BLINK REFLEX TESTING

ELECTRODE PLACEMENT

1. Recording electrodes: -
   A. Bipolar, surface, disposable square electrode.
   B. Active electrode (G1): over the orbicularis oculi muscle on the inferior rim of the orbit directly below the center of the pupil.
   C. Reference electrode (G2): over the orbicularis oculi just lateral to the palpebral fissure.
   D. For infraorbital and mental nerve stimulations, G1 can be placed on the superior portion of the orbicularis oculi by taping it on the upper lid over the bony rim of the orbit. The reference electrode in this situation remains as in 1 (C).
   E. Recording electrodes should be in place symmetrically on both sides so that simultaneous bilateral recordings can be made with stimulation on each side.
   F. If the response is too small to measure reliably, a standard concentric needle electrode in the inferior orbicularis oculi can be used.
2. Stimulating electrodes:
   A. Bipolar, surface prongs, held in place by hand.
   B. Cathode over supraorbital branch of the trigeminal nerve as it exits through the supraorbital notch. Anode is above the cathode and may have to be rotated to reduce shock artifact.

   If it is necessary to stimulate the second division of the trigeminal nerve, the infraorbital nerve is stimulated by placing the cathode over the infraorbital foramen at the inferior rim of the orbit. The anode in this case is below the cathode and is rotated in order to reduce the stimulus artifact.

   If the third division of the trigeminal nerve is to be studied, the mental nerve should be stimulated at a point halfway between the angle of the jaw and the chin with the cathode in front and the anode behind.
3. Ground: Disposable round electrode on the chin or on the neck.

TECHNIQUE

1. The branches of the trigeminal nerve to be studied are stimulated on each side individually with simultaneous recordings being made from both orbicularis oculi.
2. A low intensity stimulus is initially used and gradually increased. Usually a stimulation duration of 0.05 msec and a strength of less than 30 mA is usually sufficient to evoke a response. The maximum intensity used is 50 mA with a duration of 0.2 msec. If an early response cannot be obtained a paired stimulus can be used with an interstimulus interval of 2 msec.

3. The patient is requested to look at a fixed spot on the ceiling and is monitored during the procedure. The best time to stimulate the nerve is just after a spontaneous blink in order to minimize the amount of movement artifact. The stimuli should be given irregularly at least 5 seconds apart so that the habituation is minimized.
   Stimuli are given and can be repeated several times so that the best artifact-free recording can be chosen for measurement. Four responses are saved and measured.

MEASUREMENTS

1. There are no standard distance measurements to be made.
2. Three latencies should be measured for stimulation on each side:
   A. To initial deflection of the early response (R1) on the ipsilateral side (8-13 ms).
   B. To earliest reproducible late response (R2) on the ipsilateral side (28-41-ms).
   C. To earliest reproducible late response on the contralateral side (28-41 ms).
   D. Each of these three should be measured from responses produced by stimulation of each side (four responses).
   E. Since the responses are variable, repeated stimuli should be given until reproducible latency can be measured.
3. The amplitudes are variable and are not measured.

ERRORS

1. Sweep speed to fast and late responses not seen. Should be at 5 or 10 ms/cm.
2. Gain too low and responses not recognized. Should be 500 or 200 μv/cm.
3. Background muscle activity from poor relaxation obscures the potentials. This can be minimized by having the patient fix on one spot on the ceiling and stimulating just after a spontaneous blink.
4. Excess shock artifact obscuring R1.
5. Absent R1 response. Consider paired stimulation.

NORMAL VALUES ⇒ blink

1. Supraorbital nerve stimulation.

Latency	R1	R2, Ipsilateral	R2, Contralateral
Mean	10.5 ms	31 ms	31 ms
Range	8-13 ms	29-41 ms	29-44 ms

* There should be no more than a 1.2 ms difference between the two sides in R1 latency.

* The maximum difference between R2 latency on the two sides of stimulation is 8 ms.

2. Infraorbital nerve stimulation.

An R1 response is obtained in 20 percent or less of patients when stimulating the infraorbital nerve. If it is present, comparisons can be made on the two sides as with supraorbital nerve stimulation. If it is absent bilaterally, the only comparison that can be made is with the R2 responses. A difference of 8 ms or greater of the R2 responses when stimulating the two sides is probably significant.

3. Mental nerve stimulation

An R1 response is rarely obtainable on stimulating a mental nerve. No data are available to allow us to use the comparison of the R2 responses for clinical purposes at present.

FACIAL NERVE-MOTOR FIBER CONDUCTION STUDIES

ELECTRODE PLACEMENT

1. Recording electrodes: -
   A. Bipolar, surface, disposable square electrode.
   B. Active electrode (G1): Over the nasalis muscle just lateral and 1 cm above the external nares, directly beneath the pupil.
   C. Reference electrode (G2): In the same position on the opposite side of the face.
   D. Recording can also be made from the frontalis, orbicularis oris, orbicularis oculi, or mentalis muscles when indicated.
   E. Needle electrodes may be used for recording when responses from the surface are small. Insert a standard concentric disposable needle into the muscle to be studied.
2. Stimulating electrodes:
   A. Bipolar, surface prongs, held in place by hand.
   B. The cathode is just below and anterior to the lower tip of the mastoid, beneath the ear lobe. The anode is inferior to the cathode.
   In some patients the nerve is deep and difficult to stimulate at this location. The cathode can then be placed just anterior to the tragus of the ear lobe. The anode often must be rotated to reduce artifact or eliminate masseter contraction.
3. Ground: Disposable round electrode placed on the chin.

MEASUREMENTS

1. Distance from the cathode to the active recording electrode.
   (THIS MUST BE IDENTICAL ON THE TWO SIDES)
2. Latency from the shock artifact to the initial negative deflection of the compound muscle action potential.
3. Amplitude of the compound muscle action potential from baseline to negative peak.
4. Values must always be compared with those from the opposite facial nerve.

ERRORS

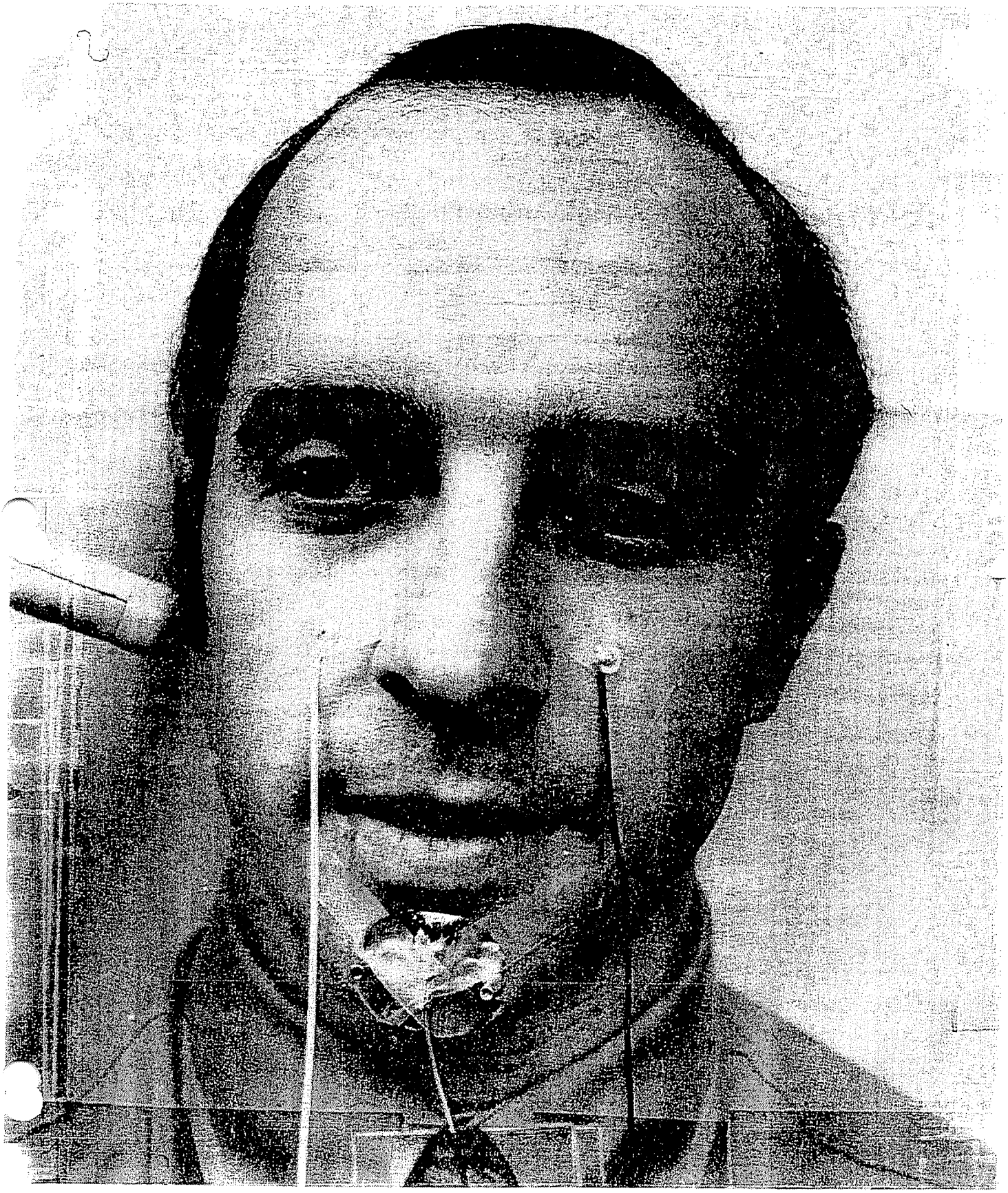
1. Stimulation of the masseter by incorrect position of the cathode. This produces an initial positivity as well as jaw jerk. A recording is unacceptable if there is initial positivity.
2. Excess shock artifact obscuring the take-off.
3. Unequal distances between stimulating and recording electrodes on the two sides of the face.

NORMAL VALUES - Facial Nerve Conduction

	Amplitude	Latency	Distance
Range	1.8 - 4.0	1.5 - 4.0	8 - 14
Mean	2.2	2.7	-

Values must always be compared with those from the opposite facial nerve ($\leq$0.6 ms).

FACIAL MOTOR NERVE CONDUCTION STUDY



Chapter 4

REFLEX STUDIES

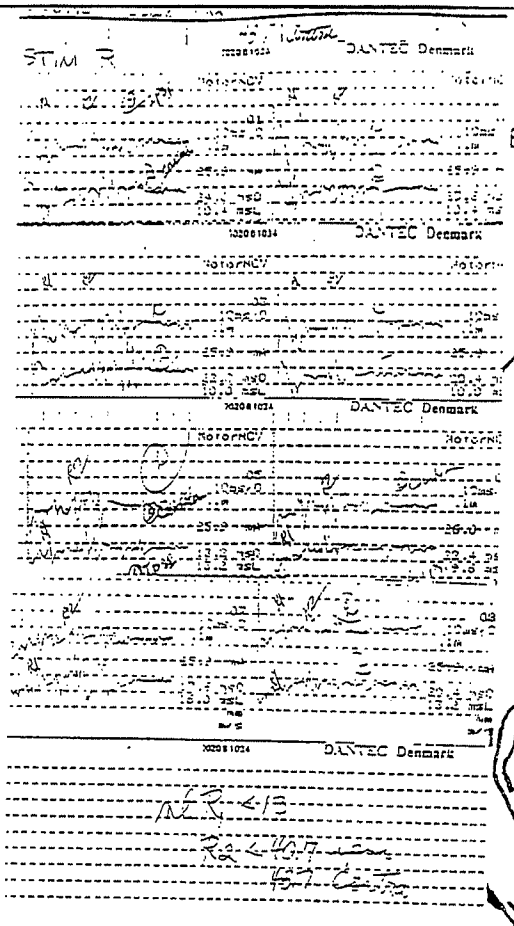
BLINK REFLEX

BLINK REFLEX STUDIES are by far the most complicated of all the nerve conduction studies performed routinely in an average clinical EMG Laboratory. The exact pathways and mechanisms for the blink reflex are still unknown. There are in the literature many different theories regarding these pathways. These range from Kukelberg's and Rushworth's (40, 52) theory that R1, the first component, is a monosynaptic proprioceptive reflex similar to the H-reflex (described later) and R2, the second component, is a polysynaptic cutaneous reflex, to Pender's and Delwaide's (51) theory that both components are in fact cutaneous reflexes.

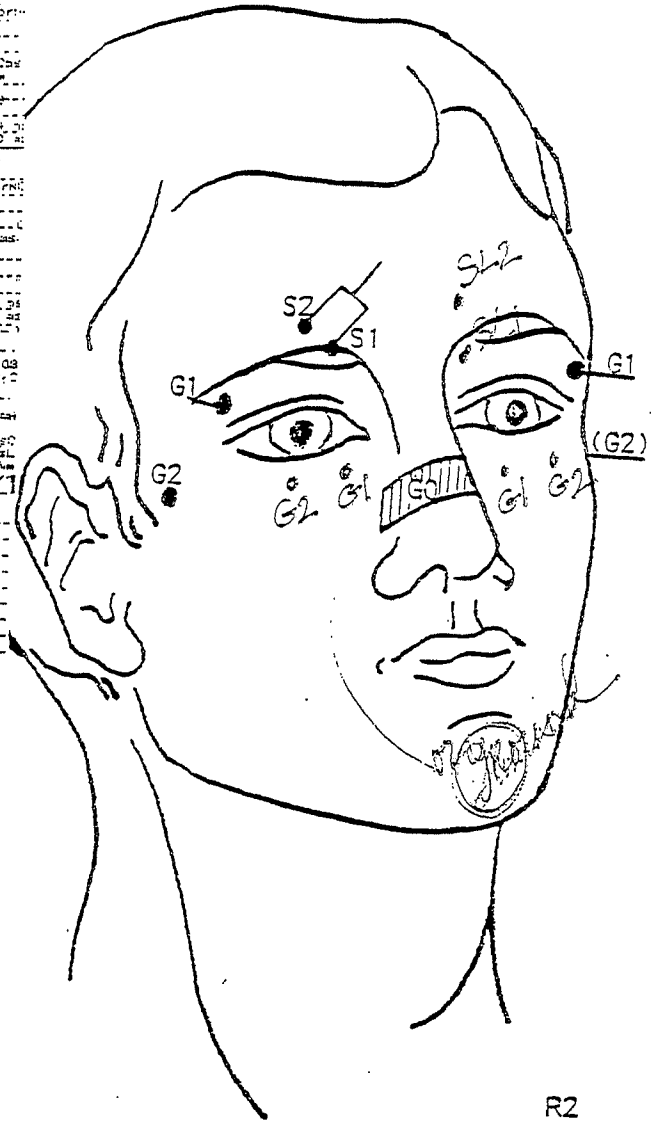
Even though the exact central nervous system pathways are unknown, the peripheral nervous system pathways are quite well documented. When the supraorbital nerve is stimulated, the impulse travels via the afferent or sensory fibers of the V trigeminal nerve to the brain stem. After this impulse completes its central connections, it then travels via the efferent facial (motor) fibers of the VII cranial nerve to the obicularis oculi muscle where the impulse is recorded (35, 38).

Procedures for the Blink Reflex (38, 48, 50)

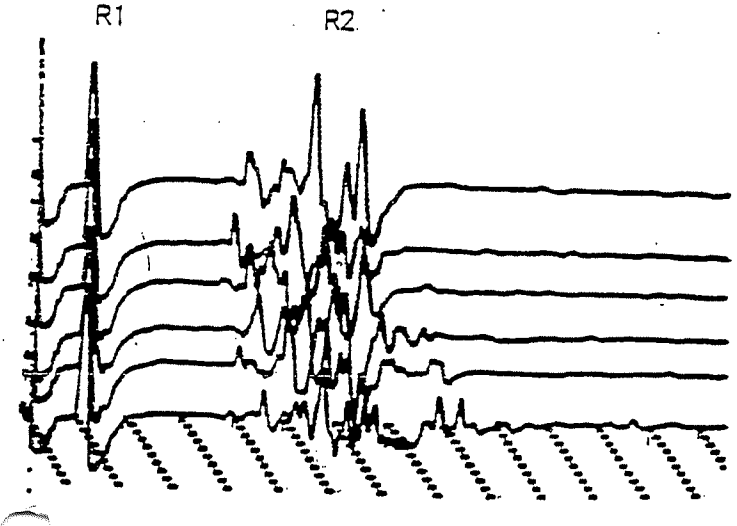
To record the blink reflex, the patient should be supine on a bed with the head and neck supported in a comfortable position. The recording electrode (G1) is placed laterally on the superior portion of the eyelid over the obicularis oculi muscle. The reference electrode (G2) is placed laterally over the temple region on the zygomatic arch. Since normal values are based on a side-to-side comparison, these electrodes must be symmetrically placed on the contralateral side. The ground (G0) is placed either in the center of the forehead above the nose or directly on the bridge of the nose. If both the ipsilateral and contralateral responses are to be recorded simultaneously, it is best to use a ground that has two leads. This tends to decrease the amount of artifact sometimes received when two preamplifiers are used and one of them is left ungrounded. In theory this is not necessary but in practice it often helps.



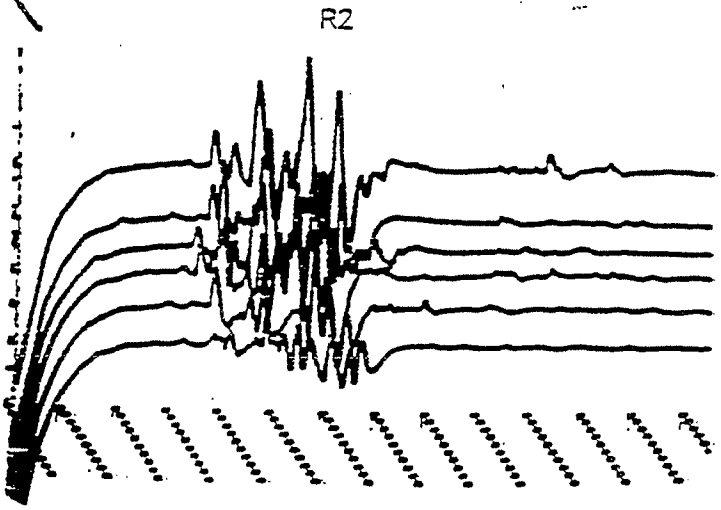
BLINK REFLEX STUDY



200μv
20 msec



recording ipsilateral side



recording contralateral side

The hand stimulator used to perform blink reflex studies should be considerably smaller than the stimulator used for other routine studies. In fact, to obtain a small stimulus artifact, the diameter of the stimulating prongs as well as the distance between the cathode and the anode should be smaller than the routine stimulator. The cathode (S1) is placed directly over the supraorbital nerve on the eyebrow at the point where the nerve exits through the frontal notch. The anode (S2) should be on the forehead angled to give the least amount of artifact. If both sides are recorded simultaneously, the oscilloscope should be set so the time lines are located between the ipsilateral and contralateral baselines. Displaying the sweeps in this manner will make it easier to determine the side of the recorded response and will make calculating the latencies more accurate. The gain setting is either 500 or 200 μv and the filter settings are the same as those used for routine sensory studies (32 Hz-1.6 KHz). Even though these filters will decrease the overall amplitude, they will give more stability to the baseline and will make the latencies more definite. Although amplitude and duration of the blink reflex is taken into account, normals for our laboratory are based on side-to-side amplitude, duration, and latency comparisons using sensory filter settings. Latency normals: (48)

	R1	R2 Ipsilateral	R2 Contralateral
Mean	10.5 msec	31 msec	31 msec
Range	8-13 msec	29-41 msec	29-44 msec

Side to Side $\leq$ 1.2 msec difference between R1 responses
Comparison $\leq$ 5.0 msec difference between R2 responses

Sweep speed of 10 to 15 msec/div should be used for the blink reflex study so the entire response can be seen. Because of the variability of the blink reflex latencies, a series of four to six stimuli are given randomly on each frame, leaving at least 3 seconds between each stimulus.

There are also two other branches of the fifth trigeminal nerve that can be evaluated by blink reflex studies, the infraorbital nerve and the mental nerve. The infraorbital nerve can be stimulated as it exits through the infraorbital foramen located just below the base of the eye socket in line with the supraorbital nerve. The mental nerve can be stimulated as it exits through the mental foramen located in the midportion of the chin in line with the supraorbital and infraorbital foramen. To evaluate these nerves, set up the study as described above (for the supraorbital nerve) the only variation being the different stimulation sites. Normal values for infraorbital nerve stimulation are approximated the same as those for the supraorbital nerve except that R1 may be unobtainable bilaterally in over 50 percent of the patients and still be within normal limits. At the present time normals for mental nerve stimulation are quite unreliable (48).