CASE REPORT

Radial nerve donor branch selection and transfer to anterior branch of axillary nerve using the Checkpoint Stimulator

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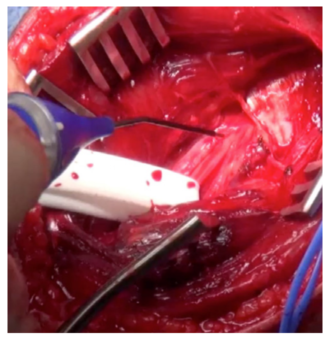
This case involves a 16-year-old male who is 6 months status post glenohumeral dislocation and resultant axillary nerve palsy. He presented with limited ability to abduct his right shoulder. The goal of the surgery was to re-innervate the anterior and middle deltoid muscles using a branch from the radial nerve to one of the heads of the triceps muscle.

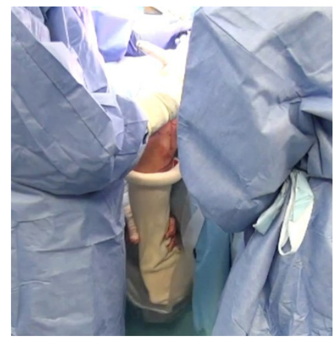
We used the Checkpointstimulator (Checkpoint Surgical, Cleveland, Ohio) to help us confirm the location of the nerve block, and in particular the candidate motor branches of the radial nerve for transfer. In our experience intra-operative nerve stimulation enhances intra-operative decision-making.

The initial posterior shoulder dissection involves identification of the radial and axillary nerves as they emerge on either side of the teres major muscle. Identification of the muscular branches ensues with the use of Checkpoint to confirm the integrity and excitability of the motor nerves and to help us assure that we protect these critical structures during surgery.

The Checkpoint device produces a fused, or tetanic, muscle contraction that varies in response to stimulus parameters — current amplitude and pulse width — the latter of which is under the surgeon's fingertip control through a slider switch. Since the Checkpoint device is biphasic, there are no concerns about prolonged tissue contact.

As the case advances, we identify and confirm the branches off the radial nerve to the long, lateral and medial heads of the triceps muscle. Nerve stimulation is used a) to select the best branch for transfer to the axillary nerve and b) to confirm that the residual triceps contraction will be vigorous and functional from the remaining branches that are protected and left intact. It is also important to assure that nerve selection and harvest will not deleteriously affect distal wrist, finger or thumb extension. The sustained muscle contraction afforded by



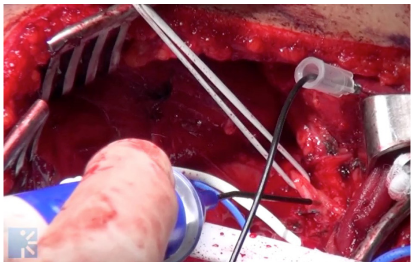


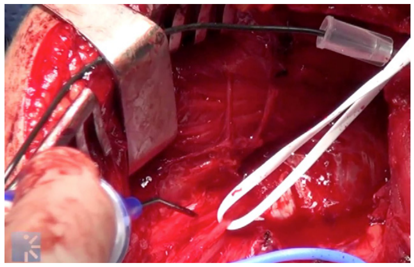
a biphasic stimulator makes it quite easy to discern distal motion and to then select the most appropriate nerve branches for transfer.

It is important that the stimulator not be utilized when paralyzing anesthetic agents are in effect, as an absent or inconsistent response to stimulation may result in inaccurate assessment of nerve and muscle function.

After identifying an appropriate radial nerve branch for transfer, we use the Checkpoint device to stimulate each of the branches of the axillary nerve. Stimulation of the branches begins with the lowest current level (0.5 mA). If no response is identified, we increase the pulse width incrementally to a maximum pulse width of 200 microseconds. In this case, the posterior branch did not stimulate at the 0.5 mA level, so we re-assessed the motor response with a decreased pulse width, and an increased current of 2.0 mA, gradually increasing pulse widths until a response was identified.

While stimulation of the posterior branch did not result in a visible motor response at 0.5 mA, a robust response was observed at 2.0 mA. Regardless of the output parameters, there was no response to stimulation of the anterior branch of the axillary nerve. Selective stimulation allowed us to discriminate between the functional branch of the axillary nerve (posterior branch) and the nonfunctional branch (anterior branch).



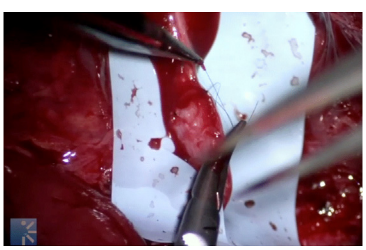


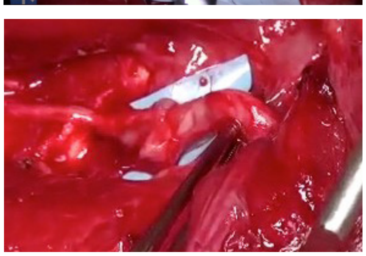
This delineation of functional and non-functional portions of the stimulated nerve enables a targeted approach to grafting of only the injured portion of the axillary nerve, using a radial nerve branch (medial head) that will not impair triceps or distal upper extremity function. The anterior branch can be selectively sectioned in preparation for nerve transfer.

When at all possible, preservation or re-innervation of the teres minor is important, as external rotation of the shoulder is arguably equal in functional importance to shoulder abduction. In this case, both the posterior deltoid and teres minor were spared by this traction injury, and demonstrated muscle contraction following Checkpoint stimulation. Stimulation of the posterior branch of the axillary nerve following sectioning of the anterior branch confirms that we have protected its innervation.

Following sectioning of the anterior branch of the axillary nerve, we sent a sample of the nerve to pathology to determine the degree of axonal viability. In scarred or stretched nerves, it is helpful to demonstrate micro-histological evidence of preserved fascicular anatomy prior to nerve transfer and micro-neural coaptation.

Prior to taking the donor nerve, strong contractions of the remaining branches to long and lateral heads of the triceps were confirmed using the stimulator at 0.5 mA. Care should be taken to make certain that the lowest level of stimulation is used to generate the motor response sought. Levels of stimulation higher than necessary should be avoided as they may activate unintended structures.





Upon confirmation from pathology that healthy axons were abundant and that at least 2/3 of the nerve had viable axonal preservation, we prepared to transfer. If pathology had indicated there was scarring and inadequate fascicular preservation, we would have sectioned the axillary nerve more distally and re-assessed axonal viability at this level prior to proceeding with the transfer. The radial nerve branch to the medial head of triceps was sectioned distally near its motor point, harvesting all terminal branches for maximal axonal count, and ensuring adequate "swing distance" to approximate the recipient anterior axillary branch.

The donor nerve is trimmed with a nerve-cutting device to present clean fascicular bundles for repair. Next the operating microscope is brought into place and three 9-0 nylon epineurial sutures are used to suture the donor and the recipient nerves.

We then encase the conjoined segment in fibrin glue, letting it cure in situ for several minutes before initiating closure of the surgical wound.

At 16 weeks post transfer, the patient is beginning to show signs of recovery and demonstrates the ability to actively contract the anterior deltoid and to abduct the shoulder with gravity eliminated. As is typical in these cases, the patient is expected to return to improved deltoid and shoulder function within the 12 to 18 months.

About the authors

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The Checkpoint Stimulator is a single-use, sterile device intended to provide electrical stimulation of exposed motor nerves or muscle tissue to locate and identify nerves and to test nerve and muscle excitability. Do not use this Stimulator when paralyzing anesthetic agents are in effect, as an absent or inconsistent response to stimulation may result in inaccurate assessment of nerve and muscle function. For a complete list of warnings and precautions regarding the use of the Stimulator please see www.checkpointsurgical.com.
Note: Case Reports are company funded and non-peer reviewed.

CS-9094-MKT-043-B