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PICTURES TO BE ADDED:
- position of the distal motors in the forearm
- section of the little or ring finger
- lateral view of the arm

TOOLS TO BE USED
- coated steel wire (Cod U7194561 Carl Stahl)
- uncoated steel wire (Cod CG077063 Carl Stahl)
- teflon tube (Cod ?????????????????)
- steel spring tubes (Cod ?????????????????)
- precision grippers
- set of small screwdrivers
- cyanoacrylic glue
- steel wire cutter
- set of hexagonal screw drivers
- power grippers
- tensioners (tube version: CAD code ?????????????)
1. Basic Principles

In the following document we describe how to connect the hand joints with the motors positioned in the forearm. The basic scheme is very simple and based on the following ideas.

− Each motor rotates a pulley (P)
− A (optionally coated) cable is twined around the pulley. The cable is fixed to the pulley by passing through a hole in the pulley (H).
− The cable exits the motor by passing through holes H1 and H2.
− The cable enters into a tube (T1, T2, T3, T4) which guides its path through the wrist. All the tubes are positioned on suitable sockets in correspondence of the holes (H1, H2).
− Optionally the cable passes through tensioners (Te1 and Te2) in between T1/T2 and T3/T4. Again the tensioners are provided with suitable sockets.
− The cable exits the tube by entering into holes H3 and H4 once more equipped with suitable sockets for the tubes.
Figure 1-2 Motor case

Figure 1-1 Finger holes

Figure 1-3 Motor pulley

Figure 1-4
2. General Rules to be Followed

1. When mounting cables, pay attention to the fact that rotating the motor in a clockwise direction should correspond to a closure of the finger. The definition of clockwise rotation is given in the picture. This rule is valid for all joints but distal joints; in the case of distal joints the closure of joints depends on some issues that will be discussed later on.
3. General Tips and Tricks

- The uncoated cable is a bundle of smaller wires. When the cable is cut, this bundle may be corrupted (especially at the cable ending) by trying to pass the cable trough holes. A drop of glue on the cable ending may be useful.

- Ideally the cable should be twined around the pulley P (see Figure 1-3) exactly at the middle of it. In particular, when the joint is in the middle of its range of movements the cable should leave the pulley P exactly at the level of the holes H1 and H2 (see Figure 1-2). If this is not the case, the friction of the cable at the level of H1 and H2 may break the cable after short usage.

- Always check that the tubes are inside their sockets. If this is not the case cables will break easily due to high friction in correspondence of the input and output holes.

- The tension of the cable is fundamental for having fingers working correctly. Always consider the possibility of using tensioners for increasing the cable tension.
4. Finger cables description

4.1 thumb_oppose: SxThOp and DxThOp

<table>
<thead>
<tr>
<th>SxThOp</th>
<th>Label</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor</td>
<td>1B3M0 (SxThAb) and 2B3M0 (DxThAb)</td>
<td></td>
</tr>
<tr>
<td>Cable</td>
<td>Carl Stahl CG077063</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T1</th>
<th>Total length:</th>
<th>S0</th>
<th>Exits the motor case from the hole near the motor (H2). Enters the finger in the hole which is internal to the palm (H3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2</td>
<td>50[mm]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T3</td>
<td>Total length:</td>
<td>S2</td>
<td>Exits the motor case from the hole near the bearing (H1). Enters the finger in the hole which external to the palm (H4)</td>
</tr>
<tr>
<td>----</td>
<td>---------------</td>
<td>----</td>
<td>-----------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>T4</td>
<td>57[mm]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Take a piece of non coated cable (more or less 40cm).
2. Pass the cable trough the hole (H) in the pulley. Optionally you can block the cable on the pulley putting a drop of cyanoacrylic glue into the hole.
3. Twine the cable on the pulley. The number of turns around the pulley has to be decided on the basis of the entrance and exit holes (H1 and H2): the cable should enter the holes tangentially.
4. Insert the cable extremities, E1 and E2, in holes H1 and H2 respectively.
5. Pass E1 trough the tube T1. Pass E2 trough T2. Position the extremities of the tube on the sockets of the holes H1 and H2 in the motor support. Note: the tube extremity should be inserted correctly in its socket.
6. Pass E1 trough the tensioner and insert the tube T1 extremity in one of the tensioner socket. Pass E2 trough the tensioner and insert the tube T2 extremity in one of the tensioner socket.
9. Put the thumb opposition in its fully extended limit. Twine E1 around the pulley P1. Pass the cable ending E1 trough the hole H6 and exit from H5. Tension the cable by pulling E1 strongly. Check that all the tube extremities are inside their sockets. Pass the cable ending E2 trough the hole H7 and exit from H5. Tension the cable pulling E2. Note: if inserting the cable into H6 and H7 results difficult, the thumb should be removed from
the palm by unscrewing S3 and S4. Additionally after this operation the pulley P1 can be
made more accessible by rotating it around the spindle Pin1.

10. Maintain the thumb opposition in its fully extended limit. Pull E2 (the part of the tendon
actuating the thumb opposition extension) and block the cable on the joint with the screw
S2. Note: do not block the cable with the screw S1.

11. Increase the cable tension with the help of the motor. First try understand in which
direction the motor should rotate to extend the thumb. Rotate the motor in this direction
by applying an increasing voltage up to 5V. Since the thumb was already fully extended
you should not observe any evident movement. The only effect of this procedure is to
increase the tension of one side of the cable. Maintain the 5V until the system is
stationary.

12. Pull E1 in order to give tension to the other side of the cable. While pulling block the
cable with S1.

13. Remove the power supply from the motor thus observing the tension distributing equally
on both sides of the cable.
4.2 **hand_finger: SxFAb and DxFAb**

<table>
<thead>
<tr>
<th>Label</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor</td>
<td>1B2M3 (SxFAb) and 2B2M3 (DxFAb)</td>
</tr>
<tr>
<td>Cable</td>
<td>Carl Stahl CG077063</td>
</tr>
</tbody>
</table>

- T1 38(mm) T0
- T2 27(mm) T2
- T3 38(mm) T3
- T4 44(mm) T4

1. Take a piece of non coated cable (more or less 40cm).
2. Pass the cable trough the hole (H) in the pulley. Optionally you can block the cable on the pulley putting a drop of cyanoacrylic glue into the hole.
3. Twine the cable on the pulley. The number of turns around the pulley has to be decided on the basis of the entrance and exit holes (H1 and H2): the cable should enter the holes tangentially.
4. Insert the cable extremities, E1 and E2, in holes H1 and H2 respectively.
5. Pass E1 trough the tube T1. Pass E2 trough T2. Position the extremities of the tube on the sockets of the holes H1 and H2 in the motor support. Note: the tube extremity should be inserted correctly in its socket.
6. Pass E1 trough the tensioner and insert the tube T1 extremity in one of the tensioner socket.
7. Pass E1 trough the tube T3.
9. Twine E1 around the pulley P1. Pass the cable ending E1 trough the hole H7 and exit from H8. Block the cable on the pulley with the screw S9. **Note:** if passing trough H7 and H8 is complicated, unscrew S1 and S5 so as to remove the finger from the palm. After this operation the pulley can be made more accessible by rotating it around the pin Pin1.
11. Twine E2 around the pulley P2. Pass the cable ending E2 trough the hole H9 and exit from H10. Block the cable on the pulley with the screw S10. **Note:** if passing trough H9 and H10 is complicated, unscrew S4 and S8 so as to remove the finger from the palm. After this operation the pulley can be made more accessible by rotating it around the pin Pin2.
12. Twine E2 around the pulley P3.
13. Twine E2 around the pulley P4. Pass the cable ending E2 trough the hole H11 and exit from H12. Block the cable on the pulley with the screw S11. **Note:** if passing trough H9 and H10 is complicated, unscrew S3 and S7 so as to remove the finger from the palm. After this operation the pulley can be made more accessible by rotating it around the pin Pin3.
15. Pass E2 trough the tube T4. Position the extremity of the tube on the socket of the hole H5. Note: the tube extremity should be inserted correctly in its socket.
17. Twine E2 around the pulley P1. Pass the cable ending E2 trough the hole H13 and exit from H14. Block the cable on the pulley with the screw S12. **Note:** if passing trough H13 and H14 is complicated, unscrew S1 and S4 so as to remove the finger from the palm. After this operation the pulley can be made more accessible by rotating it around the pin Pin1.

18. Unscrew all the screws blocking the cable on the pulleys (S9, S10, S11 and S12). Note that this operation can be done only at a specific configuration of the fingers At this configuration the screws are accessible thanks to suitable holes on the palm.

19. Tension the cable E1 by pulling the cable ending. Check that the tube is inside its sockets at H1 and H3. Block the cable with the screw S9.

20. Tension the cable E2 by pulling the cable ending. Check that the tube is inside its sockets at H4, H5 and H6. Block the cable with the screw S10, S11 and S12.

**TIPS and TRICKS:**
- Tensioning the cable is very important. Even when all the screws are not tight, it may results difficult to tension the cable in all its parts. This is due to the sharp edges of the pulley which do not allow a uniform distribution of the tension.
4.3 thumb_proximal: SxThPrx and DxThPrx

<table>
<thead>
<tr>
<th>Motor</th>
<th>1B3M1 (SxThPrx) and 2B3M1 (DxThPrx)</th>
<th>Label</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable</td>
<td>Carl Stahl CG077063</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>74(mm)</td>
<td>6+S</td>
<td>Exits the motor case from the hole near the bearing (H1)</td>
</tr>
<tr>
<td>T2</td>
<td>74(mm)</td>
<td>6-S</td>
<td>Exits the motor case from the hole near the motor (H2)</td>
</tr>
<tr>
<td>T3</td>
<td>124(mm)</td>
<td>6+L</td>
<td>Enters the finger in the hole near the other fingers(H3)</td>
</tr>
<tr>
<td>T4</td>
<td>124(mm)</td>
<td>6-L</td>
<td>Enters the finger in the hole near the wrist (H4)</td>
</tr>
</tbody>
</table>

1. Take a piece of non coated cable (more or less 40cm).
2. Pass the cable trough the hole (H) in the pulley. Optionally you can block the cable on the pulley putting a drop of cyanoacrylic glue into the hole.
3. Twine the cable on the pulley. The number of turns around the pulley has to be decided on the basis of the entrance and exit holes (H1 and H2): the cable should enter the holes tangentially.
4. Insert the cable extremities, E1 and E2, in holes H1 and H2 respectively.
5. Pass E1 trough the tube T1. Pass E2 trough T2. Position the extremities of the tube on the sockets of the holes H1 and H2 in the motor support. Note: the tube extremity should be inserted correctly in its socket.
6. Pass E1 trough the tensioner Te1 and insert the tube T1 extremity in one of the tensioner socket. Pass E2 trough the tensioner Te2 and insert the tube T2 extremity in one of the tensioner socket.
9. Twine the cable E1 around the pulley P1 (see detailed picture for the tendon path) and enter the hole H5 with the cable end E1 and exit from H7.
10. Twine the cable E2 around the pulley P1 (see detailed picture for the tendon path) and enter the hole H6 with the cable end E2 and exit from H8.
11. Pull the extremity E1 and check that all the tubes are inside their sockets. Tie in a knot at the level of the hole H7. Rotate the motor in a clock wise manner (see picture in section “RULES TO BE FOLLOWED”) so as to close the finger till its hardware limit. In order to increase the cable tension rotate the motor with an external power supply (more or less 5V) always in a clock wise direction.
12. Pull the extremity E2 and check that all the tubes are inside their sockets. Tie in a knot at the level of the hole H8. This knot should be done as close as possible to the hole H8.
13. Remove the external power supply.
Figure 4-22

Figure 4-21

Figure 4-23

Figure 4-24

Figure 4-26

Figure 4-25

H1
H2

H3
H4

1B3M1

2B3M1

Te1
T4
T3
Te2
T1
T2

H
P
4.4  humb_distal: SxThDst and DxThDst

<table>
<thead>
<tr>
<th>Motor</th>
<th>1B3M2 (SxThDst) and 2B3M2 (DxThDst)</th>
<th>Label</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable</td>
<td>U7194561 Carl Stahl</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>132(mm)</td>
<td>4</td>
<td>Exits the motor case from the hole inside the forearm (H1).</td>
</tr>
</tbody>
</table>

Take a piece of coated cable (more or less 40cm).

1. Tie in a knot at the extremity E2 of the cable.
2. Pass the cable trough the hole (H) in the pulley (P).
3. Pass the cable trough the hole H1 of the motor support. Position the knot at the extremity E2 on its socket S1 which is positioned on the pulley P.
4. Pass E1 trough the tube T1. Note: the tube extremity should be inserted correctly in its socket.
5. Pass E1 trough the hole H2. Position the tube extremity on its socket in H2.
6. Perform a complete 360 deg turn around the pulley P1 (see the detailed picture).
7. Pass E1 trough the hole H3 and exit trough the hole H4.
8. Perform a complete 360 deg turn around the pulley P2 (see the detailed picture).
9. Pass E1 trough the hole H5 and exit trough the hole H6. Note: the hole H6 is on a piece of metal that was designed to be mounted with strain gauges in order to measure the cable tension.
10. Pull the extremity E1 and be sure that all tubes extremity are all inside their sockets.
11. Tie in a knot at the extremity E1 as close as possible to the hole H6.
12. Rotate the motor and check that the finger extension works correctly. Note: sometimes the finger extension does not work properly because of the cable friction in correspondence of the pulleys P1 and P2.

TIPS and TRICKS:
- The knot of the finger proximal joint movement may increase the friction in correspondence of the cable at the position where the cable exits the hole H2. Always check that this is not the case.
- The joint can be moved by rotating the motor either in a clockwise or in a counter clock wise direction. However, only one of the two directions will correspond to a correct alignment of the cable with the hole H1. Always check that the cable is working properly (see pictures below: gray cable=correct, red cable= wrong) and that the motor rotates in the correct direction to close the finger(green=correct closure rotation, red = wrong closure rotation).
- The motor housing has two different holes (H1 and H1bis) which can be potentially used. Choose the one that will not be closed by the forearm support when the motor will be mounted.
### 4.5 index_proximal: SxIndPrx and DxIndPrx

<table>
<thead>
<tr>
<th>Motor</th>
<th>Label</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable</td>
<td>Carl Stahl CG077063</td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>80(mm)</td>
<td>8+S</td>
</tr>
<tr>
<td>T2</td>
<td>60(mm)</td>
<td>8-S</td>
</tr>
<tr>
<td>T3</td>
<td>125(mm)</td>
<td>8+L</td>
</tr>
<tr>
<td>T4</td>
<td>140(mm)</td>
<td>8-L</td>
</tr>
</tbody>
</table>

![Figure 4-38](image1.png)  ![Figure 4-37](image2.png)
### 4.6 index_distal: SxIndDst and DxIndDst

<table>
<thead>
<tr>
<th>Motor</th>
<th>1B4M0 (SxIndDst) and 2B4M0 (DxIndDst)</th>
<th>Label</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable</td>
<td>U7194561 Carl Stahl</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>140(mm)</td>
<td>5</td>
<td>Exits the motor case from the hole inside the forearm (H1).</td>
</tr>
</tbody>
</table>

![Diagram showing motor case and forearm hole](image)
### 4.7 middle_proximal: SxMidPrx and DxMidPrx

<table>
<thead>
<tr>
<th>Motor</th>
<th>1B4M1 (SxMidPrx) and 2B4M1 (DxMidPrx)</th>
<th>Label</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable</td>
<td>Carl Stahl CG077063</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>75(mm)</td>
<td>7+S</td>
<td>Exits the motor case from the hole near the bearing (H1)</td>
</tr>
<tr>
<td>T2</td>
<td>60(mm)</td>
<td>7-S</td>
<td>Exits the motor case from the hole near the motor (H2)</td>
</tr>
<tr>
<td>T3</td>
<td>125(mm)</td>
<td>7+L</td>
<td>Enters the finger in the hole close to the palm side (H3)</td>
</tr>
<tr>
<td>T4</td>
<td>143(mm)</td>
<td>7-L</td>
<td>Enters the finger in the hole close to the back of the hand side (H4).</td>
</tr>
</tbody>
</table>

![Figure 4-39](image1.png)

![Figure 4-40](image2.png)
4.8 middle_distal: SxMidDst and DxMidDst

<table>
<thead>
<tr>
<th>Motor</th>
<th>1B4M2 (SxMidDst) and 2B4M2 (DxMidDst)</th>
<th>Label</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable</td>
<td>U7194561 Carl Stahl</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>135(mm)</td>
<td>3</td>
<td>Exits the motor case from the hole inside the forearm (H1).</td>
</tr>
</tbody>
</table>
### 4.9 pinky: SxRngLit and DxRngLit

<table>
<thead>
<tr>
<th>Motor</th>
<th>1B4M3 (SxRngLit) and 2B4M3 (DxRngLit)</th>
<th>Label</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable</td>
<td>Carl Stahl CG077063 (slider movement) U7194561 Carl Stahl (from slider to fingers)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>60(mm)</td>
<td>0-S or 0-</td>
<td>Exits the motor case from the hole closer to the motor. Enters the hole in the slider near the hand (H5)</td>
</tr>
<tr>
<td>T2</td>
<td>73(mm)</td>
<td>0+S</td>
<td>Enters the hole in the slider near the elbow (H4)</td>
</tr>
<tr>
<td>T3</td>
<td>80(mm)</td>
<td>0+L</td>
<td>Exits the motor case from the hole close to the bearing.</td>
</tr>
<tr>
<td>T4</td>
<td>112(mm)</td>
<td>2</td>
<td>Exits from the slider (H10) and enters the finger which is closer to the hole.</td>
</tr>
<tr>
<td>T5</td>
<td>112(mm)</td>
<td>9</td>
<td>Exits from the slider (H10) and enters the finger which is closer to the hole.</td>
</tr>
</tbody>
</table>

This join differs from the others since its movement is realized with a slider. The motor rotates so as to move the slider (clockwise rotations correspond to moving the slider proximally, i.e. closer to the elbow). The slider pulls a couple of wires so as to close the ring and little fingers.

Let's first describe how to mount the cables that will move the slider mounted on the forearm.

1. Take a piece of non coated cable (more or less 40cm).
2. Pass the cable trough the hole (H) in the pulley. Optionally you can block the cable on the pulley putting a drop of cyanoacrylic glue into the hole.
3. Twine the cable on the pulley. The number of turns around the pulley has to be decided on the basis of the entrance and exit holes (H1 and H2): the cable should enter the holes tangentially.
4. Insert the cable extremities, E1 and E2, in holes H1 and H2 respectively.

5. Pass E1 trough the tube T1. Pass E2 trough T2. Position the extremities of the tube on the sockets of the holes H1 and H2 in the motor support. Note: the tube extremity should be inserted correctly in its socket.

6. Pass E1 trough the tensioner Te1 and insert the tube T1 extremity in one of the tensioner socket.

7. Pass E1 trough the tube T3.


10. Pull the extremity E1 and check that all the tubes are inside their sockets. Tie in a knot (on the cable side E1) at the level of the hole H6. Rotate the motor in a clock wise manner so as to move the slider closer to the elbow. In order to increase the cable tension rotate the motor with an external power supply (more or less 5V) always in a clock wise direction.

11. Pull the extremity E2 and check that all the tubes are inside their sockets. Tie in a knot at the level of the hole H7. This knot should be done as close as possible to the hole H8.

12. Remove the external power supply.

Let's now describe how to set up the cables that will pull the tendons that close the fingers thanks to the slider movements.

1. Take a piece of coated cable (more or less 15cm). Tie in a knot at one extremity. Pass the other extremity (E1) trough the hole H8. and pull it so as to move the knot on H8. -- Take a second piece of coated cable. Tie in a knot at one extremity. Pass the other extremity (E2) trough the hole H9. and pull it so as to move the knot on H9.

2. Pass E1 trough the hole H10. -- Pass E2 trough the hole H11.

3. Insert E1 trough the tube T4. Position the tube extremity on the socket in H10. --Insert E2 trough the tube T5. Position the tube extremity on the socket in H11.

Let's now restrict to one of the two fingers (either pinky or ring). Similar operations should be repeated for the other finger.

4. Pass E1 trough the hole H12. Position the tube extremity on its socket in H12.

5. Perform a complete 360 deg turn around the pulley P1 (see the detailed picture).

6. Pass E1 trough the hole H13 and exit trough the hole H14.

7. Perform a complete 360 deg turn around the pulley P2 (see the detailed picture).

8. Pass E1 trough the hole H15 and exit trough the hole H16.

9. Perform a complete 360 deg turn around the pulley P3 (see the detailed picture).

10. Pass E1 trough the hole H17 and exit trough the hole H18. **Note:** the hole H18 is on a piece of metal that was designed to be mounted with strain gauges in order to measure the cable tension.

11. Pull the extremity E1 and be sure that all tubes extremity are all inside their sockets.

12. Tie in a knot at the extremity E1 as close as possible to the hole H16.

13. Rotate the motor and check that the finger extension works correctly.
### Table of cables lengths

<table>
<thead>
<tr>
<th>Joint</th>
<th>Finger closure guide length [mm] [Symbol +]</th>
<th>Finger aperture guide length [mm] [Symbol -]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without tensioner</td>
<td>With tensioner (10mm)</td>
</tr>
<tr>
<td>Thumb proximal (Num. 6)</td>
<td>(6+) 208</td>
<td>(6+L) 124</td>
</tr>
<tr>
<td></td>
<td>(6+S) 74</td>
<td>(6-L) 124</td>
</tr>
<tr>
<td>Index proximal (Num. 8)</td>
<td>(8+) 213</td>
<td>(8+L) 125</td>
</tr>
<tr>
<td></td>
<td>(8+L) 125</td>
<td>(8-L) 140</td>
</tr>
<tr>
<td>Middle proximal (Num. 7)</td>
<td>(7+) 205</td>
<td>(7+L) 125</td>
</tr>
<tr>
<td></td>
<td>(7+S) 75</td>
<td>(7-L) 143</td>
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<tr>
<td>Sleigh (Num. 0)</td>
<td>(0+) 80</td>
<td>(0+L) 80 (exits from the slider)</td>
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<tr>
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<td>(0+S) 73</td>
<td>(0-S) 60</td>
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<tr>
<td>Index Distal (Num. 5)</td>
<td>140</td>
<td>-</td>
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<tr>
<td>Thumb Distal (Num 4)</td>
<td>132</td>
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<tr>
<td>Middle Distal (Num 3)</td>
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<td>-</td>
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<tr>
<td>Ring Distal (Num 2)</td>
<td>112</td>
<td>-</td>
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<tr>
<td>Pinky Distal (Num 9)</td>
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<tr>
<td>Finger Abduction (T4)</td>
<td>44</td>
<td>Diagonal holes on the motor</td>
</tr>
<tr>
<td>Finger Abduction (T0)</td>
<td>38</td>
<td>Diagonal holes on the motor</td>
</tr>
<tr>
<td>Finger Abduction (T3)</td>
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<td>Finger Abduction (T2)</td>
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<td>Diagonal holes on the motor</td>
</tr>
<tr>
<td>Thumb abduction (S0)</td>
<td>50</td>
<td>Holes in the back of the palm</td>
</tr>
<tr>
<td>Thumb abduction (S2)</td>
<td>57</td>
<td>Holes in the back of the palm</td>
</tr>
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