ETH zürich

Soft Robotics Laboratory

Assembling the ORCA v1 Robotic Hand

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D MAVT

ORCA v1 Robotic Hand

ORCA v1 features [1]

Open-source
Reliable
Cost-effective
Anthropomorphic Robotic Hand

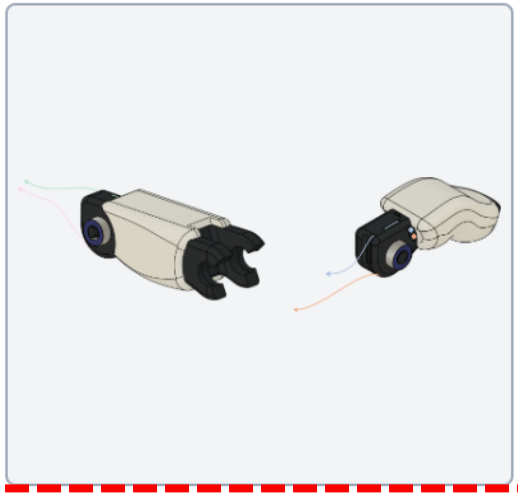
- Tendon driven
- 17 independent degrees of freedom (DoF)
- Soft silicone skin

1. Clemens C. Christoph, Maximilian Eberlein, Filippos Katsimalis, Arturo Roberti, Aristotelis Sympetheros, Michel R. Vogt, Davide Liconti, Chenyu Yang, Barnabas Gavin Cangan, Ronan J. Hinchet, and Robert K. Katzschmann. Orca: An open-source, reliable, cost-effective, anthropomorphic robotic hand for uninterrupted dexterous task learning. arXiv preprint arXiv:2504.04259, 2025.

Assembly Instructions

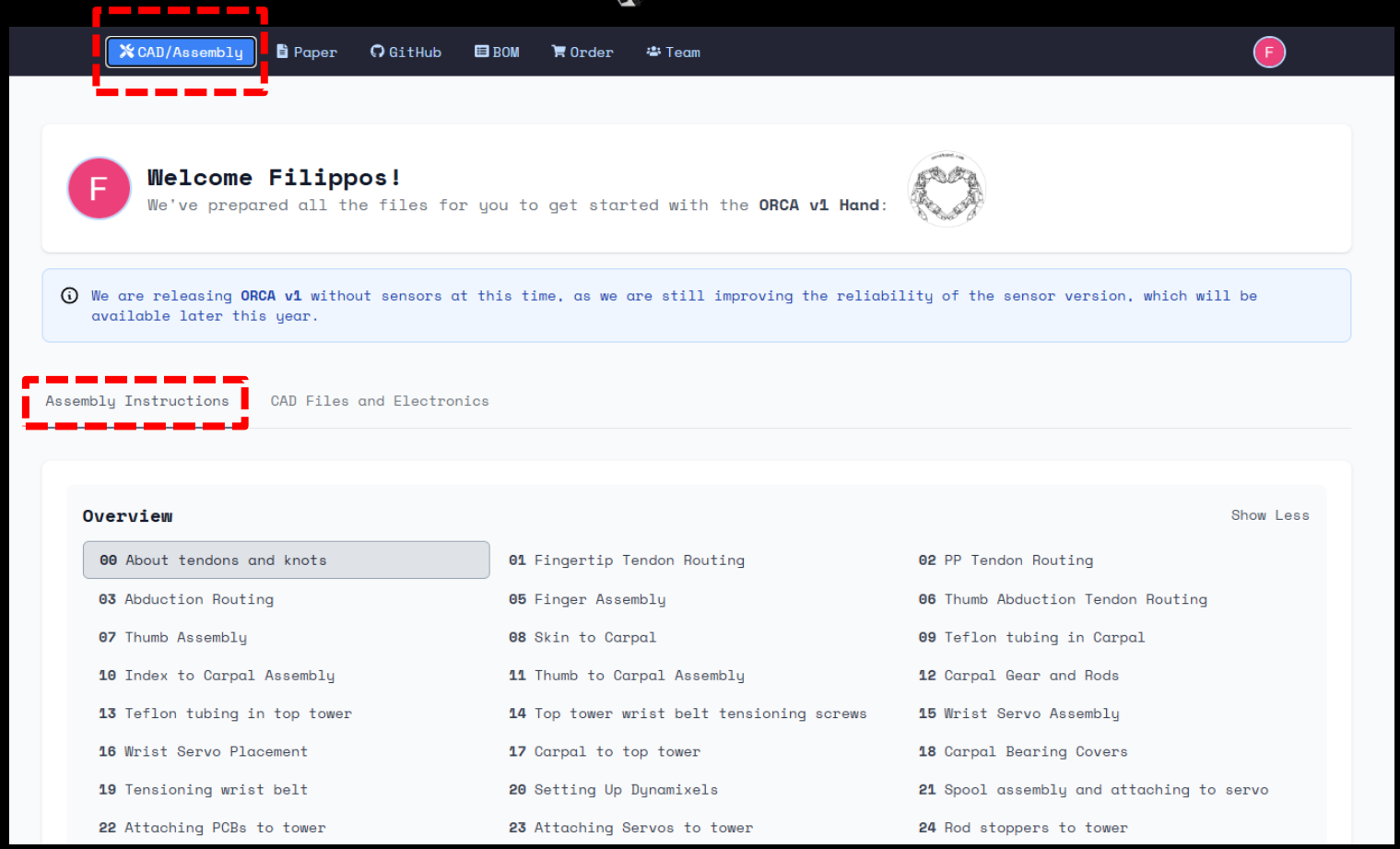
Overview | Preparation | Dividing Tasks | Tips

Please read the text under each picture carefully to avoid mistakes



The tendons are color coded to help you identify them. **Remember:** All tendons should be cut with a sharp blade. If they are frayed, they will not fit through the holes.

www.orcahand.com > CAD/Assembly



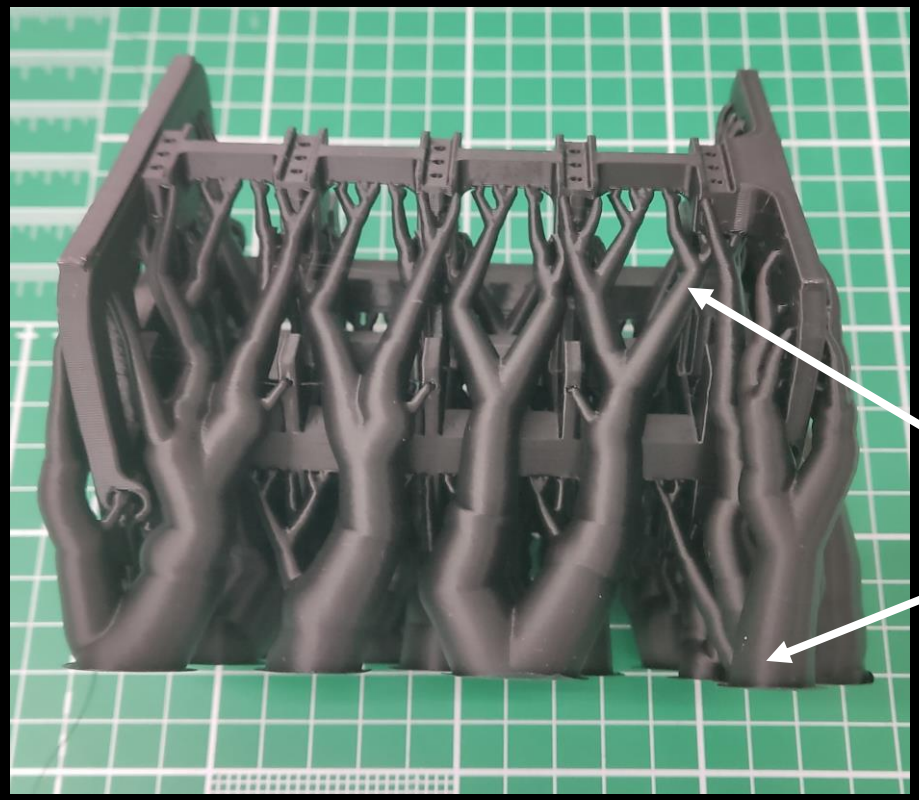
Additional Hardware

Item	Quantity	Comments
Tendon	16m	
PCB Motor Connectors	12	Later this week
Cooling Fans	2	Later this week
Dowel Pin 2x6mm	15	
Dowel Pin 4x10mm	1	
Threaded Rods M6x130mm	2	Later this week
M6 Nut for Threaded Rods	4	
Screw M4x16mm	2	
Screw M4x14mm	4	
Washer M4	6	
Nut M4 Hexagonal	4	
Nut M4 Square	2	
Dowel Pin 3x50mm	2	
Nut M2 Hexagonal	16	
Screw M2x10mm	16	
Washer M2	20	
Screw M2x4mm	68	
Screw M1.7x8mm	9	
Silicone Skins	10	Later this week

Labeling Dynamixels

Please make sure not to remove the label on the bottom of the servos. This label is used internally for identification.

Removing Supports



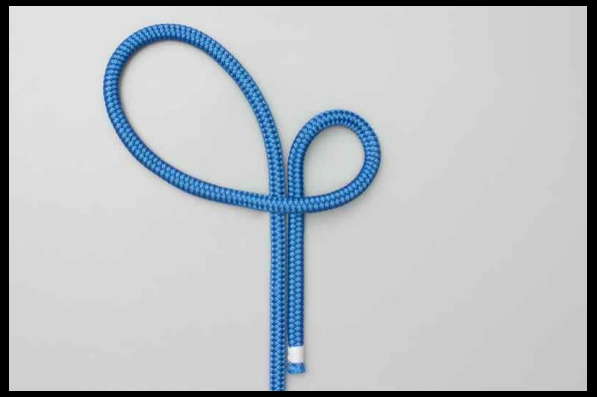
- Use pliers
- Break away support structures without damaging the parts

Keep a safe distance between your eyes and the part during support removal!

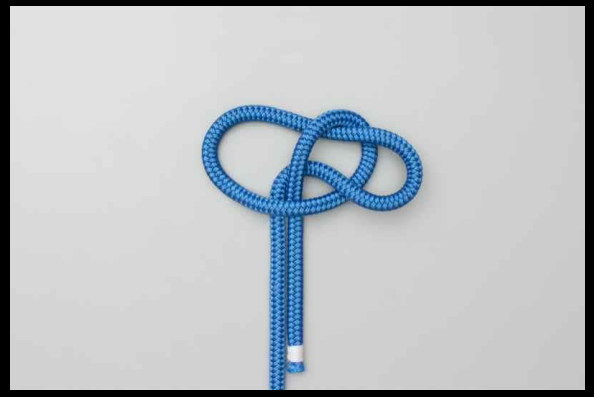
Ashley Stopper Knot

Ashley Stopper Knot Tutorial: www.animatedknots.com/ashley-stopper-knot

Step 1



Step 2



Step 3

Step 4

Step 5

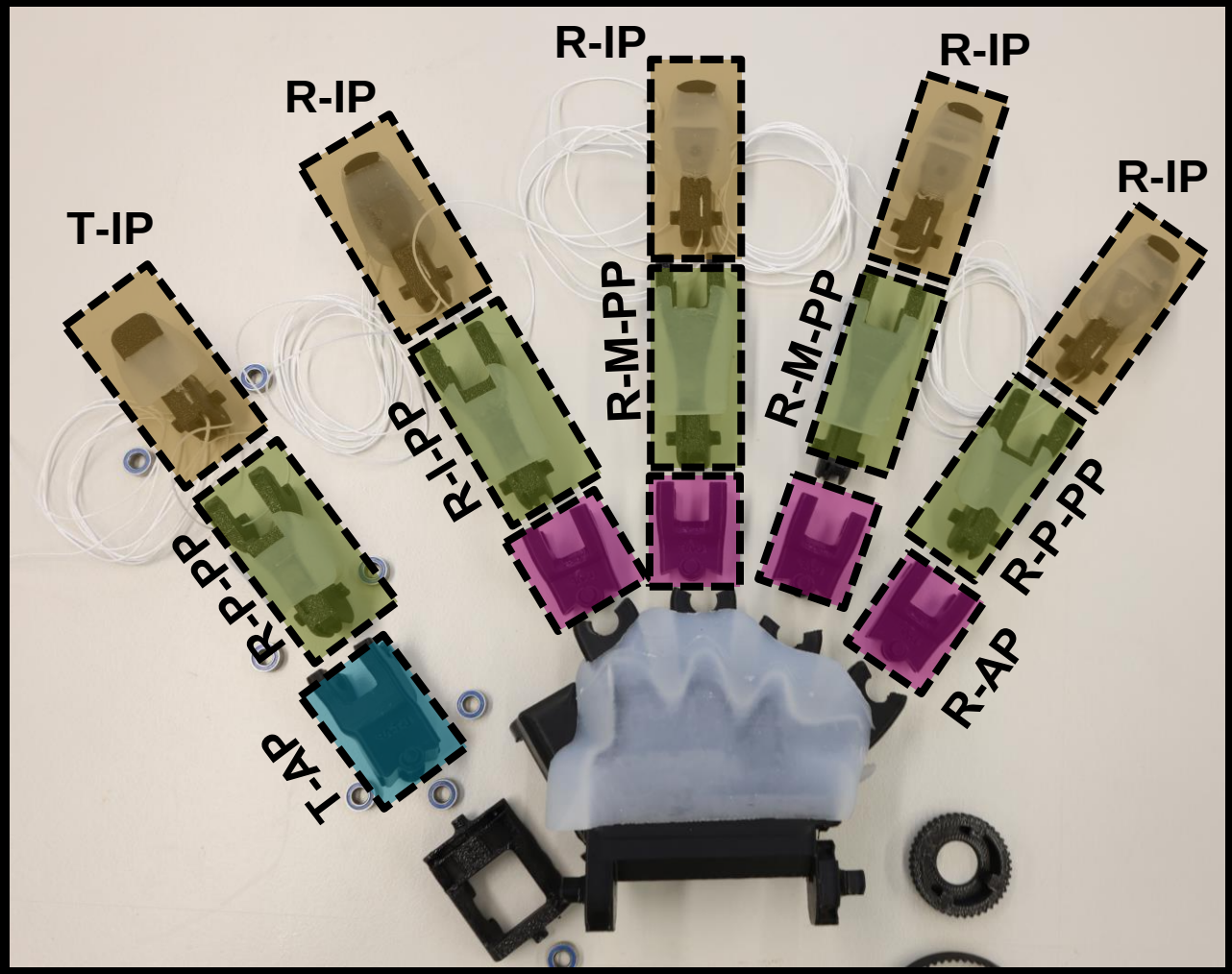
Step 6

Step 7

Step 8

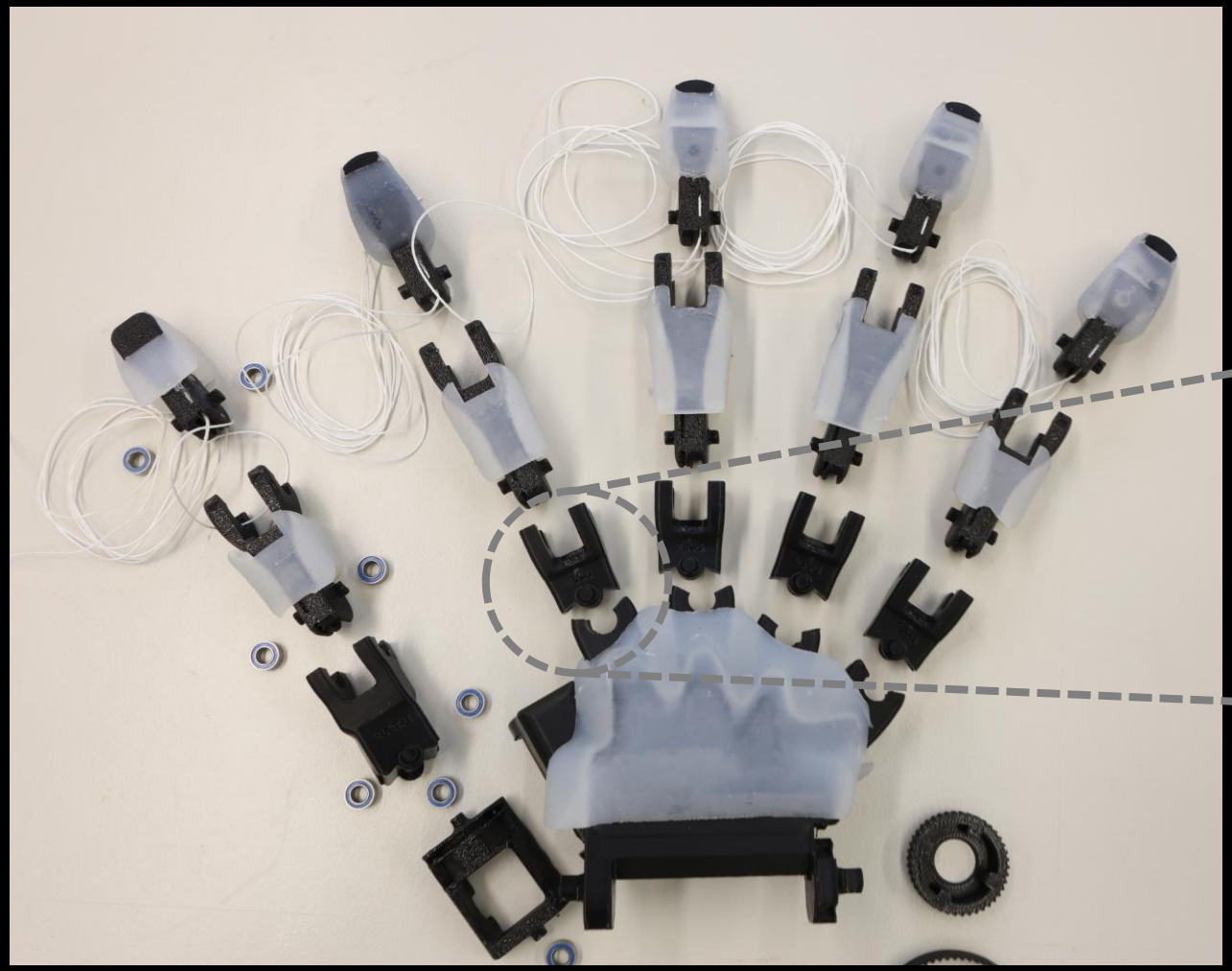
Assembling Fingers

- Fingertip Tendon Routing
- PP (Proximal Phalange) Tendon Routing
- Abduction Tendon Routing
- Thumb Abduction Tendon Routing

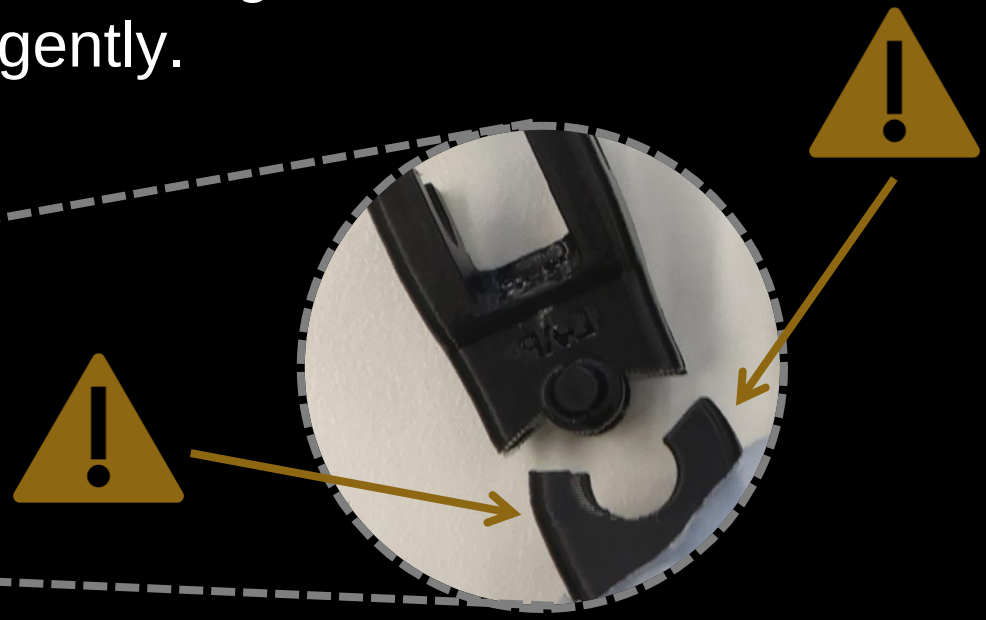


Double check tendon routing after assembling each finger

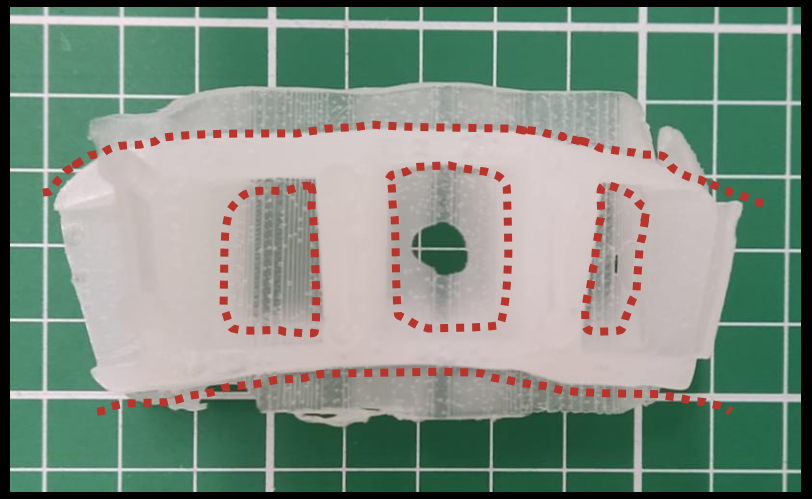
Assembling Carpals



Carpals at the index finger socket is fragile! Please insert index finger first and do it gently.



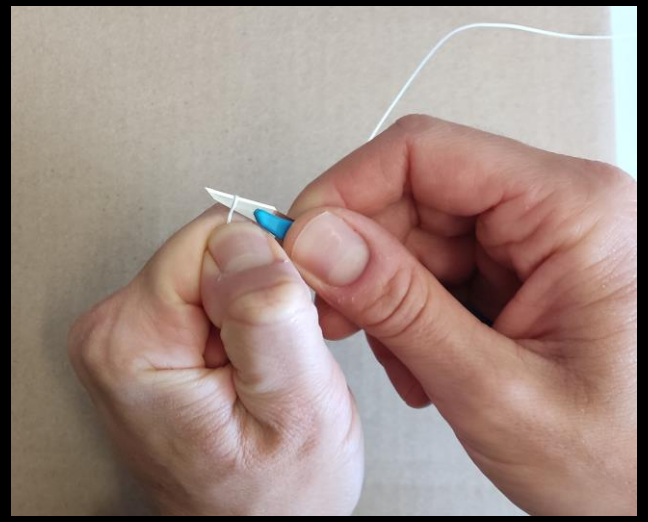
Trimming Silicone Skins



Trim excess silicone using the scalpel. Take care not to cut useful material.

Step 00: Cutting Tendons

Tendons need to be cut cleanly to be routed easily. Use the scalpel but be careful!



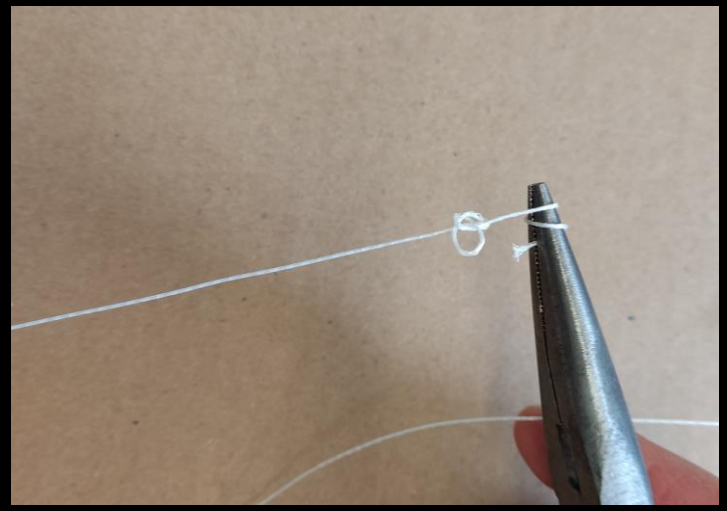
Clean cut

Make sure that the free tendon end remains intact during assembly. This ensures that the free end is firm and easy to route. Otherwise, it will get soft and will be difficult to route later.

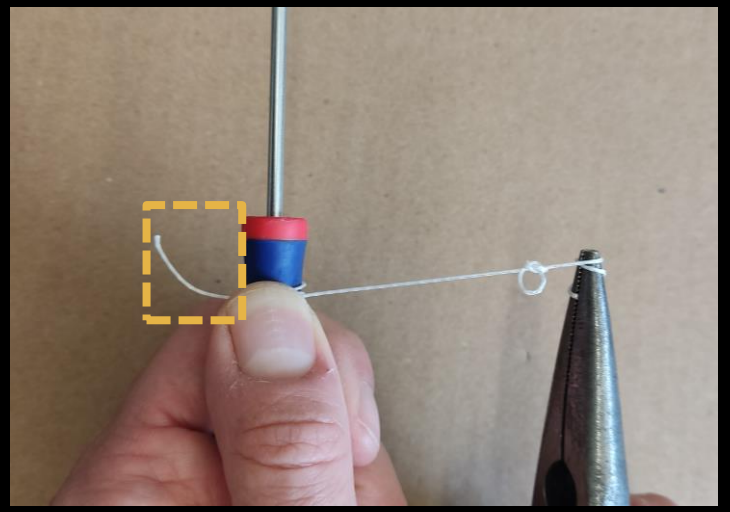
Frayed

Step 00: Tying Knots Firmly

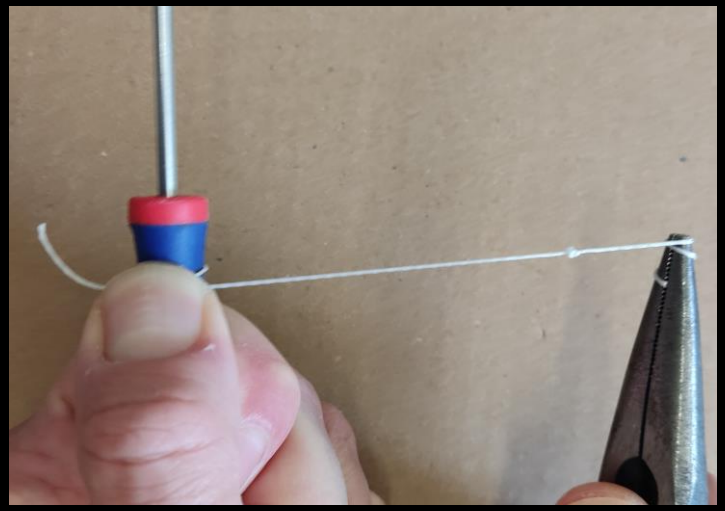
Step 1: Grab the short end with pliers



Step 2: Spool the long end on a cylindrical object (e.g. screwdriver)



Step 3: Tighten firmly



⚠ Don’t spool the free end of the tendon to keep it firm

Step 00: Trimming Excess Tendons

Some excess tendon is necessary to avoid knot un-tying over time

OK

Still OK

Too much

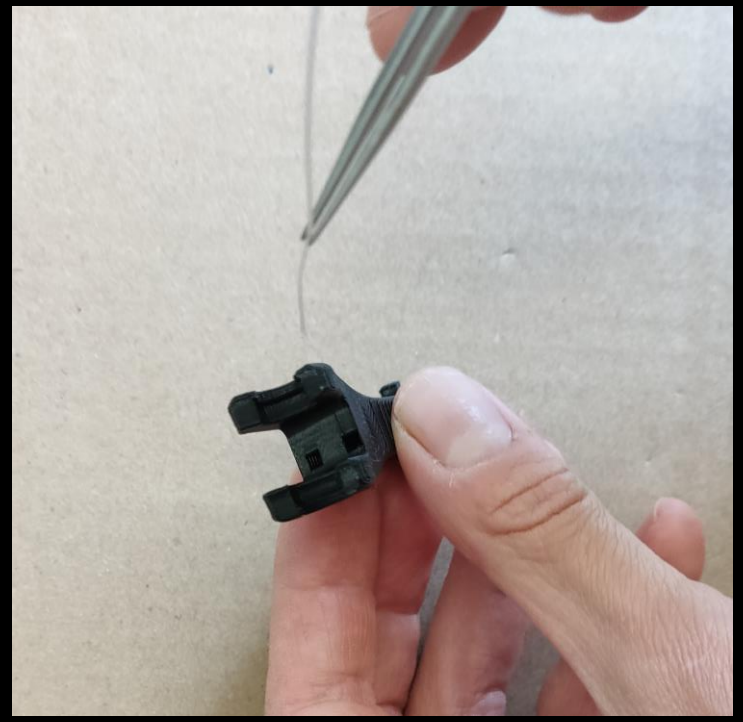
Too little

Step 02: Fully Insert Pins in Phalanges

Use a screw bit to fully insert the pin

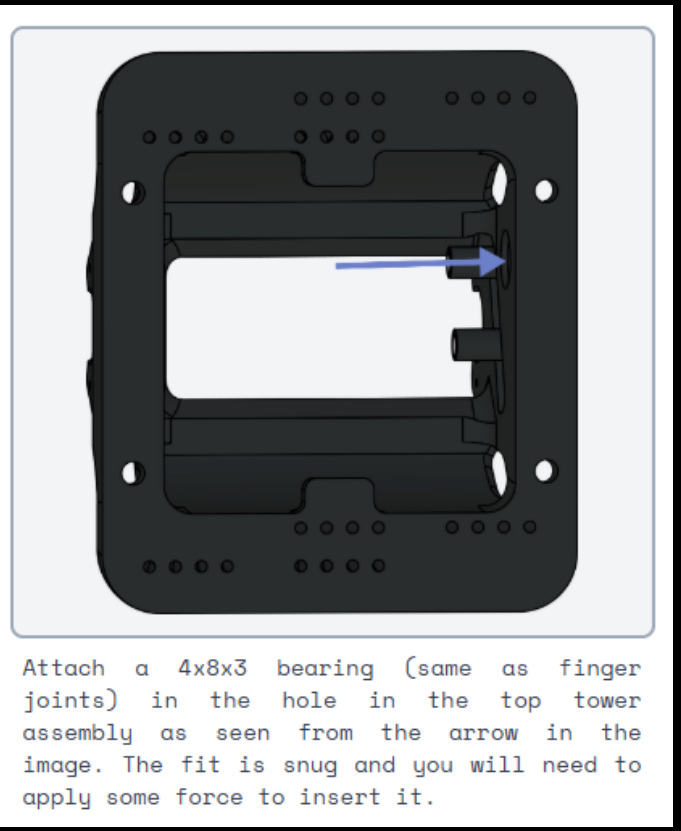
Steps 01-07/10-11/17: Using Tweezers

Using the tweezers can help you with tendon routing, especially when pushing tendons through the phalange pins (step 05)

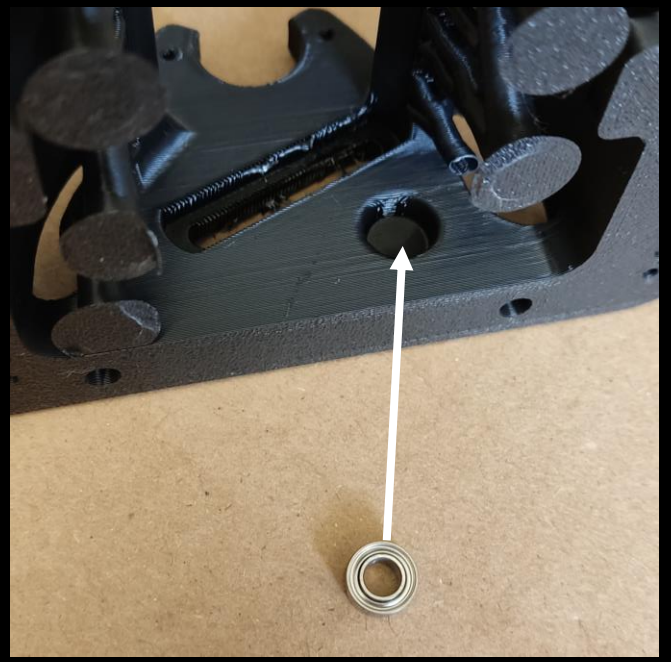


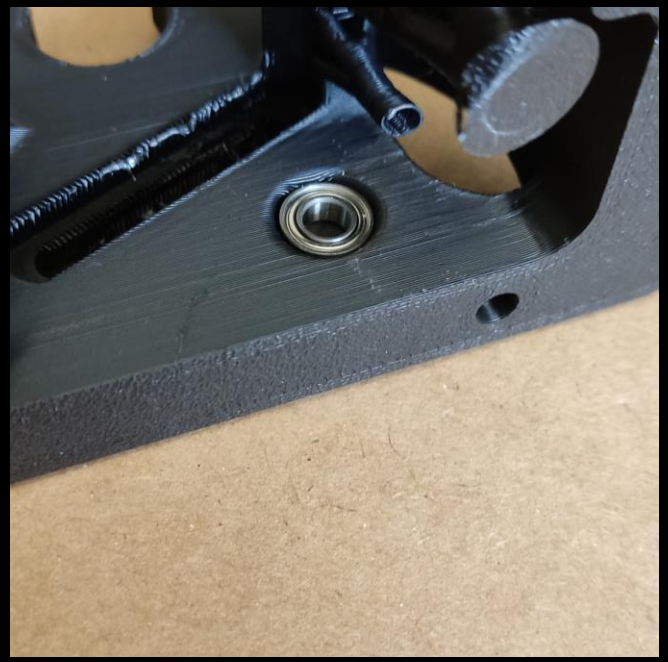
Step 14: Don’t Forget the Wrist Pulley Bearing

This is described on step 14, but bearing is missing from picture



Attach a 4x8x3 bearing (same as finger joints) in the hole in the top tower assembly as seen from the arrow in the image. The fit is snug and you will need to apply some force to insert it.





Step 14: Use PTFE instead of Idler Pulleys on Wrist Belt

- Instead of using idler pulleys as shown on step 14, we will use PTFE tube
- Screw each tensioning screw in the thick PTFE tube and cut the excess

Glue Fingertip Skin

At the very end of the assembly, you will glue the fingertip skin on the fingertip phalange. This ensures that fingertips won’t move during manipulation.

Don’t Hesitate to Ask

If you have any questions or doubts, don’t be shy - just ask :)