The R.E.P.A.I.R.™ Technique:

A Case Based Step-By-Step Guide for Nerve Reconstruction

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Nerve repair is an evolving field, with many new technological advances that have the potential to improve outcomes. This technique guide will focus on utilizing these technologies in the appropriate patients, with the goals of:

- Restoring natural anatomy
- Optimizing sensory and motor function
- Minimizing the risk of neuroma formation and pain
- Enabling the appropriate post-operative rehabilitation protocol and return to daily activities

THE R.E.P.A.I.R. TECHNIQUE AT-A-GLANCE:

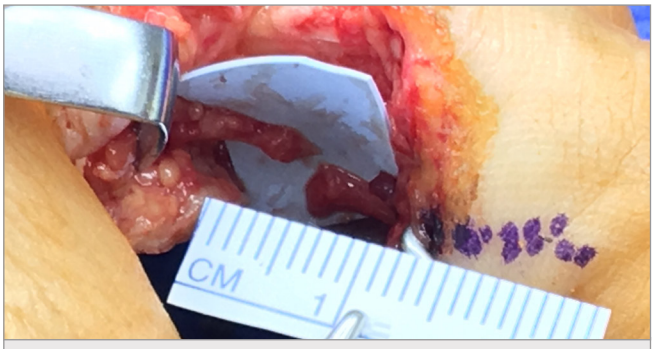
1. **R**ESECT to healthy nerve.
2. **E**XTEND joints to measure the actual gap.
3. **P**ICK the method for managing the gap.
4. **A**PPROXIMATE nerve ends.
5. **I**MPLEMENT using microsurgical technique.
6. **R**ANGE to verify the REPAIR.

1. **RESECT** to healthy nerve.

Nerves will not adequately regenerate through scar tissue, which makes tissue debridement a critical first step of the procedure. Start by gently palpating healthy nerve and then moving toward the injury site, determining the location where tissue stiffness increases.

Continue trimming until you can verify:

- Soft and supple handling, like the patient's healthy nerve.
- Slight, punctate bleeding around the fascicles, not just the epineurium. Note this might not be visible in small nerves or when tourniquet is applied.
- Normal architecture (i.e., fascicular count) comparable to what is appropriate for the anatomical location.
- Healthy nerve endoneurium and 3D structure blooming from the end of the fascicle.

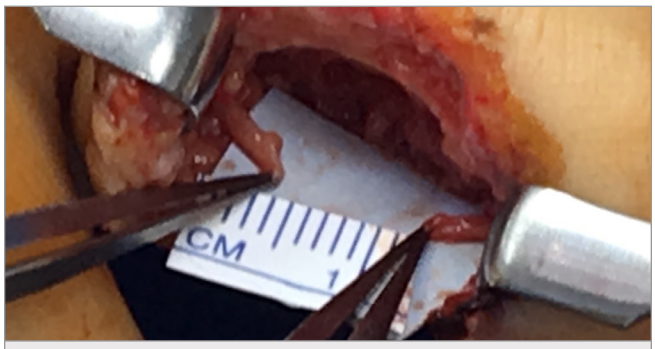


The REPAIR technique will be demonstrated through an example case of a digital nerve injury caused by kitchen knife laceration, presented in clinic 3 weeks after injury.

2. **EXTEND** joints to measure the actual gap.

It is critical to provide a nerve repair option that will not hinder rehabilitation, especially after tendon injury. Position the joints with the wrist in neutral and fingers in full extension, taking careful consideration of the patient's circumstances, including:

- Associated injuries, especially tendon.
- Desired rehabilitation protocol.
- Expected level of patient compliance to immobilization and splinting.
- Patient quality of life and timeline desired to return to daily activities.



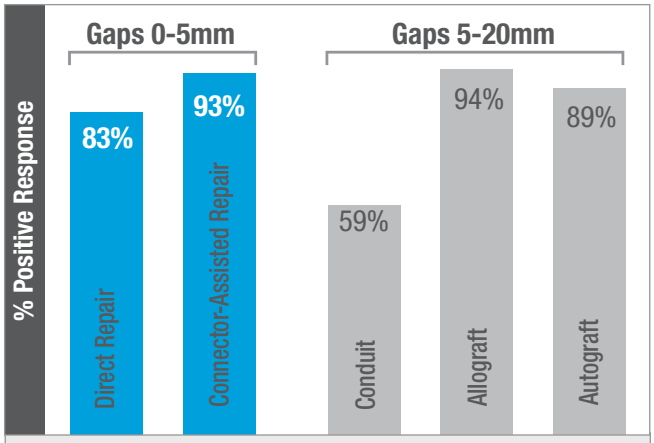
In this case example, proper trimming and measurement techniques resulted in a 10mm gap.

3. PICK the method for managing the gap.

The method of repair will be dependent upon the resulting gap length and desired rehabilitation protocol. Direct neurorrhaphy is limited to situations only when tension free repair can be achieved. Literature shows that as little as 7.4% nerve elongation can create nerve ischemia and decrease the regenerative potential[1], making it necessary to utilize a bridging material in those instances.

Consider the following when selecting the appropriate algorithm:

- Desired efficacy of treatment option at the gap length being repaired.
- Flexibility and gliding requirements, especially at joints.
- Potential for donor site morbidity.



Positive outcomes in digital nerves, as reported in the literature when defined as S3 or above on MRCC scale.[2,7,8,9]

4. APPROXIMATE nerve ends.

The ideal coaptation is tensionless while minimizing the risk of axonal escape and the potential for painful neuroma formation. Ensure that the coaptation is approximated without overtightening, and that sutures are minimized to limit the inflammatory response.

Meta-analysis demonstrates that performing a Connector-Assisted Repair® technique can result in:

- 10% improvement in positive outcomes.[2]
- 50% less likelihood of sensitivity at the repair site.[2]

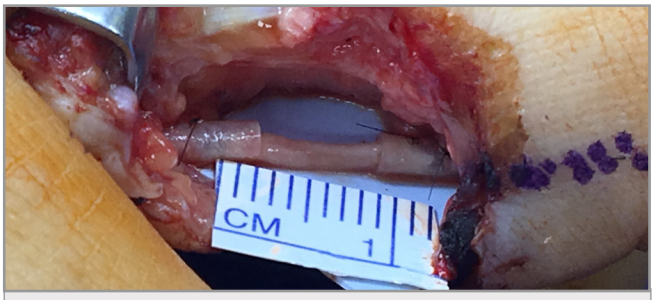
An example of repair options can be seen in the photographs.

Direct repair (top) and Connector-Assisted Repair (bottom) during full finger extension. Tension on the direct repair coaptation results in visible gapping and may limit revascularization and axonal regeneration.

5. IMPLEMENT using microsurgical technique.

After selecting the appropriate algorithm, perform the technique using the following pearls:

- Accept only a tensionless repair.
- Minimize number of sutures required to obtain a stable coaptation, as described previously in the literature.[3,4,5,6]
- Use standard microsurgical principles to complete the repair, without over-tightening.
- Determine implant sizing based on diameter of largest nerve stump, taking the post-operative inflammatory phase into account and upsizing when appropriate.



10 mm gap repaired with Avance® Nerve Graft and Axoguard® Nerve Connector.

6. RANGE to verify the R.E.P.A.I.R.

Perform range of motion to the desired level for the patient's post-operative rehabilitation protocol and lifestyle. Visual inspection can be performed prior to closing the skin in order to confirm:

- Approximated neurorrhaphy with no gapping, stretching, or misalignment at coaptation points.
- Tissue gliding, especially near joints.
- Range of motion is appropriate for intended post-operative rehabilitation without generating tension on the nerve.
- Appropriate measures have been taken to minimize the risks associated with scar tissue formation and local inflammation.

Click on image to view range of motion assessment video.
www.axogeninc.com/video

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Avance Nerve Graft

REGULATORY CLASSIFICATION: Avance Nerve Graft is processed and distributed in accordance with US FDA requirements for Human Cellular and Tissue-based Products (HCT/P) under 21 CFR Part 1271 regulations, US State regulations and the guidelines of the American Association of Tissue Banks (AATB). Additionally, international regulations are followed as appropriate. Avance Nerve Graft is to be dispensed only by or on the order of a licensed physician.

INDICATIONS FOR USE: Avance Nerve Graft is processed nerve allograft (human) intended for the surgical repair of peripheral nerve discontinuities to support regeneration across the defect.

CONTRAINDICATIONS: Avance Nerve Graft is contraindicated for use in any patient in whom soft tissue implants are contraindicated. This includes any pathology that would limit the blood supply and compromise healing or evidence of a current infection.

Axoguard Nerve Connector

INDICATIONS FOR USE: United States: Axoguard Nerve Connector is intended for the repair of peripheral nerve discontinuities where gap closure can be achieved by flexion of the extremity. The device is supplied sterile and is intended for one-time use

CONTRAINDICATIONS: This device is derived from a porcine source and should not be used for patients with known sensitivity to porcine material.

The educational surgical techniques presented here have been made available by Axogen for educational and informative purposes only and do not render any kind of medical advice. These educational techniques are intended to be used as an information source for qualified physicians treating patients with tissue injuries.

Dr. Jason Nydick and Dr. Peter Evans are clinical and scientific advisors for Axogen Corporation.

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