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THE RELATIONS BETWEEN EYE MOVEMENTS AND OTHER CRANIAL MUSCLES

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THE earliest and best known example of a movement associated with contraction of extrinsic eye or eyelid muscles is the jaw-winking reflex carefully described by Marcus Gunn and others. Kinnier Wilson has since drawn attention to an associated movement of the ear and eye muscles, and Stannus has added an interesting contribution on this subject.

In a recent clinical investigation at the National Hospital, Queen Square, we have noted six types of associated movements which may occur singly or combined. Each of these types will be considered briefly.

If the eyes be fully deviated laterally, the helix of each pinna becomes rotated backwards and inwards towards the mastoid. This movement is slow and deliberate; it is a bilateral phenomenon with a wider excursion occurring in the contralateral ear. This we have termed the oculo-aural movement.

In many people it is possible to demonstrate a depression of the contralateral eyebrow and a raising of the homolateral eyebrow on deviating the eyes laterally. To this we have assigned the name oculo-frontalis movement.

We have observed that the point of the tongue may turn over to the homolateral side in deviation of the eyes. This movement we have designated the oculo-lingual.

Furthermore, in our investigation we have had the opportunity of observing and demonstrating satisfactorily the presence of an oculo-mandibular movement. If the eyes be rapidly deviated to one and then the other side, a protrusion and deviation of the mandible to the contralateral side occurs.

In a previous paper we have placed on record two cases demonstrating a relation between the stapedius muscle and the eyes. Both these cases suffered from unilateral blepharospasm, and complained of a buzzing noise in the homolateral ear. For brevity we refer to this as the orbiculo-stapedial movement.

In one case an oculo-nasal movement was observed consisting of dilatation of the nostrils on extreme deviation of the eyes.

It is not necessary to enumerate here the various muscles and their nerve supply, but the wide distribution of the cranial nerves involved should be emphasized. An observation of anatomical interest arises at this point. No case suffering from an ocular palsy exhibited these movements; but in a case with a complete facial paralysis involving the taste fibres to the tongue, the movements of the ear on the paralyzed side were still present. This at once suggests that the innervation of the intrinsic ear muscles may be other than by the 7th nerve. The possibility has been brought to our notice that embryologically these muscles derive their supply from the 5th nerve. If so, it simplifies the anatomical arrangements considerably as the 3rd, 4th, 5th, and 6th nerves are supposed to have a common mesoblastic origin in the premandibular portion of the foetal embryo.

The nature of these associated movements is not at first sight evident. Are they pathological manifestations, indicating an abnormal nerve supply to the cranial musculature? This hypothesis has been suggested in explanation of the jaw-winking phenomenon—the levator palpebrae in these cases being presumed to have an innervation from the 5th nerve. Are the movements, on the other hand, reflex in character? Could active contraction and relaxation of the eye muscles or alteration in posture constitute the afferent side of a reflex arc, causing movement of the ear, jaw, tongue, or nares? If this were so, these phenomena would be brought into line with the tonic neck reflexes of Magnus and de Kleijn. The selective nature of the motor response, its slow rate of manifestation, and its ready fatiguability are points against this view. Neither is it possible to regard these movements as instances of facial tics, the inability of the subject voluntarily to reproduce the retraction movement of the pinna precluding this hypothesis. The possibility remains, therefore, that these

phenomena are "associated movements"—vestigial in origin, and relics of purposive and more specialized movements which are to be found in the animal kingdom. Referring to the jaw-winking phenomena again, Harman favours a phylogenetic origin and refers to the fact that in certain fishes the pterygoid and orbicularis are in close anatomical association.

An investigation into the facial and ocular movements in various animals supports the theory of phylogenetic origin. Their presence or absence depends apparently upon the mode of life of the animals with the resulting anatomical adaptations. Thus, among the carnivora and animals preyed upon by larger beasts, or those living a solitary existence, the sense of smell and of hearing is far more specialized than that of sight. In consequence we find high grade external nasal and aural appendages capable of every kind of independent and voluntary movement. The eyes, on the contrary, are movable through an extremely small range so that in order to look sideways the animal is compelled to turn its head and neck. Mounting higher in the anatomical scale, we find that as the animal becomes more observant, it learns to depend less upon smell and hearing, and the external organs of these senses dwindle and become less mobile. The eyes, however, become more and more under control of the will and are capable of wider ranges of movement: such animals are exemplified by the higher primates—chimpanzees and oranges—and in these the oculo-aural movement is well seen. The phenomena, therefore, would appear to be a device whereby the senses of sight and hearing are simultaneously brought to bear upon an object. In man, who depends far more than the monkey upon his visual acuity, the oculo-aural associated movement dwindle and is no longer a well-marked and constant phenomenon.

The oculo-frontalis movement of man is also met with amongst animals—particularly those with long tufts of hair about the head and eyebrows. This suggests that the movement is a device for retracting the hair from the field of vision.

Reference has been made to a possible association between contraction of the orbicularis and of the stapedius. Although the exact function of the latter muscle in regard to the appreciation of high tones is not clear, certainly one of its actions is to deaden loud and raucous noises. This may, therefore, explain the familiar screwing up of the eyes when a shrill and unpleasant noise is heard, the object being perhaps to damp down some of the tympanic vibrations. It is probable, moreover, that the stapedius also picks up and intensifies subdued tones; the familiar deviation of the eyes to one side or the other when listening for a very quiet sound may therefore be a mechanism whereby the stapedius muscle is rendered tense. This oculo-aural association is best studied

phylogenetically amongst the reptilia—creatures possessing no external ear but having a wide range of eye movement, each eye independent of the other. If a note is blown upon a Galton's whistle just behind a chameleon, the animal immediately deviates its eyes in that direction, as though to intensify the sound, and later slowly turns its head and neck and advances sluggishly towards the whistle.

So far as our investigations have gone, we have not observed in animals any instances of tongue or snout movement associated with deviation of the eyes.

Facial Nystagmus

Analagous to these associated movements, we have observed in many cases of disseminated sclerosis a nystagmus of various facial muscles, arising only when the eyes are deviated laterally. Five cases exhibiting ocular nystagmus showed in addition a synchronous retraction-relaxation of the pinna. This "nystagmus of the ear" was sustained just as long as one maintained lateral ocular deviation.

In many cases of disseminated sclerosis, a vertical nystagmoid movement of the homolateral eyebrow was observed on lateral deviation of the eyes. In a large proportion of these cases there was no ocular nystagmus whatever; in such instances, therefore, frontalis nystagmus becomes of diagnostic importance.

In one case of disseminated sclerosis, a nystagmoid movement of the right-hand corner of the mouth was observed when the eyes were deviated to one side or the other: this movement was apparently due to a rapid contraction-relaxation of the levator anguli oris, and was more marked when the eyes were turned away from that muscle.

It is difficult, in the absence of pathological evidence, to state definitely the nature of facial nystagmus. Every one of our cases has been observed in pathological states, and it is probable that the question of causation is closely bound with the problem of ocular nystagmus. Whether these cases of ours exhibited associated oculo-aural or oculo-frontalis movements prior to the onset of nystagmus is of course impossible to tell, but it seems feasible that facial nystagmus is really an incoordinated facial associated movement.

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