The role of CC7 in BPI

JST experience

Pengcheng Li, Shufeng Wang
Beijing Jishuitan Hospital
Introduction

Invented by YuDong Gu in 1986

C looped nerve graft

VUNG (vascularized ulnar nerve grafting)

Less satisfactory result

ShuFeng Wang: the shortest route for CC7 transfer

More than 1000 cases

The shortest route

McGuiness and Kay, UK.
Prespinal route 2002

Highlight:
- Longer CC7
- Window inner side to the muscle
- Pass underneath Anterior Scalene
Longer CC7 & the shortest route
Applications

- C5-8 avulsion
  - Nerve graft to upper trunk
  - Oberlin procedure less effective

- C5-T1 avulsion (TBI)
  - Direct anastomosis to lower trunk

- Obstetric BPI
  - Short of remanent root stump (usually only C5)
  - Overcome the sural nerve shortage

Detoid, Biceps, ECRL/B

Biceps and Hand grasp
Indication: C5-8 or C5-T1 avulsion with Nonfunctional SAN or phr.n nerve graft: 6.8±1.9 cm, 5-7 strands

Result: M3+M4 Biceps 85.4%
Deltoid 82.9%
upper Pectoral Major 92.7%
better than distal fascicle transfers when only T1 remain

Table 1. Patient's Numbers with Varied Strength Restoration in Different Muscle at the Latest Follow-up

<table>
<thead>
<tr>
<th>Strength</th>
<th>Biceps</th>
<th>Deltoid</th>
<th>Triceps</th>
<th>UPPM</th>
<th>ECRL and ECRB</th>
<th>FCR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HULA</td>
<td>HULR</td>
<td>HULA</td>
<td>HULR</td>
<td>HULA</td>
<td>HULR</td>
</tr>
<tr>
<td>M4</td>
<td>33</td>
<td>26</td>
<td>30</td>
<td>24</td>
<td>0</td>
<td>37</td>
</tr>
<tr>
<td>M3</td>
<td>2</td>
<td>7</td>
<td>4</td>
<td>6</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>M2</td>
<td>6</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>M0-1</td>
<td>0</td>
<td>6</td>
<td>2</td>
<td>5</td>
<td>13</td>
<td>38</td>
</tr>
</tbody>
</table>

*aUPPM, upper parts of pectoral major; ECRL and ECRB, extensor of carpi radialis longus and brevis; FCR, flexor of carpi radialis; HULA, healthy upper limb adducted; HULR, healthy upper limb relaxed.*
C5-8 avulsion, 3 yrs followup

Ph. n to SSN
CC7 to upper trunk

SAN to SSN
CC7 to upper trunk

Notice the bulky Detoid

External rotation
To get direct coaptation CC7-injured ADLT

- Longer CC7 transection
- Transfer through the shortest route
- Free and mobilize the injured lower trunk and lift up
- Shorten the humeral 3-4.5cm (when necessary)
- Ulnar nerve anterior transposition (when necessary)

Ulnar nerve
Repair rather than Sacrifice
Powerful grasp
More effective than MN
Roughly one half recovered powerful grasping.
Proposal:
Phrenic nerve to PDLT (posterior division of lower trunk)

Finger extension (C8 component)
Elbow extension (long head of Triceps)

Concern about Extensors innervation
CC7 direct coaptation with lower trunk
Phr.N—PDLT

branches and Axi n. cuted off from posterior cord
PIN neurolysis
One Procedure of Neurotization in Total Brachial Plexus Nerve Root Avulsion Injuries

three direct coaptations, five functions

SAS → SSN (shoulder abduction)
CC7 (prespinal route) → ADLT (median nerve (medial part), MABCN (as a nerve graft) → MCN (elbow flexion)
phrenic N. → PDLT (elbow and finger extension)

ADLT, anterior division of lower trunk. PDLT, posterior division of lower trunk.
MABCN, medial antebrachial cutaneous nerve. SAS, spinal accessory nerve.
SSN, superior scapular nerve. MCN, musculocutaneous nerve.
Enhanced MCN repair by another fascicle sural nerve graft in addition to MABC bridging
RESULT

shoulder abduction 48°±25°

Presenting in Narakas Meeting (Barcelona, 2016)

Encouraging results
Still inconvenience daily use even if the nerve recoverd

Secondary Reconstruction Procedure

- Wrist fusion or tenodesis
- Opponensplasty with FCU+tendon graft
- Zancolli MPJ capsulodesis
C5 rupture, C6-T1 avulsion injury
C5 → Suprascapular n./Axillary n.
CC7 → Lower trunk + MCN
Phr. N → Posterior division of lower trunk.
4 ys, TBAI, humeral shorten: 2.5cm SAN-SSN Ph.n.-PDLT CC7-LT+ADUT+Axi. N.(M.A.B.C)
SAN-SSN
Phn—PDLT
CC7-Lower trunk+ADUT (direct coaptation)
Wrist fusion, 6.5ys followup
Independent movement can appear

- Easier for children
- M4+ and frequently daily use

Mechanism still unclear

- The cerebral cortex reorganization
- Get used to the condition

23 years old, TBAI, 3.5 ys postop
SAN-SSN
Ph.n.-PDLT
CC7-LT+MCN(MABC bridging)
1st webservice bone graft
Contralateral C-7 transfer: is direct repair really superior to grafting?

Anil Bhatia, MD,¹ Piyush Doshi, MD,² Ashok Koul, MD,¹ Vitrak Shah, MD,⁴ Justin M. Brown, MD,⁶ and Mahmoud Salama, MD⁶

¹Department of Brachial Plexus Surgery, Deenanath Mangeshkar Hospital, Pune. ²Department of Plastic Surgery, SBKBB Medical Institute and Research Centre, Vadodara. ³Department of Plastic Surgery, Saif Hospital, Bangalore. ⁴Department of Plastic Surgery, Shah Hospital, Surat, India. ⁵Department of Neurosurgery, UC San Diego Health, San Diego, California; and ⁶Department of Orthopaedics, Awan University, Awan, Egypt

TABLE 1. Characteristics of patients in the direct coaptation group

<table>
<thead>
<tr>
<th>Group</th>
<th>Age (yrs)</th>
<th>Preep Denervation Time (mos)</th>
<th>Follow-Up (mos)</th>
<th>Finger &amp; Wrist Flexion MRC Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1⁴</td>
<td>29</td>
<td>2</td>
<td>38</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>24</td>
<td>2</td>
<td>30</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>29</td>
<td>3</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>1</td>
<td>31</td>
<td>2</td>
</tr>
<tr>
<td>5⁵</td>
<td>23</td>
<td>3</td>
<td>33</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>17</td>
<td>1</td>
<td>27</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>31</td>
<td>3</td>
<td>33</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>18</td>
<td>2.5</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>20</td>
<td>6.5</td>
<td>23</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>23</td>
<td>6</td>
<td>24</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>35</td>
<td>3</td>
<td>24</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>20</td>
<td>4</td>
<td>23</td>
<td>2</td>
</tr>
</tbody>
</table>

* Shortening of the humerus was not required.

FIG. 4. At 36 months after direct cC-7 repair for trunk, from a neutral position (A), this patient is well, easily overcoming gravity (B). This is done contralateral limb.

TABLE 2. Characteristics of patients in the nerve graft group

<table>
<thead>
<tr>
<th>Group</th>
<th>C-7 Nerve Graft Group</th>
<th>Age (yrs)</th>
<th>Preep Denervation Time (mos)</th>
<th>Follow-Up (mos)</th>
<th>Finger &amp; Wrist Flexion MRC Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>cC-7 Direct Coaptation Group</td>
<td>15</td>
<td>6.5</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>cC-7 Direct Coaptation Group</td>
<td>24</td>
<td>1.5</td>
<td>35</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>cC-7 Direct Coaptation Group</td>
<td>24</td>
<td>2</td>
<td>34</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>cC-7 Direct Coaptation Group</td>
<td>21</td>
<td>2</td>
<td>36</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>cC-7 Direct Coaptation Group</td>
<td>19</td>
<td>1.5</td>
<td>31.5</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>cC-7 Direct Coaptation Group</td>
<td>24</td>
<td>2.5</td>
<td>29</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>cC-7 Direct Coaptation Group</td>
<td>19</td>
<td>11</td>
<td>28</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>cC-7 Direct Coaptation Group</td>
<td>27</td>
<td>4</td>
<td>26</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>cC-7 Direct Coaptation Group</td>
<td>24</td>
<td>7</td>
<td>23</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>cC-7 Direct Coaptation Group</td>
<td>27</td>
<td>6</td>
<td>26</td>
<td>2</td>
</tr>
</tbody>
</table>

TABLE 3. Comparison of finger and wrist flexion outcomes between the 2 groups

<table>
<thead>
<tr>
<th>Finger &amp; Wrist Flexion MRC Grade</th>
<th>cC-7 Direct Coaptation Group</th>
<th>cC-7 Nerve Graft Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>10 (83.3%)</td>
<td>2 (20%)</td>
</tr>
<tr>
<td>2</td>
<td>2 (16.6%)</td>
<td>7 (70%)</td>
</tr>
<tr>
<td>0</td>
<td>—</td>
<td>1 (10%)</td>
</tr>
</tbody>
</table>

* Shortening of the humerus was not required.
whole CC7 is Saft and expendable

- Semi-CC7 means less fascicles and less effective
- Temporary Index finger numbness or hyperalgesia
- Temporary weakness of EDC and Triceps
- Loss of flexion or intrinsic may due to wrong transection or variations
MERCI !

Alain Gilbert

Merry Christmas

Happy New Year