ISSN 1220-8841 (Print)
ISSN 2344-4959 (Online)

ROMANIAN
NEUROSURGERY

Vol. XXXVIII | No. 4 December 2024

Peripheral nerves adjacent to spinal cord injury could help restore sensory motor regeneration in complete paralysis patients

Mohammad Mousazadeh

DOI: 10.33962/roneuro-2024-175

Romanian Neurosurgery (2024) XXXVIII (4): pp. 461-465
DOI: 10.33962/roneuro-2024-175
www.journals.lapub.co.uk/index.php/roneurosurgery

Peripheral nerves adjacent to spinal cord injury could help restore sensory motor regeneration in complete paralysis patients

Mohammad Mousazadeh

Faculty of Medicine, Iran

Abstract

Peripheral nerves adjacent to spinal cord injury could help restore sensory motor neurons regeneration

Background and objectives: In people with spinal cord injury we hypothesize that peripheral nerves in the thoracic segment and accessory nerve and supra scapula nerve branches on the back of the patient can be sacrificed to use them to stimulate regeneration in spinal cord injury due to trauma.

Method: To test this hypothesis, we establish a loop shape framework with distal end-to-end anastomosis of peripheral nerves adjacent to cord injury or anastomosis of the distal end of the accessory nerve and supra scapula nerve on the back of the patient and guide growth stimulation balance from the loop shape framework to injured side. We developed this novel technique and tested it in four individuals with complete sensory-motor paralysis as part of the ongoing clinical trial.

Result: Within 6 months time loop shape frame work stimulation novel technique mediated ASIA score improvement from A score to C score in case 1,2 and after 8 months case three can move his hand and foot, Mr. 4 sensory recovered from umbilical level to beneath of knee and the patient move proximal muscle voluntary (3/5).

Conclusion: This novel technique in neurosurgery opens a majestic path to recovery of spinal cord injury and brain regeneration.

Keywords
peripheral nerves, spinal cord injury, sensory motor regeneration

Corresponding author:
Mohammad Mousazadeh

Faculty of Medicine,
Iran

m_mosazadeh@yahoo.com

ISSN online 2344-4959
© Romanian Society of Neurosurgery

First published
December 2024 by
London Academic Publishing
www.lapub.co.uk

Introduction

Traumatic spinal cord injury is a tragic event there is no effective treatment for neurological recovery the primary injury cord compression or contusion leading to secondary injury by blood flow interruption and the release of oxygen free radicals, inflammation and edema. The only intervention for improving neurological outcome is decompression and vertebral column stabilization and it doesn't change effectively ASIA score of patien[1,2] the inability of adult mammalian central neuron to regrowth in response to spinal cord injury is due to them limited intrinsic regrowth capacity due to glial scar and cystic cavities in combination with poor endogenous re myelination and axonal regrowth[2,3].

Multiple trophic factor should be combined for a spinal cord repair therapy and any single intervention is unlikely to improve patient outcome. Peripheral nerves adjacent to spinal cord injury could help restore sensory motor axon regeneration.

In people with spinal cord injury we hypothesized that peripheral nerves in thoracic segment can be sacrificed to use them stimulate regeneration in spinal cord injury due to trauma. And similarly accessory nerve and supra scapula nerve branch on the back of patient can be used for cervical cord regeneration.

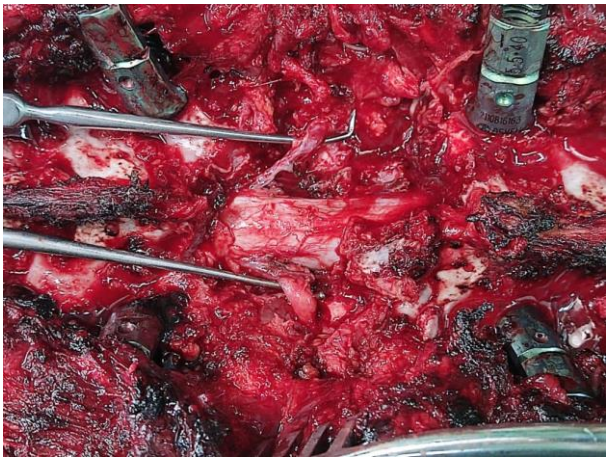

Figure 1. Case 1 T7 pair nerves.

Figure 2. Case 1 T7 pair nerves after anastomosis together.

To test this hypothesis, we establish a loop shape frame work with distal end to end anastomosis of peripheral nerves adjacent to cord injury (Fig 1,2) and anastomosis between accessory nerve and supra scapula nerve on left back side of patient which guides growth stimulation balance from the loop shape frame work to injured site. We developed this novel technique and tested it in four individual with complete sensory motor paralysis as part of ongoing clinical trial.

Within six-month time loop shape frame work stimulation novel technique mediated ASIA score improvement from A score to C score in case1,2. and case 3 could move his hand and foot after 8 months. In 3 months Mr. 4 sensory recovered from umbilical level to beneath of knee and the patient move proximal muscle voluntary (3/5).

This novel technique in neurosurgery opens a majestic path to recovery of spinal cord injury.

Method

This research approved by ethic committee in research and consent form completed by patients.

Figure 3. Case 1 CT.

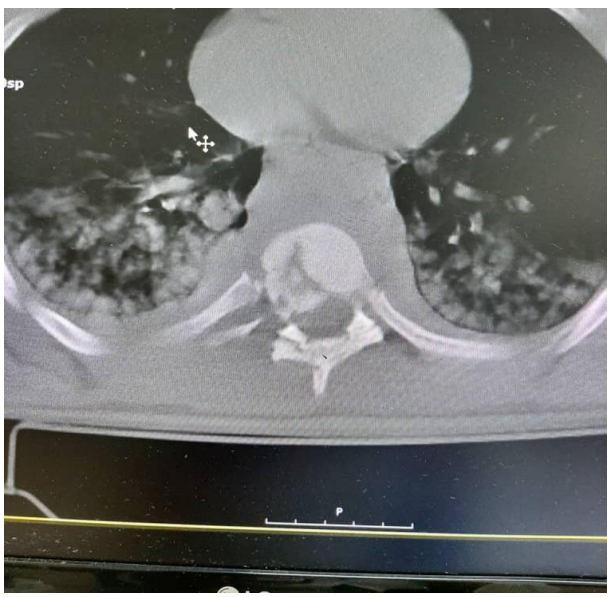

Figure 4. Case 1 T2 MRI.

Case 1

Mr. 1, age 14 had traumatic spinal cord injury his leg motion strength was zero and has not any sensory function below T8 lesion level.

Mr. 1 sent for CT, MRI and finding showed burst fracture of T8 vertebra (fig 3,4) the patient was taken for neurosurgical vertebral stabilization and fusion 6th day after incidence and we established a loop shape frame work with distal end to end anastomosis of T7 peripheral nerves adjacent to cord injury (Fig 1,2).

Case 2

Mr.2 age 36 years old man became paraplegic after trauma to lumbar spine. after the incident his bilateral lower limb showed no muscle contraction with sensory loss. A CT, MRI scan revealed a L1 burst fracture (FIG 5,6) the patient underwent surgery 2th day after incidence and we established a loop shape frame work with distal end to end anastomosis of T11 peripheral nerves adjacent to cord injury.

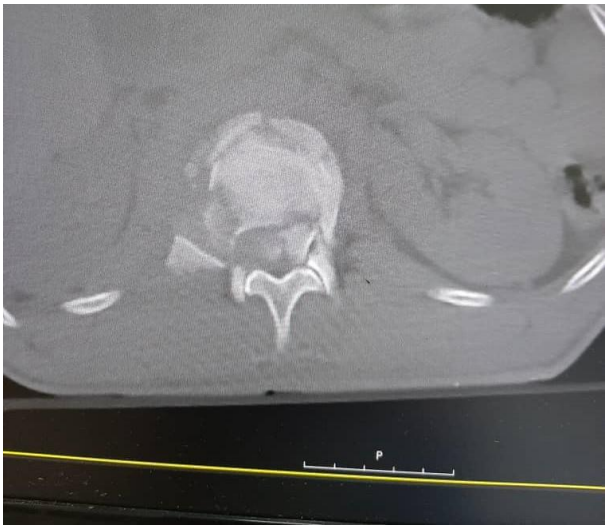

Figure 5. Case 2 CT.

Figure 6. Case T2 MRI

Case 3

Mr.3 age 53 old man became quadriplegic after trauma to cervical spine A MRI scan revealed C3-C4 segment lesion (fig 7) the patient underwent surgery 30th day after incidence and we established a loop shape frame work with distal end to end anastomosis between accessory neve and supra scapula nerve on the left side back of patient (8,9).

Figure 7. Case 3 T2 MRI

Case 4

Mr.4 age 38 old man became paraplegic after trauma to thoracolumbar spine MRI revealed T11-T12 dislocation (fig 10) the patient underwent surgery 3 day after incidence and after correction of dislocation we cut distal and ligate of T10 pair nerves.

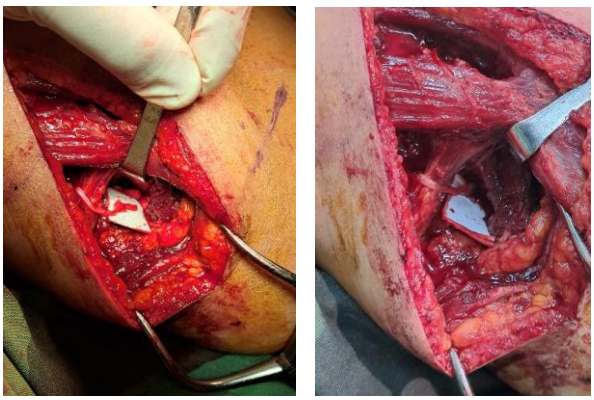

Figure 8. Suprascapula and accessory nerves before anastomosis.

Figure 9. Suprascapula and accessory nerves after anastomosis.

Result

Flow chart

Patient selection, surgery for fusion, nerve anastomosis proximal to spinal injury, clinical response consideration.

Figure 10. Case 4/

Case 1

On the 90th day after peripheral nerve anastomosis Mr.1 sensation down to T8 segment recovered. On 180th day after anastomosis sitting balance recovered and the patient adduct and abduct knee and flex foot finger and ASIA score improved from A to C Mr.1 step with walker and orthosis brace.

Case 2

On the 90th day after peripheral nerve anastomosis Mr.2 sensation down to L1 Segment beneath the knee and sitting balance recovered and the patient adduct and abduct knee. On the 180 day after anastomosis Mr.2 step with walker and orthosis brace.

Case 3

8 months after anastomosis Mr.3 move his foot and hand on the left side and we don't see any movement at right side as control and we did anastomosis in right side after 9 months of first left anastomosis and see better sensation in right side but no movement.

Case 4

3 months after distal cutting and ligation of T10 pair nerves proximal to spine lesion Mr. 4 sensory recovered from umbilical level to beneath of knee and the patient move proximal muscle voluntary (3/5).

Discussion

In neuroscience effort for spinal cord regeneration has been unsuccessful. Why axons cannot grow. Three theories dominate the field the first theory hypothesized protein that inhibit axons growth and the second describe a glial scar forms at the injury site, the third theory say neurons is genetically shut off after birth [5].

Most scientist believe that many factors modulate spinal axons growth and combination therapies will be necessary to achieve functional regeneration of spinal cord 4. but what happens in peripheral nerve regeneration. It comprises the formation of axonal sprouts and re innervation of original targets.

It has been accepted that CSF flows from subarachnoid spaces along all brain nerves and all peripheral nerve into the respective tissues. CSF has been found to have an important signaling function and there is interaction between CSF and peripheral nerves. CSF flow along lumbar nerves in distal direction at a speed of 10 cm /per hour6

Base on CSF interaction with nerves and its circulation we establish a loop shape frame work with distal end to end anastomosis of peripheral nerves adjacent to cord injury (FIG 1,2) and guided CSF and growth stimulation balance from the loop shape frame work to injured side.

It is possible improve result with more using of nerves proximal to lesion or with using of granulocyte colony stimulant factor (GCSF) and successful trial open way for treatment of chronic patients and maybe help to treatment of brain neural cells in cortical spinal tract and basal ganglia due to observation in case 3 which show specific effect on left side of patient. on the other hand C2 nerve pair can be used to help regeneration of cervical spine alongside using of accessory nerve on the back of patient also vestibular neve can help to medulla regeneration and cochlea, facial nerve treatment using of some drugs such as riluzole and refanezumab may be help to treatment and result

References

1. Ahuja, C., Wilson, J., Nori, S. et al. Traumatic spinal cord injury. Nat Rev Dis Primers 3, 17018 (2017).
2. Fitch MT, Silver J. CNS injury, glial scars, and

inflammation: Inhibitory extracellular matrices and regeneration failure. Exp Neurol 2008;209:294–301.
3. Tuszynski MH. Growth-factor gene therapy for neurodegenerative disorders. Lancet Neurol. 2002;1:51–7.
4. Griffin JM, Bradke F. Therapeutic repair for spinal cord injury: combinatory approaches to address a multifaceted problem. EMBO Mol Med. 2020 Mar 6;12(3):e11505. doi: 10.15252/emmm.201911505. Epub 2020 Feb 24. PMID: 32090481; PMCID: PMC7059014.
5. Young W. Spinal Cord Regeneration. Cell Transplantation. 2014;23(4-5):573-611.
6. Bechter K, Schmitz B. Cerebrospinal fluid outflow along lumbar nerves and possible relevance for pain research: case report and review. Croat Med J. 2014 Aug 28;55(4):399-404.