CASE REPORT: ABNORMAL INNERVATION OF THE SPHINCTER PUPILLÆ AND CILIARY MUSCLE FOLLOWING THIRD-NERVE REGENERATION

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Bender and Fulton (1939) showed that in monkeys, following regeneration of the sectioned third cranial nerve, a mass innervation of the muscles supplied by the third nerve develops. This resulted in limitation of upward and downward movement of the eye owing to synkinesis of the antagonist muscle. Recovery of inward movement was good, but was associated with pupillary contraction. Ford, Walsh, and King (1941), and Bender (1945), pointed out that after regeneration of the oculo-motor nerve in man pupillary constriction on convergence may be one of several synkineses observed, and, as the pupil is often inactive to light a "pseudo-Argyll-Robertson" pupil phenomenon may appear. It seems that indiscriminate regeneration through the scar on the injured nerve leads to this phenomenon, and Bender reported cases in which the pupil reacted on contraction of any one or all of the formerly paralytic muscles. He also described a case in which there was synkinetic contraction of both the ciliary muscle and the sphincter pupillæ in association with eye movement. Schretzenmayr (1947) studied similar synkinetic movements of the upper eyelid.

In the following example of this phenomenon both the sphincter pupillæ and the ciliary muscle contract when the eyeball is turned inwards.

Case Report

On July 11, 1944, a bombardier, aged 29, had a severe motor-cycle accident which caused fracture of the left parietal bone and base of the skull. There was bleeding from the left ear. The duration of retrograde amnesia was about one minute, and of post-traumatic amnesia ten days.

His physical recovery was satisfactory except for ocular palsies affecting the left eye. He was reported during convalescence to have left ptosis; the left pupil was dilated and inactive; all movements of the left eyeball were lost except for slight upward and downward

movement. There was analgesia of the left upper lip, and slight deafness of the left ear.

He was invalided from the service in December, 1944, and returned to work as a mechanic and driver in January, 1945. Later he left this work as looking upward made him feel giddy, and for the past year has been working as a handyman. He complains now (May, 1948) of deafness in the left ear, paræsthesiæ over the left cheek, and difficulty in reading. The visual difficulty appeared to be due to paralysis of accommodation of the left eye while the right eye "had never been strong." Examination of the eyes revealed some interesting abnormalities.

Figs. 1 and 2 illustrate respectively the size of the pupils in the dark and when exposed to a bright light. The absence of light reaction in the left pupil is quite evident. Ocular movements to the left appeared to be full in both eyes: upward and downward movement of the left eye were defective (Figs. 5 and 6). *On looking to the right the movement of the left eye was good, but was associated with well-marked contraction of the pupil.* This is seen in Figs. 3 and 4, Fig. 3 being in the dark and Fig. 4 in bright light (compare Figs. 1 and 2 respectively). A similar contraction of the left pupil occurred on convergence, as is seen in Fig. 7 (photograph by flash in the dark).

Further, not only was the sphincter pupillæ made to contract by deviating the left eye to the right, *but also the ciliary muscle was thrown into activity.* Visual acuity in the left eye was full at six metres (6/6), but owing to paralysis of accommodation the near vision of the left eye was reduced to J 12. However, when the Jæger type was held to the right so that the left eye turned inwards, the near vision improved to J 1, clearly indicating that this inward movement of the eye caused contraction of the ciliary muscle.

Ophthalmological Examination.—Ophthalmological examination revealed the following:

Right Eye.—This eye showed no abnormality apart from a refractive error; he had never used correction for this eye. Visual acuity (unaided) was Snellen 6/60; corrected $-3.5/+5.0$, 110° it was Snellen 6/18, Jæger 4.

FIGS. 1 and 2.—Size of pupils in dark and bright light respectively. The left pupil remains unchanged in size.

FIGS. 3 and 4.—Contraction of left pupil on looking to the right in dark and bright lights respectively. Compare Figs. 3 with 1, and 4 with 2.

FIGS. 5 and 6.—Defective upward and downward movement of left eye.

FIG. 7.—Contraction of left pupil on convergence (flash photograph in dark). Compare Fig. 1.

Left Eye.—There was no ptosis; the conjunctiva, cornea, anterior chamber, media, and fundi were normal. The left pupil was larger than the right, and showed no reaction to direct or consensual light. There was a sluggish contraction on convergence. The left pupil contracted briskly on turning the eye 30° to the right (inwards), and dilated on turning the eye to the left.

Visual acuity looking straight ahead (unaided) was
Snellen 6/5, Jæger, less than 12. Retinoscopy : — $\begin{array}{c} +1.0 \\ -1.0 \end{array}$.

Visual acuity on looking 30° to the right (unaided) was
Snellen 6/24, Jæger 1. Retinoscopy : — $\begin{array}{c} -1.0 \\ -1.0 \end{array}$.

Extrinsic Ocular Movements.—There was limitation of the upward and downward movement of the left eye. The Hess diplopia chart suggested paresis of the left inferior oblique, inferior rectus, superior oblique, and superior rectus muscles.

Intrinsic Ocular Movements.—Accommodation as measured by the Livingstone Gauge was as follows :

Looking straight ahead	..	34 cm.
Looking 20° (approx.) to the right (inwards)		22 cm.
Looking 30° (approx.) to the right (inwards)		14 cm.
Looking 20° (approx.) to the left (outwards)		49 cm.

Discussion

These findings illustrate clearly the abnormal regeneration of the oculo-motor nerve with mass innervation of the muscles supplied. Previous attempts to give the patient reading vision had been directed towards correcting the refractive error in his "lazy" right eye. A plus lens provided for the left eye enabled him to read with comfort.

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