction is a regular synkinetic group in which the opisthotonos is the last to relax, whilst the eyeballs are the first to change their position.

In the clonic phase the eyelids immediately participate in or even initiate the general convulsions; the head, too, makes powerful back or sideways jerky movements, but no clonic twitchings of the eyeballs can be discovered.

At the end of, or even during, the clonic stage the eyeballs commence from their upwards position a slow, smooth and extensive rotation, which ends at first as a conjugate latero-superior posture, but after several seconds changes into a strictly lateral one.

Thus it happens that the eyeballs continue a tonic type of movements at a time in which all other voluntary muscles are still involved in convulsive twitchings.

After an individually variable interval the eyes return slowly to their normal central posture or, more rarely, cross this position, moving to the opposite canthus, and after a while return definitely to their point of departure.

Occasionally some individual variations of these eye-rotations can be observed. The eyes may turn straight upwards or still rarer straight downwards and the regular lateral conjugate deviation is missing.

Another remarkable feature of these eye movements is their constancy in a given individual. Under the same experimental conditions each person exhibits the same motor eye phenomenon, peculiar to this individual not only with respect to the whole motor pattern but even to the duration of a given deviation. The lateral deviation is rarely under 20 seconds in duration, in many cases it is very forceful and as long as two minutes or so, but on the average it lasts for about one minute.

The following examples illustrate the individual motor patterns:

E. B—, aged 46.	19.viii.43:	Deviation to left for	70	sec..
	22.viii.43:	,, ,,	75	,,
	24.viii.43:	,, ,,	65	,,
L. C—, aged 33.	15.vii.43:	Deviation to right for	90	sec.
	17.vii.43:	,, ,,	80	,,
	20.vii.43:	,, ,,	90	,,
	27.vii.43:	,, ,,	120	,,
	8.viii.43:	,, ,,	80	,,

https://doi.org/10.1192/bjp.90.379.592 Published online by Cambridge University Press

E. M. R—, aged 44. 20.vii.43 : Deviation to right for 85 sec.
then to left for 20 ,,
22.vii.43 : Deviation to right for 80 ,,
then to left for 25 ,,

As long as the eyes are directed upwards or latero-superiorly the eyelids are kept widely open; they are semi-closed and finally closed during the further stages of the eye rotations.

The head shows as a rule a faint lateral inclination homonymous to the deviation of the eyes. In some persons the turning of the head is more marked, although, on the other hand, many keep their head straight forward or may even turn it in a contralateral direction.

Statistical control of several hundred cases has evidenced that the number of persons who deviate their eyes to right or to left is almost equal.

Right-handedness has no bearing whatever on the direction of the primary deviation. Moreover, observations made with left-handed persons have shown almost the same distribution of the direction of deviation as observed in right-handed individuals.

The same can be said with regard to other possible factors as sex, age or character of the mental disorder.

An attempt was made to influence this constant individual pattern of eye-movements, especially the direction of the primary lateral deviation, by a simple experiment.

A person who in several sessions has shown an invariable deviation to one particular side has been instructed to keep her eyes actively and steadily fixed for 2–3 minutes on a given homolateral point just before a new shock application. In many cases, under the influence of this purposive movement, a reversal of the individual direction could be brought about; in others the eyes did not deviate at all; and finally in a large group the preparatory fixation did not influence the individual pattern in the least.

Three instances illustrate these three degrees of influence:

D. H—, aged 32. In four consecutive sessions eyes deviate to left. Eyes actively fixed for one minute to left. Deviation in opposite direction, to right.

M. M—, aged 48. In four consecutive sessions eyes deviate to left for about 30 sec. Actively fixed to left for two minutes before a new shock. Eyes do not deviate at all.

M. B—, aged 30. During six consecutive sessions eyes deviate to left for about 40 sec. Before a new shock eyes are actively fixed to left for two minutes. Deviation nevertheless to the left for 40 sec.

Discussion.

The character of the conjugate eye deviation as observed in our cases and its association with the movement of the head is almost identical with the results obtained in direct experimental electrical stimulation of a definite part of the frontal cortex in monkey and man.

Leyton and Sherrington (1917) found that from a frontal area embracing a considerable part of the surface of the second and third frontal gyri conjugate deviation to the side away from the stimulus could be obtained. When the lateral conjugate deviation has been obtained, it has been usual for the eyes to remain for some time in the posture thus assumed, and to return very slowly towards the primary straightforward posture after the stimulus has been withdrawn.

Similar effects have been found in man. Boldrey and Penfield (1937) obtained adversive movements of the eyes alone as a large group of responses in an area which centres roughly in area 8.

It is obvious that the conjugate eye deviation of our patients, which has quite the same features as those observed by direct stimulation of one frontal adversive eye-field in monkey and man, has been brought about by stimulation of the same frontal eye area.

What makes these observations more complicated and at variance with the usual physiological behaviour is the fact that equal and simultaneous bilateral stimulation has produced the same effect as the stimulation of one side only.

https://doi.org/10.1192/bjp.90.379.592 Published online by Cambridge University Press

On account of the individual constancy of the direction and even of its duration any casual factor directing the eyes to one or the other side can be definitely dismissed. The response is a regular neurophysiological act.

The mechanism leading to a lateral conjugate deviation under the conditions of our observations must consequently be based on a difference in the degree or duration of a sustained excitation in both adversive eye-fields.

The physiological difference between the right and left hemisphere, particularly in their motor activities, could, *a priori*, suggest that an equal stimulus may be able to produce in the two opposite eye areas a different degree of response. But the motor dominance of the left hemisphere in the large majority of our right-handed cases has proved to have no bearing whatever on the direction of deviation, and the same has been true with regard to the small group of left-handed individuals.

The difference in response of the two adversive eye-fields in a given individual to a simultaneous electric stimulation represents therefore a particular and specific property of the adversive eye-field. This personal quality varies in degree from one person to another. On the grounds of the results obtained by the experimental part of our investigations three degrees of this property could easily be distinguished.

In the case of a person whose habitual deviation in the post-convulsive phase is to the left, the right adversive eye-field is obviously in a state of stronger and/or longer excitation than the left. Now we keep this person looking steadily to left for 2–3 minutes just before a new shock has been given. With this purposive deviation of the eyes we are putting an active strain on his right adversive eye-field. In many cases his eyes turn now to the right instead of to the habitual left side. Obviously the active fixation of the eyes to left for 2–3 minutes brought about a state of relative inhibition in the right adversive field, and the following bilateral electrical stimulation originated in the left unstrained area a stronger and probably longer response than in the right one.

In some cases such total inversion of the habitual direction of the deviation could not be obtained, but the tendency to deviation was at least paralysed and the eyes remained unmoved. Eventually in others the individual inclination was so powerful that the preparatory fixation was not able to influence it at all.

From both the observation of the eye movements in the post-convulsive phase and the results of experimental investigations, the fact seems to be established that each person is endowed with a dominant adversive eye-field responding stronger or longer to an equal electrical stimulation.

Summary.

In spite of a symmetrical, equal and simultaneous stimulation of the frontal lobes in the electrical shock procedure, the eyes perform as a rule during the post-convulsive stage a forceful lateral conjugate deviation.

The direction and the duration of this deviation is a constant feature, characteristic of a given individual.

By an active turning of the eyes to the homonymous side for 2–3 minutes immediately before the shock this individual direction of the deviation can in many cases be paralysed or even reversed into opposite direction.

Right-handedness, sex, age or character of the mental disorder have no bearing whatever on this individual pattern of eye deviation.

References.

Boldrey, E., and Penfield, W. (1937), *Brain*, **60**, 389.
Kino, F. F. (1943), *Brain*, **66**, 152.
Idem and Thorpe, F. T. (1942), *J. Ment. Sci.*, **88**, 541.
Leyton, A. S. F., and Sherrington, C. S. (1917), *Quart. J. Exp. Phys.*, **11**, 135.

https://doi.org/10.1192/bjp.90.379.592 Published online by Cambridge University Press