Electrical study of jaw and orbicularis oculi reflexes after trigeminal nerve surgery

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SUMMARY Trigeminal nerve ophthalmic and motor division function was assessed clinically and electrically in 32 patients who had undergone various surgical procedures for trigeminal neuralgia. Using known electrophysiological techniques, the orbicularis oculi and jaw reflexes were tested in all subjects. Abnormalities of the orbicularis oculi reflex were anticipated on the basis of ophthalmic division anaesthesia. However, jaw reflex abnormalities appeared in operated cases with no clinical or electromyographic evidence of masseter denervation. These results were unexpected, and imply that the proprioceptive fibres of the jaw reflex are mediated by a sensory and not a motor root as previously believed.

Electromyographic techniques have been applied in the past to the study of lesions affecting the trigeminal nerve (Kimura *et al.*, 1970; Goor and Ongerboer De Visser, 1976). Abnormalities have been demonstrated in the orbicularis oculi (blink) reflex and jaw (jerk) reflex in patients with early cerebellopontine angle tumours, and demyelinating, and vascular lesions affecting the brainstem (Goodwill and O'Tauma, 1969; Kimura and Lyon, 1972; Lyon and Van Allen, 1972; Eisen and Danon, 1974; Kimura, 1975). These facial reflexes have been shown to be normal in idiopathic but abnormal in symptomatic trigeminal neuralgia (Ongerboer De Visser and Goor, 1974).

A standardised blink reflex may be obtained using electrical stimuli applied to the area overlying the emerging supraorbital nerves. The resultant response has two components: an early ipsilateral and late bilateral reflex (Kugelberg, 1952; Rushworth, 1962). The early reflex is transmitted via an oligosynaptic arc involving the pons (Tokunga *et al.*, 1953). Although this was initially considered to be a proprioceptive reflex, it is now thought to be a cutaneous response (Shahani and Young, 1968, 1972; Penders and Delwaide, 1973). The late component, corresponding in time to eyelid closure, is mediated centrally to the nucleus of the spinal tract via a polysynaptic pathway (Kimura

and Lyon, 1972; Shahani and Young, 1972). Early and late components share a common efferent path in the facial nerve.

Experimental animal work has led to the belief that the jaw jerk in man is a monosynaptic stretch response with specialised brainstem connections whose afferent and efferent fibres share a common pathway in the motor root of the trigeminal nerve (Corbin and Harrison, 1940; Szentágothai, 1948; McIntyre, 1951; Jerge, 1963). Further work in man suggests that the group Ib afferent nerve fibres carrying information from Golgi tendon organs located in the masticator muscle, travel in a trigeminal sensory root (Hufschmidt and Spuler, 1962). However, muscle spindle afferent (group Ia) fibres are believed to travel in the motor root (McIntyre and Robinson, 1959). In an extensive study of the normal jaw jerk Goodwill (1968) showed that the latency of this biphasic reflex is the only consistent parameter of clinical value when comparing both sides.

In this study, trigeminal motor and sensory root function was evaluated using the jaw and blink reflex in a group of patients who had undergone various types of surgery for neuralgia. All cases were refractory to medical treatment. The techniques of the various operative procedures are described elsewhere—partial root section, intradural approach (Henderson, 1967), alcohol injection of ganglion (Harris, 1940), root decompression (Pudenz and Sheldon, 1952), bulbar tractotomy (McKenzie, 1955), and rootlet radio-

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frequency thermocoagulation (Sweet and Wepsic, 1974).

Patients and methods

Thirty-two patients who had undergone surgery for trigeminal neuralgia were studied. All patients were assessed clinically at the time of electrical testing. The distribution of anaesthesia or hyperthesia and masticator power were recorded. Three patients were studied electrically before and after surgery. Eighteen cases had Gasserian ganglion radiofrequency thermocoagulation, nine had partial root section, and three alcohol root injection. One patient had a tractotomy (Fig. 1), and one a root decompression.

The blink reflex was elicited by electrical stimuli applied via surface electrodes to the skin overlying the emerging supraorbital nerves. The pulse duration and intensity required to evoke an early and late response showed considerable individual variation (duration 0.1 or 1.0 ms, intensity 30–60 volts). When an early (R1) response was obtained from the normal side of the face, the intensity and duration were maintained unchanged when studying the operated side. The resultant blink response was recorded using a Medelec EMG

recording system with surface electrodes applied to the lower eyelids.

A brisk tap on the chin using a light hammer regularly evoked a jaw jerk in all subjects. This hammer contained an inertia triggered micro-switch which initiated the oscilloscope sweep recording the jaw reflex from surface electrodes overlying both masseter muscles. The jaw jerk was considered abnormal only when absent or clearly asymmetrical in terms of latency (>0.5 ms) on more than 10 occasions. Concentric needle electromyography of the masseter muscle was studied in 11 of the 19 patients with an abnormal jaw reflex.

Results

The abnormal clinical and electromyographic findings are summarised in Tables 1 and 2. An example of a normal jaw and blink reflex is shown in Fig. 1.

BLINK REFLEX

Orbicularis oculi reflexes were abnormal in seven of the 32 cases examined. All of these patients exhibited anaesthesia in the ophthalmic division VI and three had an absent corneal reflex. Three of the

Fig. 1 Normal jaw and blink reflexes in a patient after bulbar tractotomy for trigeminal neuralgia. No sensory deficit on clinical examination.

Table 1 Clinical and electrophysiological data in patients after partial root section, ethanol root injection, and root decompression

Patient	Age (yr)	Operation	Postoperative anaesthesia distribution	Motor root function (clinical)	Orbicularis oculi reflex	Jaw jerk	Masseter concentric needle EMG
JMcL	70	Ethanol root injection	V1,2,3 (absent corneal reflex)	Asymmetry	No response	Absent	Abnormal
EW	74	Ethanol root injection	V1,2,3 (absent corneal reflex)	Normal	No response	Absent	—
CD	76	Ethanol root injection	V1,2,3 (absent corneal reflex)	Normal	No response	Absent	Normal
JM	52	Partial root section	V2,3	Asymmetry	Normal	Absent	Denervation pattern
BO	72	Partial root section	V3	Normal	Normal	Absent	Normal
AN	61	Partial root section	V2,3	Normal	Normal	Absent	—
MN	67	Partial root section	V2	Normal	Normal	Absent	—
JMcK	57	Partial root section	V2,3 Hypaesthesia	Normal	Normal	Present	—
JD	43	Partial root section	V2,3	Normal	Difficult to obtain	Absent	Normal
JJ	71	Partial root section	V3 Hypaesthesia	Normal	Normal	Present	Normal
AW	58	Partial root section	V2(3) Hypaesthesia	Normal	Normal	Absent	Normal
MC	76	Partial root section	V2,3	Normal	Normal	Absent	—
JG	60	Root decompression	None	Normal	Normal	Absent	Normal

Table 2 Clinical and electrophysiological data on eight patients after radiofrequency rootlet thermocoagulation for trigeminal neuralgia

Patient	Postoperative sensory status	Clinical masseter dysfunction	Jaw jerk	Orbicularis oculi reflex
JA	V2,3 anaesthesia	Minimal asymmetry	Absent	Normal
JS	V1,2,3 anaesthesia	Slight weakness	Absent	Absent
CM	V1,2,3 anaesthesia	Slight weakness	Absent	Absent
FC	V1,2 anaesthesia	None	Absent	Normal
EMcL	V2,3 hypaesthesia	None	Delayed latency	Normal
VH	V2,3 hypaesthesia	None	Absent	Normal
MW	V2 hypaesthesia	None	Delayed latency	Normal
EC	V3 hypaesthesia	None	Absent	Normal

cases had alcohol root injection and three radio-frequency thermocoagulation. In one of the latter, the blink reflex showed a consistently absent early response before and after surgery. One patient had an absent blink reflex after a partial root section procedure.

JAW JERK

Nineteen of the 32 patients had an abnormal jaw jerk only on the operated side. Two of these cases had a reflex of significantly delayed latency (>0.5 ms when compared with that evoked on the intact side), and in the remainder the reflex was absent. Concentric needle electromyography (EMG) of the masseter was obtained in 11 of the 19 patients with an abnormal jaw jerk. Definitive evidence of masseter denervation (positive sharp waves and fibrillation potentials) was observed in only one partial root section case (JM, Table 1). Indirect evidence of masseter dysfunction was obtained in three thermocoagulation cases with V2,3 anaesthesia and clinical masseter asymmetry,

from asymmetrical surface and needle EMG recordings. The results shown in Table 1 indicate that seven of the nine patients who had partial root section and one with root decompression had normal clinical masseter function and yet an absent jaw jerk. Masseter needle EMG failed to show evidence of motor root damage in these patients.

There were six cases who underwent ethanol root injection or thermocoagulation and had clinical evidence of motor root damage with complete anaesthesia on one side of the face. These procedures are more likely to cause motor root damage because of the occasional difficulty in producing a discrete lesion. In three thermocoagulation patients (JA, JS, and CM, Table 2) with severe pain, the initial lesion proved inadequate. They required more extensive lesions to produce analgesia and, as a result, had complete anaesthesia and masseter weakness. The five remaining thermocoagulation cases (Table 2) exhibited minimal hypaesthesia but no clinical masseter weakness. The jaw jerk was either absent or of significantly delayed latency.

Ten thermocoagulation cases and the one patient with bulbar tractotomy (Fig. 1) showed no electrophysiological abnormalities.

Discussion

Orbicularis oculi reflex abnormalities obtained in this series could be predicted from the post-operative sensory findings as shown in Tables 1 and 2. All these patients had ophthalmic division anaesthesia except one where the reflex on both sides was difficult to obtain because of technical problems. It is of interest that one patient (CM, Table 2) who had had ophthalmic division pain since the age of 30 years had a consistently absent

Fig. 2 Jaw and blink reflexes before (left) and after (right) trigeminal ganglion radiofrequency thermocoagulation (patient CM). Diagram of the face indicates minimal hypaesthesia of right maxillary and mandibular divisions. Note absent early blink response (R1) when stimulating the right supraorbital nerve and absent jaw jerk after operation.

early reflex response before surgery (Fig. 2). This raised the question of alternative pathology such as demyelination. An extensive study of this reflex in multiple sclerosis has shown that the most consistent abnormality is a delayed or absent early blink response (Kimura, 1975).

The current view of the jaw jerk pathway is largely based on work by McIntyre and Robinson (1959) who extrapolated from studies in the cat. A tap on the chin produces impulses within stretch receptors located in masticator muscles. This proprioceptive information is considered to be mediated by large diameter group Ia fibres in the motor root, to relay in the mesencephalic nucleus. Collateral connections link with the motor nucleus in the pons and efferent fibres return via the motor root to the jaw musculature. Although the evidence for this pathway in the cat is considerable, the case for it being the same in man is weak. It is based entirely on a study of the jaw jerk in four patients who had undergone partial root section for trigeminal neuralgia. The results were equivocal in two of these cases and there was no indication of the sensory loss and therefore extent of the surgical lesion (McIntyre and Robinson, 1959).

The present data cast doubt on the currently

accepted pathway of the jaw jerk afferent nerve fibres at the level of the motor root for the following reasons. There was a surprisingly high incidence of absent jaw jerk in patients with partial root section where it appeared very unlikely that the motor root had been cut. After partial root section by the intradural approach (this method was used in all sectioned cases) the motor root is said to remain intact (as assessed clinically) in more than 80% of cases (Morello *et al.*, 1971). This is attributed to the clear view of the motor root obtained during the procedure. However, the jaw jerk in the group reported here was absent in more than 80% of cases, suggesting a very high incidence of motor root damage if one accepts the currently held view of the reflex path. Moreover, there was no clinical evidence of masseter weakness or denervation using concentric needle electromyography in all but one root section case.

There were four thermocoagulation cases with minimal hypaesthesia and normal masseter power, and yet they also had an abnormal jaw reflex. These patients almost certainly had a small destructive lesion as judged by their minimal sensory loss, and, therefore, it again seems unlikely that the motor root was involved.

The proprioceptive fibres of the jaw jerk appear to travel mainly, if not entirely, via a sensory division of the trigeminal nerve, probably the mandibular, and not the motor root. This would certainly be more in keeping with the arrangement of afferent fibres subserving a similar function in general somatic nerves.

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