The Journal of
Laryngology and Otology

(*Founded in* 1887 *by* MORELL MACKENZIE *and* NORRIS WOLFENDEN)

# VESTIBULAR FACE REFLEXES.*

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IN 1910, Bartels (*Arch. f. Ophthalmologie*, vol. lxxvi., p. 1) pointed out a peculiar reflex of the eyelid in newly born infants. By bending the infant forward so that its face pointed downwards, he could make it lift the upper eyelid, the frontal muscle being contracted at the same time. Bartels supposes that this reflex, which may be observed in the prematurely born fœtus at the end of the fifth month and also in sleeping infants, is due to a labyrinthine irritation, though he admits that this cannot be proved. The reflex cannot be of optic origin as the possibility of optic fixation is precluded at that age. Bartels also states that when the forward bending movement is performed sufficiently slowly no upward movement of the bulbi appears.

Alexander has carried out a series of exhaustive investigations referring to vestibular reaction in infants on rotation, but has not observed any frontal or eyelid reflex (*Zeitschrift f. Sinnesphysiologie*, vol. xlix., p. 153 (1910).

These rotation investigations have been taken up again by Bárány (*Acta Oto-laryngologica*, vol. i. p. 97). By rotation in the sagittal plane he found a reflex in the form of a lifting of the upper eyelid and a wrinkling of the forehead, con-

* This paper was completed two years ago, but owing to unforeseen circumstances publication was delayed.



https://doi.org/10.1017/S0022215100022192 Published online by Cambridge University Press

temporary with a nystagmus downwards or a corresponding slow phase upwards.

Before the latter observations were published, and, indeed, before reading Bartels' article, I had carried out, with another object in view, a series of vestibular examinations in infants. During these investigations the conditions connected with vertical nystagmus were also examined. Like Bárány, I found that the downward nystagmus, which, even in individuals who were awake, was often represented only by a slow phase upwards, was accompanied by a transverse wrinkling of the forehead and drawing up of the eyelids. The wrinkling of the forehead may be particularly marked.

Besides, I have also seen a contemporaneous upward curl of the upper lip; it would therefore appear that it is a question of an upward movement of all the muscles of the face.

There is, however, not only a vestibular *upward* reaction of the facial nerve. When a vertical nystagmus upwards, which may only appear as a slow phase downwards, is produced, an active drawing down of the eyebrows may be seen, corresponding to the slow phase. The forehead also is more smooth and strained. This reaction, which has escaped the observation of previous investigations, is fairly constant, if not quite so evident as the upward movement. A not very distinct downward curl of the lips accompanies the straining of the forehead, corresponding to the upward curl accompanying the wrinkling of the forehead.

Having seen these facial reflexes associated with vertical nystagmus, it appeared to me reasonable to suppose that corresponding reflexes would be found along with horizontal nystagmus. Even before I found the above-mentioned forehead reflexes I had once or twice observed that during and after rotation in the horizontal plane it seemed as if one eye of the child became larger than the other. On turning my attention to the facial reflex associated with horizontal nystagmus, I observed that a contraction appeared in the cheek on the side to which the slow phase of the nystagmus was directed, both during and after rotation. If one, for instance, turns a child round to the right in the usual upright position, a rapid nystagmus phase to the right and a slow to the left will appear at the commencement of rotation, *vice versâ* on stopping. During rotation, further, the left-hand corner of the mouth is drawn a little to



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the side and upwards, whilst the left palpebral fissure is somewhat enlarged. On stopping, exactly corresponding phenomena are observable, but to the right ride. These last exactly as long as the eye movements continue. The mouth is sometimes drawn into a curious crooked position resembling the mouth of a flounder.

The reflex is, when once one is on the lookout for it, both distinct and quite constant, even if the rotation now and then has to be repeated in order to produce it. Sometimes it is only visible when the child yawns, on the other hand it disappears when the child screams; it would therefore seem that stronger and more spontaneous movements efface it. In accordance with this it disappears in older children. I have not up to now found it in infants over 1½ months old. I have sought for it, but in vain, in adults suffering from central facial paresis; I had imagined that in such cases one could produce a vestibular facial contraction in analogy with the vestibular eye movements in cases of supranuclear paresis of the movements of the eye. On the other hand, I have found the vestibular cheek reflex in a remarkably perfect form in prematurely born infants at the seventh month. The reflex appears whether the child is awake or asleep. As a rule it can be produced by rotation not only in the horizontal but also in the frontal plane.

As the right labyrinth is irritated during rotation to the right (nystagmus to the right), while on stopping rotation the left labyrinth is affected (nystagmus to the left), and as the cheek reflex during rotation appears on the left, but on the right on stopping, it would seem to prove that the crossed connections of the labyrinth with the opposite side are the dominating ones—a relation which does not quite harmonise with other facts. Further inquiry, however, into the much debated question of the labyrinthine connection with homo-lateral or contra-lateral muscles is beyond the scope of the present paper.

It will, however, perhaps be of interest to try to explain how these reflexes arise. As regards the wrinkling of the forehead and lifting of the eyebrow which appear when the patient's head is bent forward, Bartels was of the opinion that they originated in the labyrinth. Bárány, who seems to have only investigated this reflex after rotation, supposed it to be vestibular, or rather he thought the phenomenon observed by Bartels to be the same



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as he himself observed. In this he is, however, not quite justified. When the reflex is produced by rotation, and when it accompanies a vertical nystagmus downwards (*i.e.* a slow phase upwards), there is, of course, no doubt that it is of vestibular origin. But Bartels, who made use of a simple bending forward movement, remarks emphatically that when the movement is performed sufficiently slowly no eye movements appear. That is right enough. It must also be pointed out that, whilst the forehead and eyelid reaction, which appears after rotation, is only of short duration, that which appears by a forward bending movement continues as long as the child's head remains in the same position, but with only an occasional relaxation. In this case, therefore, the reflex cannot have its rise in the cupula of the semicircular canals, which must have been at rest for some time; it must be supposed to originate in the otolith organs if it is of aural origin.

The forehead- and eyelid-reflex, however, ought not to be considered as an isolated phenomenon. It is apparently a part of the greater reflex—the well-known and often very pronounced backward bend of the neck and head—which all infants exhibit when laid down on their stomachs. By placing one's fingers on the back of the new-born infant's neck, one finds that as the forehead-eyelid reflex becomes stronger or weaker the muscles of the back of the neck are either stretched or relaxed. To what extent this diffuse reflex is of vestibular origin can hardly be decided, so long as one has not had an opportunity of examining infants with extinct vestibular function. The vestibular genesis seems, however, to be less probable. If the reflex is considered as beginning as a proprioceptive innervation from the muscles and joints of the neck leading to the cerebellum, where connection is established with the efferent tracts, it will be easier to understand that only a forward bending movement gives rise to a reaction. The static system of the cerebellum is much better adapted to balance a fall forward than a fall backward. (We must remember the general forward moving tendency of the body.) This is not only proved by experiments, but in a recently published and most interesting treatise by Sven Ingvar (*Zür Phylo- und Onto-genese des Kleinhirns*, Haarlem, 1918, Erven Bohn), it is clearly demonstrated from the anatomical point of view. He shows that the proprioceptive tracts to the anterior basal part of the cerebellum (the absence



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of which cause a fall forward and whose function therefore is the regulation of backward movements) are very strongly developed, whilst on the contrary the corresponding tracts to the posterior basal part, which has the opposite function, are almost entirely wanting. The vestibular tracts, on the other hand, are equally developed to both parts. Vestibular irritation, in conformity with the above, gives not only eye movements but also head and facial movements in both upward and downward directions. It must, however, be remarked that the downward movements are not quite as marked as the upward. In the case of head movements this has already been remarked by Bárány. To this corresponds the circumstance that in adults the vertical nystagmus downwards (answering to the slow vestibular phase upwards) is not so marked nor of so long duration as the vertical nystagmus upwards. This difference is also found in newly-born infants, though in a lesser degree—on an average 8·6 seconds for nystagmus downwards, and 7·7 seconds for nystagmus upwards; for children between one and twelve months the figures are already higher, being 12 seconds and 10·6 seconds.

The result we arrive at is, then, that though the reflex observed by Bárány (after rotation) is doubtless vestibular, that observed by Bartels (by slow forward bending) is of different origin. The latter probably arises in the neck and is formed by the cerebellum. The reflex produced by quick forward bending of the head is a combination of both of the above.

As far as the cheek reflex is concerned, text-books on anatomy describe fibres, which *via* the posterior longitudinal bundle connect the vestibular with the facial nerve. We must, however, remember that the cheek reflex represents the so-called central facial nerve, as the muscle group which contracts is exactly that which becomes paralysed in a central facial paresis. That the other branches of the facial nerve are not affected either by vestibular irritation or by the pathological process (apoplexy) is due to the fact that their centres are bilateral, corresponding to the close connection between the functions of both sides of the face. It is, therefore, practically impossible that the upper centres of the facial nerve should be affected by a pathological process.

Although we know only central facial phenomena originating from the cerebrum, it is difficult to imagine that the vestibular



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cheek reflex is formed in this region. The tracts of other vestibular reflexes run, from all we know, below the cerebrum; this is the case even with the rapid phase of nystagmus, at all events in animals. Further, all doubt is out of the question as far as human beings are concerned, in regard to the slow phase of nystagmus. It is therefore probable that the cheek reflex, which corresponds to the slow phase, has a deep running reflex arc in the cerebellum. We know that the muscles of the whole body are widely represented here; amongst these we find certain facial elements, because derangements of speech may be caused by disease of the cerebellum, for instance tumours and disseminated sclerosis.

According to Bárány's theory, the muscular function of each joint is represented in the cerebellum at least four times, namely for the movement up, down, to the right and to the left. Ingvar imagines the cerebellum as containing large ring-shaped confluent centres, in which the direction of any movement whatever is represented by a corresponding meridian in the ring. If we accept either one or other of these two kindred theories, we should expect to find in the cerebellum centres of the facial nerve representing, like other centres here, not anatomical groups of muscles or peripheral nerves, but certain directions of movement, amongst others the upward and downward movements and those to the right and left as we have seen them in our rotation experiments. The centres for the upward movement may possibly act not only on vestibular irritation, but also under the influence of the neck reflexes, such as we have seen in infants when bent forward.

If the theory here put forward is correct, we must suppose that there is a distinction between the superior and the inferior facial nerve in the cerebellum as there is in the cerebrum. We may, therefore, suppose that a cerebellar trouble also might cause "central" symptoms, embracing only the facial nerve to the mouth. A true paresis would not of course appear, but perhaps an atony or an ataxy in this region, which might resemble a slight paresis. The phenomenon would in this case be on the same side as the trouble, in contradistinction to the crossed central facial paresis caused by cerebral disease.

The face reflex disappears soon after birth, corresponding to the increase of the development of the cortical cerebral tract. Its disappearance is perhaps dependent on the circumstance that it is useless for human beings, whereas the regulation of



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the eyes, trunk, and extremities from the vestibule, is important in the orientation of these parts of the body as to change of position.

As far as animals are concerned the author has only examined rabbits, which exhibit a very distinct mouth reflex, the upper lip moving vigorously from side to side in time with and in the same direction as the rapid phase of nystagmus. The movement is finely marked by the much increased oscillations of the hairs of the animal's whiskers. This reflex in rabbits is doubtless identical with the cheek reflex in new-born infants. Corresponding movements are also observable in the rabbit's eyebrows and eyelashes, but the author is unable to decide how much of this is due to the movements of the eyes (as seen in human beings), and how much to direct innervation of the facial nerve. The mouth reflex is probably preserved by animals, because it is of use to them, for they, unlike us who put our food decently into our mouth, seize their food with their mouth, moving both head and body to assist them. A uniform tonus of all the muscles in question is necessary for the intended action.

These experiments were carried out in the hospital departments of Professor Hauch and Professor Holger Mygind. The author wishes to thank both of these gentlemen very heartily for their kindness and assistance.



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