

A photograph of surgeons in an operating room, wearing masks and caps, focused on a surgical procedure. The scene is dimly lit, with the primary light source being the surgical lamps, creating a professional and clinical atmosphere.

# **Functional and electrophysiological aspects of the neurotization procedure in brachial plexus injury**

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# Mechanisms of the brachial plexus injury in our group of patients



<b>Motorbike accident</b>	–	<b>45%</b>
<b>Car accident</b>	–	<b>15%</b>
<b>Bicycle accident</b>	–	<b>9%</b>
<b>Fall</b>	–	<b>7%</b>
<b>Pedestrian injury</b>	–	<b>5%</b>
<b>Obstetrical</b>	–	<b>3%</b>
<b>Miscellaneous</b>	–	<b>16%</b>

# Types of the brachial plexus injury

- Avulsion of cervical roots
- Direct injury of the trunks, cords and peripheral nerves
- Combination of both

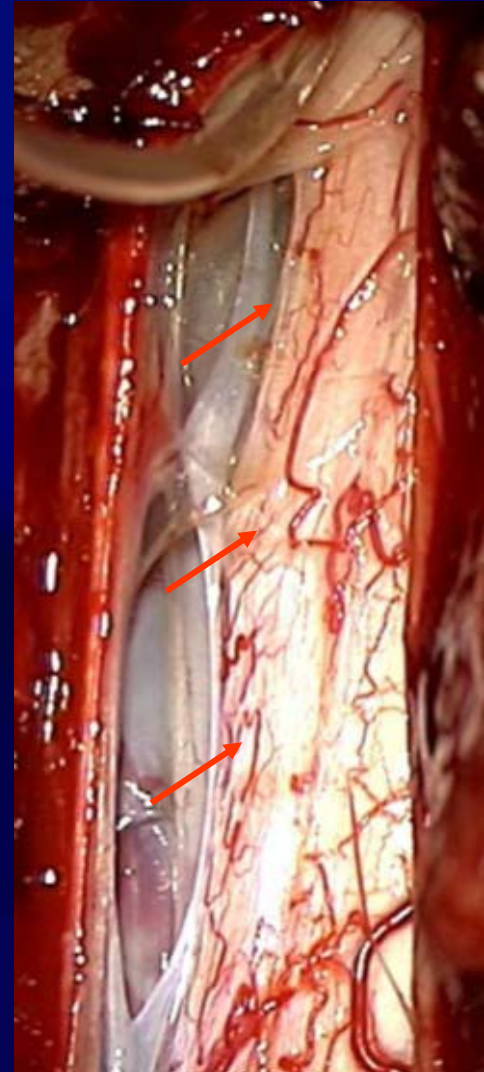
Anatomický preparát pažní pleteně (A)  
a pravá strana míchy s avulzí kořenů C5-C8 (B)





# Preoperative assessment

- Clinical status
- Electrophysiological measurements:
  - needle EMG
  - conduction studies
  - SEPs, MEPs
- CT myelography



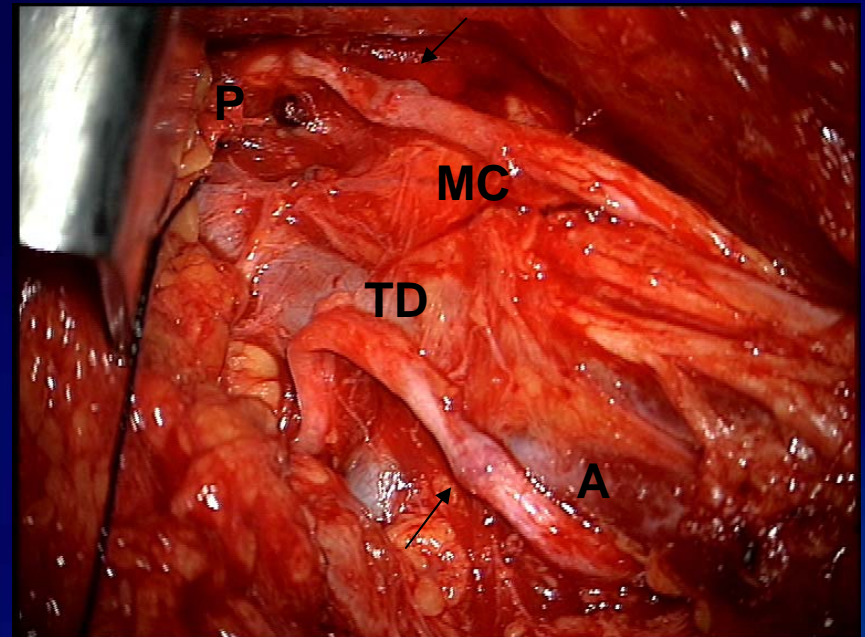
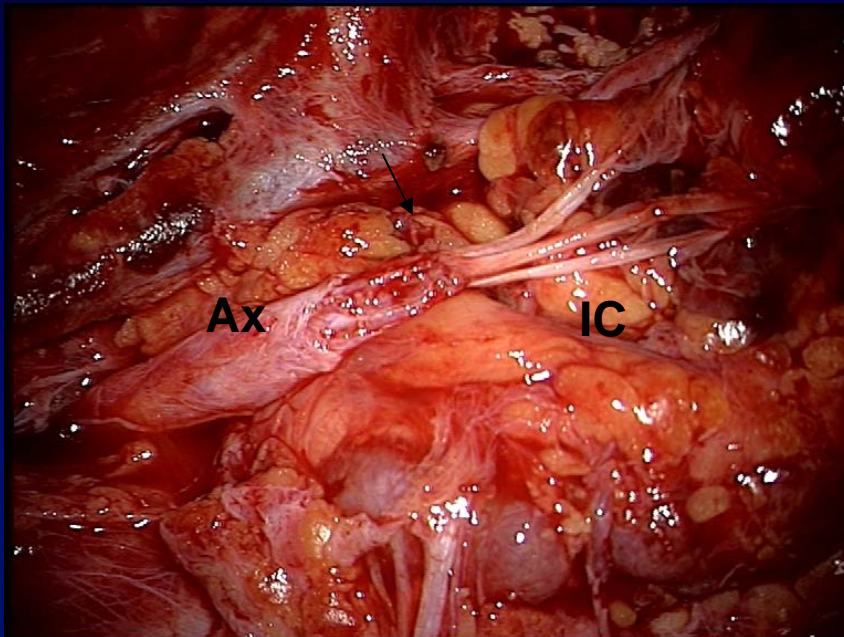
# Nerve transfer

## Extraplexal nerves:

- spinal accessory nerve
- motor branches of C4
- phrenic nerve
- Intercostal nerves

## Regional (intraplexal) nerves:

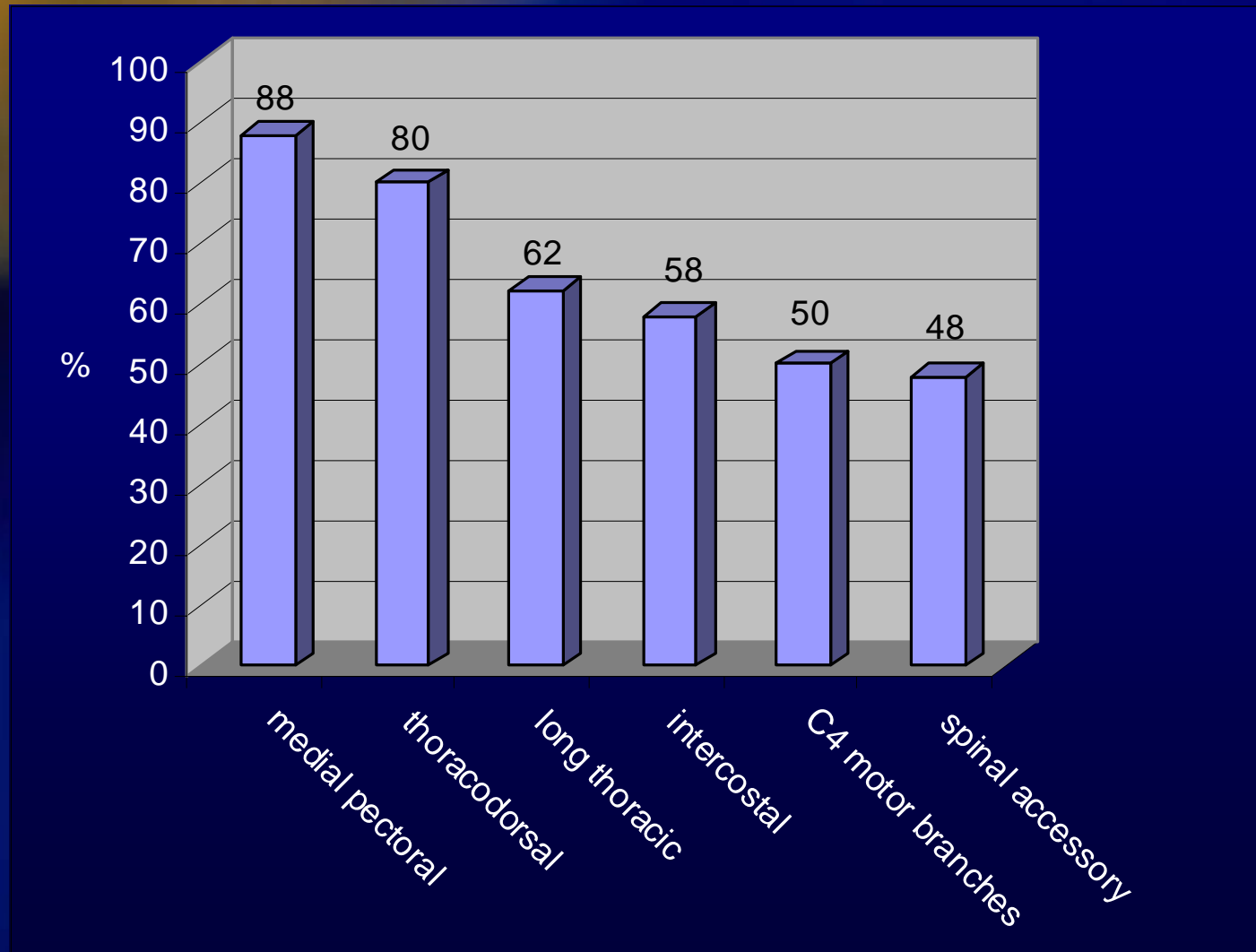
- medial pectoral nerve
- long thoracic nerve
- thoracodorsal nerve
- subscapular nerve



## Success rate of nerve transfer (follow-up $\geq 2$ years)

- 46 procedures
  - 31 successful (67%)
- 98 transfers of individual nerves
  - 53 successful (54%)

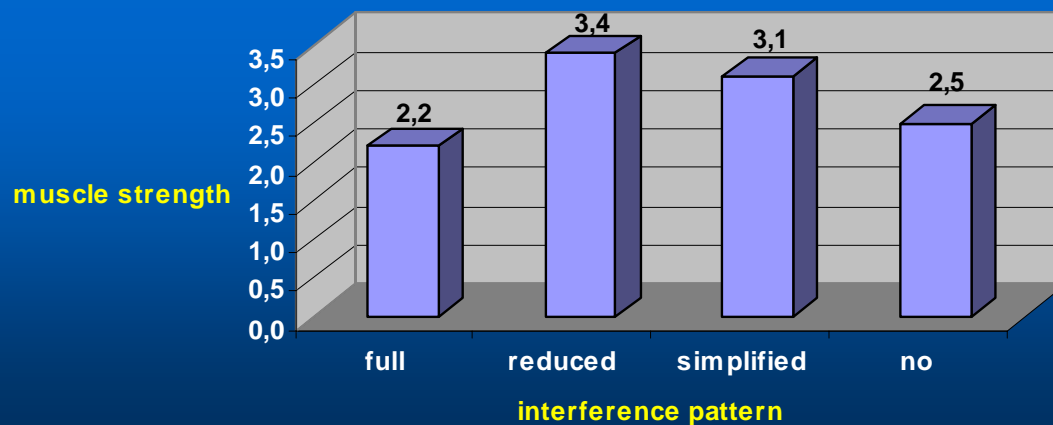
# Success rate of individual donors in nerve transfer procedure





# Relationship between preoperative EMG pattern and postoperative results

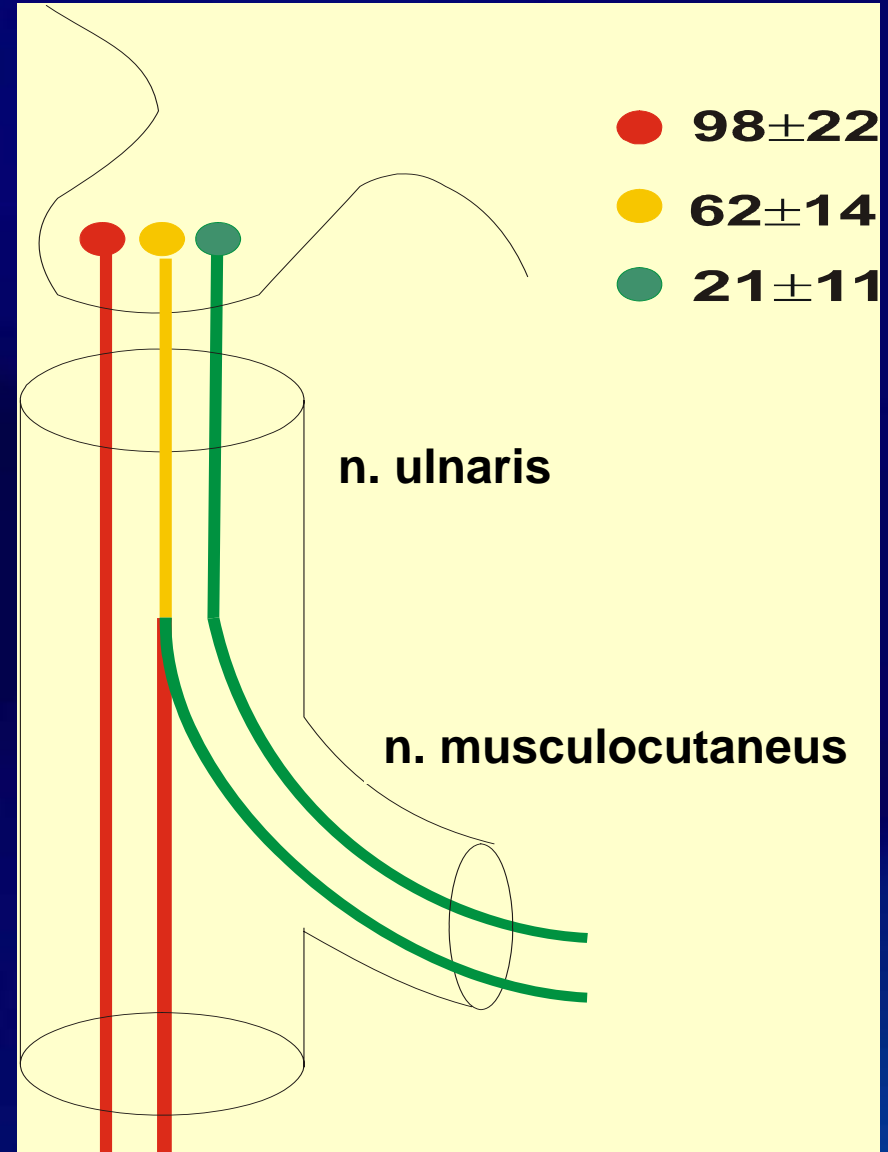
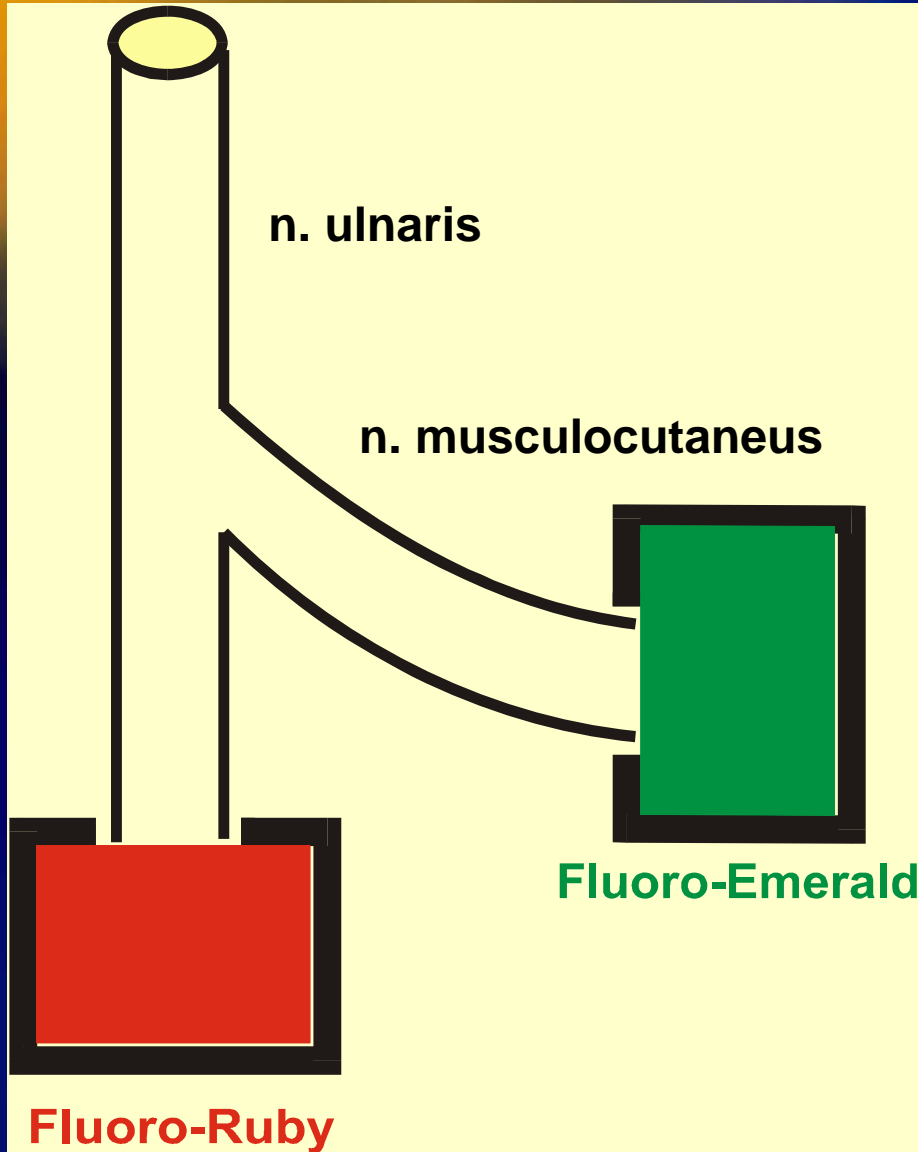
Interference pattern	Evaluated nerves [n]	Successful [n]	Successful [%]	Average muscle strength [ $\varphi \pm SD$ ]
full interference	40	18	45	2,2 $\pm$ 1,4
reduced	12	10	83	3,4 $\pm$ 0,9
simplified	18	13	72	3,1 $\pm$ 1,3
no	12	7	58	2,5 $\pm$ 1,5
total	82	48	58	2,7 $\pm$ 1,4



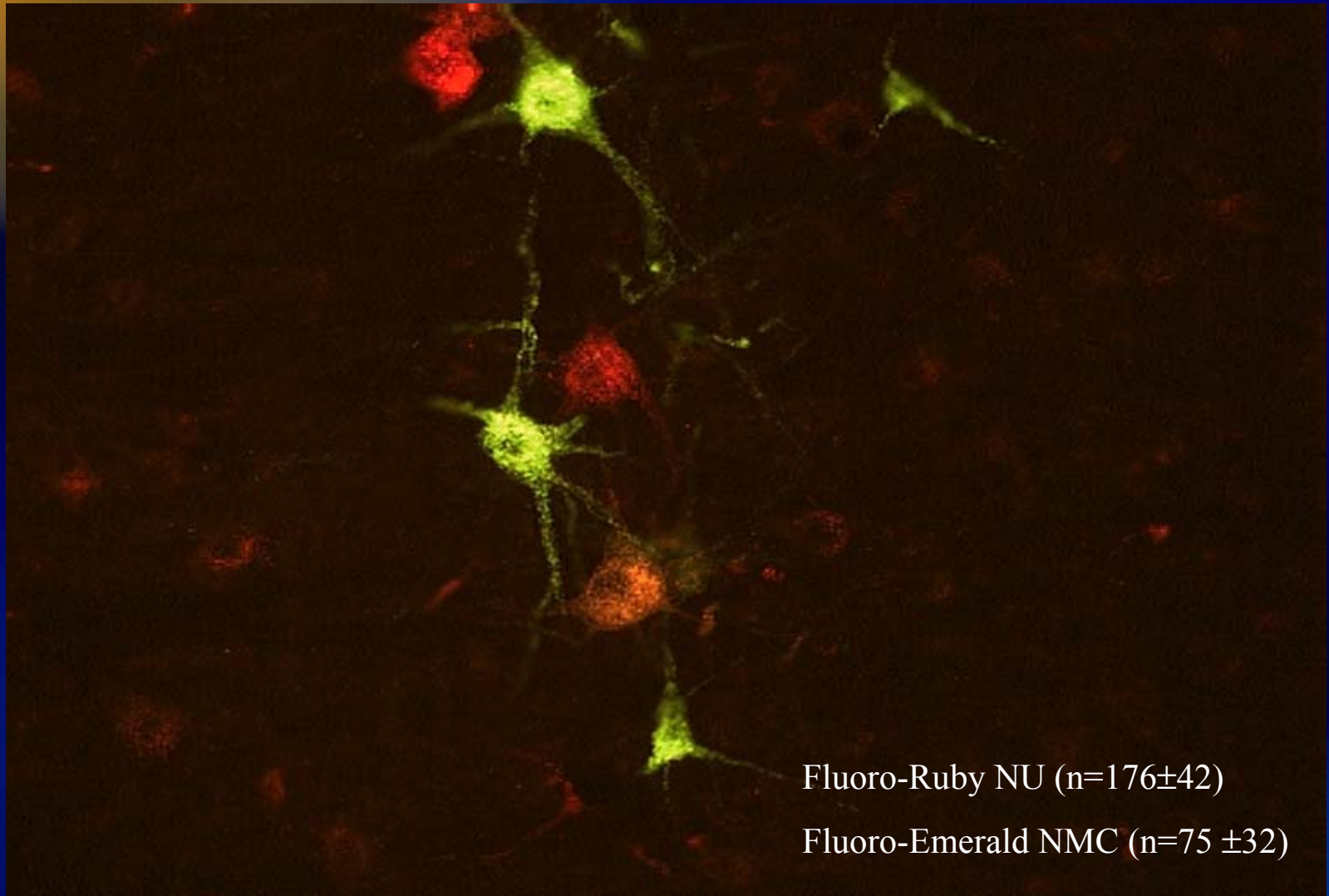
# Relationship between intraoperative response to electrical stimulation of donors and functional recovery

Muscle response to electrical stimulation of donor nerve	Total [n]	Successful [n]	Successful [%]	Average muscle strength [ $\phi \pm SD$ ]
reduced	19	10	53	2,4 $\pm$ 1,4
full	79	43	54	2,4 $\pm$ 1,5
total	98	53	54	2,4 $\pm$ 1,4

# End-to-side neurorrhaphy – experimental model



End-to-side neurorrhaphy n. musculocutaneus  
→ n. ulnaris in rat (cross-section of the spinal cord)

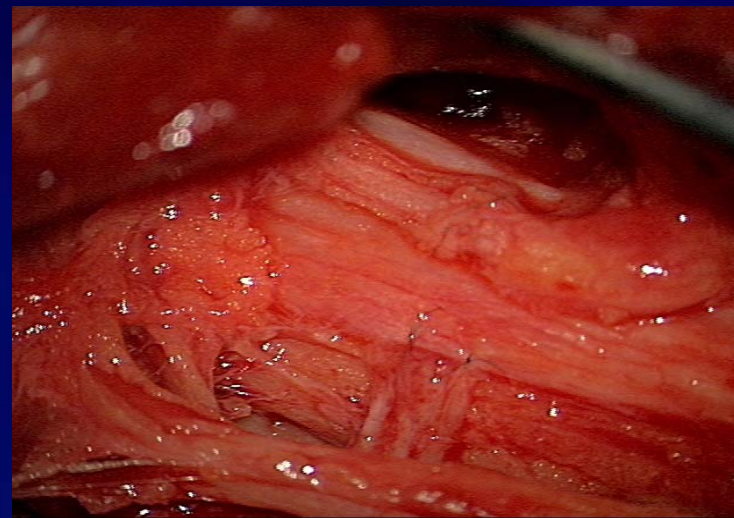
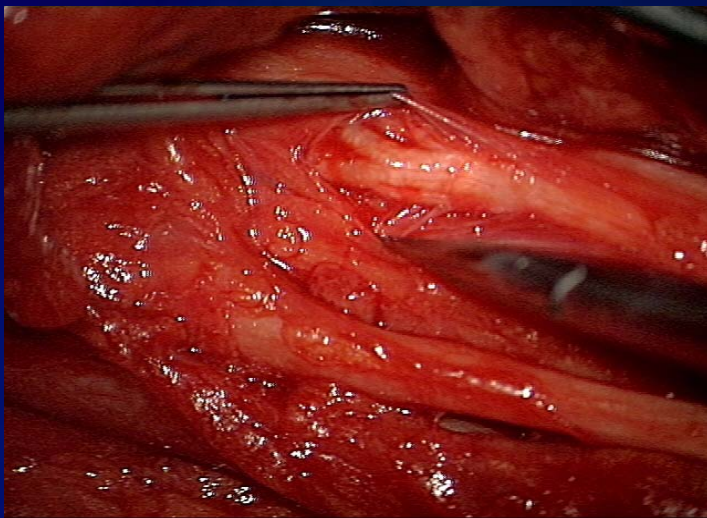
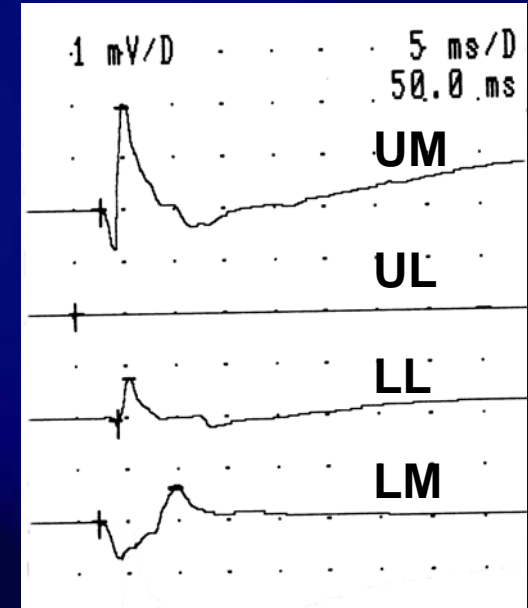
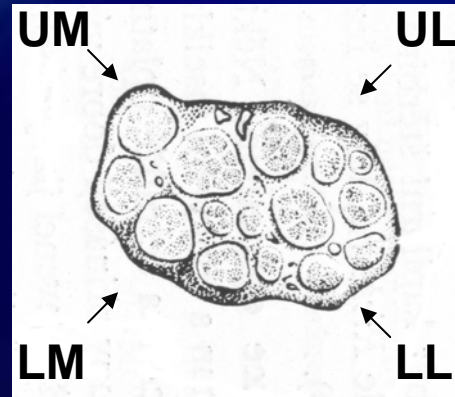
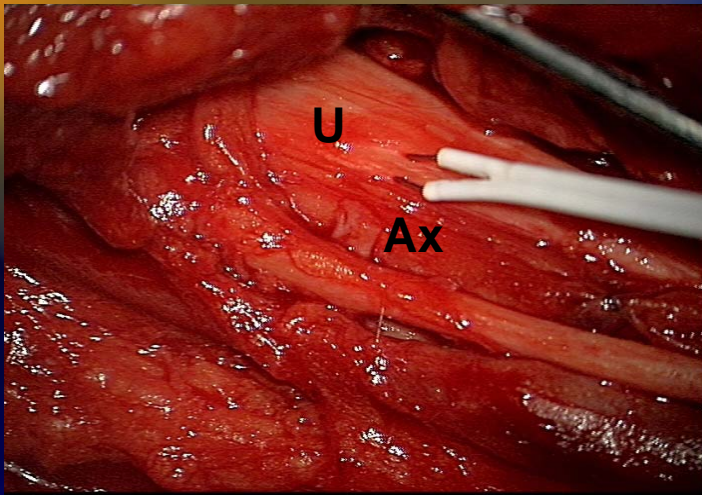


Fluoro-Ruby NU (n=176±42)

Fluoro-Emerald NMC (n=75 ±32)



# End-to-side neurorrhaphy in group of patients



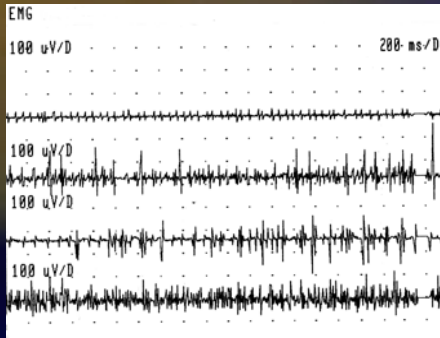
# End-to-side neurorrhaphy – results

- 23 patients have been operated
- 14 patients with follow-up  $\geq 2$  roky
- successful 9 (64%)
- Types of end-to-side neurorrhaphy:

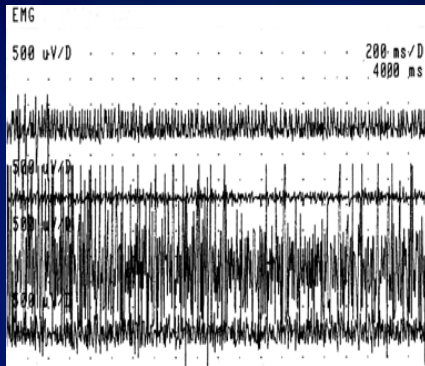
Affected nerve	Donor nerve	[n]
C6	Th1	1
C8,Th1	C5,6	1
n.axillaris	n.ulnaris	8
	n.medianus	8
	n.radialis	1
n.musculocutaneus	n.medianus	2
	n.ulnaris	1
n.ulnaris	n.radialis	1
total		23

# End-to-side neurorrhaphy – postoperative synkinesis

Abduction of arm



Abduction of arm  
+ fist

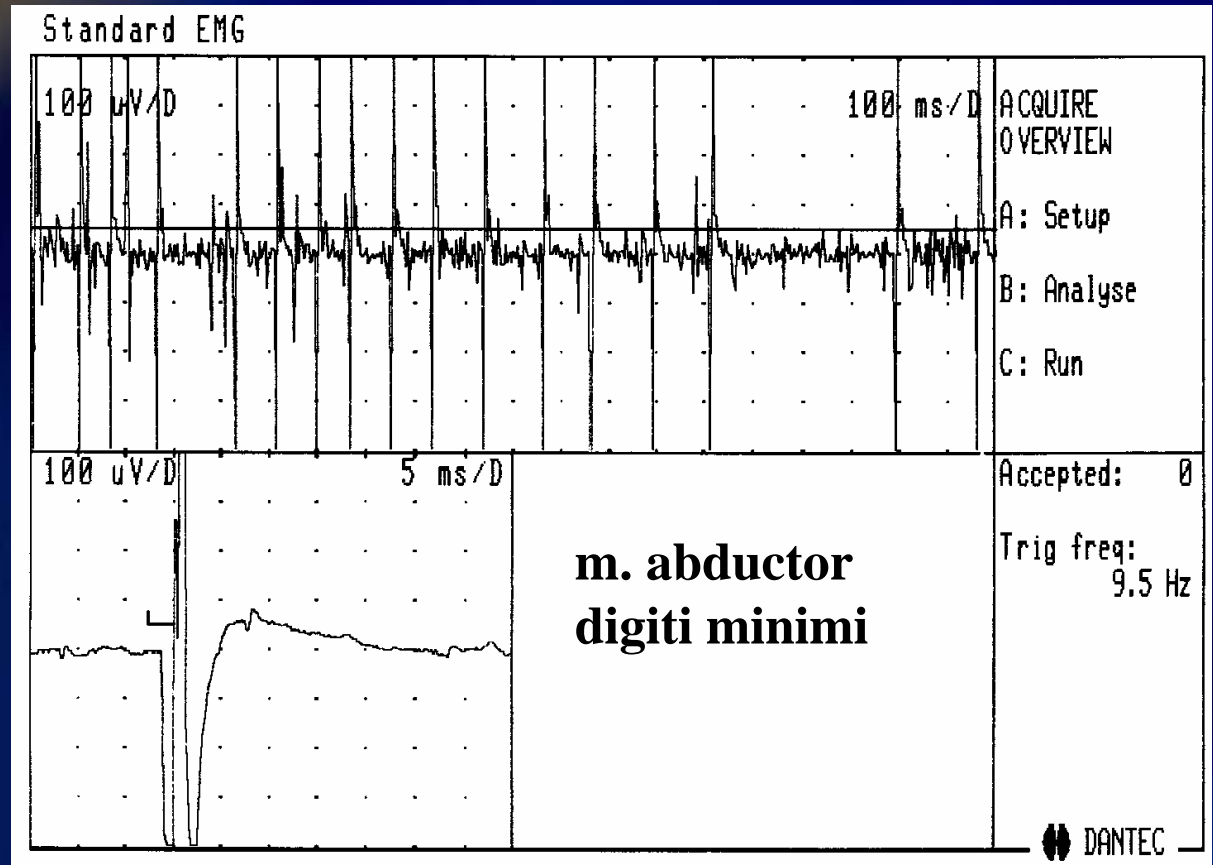


D  
FCU  
ADV  
IDI

D  
FCU  
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# End to side neurorrhaphy – C8, Th1 → C5, C6

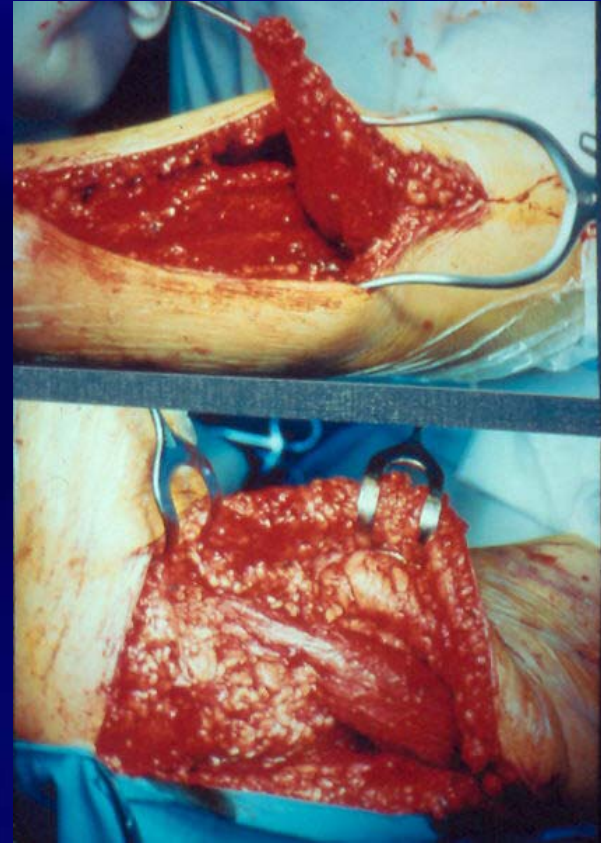




# Types of the muscle transpositions (n=15)

- m. latissimus dorsi → m. biceps brachii (n=5)
- m. flexor carpi ulnaris → m. extensor digitorum (n=5)
- caput longum m. tricipitis brachii → m. biceps brachii (n=4)
- m. flexor carpi radialis → m. extensor pollicis brevis and m. abductor pollicis longus (n=1)

# Anatomical study and operation technique



# Results of muscle transpositions

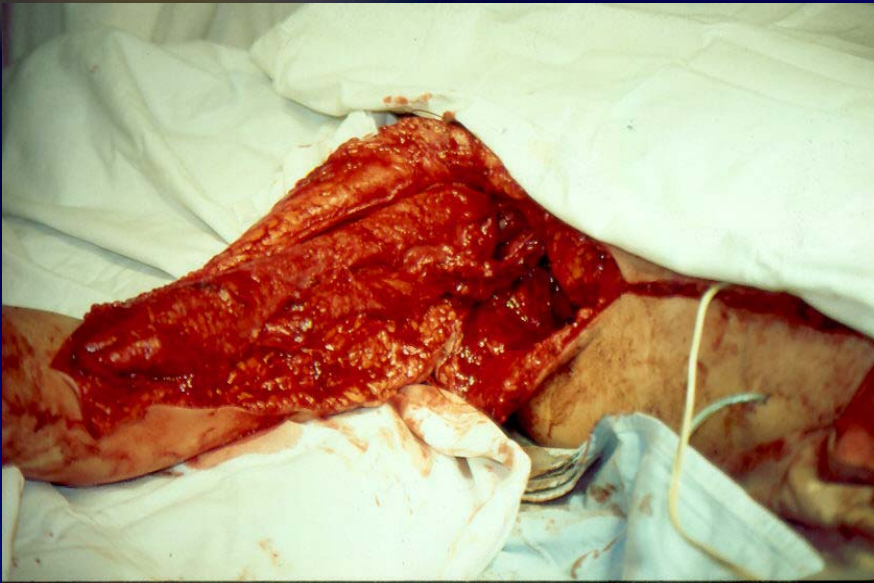
caput longum m. tricipitis brachii → m. biceps brachii





# Results of muscle transpositions

m. latissimus dorsi → m. biceps brachii





# Results of muscle transpositions

m. flexor carpi ulnaris → m. extensor digitorum



# Conclusions

- Functional recovery after nerve transfer procedure strongly depends on the type of donor nerve and better functional recovery was achieved using regional (intraplexal) donors of motor fibers
- There is no relationship between the grade of denervation in muscles innervated by donors and functional recovery after the nerve transfer
- End-to-side neurotomy is a useful method of neurotization in cases, where no other suitable donors are available - overall success rate of end-to-side neurotomy is 64%
- Transposition of muscles is effective method in the treatment of cases, where neither direct repair nor neurotization of nerves is possible (overall success 88.9%)

Thank you for attention !