
Ioannis M. Skaribas, MD*

Kenneth M. Alo*, MD
Interventional Pain Management
Houston Texas Pain Management, PA
Houston, Texas

INTRODUCTION

Peripheral nerve stimulation (PNS) is a form of neuromodulation that has been used extensively in the treatment of primary refractory neuralgias for several decades (1). Combined PNS of the occipital (OPNS) and supraorbital nerves (SOPNS) has been more recently introduced by Reed et al., with promising results (2). Interest for this combined method has been increasing, however a number of technical challenges remain. Both the trial and permanent OPNS-SOPNS implants are associated with difficulty maintaining electrode anatomic position, difficulty effectively accommodating the excess hardware, and difficulty with final cosmetic and aesthetic outcome. This technical report describes optimization strategies addressing these challenges.

TECHNICAL DESCRIPTION

A. Trial Implantation (Insert Figures as indicated below)

Patients with severe daily primary holo-cephalalgias non-responsive to pharmacological and other interventional or surgical treatments present initially for the trial phase. After informed consent, the patient is taken to the operating
Application of standard ASA monitors and induction of total intravenous anesthesia (TIVA) is performed by an Anesthesiologist. The patient is placed supine on a fluoroscopic table. A small portion of the temporal hairline is removed bilaterally utilizing a hair clipper. The forehead and temporal side of the head bilaterally is prepared and draped in a sterile manner. Utilizing a sterile marker the supraorbital areas, as well as the midline are identified. The supraorbital areas are identified above the corresponding orbits with fluoroscopy and macroscopically. Placement in the supraorbital area is desired midway between the orbit and the corresponding hairline. The rational is to avoid blepharospasm that can occur if the electrodes are placed too close to the orbit. Local infiltration of 0.25% Bupivacaine with Epinephrine 1:200,000 above the temporal hairline is followed with bilateral (gently curved) 14 gauge epidural coude needles placement. The needles are advanced under direction vision and fluoroscopically with the curved tip facing towards the cranium. While advancing, a constant aspiration/injection of local anesthetic creates a “path” for the advancing neurostimulating electrode. This also facilitates analgesia and hemostasis. Two narrow spaced quadrupolar electrodes are positioned in the middle of the supraorbital fossae, targeting the narrowly spaced supratrochlear and supraorbital branches. The introducer needles are withdrawn under continuous fluoroscopy and electrodes confirmed and secured utilizing 2.0 silk. The exiting part of the electrodes is transpositioned and further secured on top of the forehead with steristrips and metapore tape.

After both supraorbital trial electrodes have been positioned, the patient is repositioned in the prone position. A pillow is utilized to accommodate the face and provide for oxygenation. Support under the chest facilitates exposure of the posterior cranial area. The hair in a line connecting the two mastoid processes is removed to facilitate ultrasound identification of the greater occipital nerves, and provide for needle insertion and infection prevention. Preparation and draping of the area follows in a sterile manner. The C-arm is utilized for fluoroscopic identification of the C1-2 interspace at midline. After infiltration with local anesthetic, the 14 gauge introducer needles are inserted in a mediolateral direction utilizing the same technique described earlier for the supraorbital
placement. After fluoroscopic verification, wide spaced quadrupolar electrodes are usually inserted targeting the more widely spaced occipital branches. Upon removal of the introducers, the electrodes are secured in a similar fashion similar.

**B. Permanent Implantation.**

The surgical goal and challenge is to accurately position the supraorbital electrodes without leaving visible scarring. Supraorbital electrodes have to be tunneled to the occipital pocket, and then to a posterior thoracic pocket where two splitters are connected, prior to final tunneling to the internal pulse generator (IPG) pocket. In an effort to perform this staged procedure without intraoperative repositioning, the following technique is used.

Informed consent is obtained in the preoperative area. Hair is removed in the temporal and posterior occipital areas. In a sitting position, the IPG pocket is marked contralateral to the patient’s dominant arm below the beltline and above the ischial tuberosity. After general endotracheal anesthesia is induced, lacrilube is applied to the eyes and taped shut. The patient is carefully positioned in a left lateral decubitus position with an axillary roll, and beanbag, on a fluoroscopic table. All pressure points are padded along the head, neck, torso, and buttock, and then prepped and draped opposing the surgeon. Accommodations are made to allow access to the top of the head, temporal, retromastoid, and parietal areas. The ipsilateral orbit and ear are infiltrated with 0.25 % Bupivacaine and Epinephrine 1:200,000 for surgical and postoperative analgesia and hemostasis. A transverse incision is extended to the deep fascia and both orbits utilizing a 22-gauge 5-inch spinal needle. Two 14 gauge curved introducer needles (one long and one short) are advanced toward each Supraorbital area. The stylets are removed and advanced along as the local anesthetic creates a conduit for the stimulating electrodes. Positioning is confirmed with fluoroscopy. Two narrow spaced quadrupolar supraorbital electrodes are positioned between the hairline
and orbit. By inserting both electrodes thru the same incision above the hairline, surgical trauma is limited, and cosmetic and aesthetic appearance optimized. The two electrodes are then secured to the deep fascia with an anchorless, locking suture technique (insert reference and/or picture).

Following anchoring, a strain relief loop is created within a bridging incision between the temporal and occiput areas. This facilitates tunneling along the extended curvature of the head posterolateral to ear. After local anesthetic is placed, a tunneling tool is then advanced between the two incisional areas and the two supraorbital electrodes are inserted and secured in the identical fashion.

For the placement of the two occipital electrodes, the C1-2 interspace is identified under fluoroscopy and the skin is marked. Infiltration with 0.25 % Bupivacaine with epinephrine 1:200,000 is followed by a longitudinal incision. Alternatively, the position of both greater occipital nerves and arteries can be determined by utilization of ultrasound. (Ref) The incision is extended to the deep fascia. Blunt dissection is used to create a pocket for the additional electrode coils. Again tunneling of the supraorbital leads from the bridging incision to the occipital pocket follows local anesthetic infiltration. 14 gauge epidural needle introducers are then advanced in a mediolateral direction toward the ipsilateral mastoid process. After electrode position is verified fluoroscopically, the occipital electrodes are secured utilizing the anchorless technique above. At the completion of these steps there are now two pairs of electrodes remaining, one pair of Supraorbital and one pair of occipital. To accommodate all four electrodes, splitters are placed in a final mid thoracic pocket at the T5-T6 level.

To create this pocket, a longitudinal incision is made midline with cautery followed by blunt fascial dissection large enough to accommodate the four leads, strain relief loops, and splitters. The two Supraorbital and two occipital leads are tunneled from the occipital to the mid thoracic pocket and Neurolon sutures utilized to maintain flat strain relief loops so there are no pressure points. From the mid thoracic pocket the final single electrodes emerge which are tunneled a gluteal IPG pocket between the beltline and the ischial tuberosity. All wounds are irrigated and closed and final radiographs obtained.
DISCUSSION

Peripheral nerve stimulation (PNS) is a form of neuromodulation that has been used extensively in the treatment of primary refractory neuralgias for several decades (1). Combined PNS of the occipital (OPNS) and supraorbital nerves (SOPNS) has been more recently introduced by Reed et al., with promising results (2). As a result, interest for this combined method began increasing, however a number of technical challenges remained. Both the trial and permanent OPNS - SOPNS implants are associated with difficulty maintaining electrode anatomic position, difficulty effectively accommodating the excess hardware, and difficulty with final cosmetic and aesthetic outcome.

Anecdotal evidence suggests that various Introducer needles, tunneling methods, and different anatomical areas for incision placement have been utilized with adverse outcomes. Any attempt to permanently position the Supraorbital leads by making incisions below the hairline, especially the forehead, can result in unsatisfactory surgical scars. Further, if the surgeon decides to surgically implant the supraorbital electrodes with bilateral temporal incisions, then a staged procedure requiring an intraoperative position change becomes laborious and risky for infection and migration.

The technical approach described bypasses the need for bilateral incisions, an intraoperative position change, and applies staged tunneling in a lateral decubitus position to limit excess hardware positioning. Finally, an anchorless suture and strain relief technique markedly minimizes the risk of electrode migration and improves the final cosmetic result.

*Reprint requests: (insert Dr. Skaribas address)

Author Acknowledgement: No financial support of any kind was received in the productions of this manuscript. All authors approved the final draft. Dr. Skaribas and Dr. Alo are consultants for St. Jude Medical Neuro Division, Plano Texas.
Bibliography: