

# Selective Dorsal Rhizotomy for Hypertonia

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No disclosures to be made.

# Contents

- Pathophysiology
- Indication and Contraindication
- Surgical procedure
- Surgical outcome and complications
- FAQ

Table 1.

## Surgical Techniques Tested in the Treatment of Spasticity

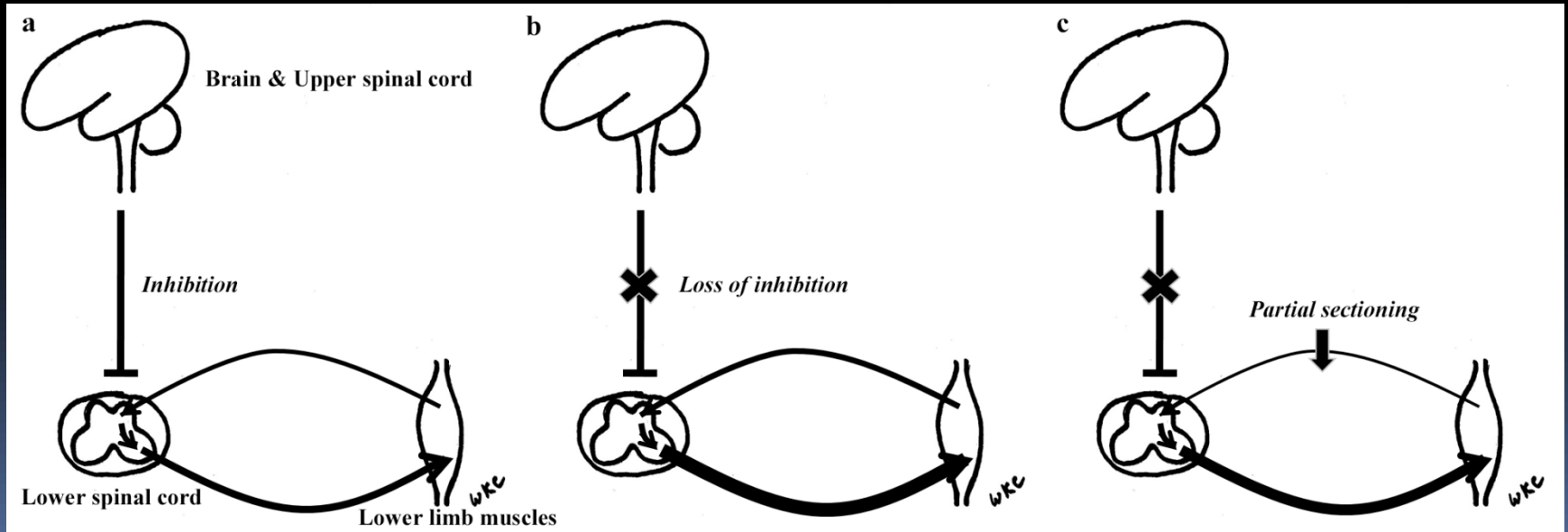
Procedure	Target	Results
Stereotactic encephalotomy	Globus pallidus Ventrolateral thalamic nuclei Cerebellum	Variable to poor
Cerebellar stimulation	Cerebellum	Poor
Longitudinal myelotomy	Conus medullaris	Variable
Cervical posterior rhizotomy	C1-C3	Slight improvements Significant potential for complications
Selective posterior rhizotomy	Selected roots of L2-S2	Variable, encouraging
Neurectomy	Involved nerves	Variable, high recurrence, possibility of permanent, painful dysesthesias
Tendon lengthening, release or transfer	Contracted or spastic muscle	Variable but generally effective

# What is SDR?

- The neurosurgical procedure *selective dorsal rhizotomy (SDR)* can provide permanent relief from spasticity.
- In this procedure, neurosurgeons disconnect abnormally functioning nerves from the spinal cord to halt the dysfunctional communication between the patient's muscles and brain.

# Pathophysiology

- Sectioning of spinal reflex arc
- To reduce the muscle tone
- By partial severing of sensory roots



# Indication

- Age
- Etiology
- Functional state
  - Spasticity vs rigidity / athetosis / dystonia
  - Severity of spasticity
  - Intelligence
  - U/E weakness
  - Contracture
  - Previous orthopedic surgery
- Spine deformity
- Response to temporary treatment

# Indication according to Goal of Surgery

- Group I: ambulation
- Group II: patient care

# Group I: Ambulation

## Functional Pre-requisite

- Pure or predominant spasticity
- Mild to moderate weakness
- Useful upper extremity motor
- Truncal control
- Preserved cognition
- No or mild contracture or deformity
- No extensive tendon lengthening



# Group I Contraindication

- Mixed or other type (dystonia)
- Severe brain damage
  - Esp. basal ganglia injury
  - Positive primitive responses
- Severe deformities
- History of extensive orthopedic surgery

# Group II: patient care

- Contracture
- Subluxation, dislocation
- Deformity
- Skin ulcer
- Voiding care



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# Surgical procedure

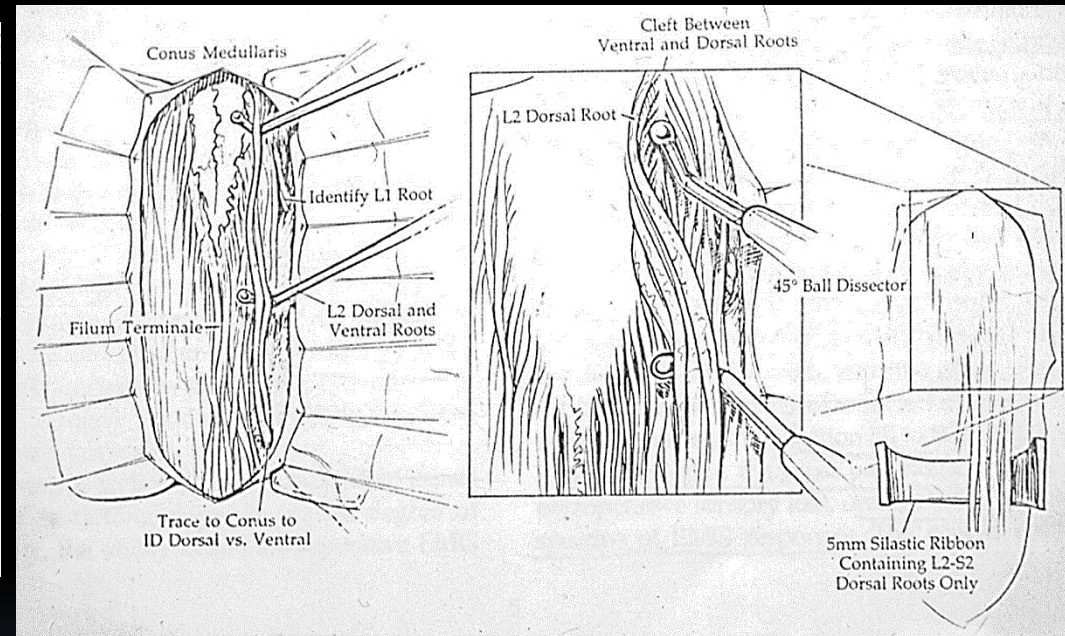
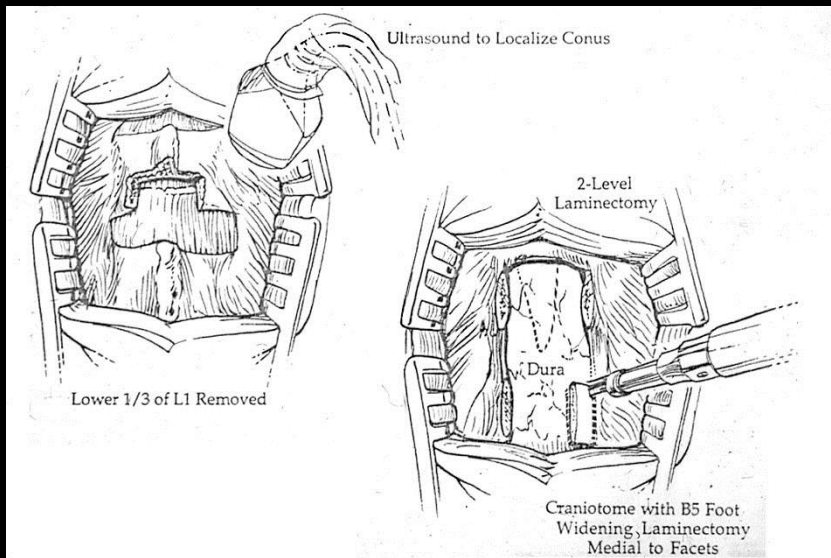
## How we do it in SNUCH

- Laminectomy (1 ~ 1.5 level, expose the tip of conus at the center of bone exposure)
- Separate sensory roots from motor roots
- Save sphincter roots
- Rhizotomy
  - Usually 60 – 75% for group I
  - Double check for motor and sensory roots

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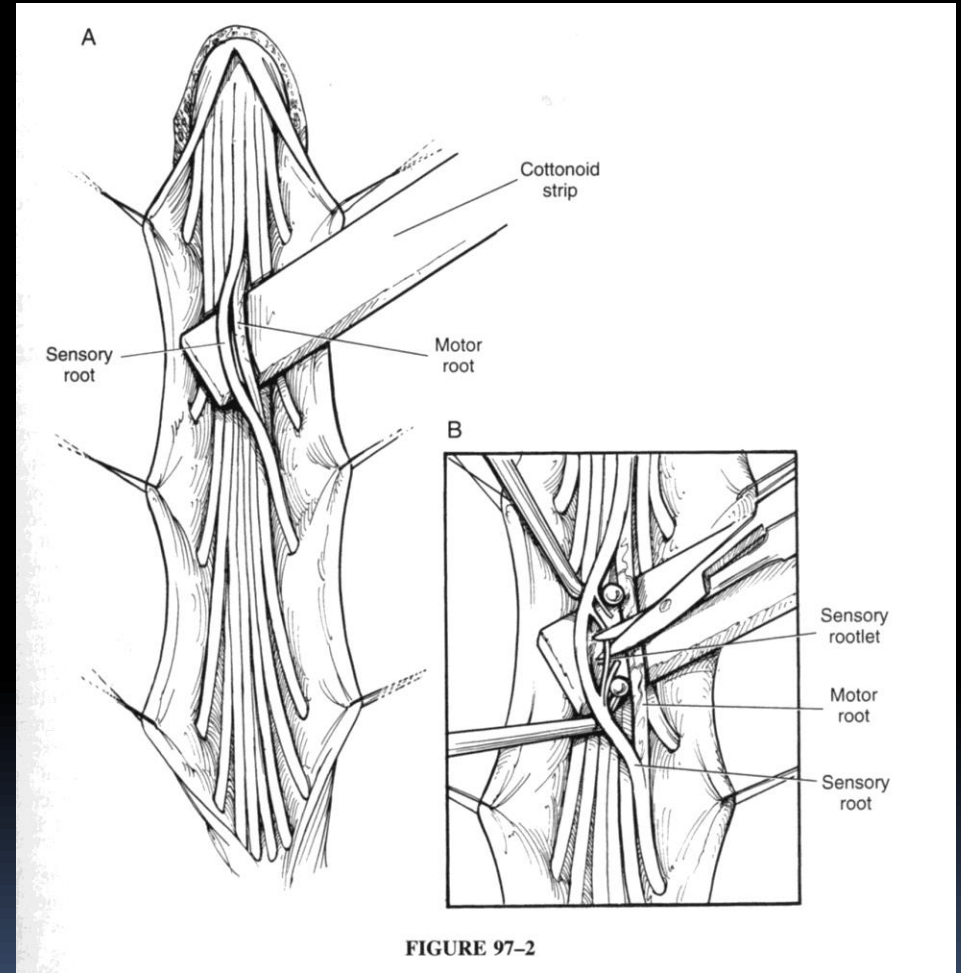
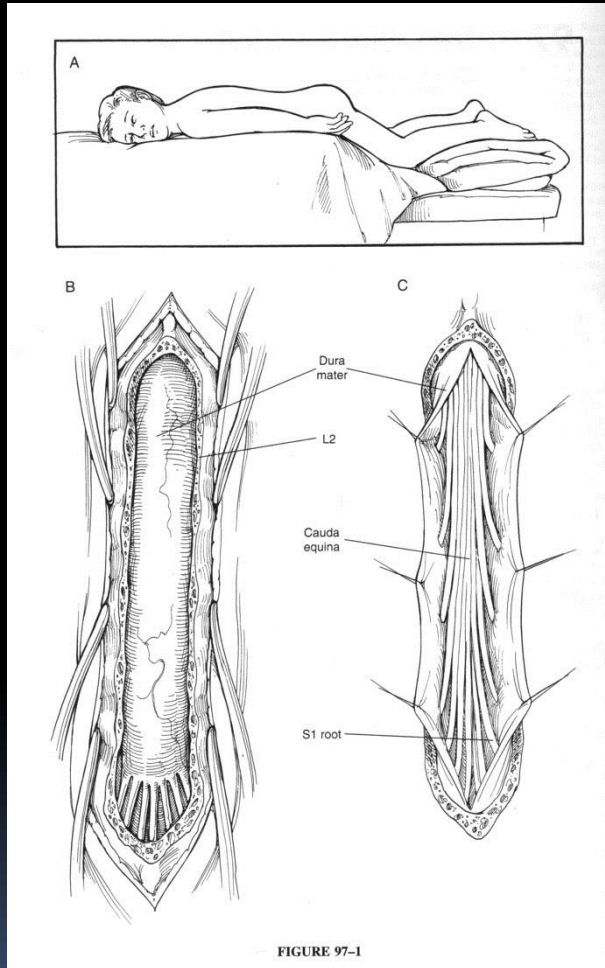
# L1-2 Single Level Laminectomy



# Extent of bone exposure (Exact identification of rootlets)

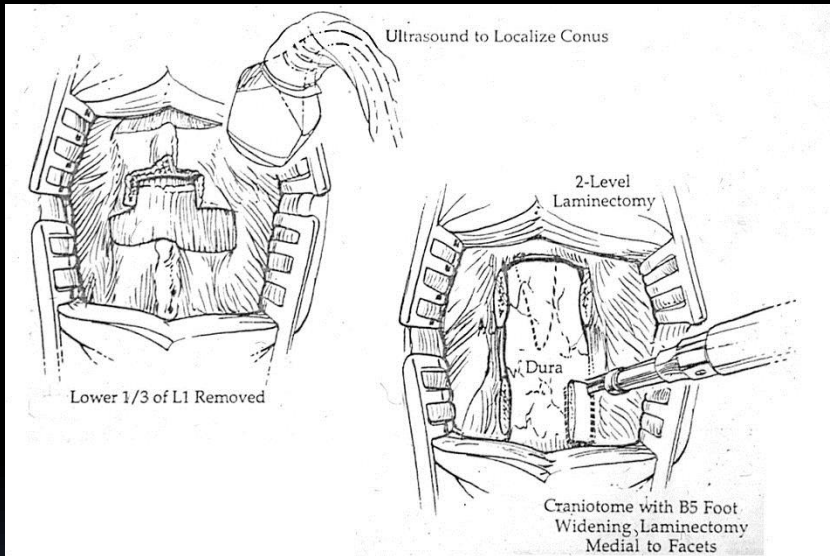
- L2-S2 laminotomy/laminectomy
  - Peacock et al.
  - wide exposure
  - precise identification of roots
- L1-2 single level laminectomy
  - Park, et al.
  - small exposure
  - uncertain identification of roots

# L2-S2 laminotomy/laminectomy





# L1-2 single level laminectomy



- short operation time
- less postoperative weakness
- same degree of spasticity reduction

# Laminectomy and dural incision (Identification of conus level)

- Preoperative

- Lumbar MRI

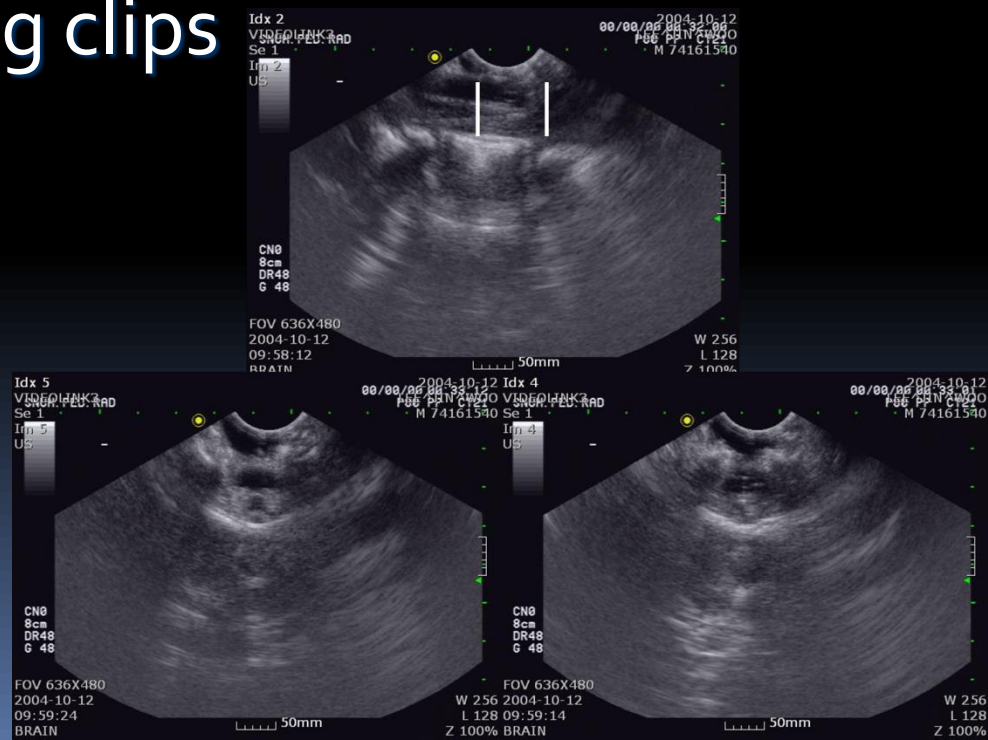
(inspection for other lesions such as lipoma)

- Plain x-ray with marking clips

- Intraoperative

- Portable x-ray

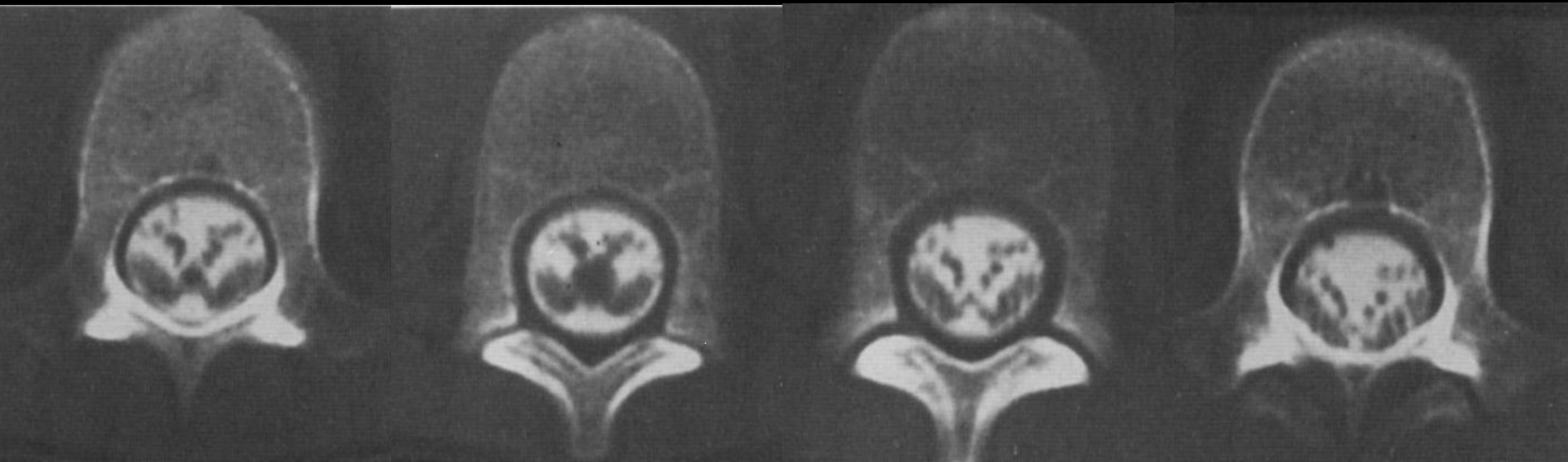
- USG



# Surgical procedure

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# Separation of sensory roots from motor roots



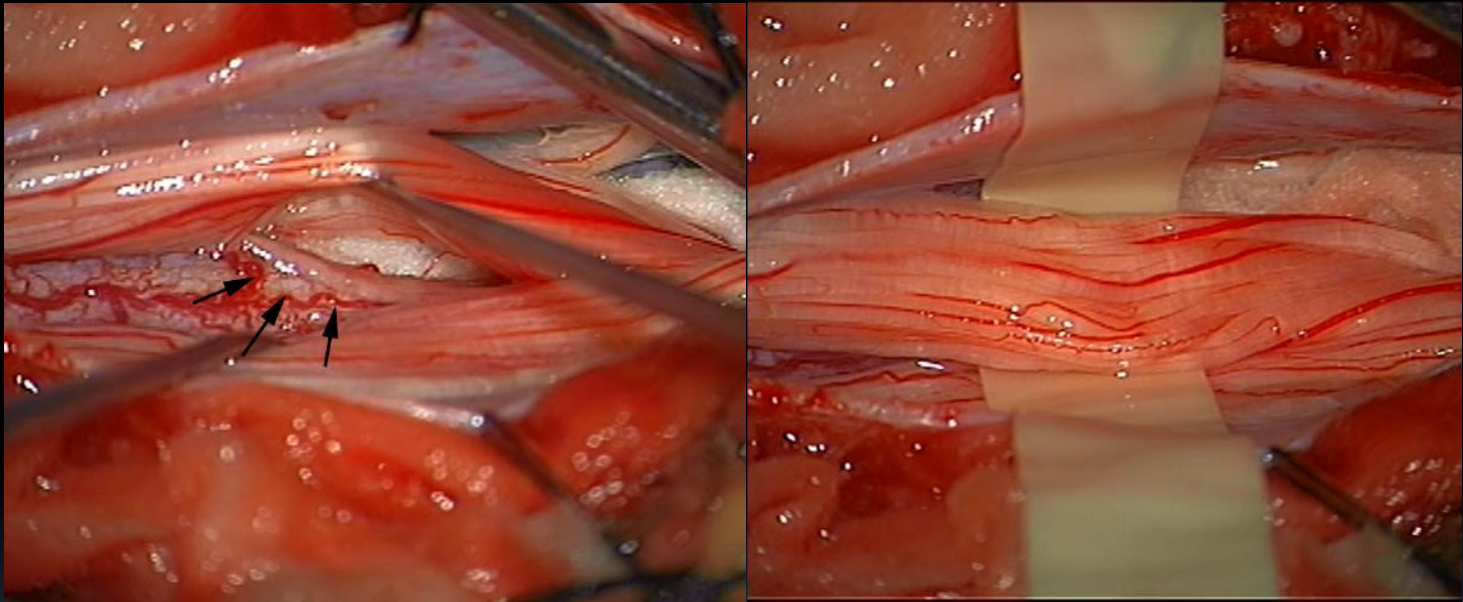




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# Saving sphincter roots





# Surgical procedure

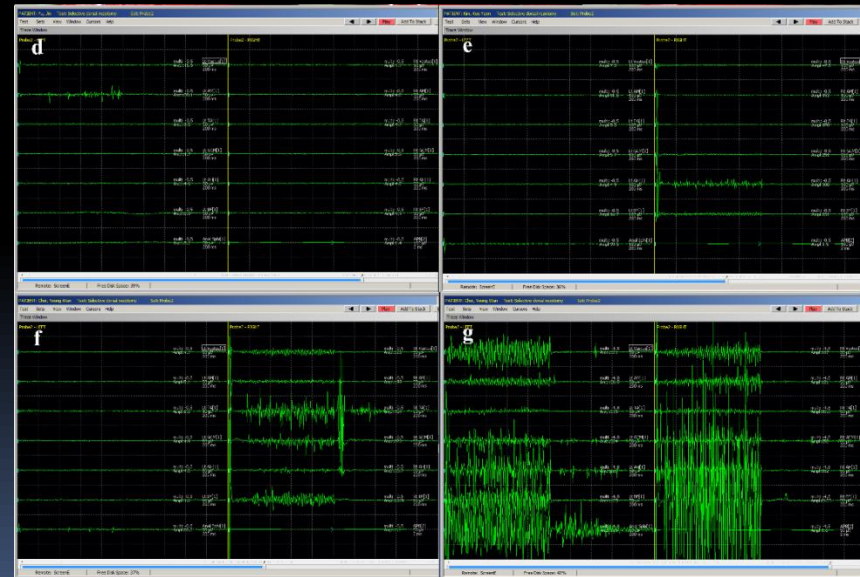
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# Preparation of Rootlets

- EMG response of whole root stimulation
- confirmation: absence of motor rootlets
  - EMG: latency
  - nerve stimulation
- division into rootlets of same size

# Intraoperative EMG

- Response to tetanic stimulation of reflex threshold of 50 Hz for 1 sec
- grading (grade 1-4: sustained)
  - 0: unsustained or single discharge
  - 1: stimulated segment
  - 2: immediately adjacent segments
  - 3: segments distant to the stimulated site
  - 4: contralateral response



# Selection of Roots to Cut

- Divide the roots into rootlets of similar size (natural plane or by needle)
- cut rootlets of higher EMG response grades
- as much as predetermined proportion
  - varies according to the goal of surgery and severity of patients
  - 60 - 75% in diplegics



# Selective Dorsal rhizotomy

## Result

- postoperative dysesthesia
  - for few days
- immediate reduction of spasticity
  - 'collapse'
  - improved range of motion and velocity
- recurrence
  - late and minimal in diplegics
- foot deformity

# Selective Dorsal rhizotomy

## Indirect Effect

- upper extremity spasticity
- swallowing, drooling
- urinary frequency, constipation
- cognition

# Complication

- < 7%
- sensory loss
- weakness
- voiding difficulty
- spinal deformity
- miscellaneous:
  - wound infection
  - pneumonia (related to prematurity (BPD) – ICU care)

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# Discussion 1

## Thoracolumbar MRI

- generally not recommended
- 2 cases with unexpected pathology
  - lumbosacral lipoma: difficulty in surgery
  - dermoid cyst at L<sub>4</sub>: save another operation

# Discussion 2

## Role of Intraoperative EMG

- questionnaire study
  - N=19
  - no intraoperative EMG monitoring 3/19
  - continue SDR when EMG machine fails during operation 10/19
    - continue only in spastic quadriplegia 4/10
    - such an experience 6/10

# Discussion 3

## Accurate Level of Root

- extensive cross over between L2-S5, even between the right and left in CP
  - Phillips and Park, 1992; Ojeman et al, 1997

## Discussion 4

# Number of Roots with Abnormal Response vs. Severity of Spasticity

- no evidence of linear relationship
  - Hays et al, 1998

# Discussion 5

## Number of Sectioned Roots vs. Outcome

- save 'useful spasticity'
- remove 'handicapping spasticity'
- 'minimum necessary': hard to expect
- around 50% cut in Group 1
  - Privat et al, 1976; Shevelev et al, 1996

# Discussion 6

## Postoperative Weakness

- no real weakness
  - apparent weakness caused by marked reduction of spasticity
- may be present transiently
  - esp., L2-S2 laminotomy/laminectomy
    - Engsberg et al, 1998

# Discussion 7

## Impact on Voiding

- high rate (>50%) of neurogenic bladder before operation
- postoperative improvement
  - Franco et al, 1992; Sweetser et al, 1995; Houle et al, 1998

# Discussion 8

## Partial Section of S2 Root

- recommended
- not clearly controlled in L1-2 laminectomy
- pudendal mapping for safety
  - Lang et al, 1994; Morota et al, 1995; huang et al, 1997



# Discussion 9

## Limited SDR

- L<sub>4</sub>-S<sub>1</sub> roots only via L<sub>4</sub>-5 laminectomy
- generally, not accepted
  - Lazareff et al, 1990

## Discussion 10

# Postoperative Pain/Dysesthesia

- epidural morphine
- intrathecal morphine
- systemic morphine and midazolam
- epidural 'morphine plus butorphanol'
- fentanyl in intensive care unit
- not so much discomfort in Korean children
  - Sparkes et al, 1989; Geiduschek et al, 1994; Lawhorn et al, 1994; Dews et al, 1996; Park, 2004