

Preface

Parts will often be removed in images demonstrating a different part of assembly to make them more clear, the parts are still meant to be in place.

The software is not developed by me but updates on it will be able to be found at

<https://github.com/Open-Muscle>

All bolts are m3 threaded

This document was meant to be viewed without page breaks

Parts needed

(all STEEL part files are alternate designs to be lighter if using SLM printed steel)

(all bolts are M3)

12palm.STEP x1

DistalPlate.STL x1

PalmPlate.STEP x1

TC.STEP x1

Tmeta.STEP x1

WristBracket.SLDPRT x1

mainring.STEP x1

DISTAL2T.STEP x1

META1.STEP x2

metacover.STEP x2

PartialBearingA.STEP x3

PartialBearingB.STEP x3

SPMbar.STEP x3

SPMbarSTEEL.STEP x3

WristSpool.STEP x3

DISTAL2.STEP x4

MCPJOINT.STEP x4

PPJOINT.STEP x4

crosslinkP1a.STEP x5

crosslinkP1aSTEEL.STEP x5

crosslinkP1b.STEP x5

crosslinkP1bSTEEL.STEP x5

crosslinkP2.STEP x5

crosslinkP2STEEL.STEP x5

spool.STEP x5

3x3x7 bearing x34

M3 hex nut x4

5x20.5mm spring x6

SG90 servo motor x5

J48 stepper motor x3
3x10x4 bearings 3
6mm bolt x47
10mm bolt x3
15mm bolt x24
18mm bolt x12
20mm bolt x7
25mm bolt x9
35mm bolt x1
100+ m3 heat set inserts (you will need extras for failed prints)
1mm dyneema tendon thread
Bowden tube ptfе tubing
Bowden tube connector x6
4.5mm bbs x24

Assembly

1- Prep one MCPJoint with two heat set inserts



2- Thread the two tendon cables through the front





3- Thread the forward most tendon through the central most hole in one Crosslink2, tie it onto a 6mm bolt and insert the bolt, then embed both parts with 7mm bearings



4- Bolt the two together with 15mm bolts as well as one Crosslink1a and one Crosslink1b (if using metal crosslinks you must also thread the bolt shaft on both Crosslink1a and Crosslink1b)



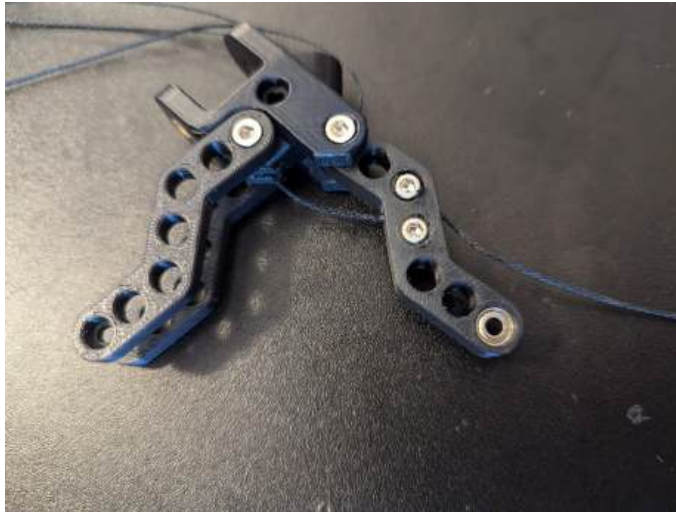
5- Pull the back tendon over and tie it to one 6mm bolt

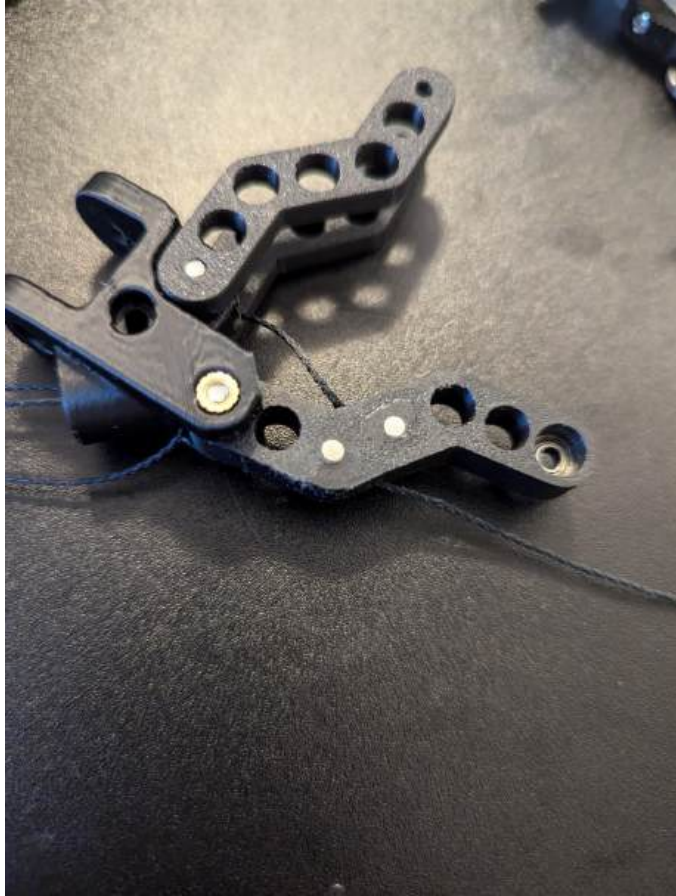


6- Then thread another short length of tendon through the last threaded hole in Crosslink2 and tie it on a 6mm bolt once through (better visualization of the process in step 3)



7- Insert the bolt and file off the back if needed for smooth motion





8- Prep on PPJoint with heat set inserts and a 7mm bearing



9- Thread the tendon bolted to Crosslink2 through the center of the PPJoint and affix with two more 15mm bolts



10- Prep one Distal2 by CA gluing one distal plate to its top and inserting a 7mm bearing

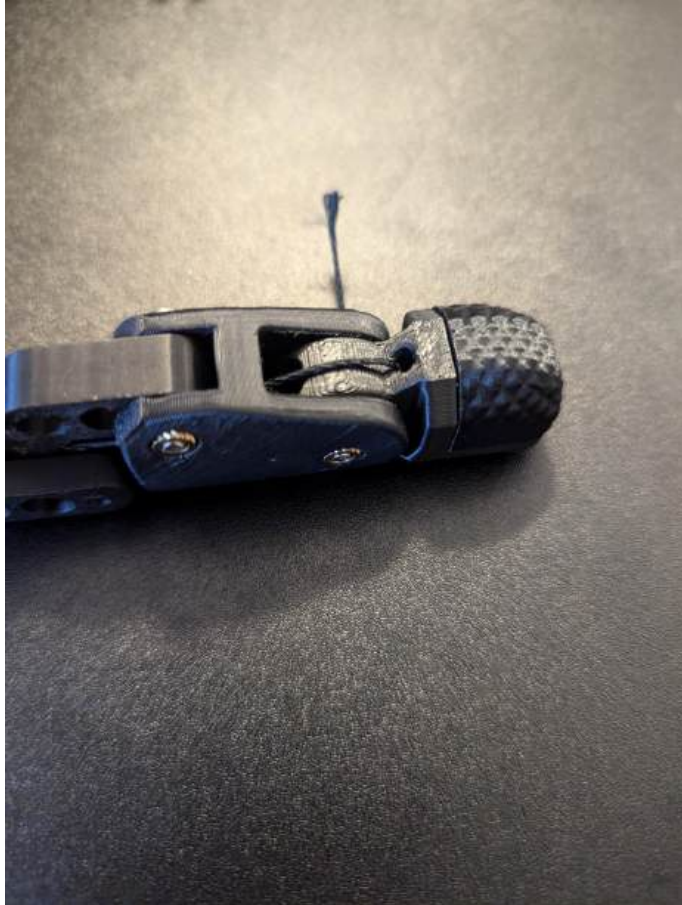




11- Bolt to PPJoint with one 15mm bolt



12- Thread the topmost tendon through this Distal2





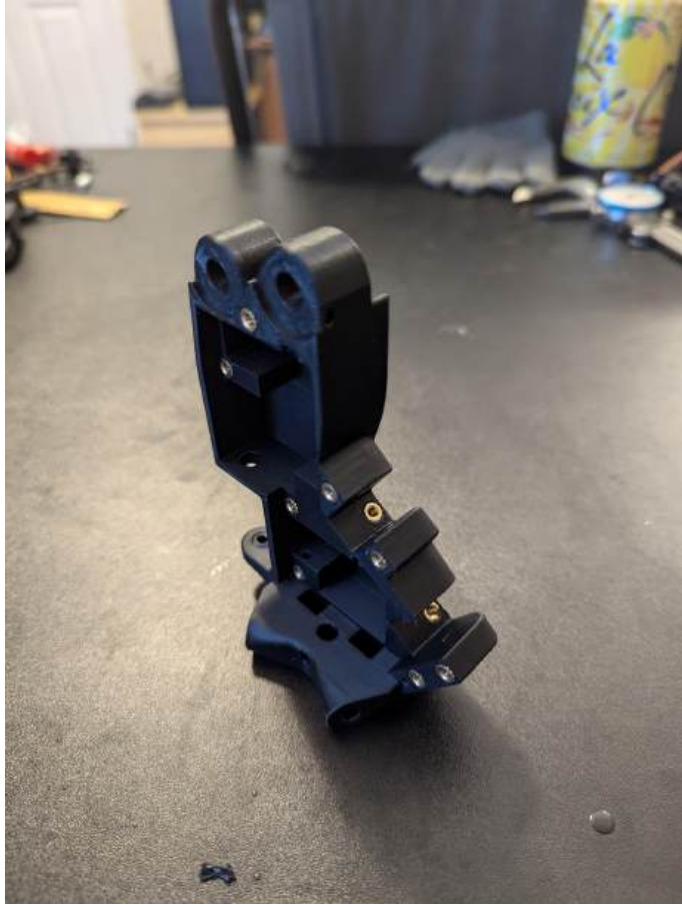
13- Pull tendon taught in a the strait position, loop a 5x20.5mm spring on to a 6mm bolt and drive it into the Distal2's channel (the distal's current position will determine its rest state)



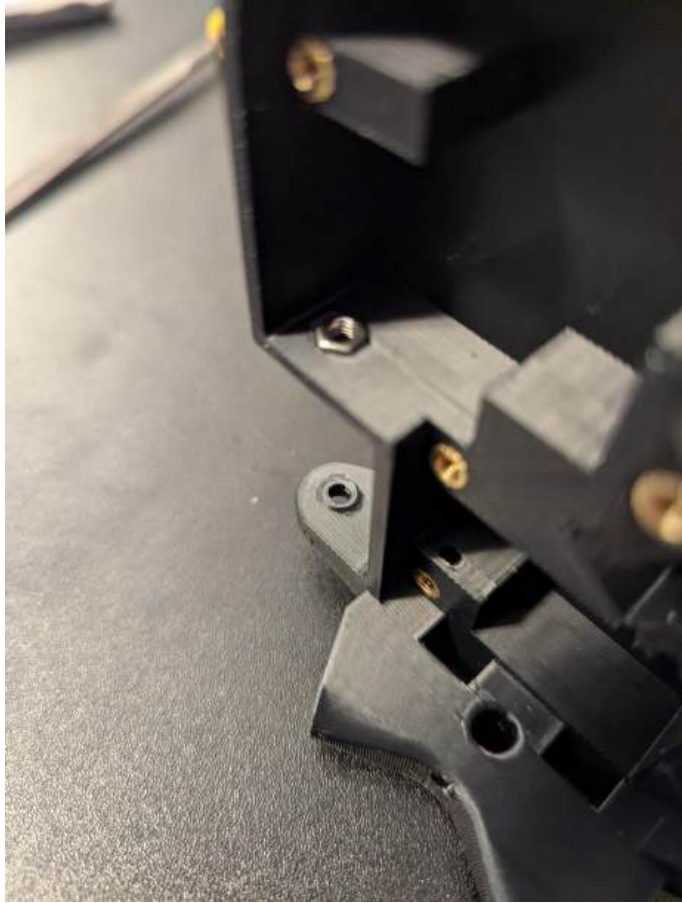
14- Tie another 6mm bolt to the tendon from the back of the MCPJoint and bolt the spring down, the finger is done, you can repeat this for the other three



15- Prep 12Palm with heat set insets, bearings, and 4 m3 hex nuts





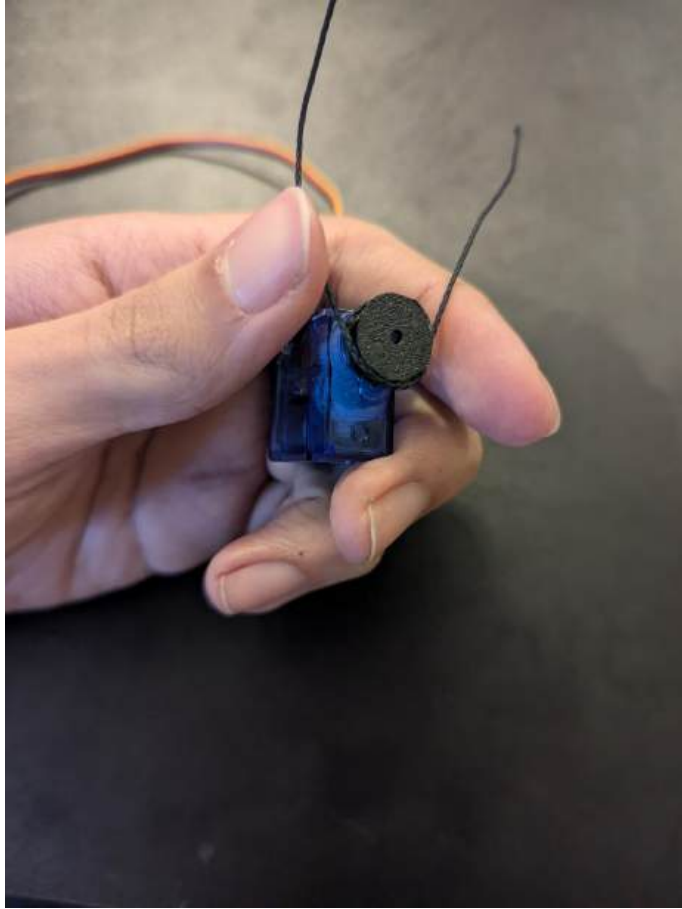


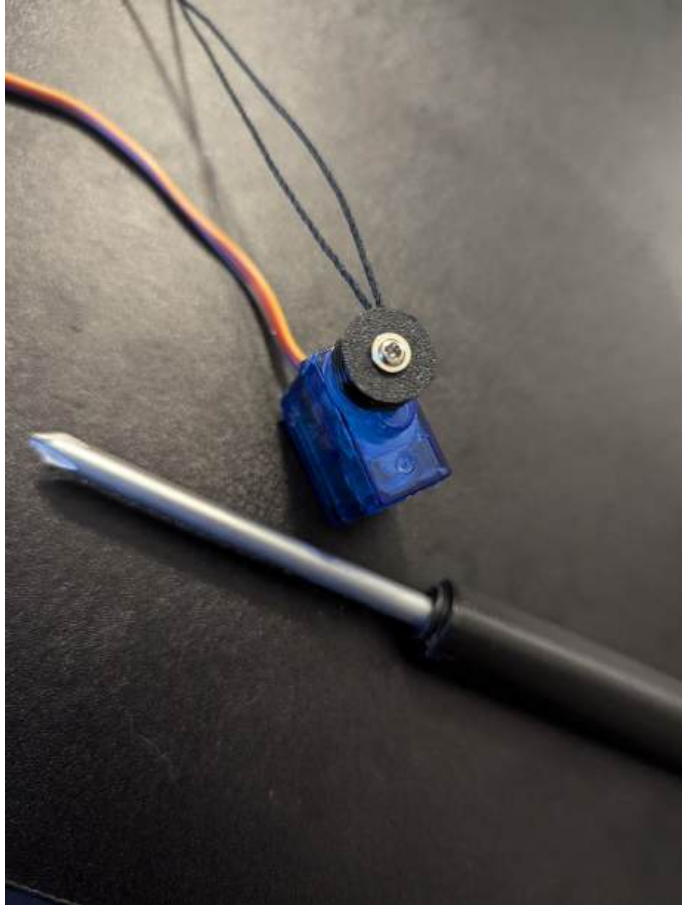


16- Thread a length of tendon cable through a Spool by bunching it into a loot and pushing it through the hole in the side

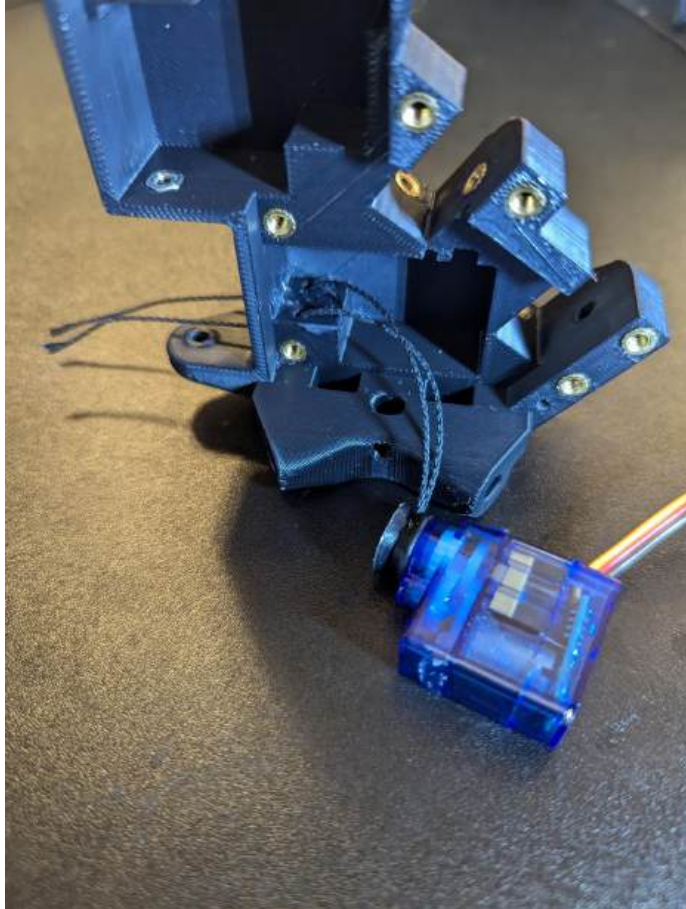


17- Then snap that spool on to one SG90 servo motor and screw it down with its included screw if necessary

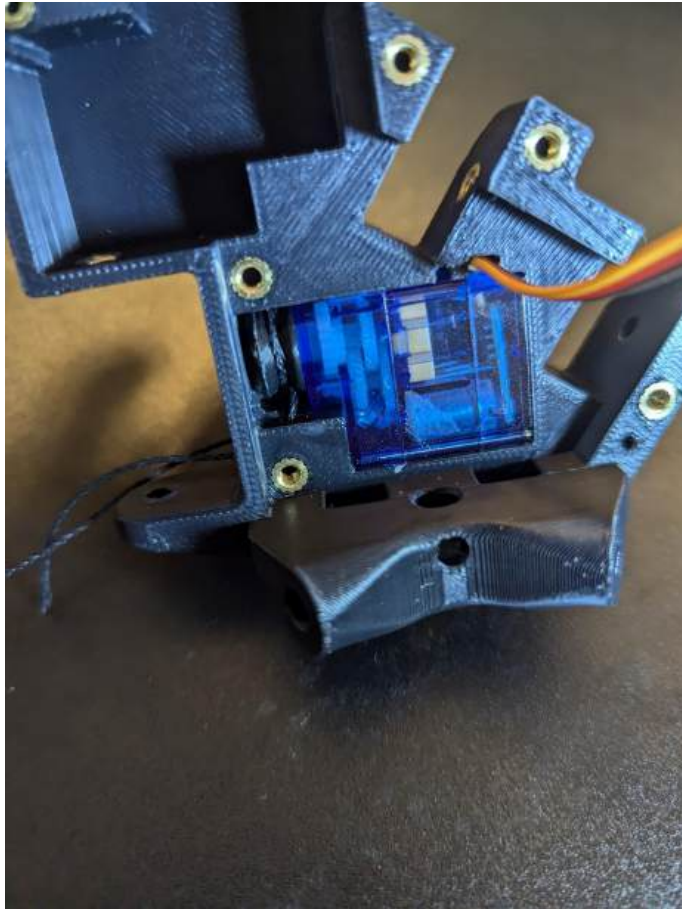




18- Thread the spool loops through the shown channels in the 12Palm



19- Now loop the two tendon threads around the spool a few times in opposite directions (number of loops can be adjusted to modulate range of motion) and slot in the motor



20- Prep one TMeta and one TC with bearings inserts as shown



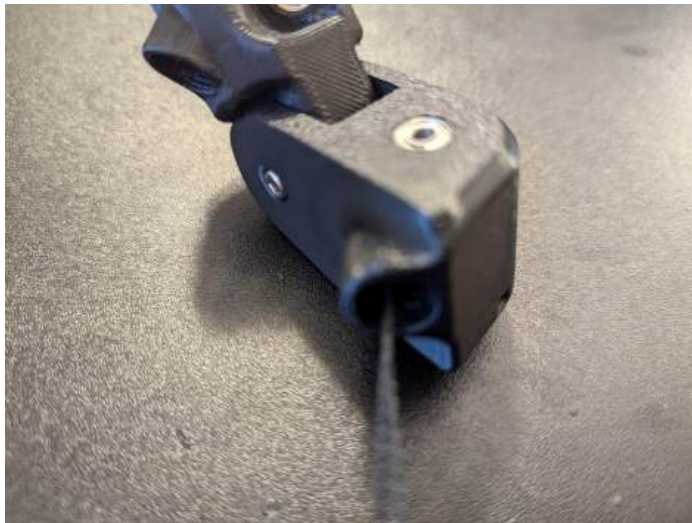




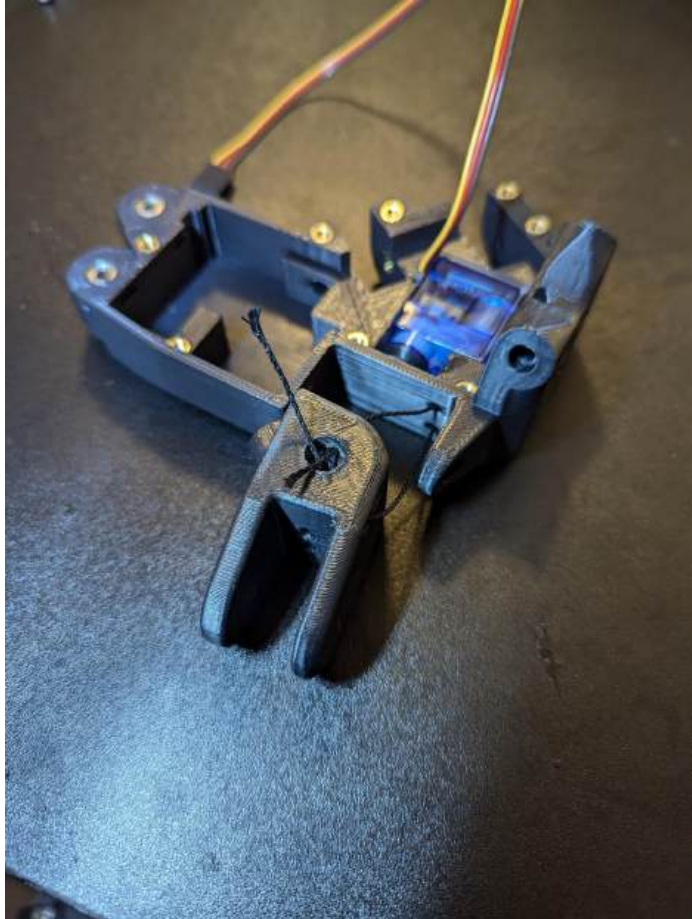
21- By tying two strands of tendon to a 6mm bolt as described before, attach two lengths of tendon to TMeta base



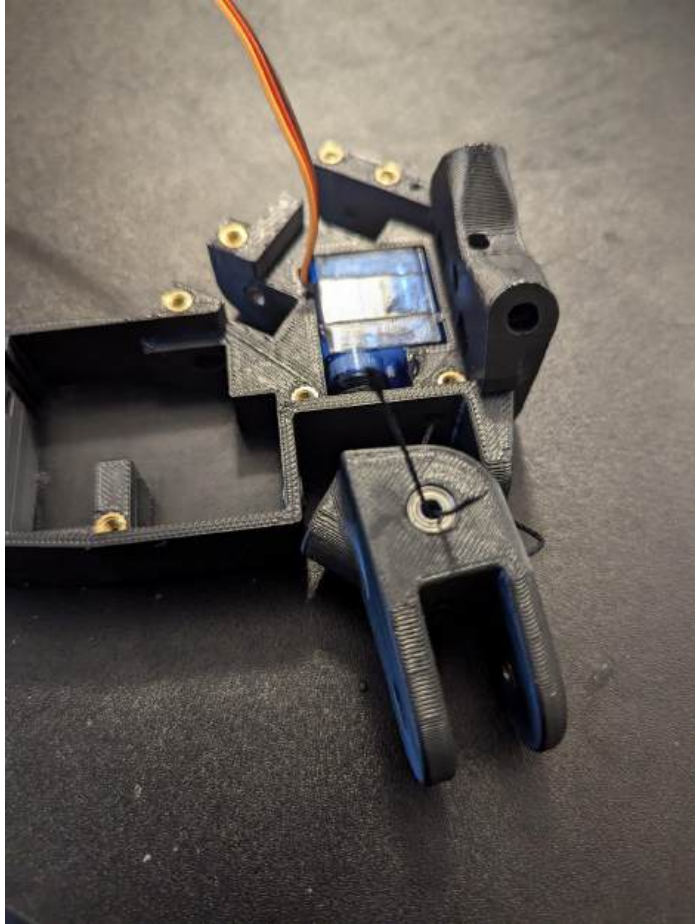
22- Thread tendons through TC channels as shown and bolt them together with an 18mm bolt



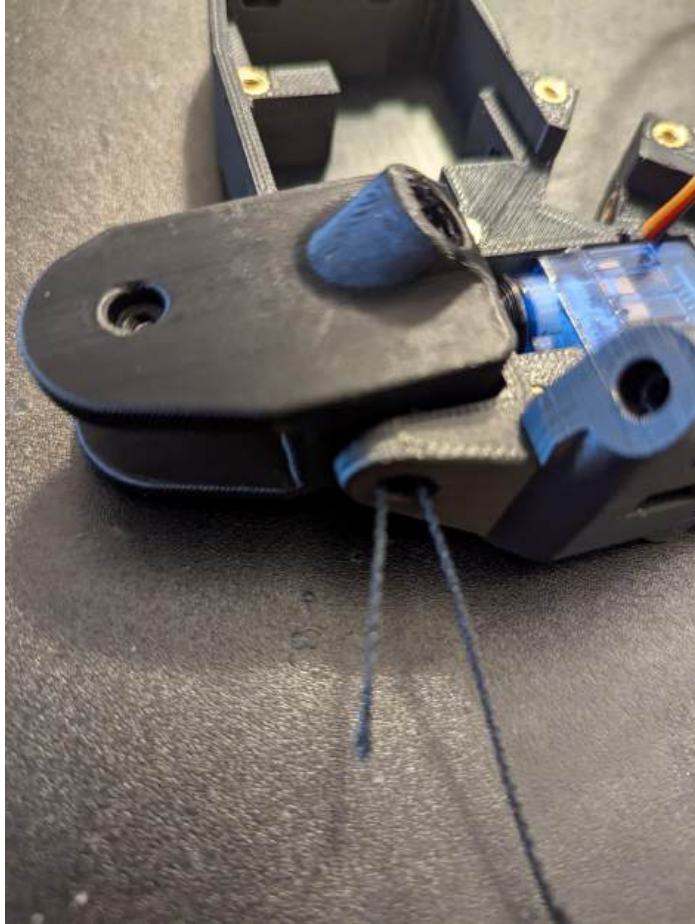
23- Now this part is a little awkward but it works, thread the tendons from the servo in the 12Palm through the side channels in the TC and up through the bottom of its shaft hole



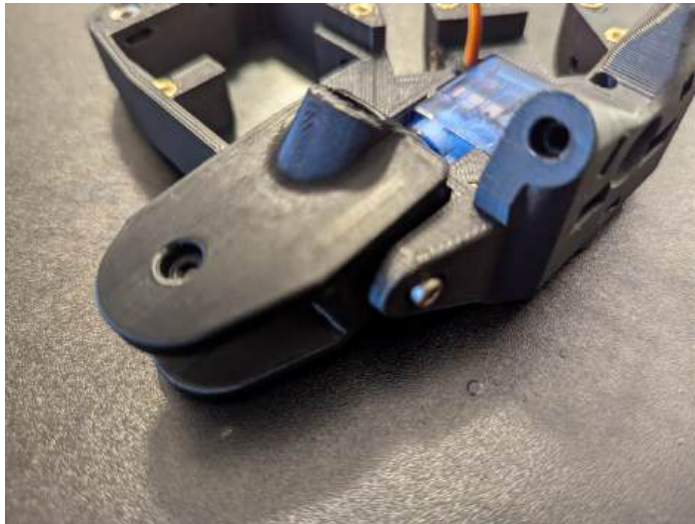
24- Run the tendons through the center and embed the bottom 7mm bearing into the TC



25- Now run the tendons through the mounting hole in the bracket on the 12Palm and tie them together as hard as you can (once the bolt is in place the TC should not move so preferable use pliers)



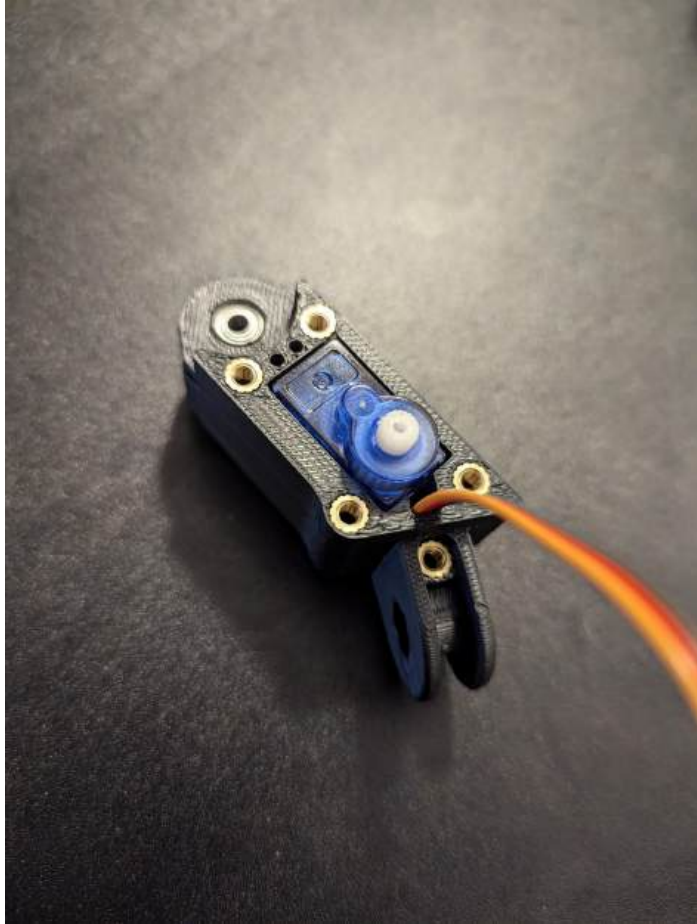
26- Drive a 35mm bolt through the bracket and past the tendons (To be careful to not break them you can use a dab of CA glue to keep the tendons in place as long as you are precise as to not glue the bearing)



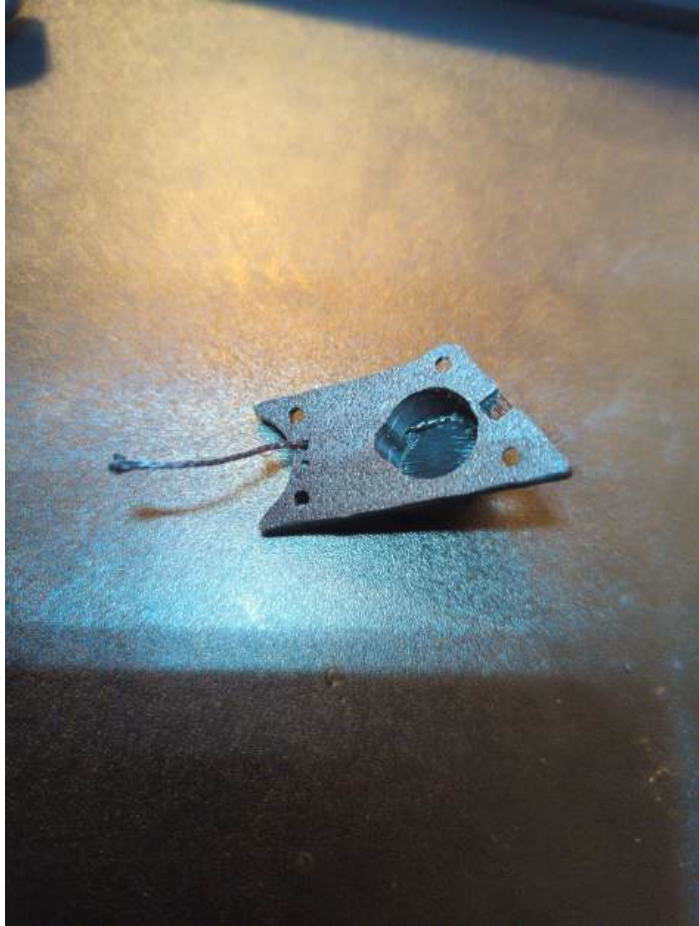
27- Prep one Meta1 with 5 heat set inserts and one bearing



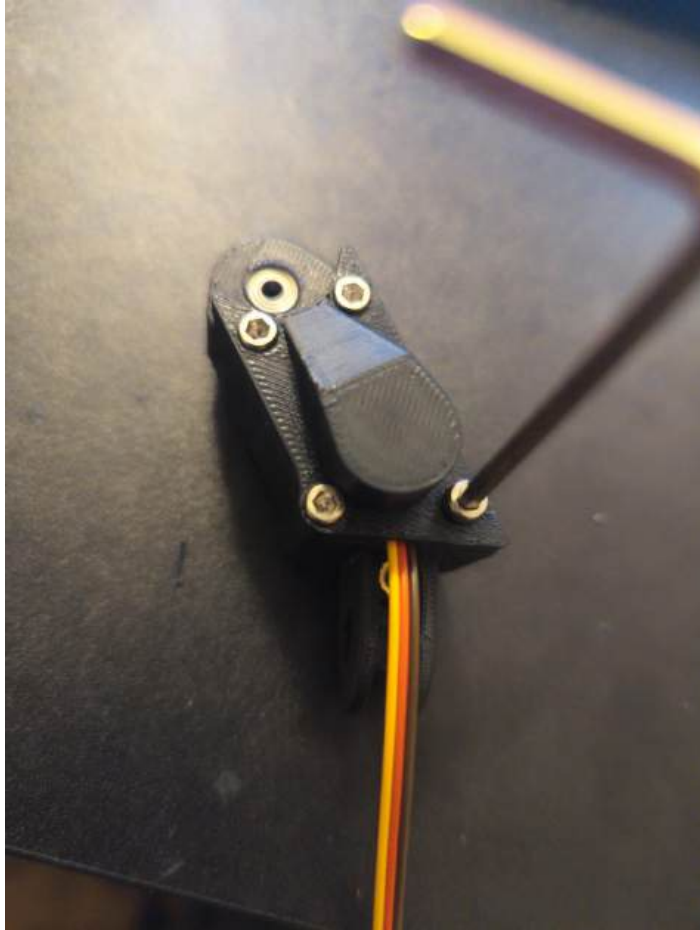
28- Then insert a servo into the cavity making sure to line the cable up



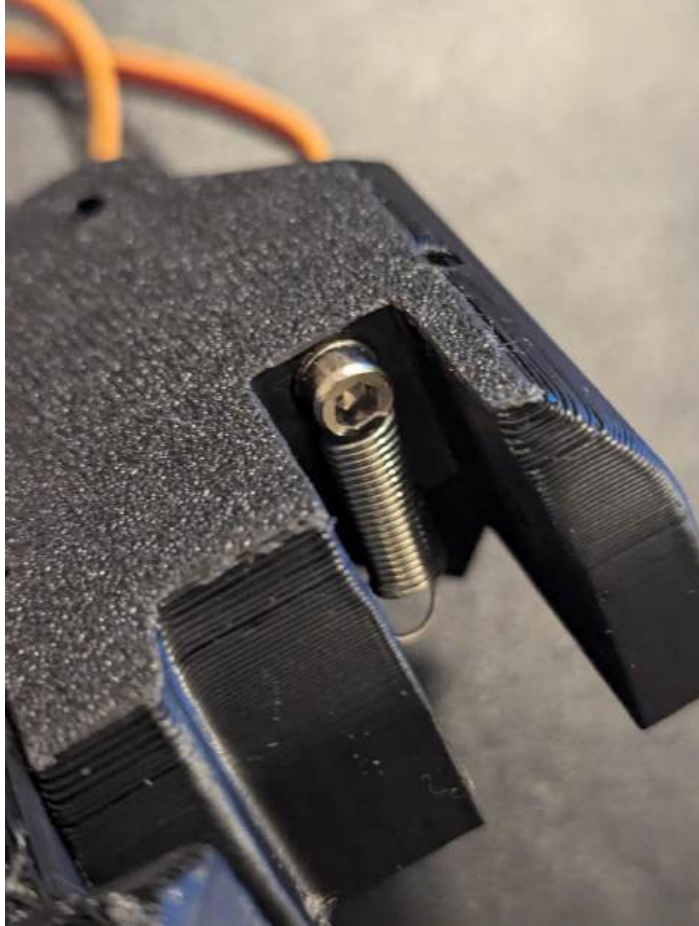
29- Attach a spool and thread the tendon cables through a MetaPlate (getting angles for this was hard so excuse the photos)



30- Finally you can bolt down the MetaPlate with 4 6mm bolts

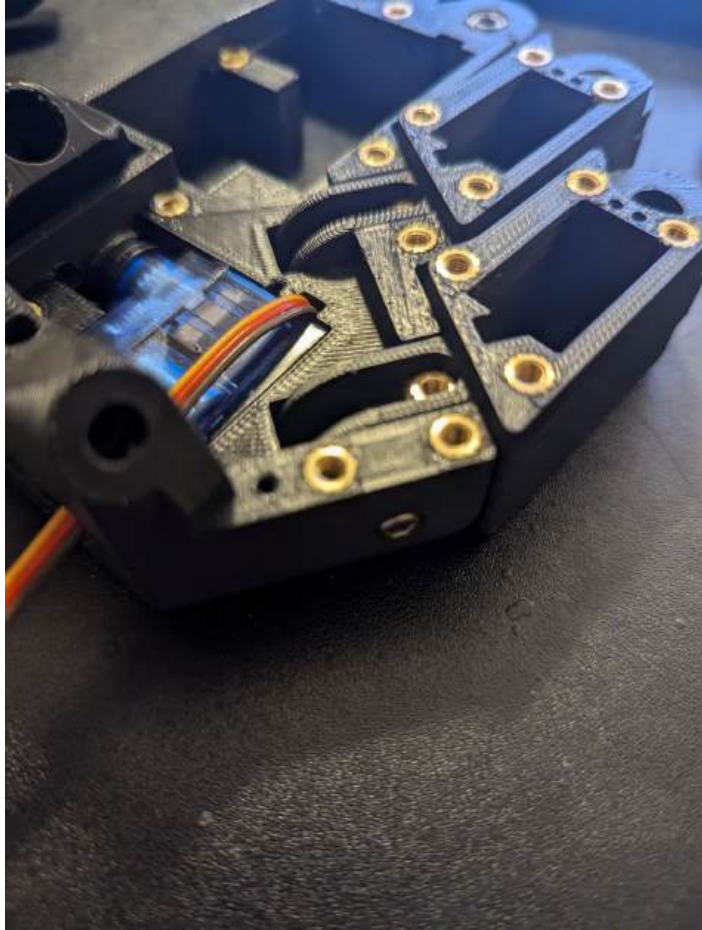


31- Prep the 12Palm by bolting two springs to both metacarpal channels with 6mm bolts

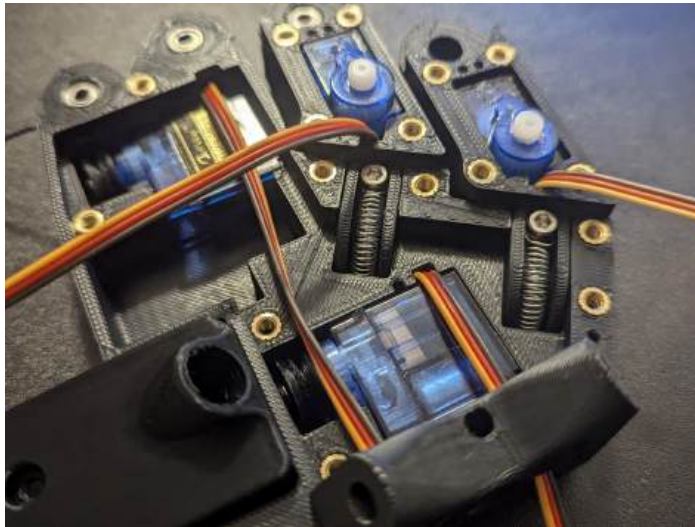


32- You can now attach the metacarpals to the palm with two 18mm bolts (The mounting hole for the top one has no direct access point so the best way i've found to fasten is it to use force and angle a hex wrench, if anyone can think of a better way please share)

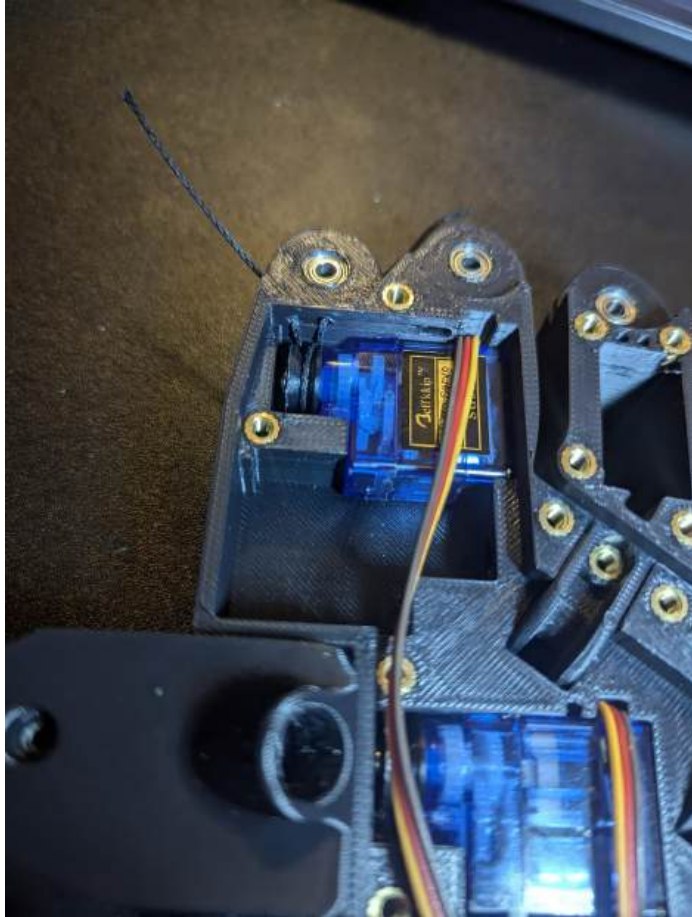




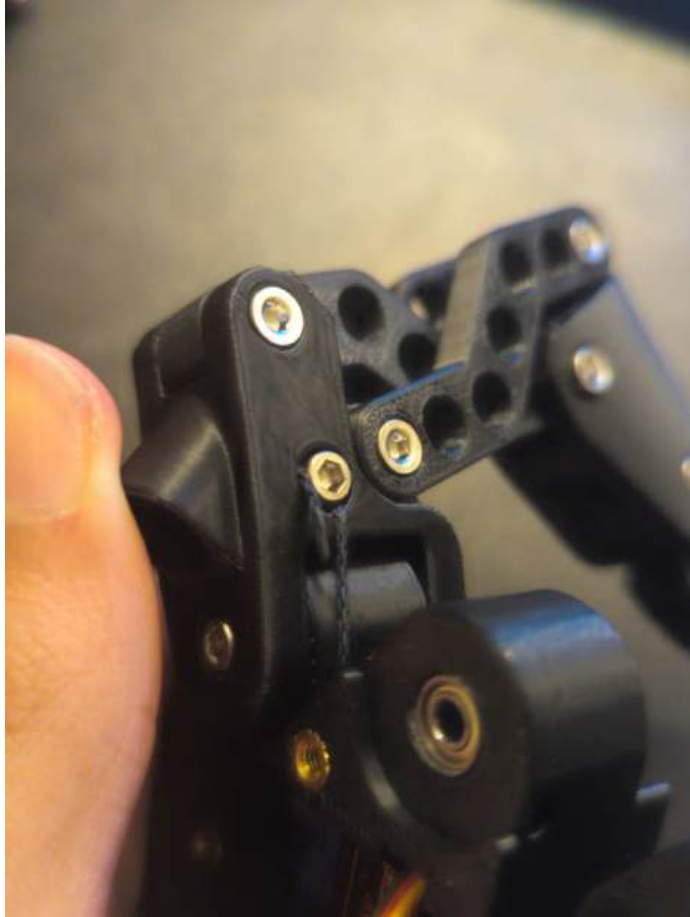
33- Insert another servo, prepped like the previous one, into the cavity at the top of the 12Palm and bolt down the top of the spring like so



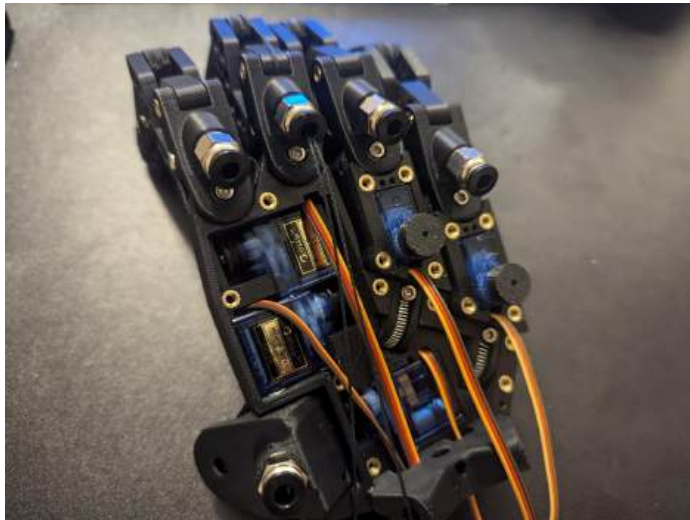
34- Thread the servo tendons through the MCP bracket on the 12palm



35- Using the tie method, attach these tendons to the sides of the MCPJoint on the finger and bolt it down with 20mm bolts



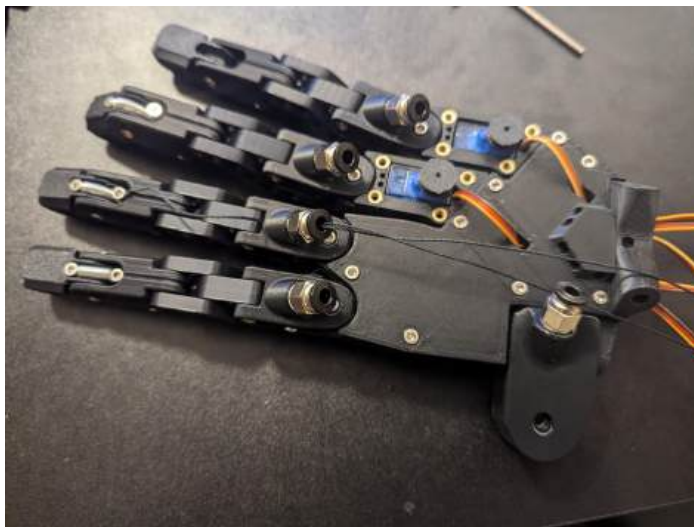
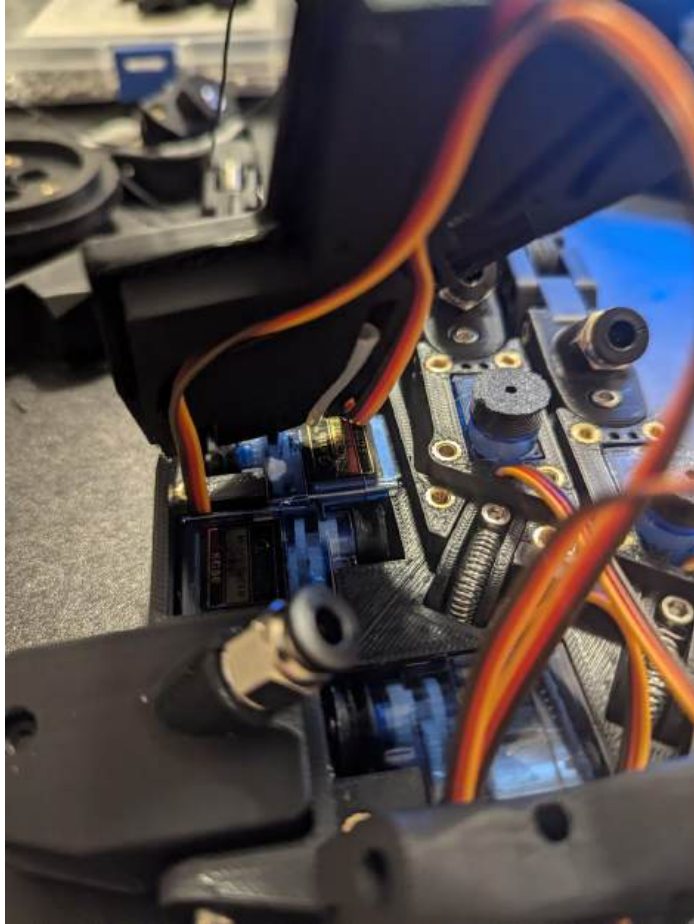
36- Install the final servo the same way as the previous one, and repeat this for all the fingers



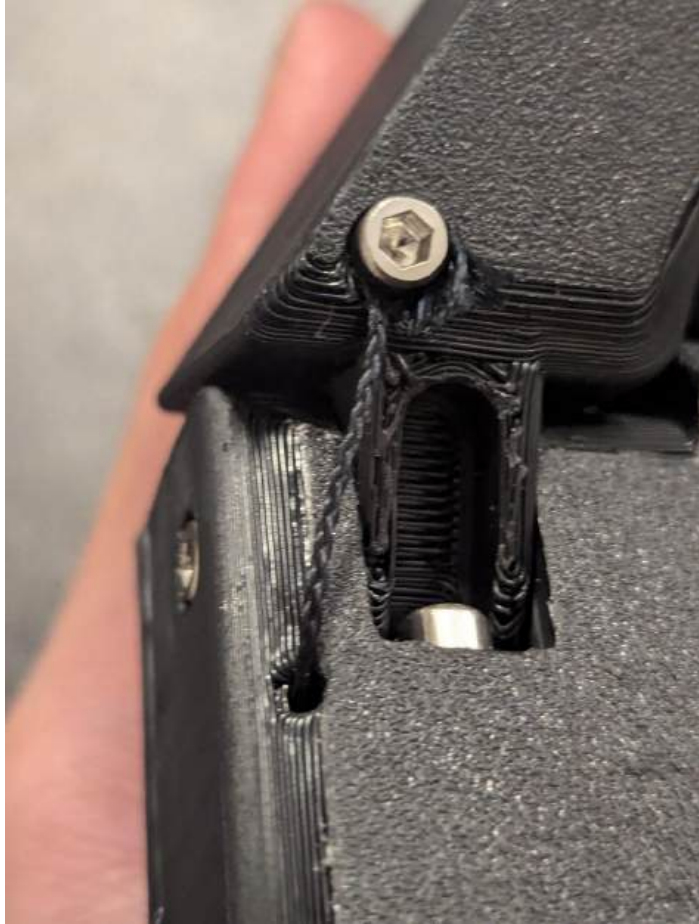
37- Prep one PalmPlate with a short length of ptfe tubing as shown



38- Route all cables through the Palm Plate, pass the tendons from the central palm servo through the ptfe tubing and bolt the PalmPlate down with 6mm bolts



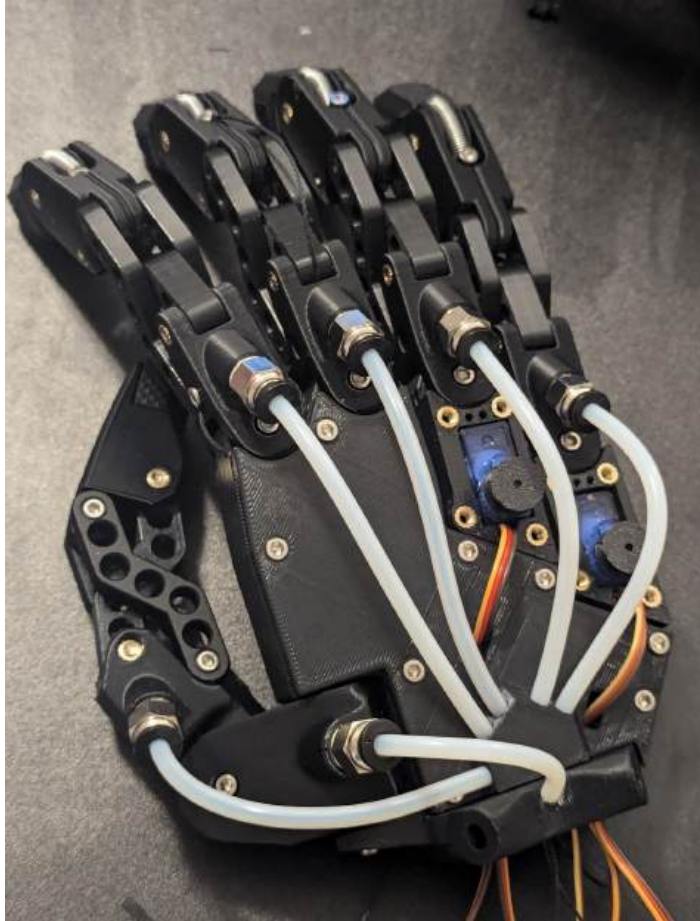
39- attach a length of tendon cable to both metacarpal bases and thread through the palm (you can check for obstructions with soldering wire, if there are none and the cable won't pass, use more lubricant)



40- The thumb can be quite easily finished in the same way as the finger, minus the distal tendon.

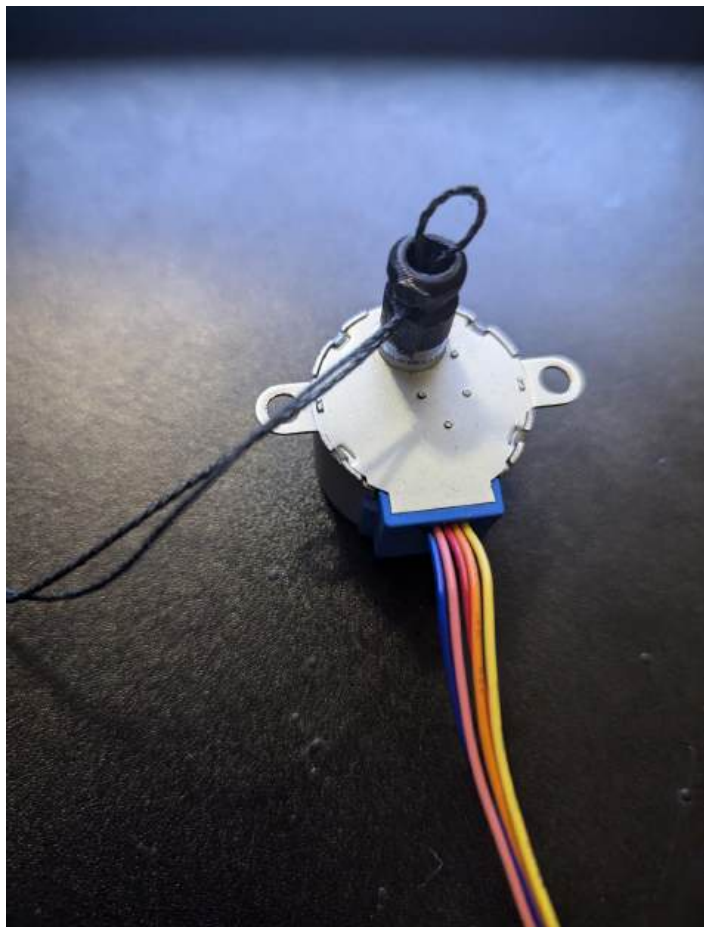


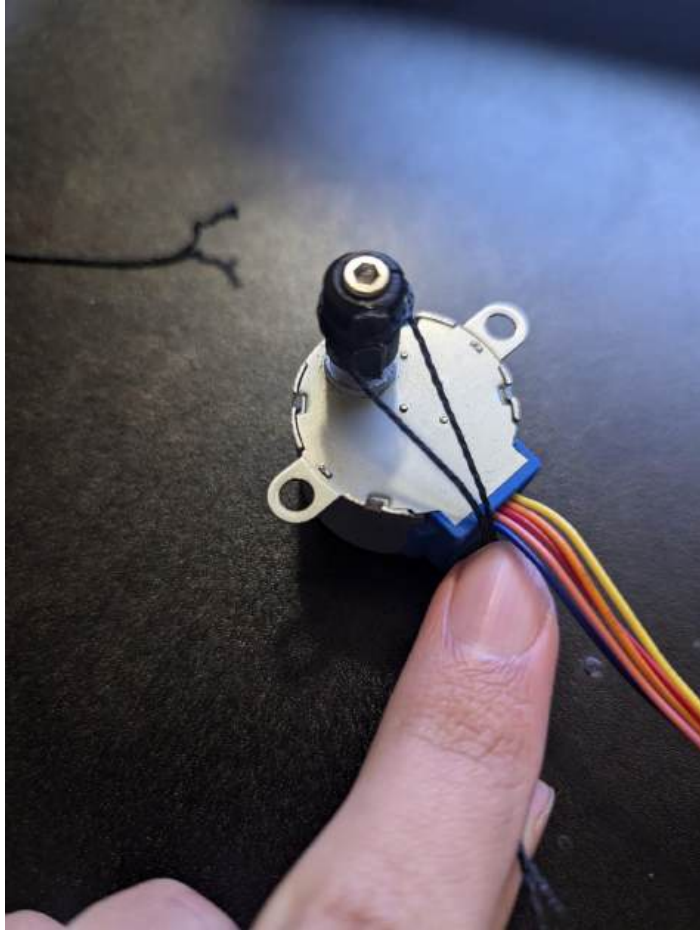
41- Run all tendons through their respective ptfe tube and coupling and ground the tubes to the hub at the base of the PalmPlate so all tendons pass out of the central bore in the bottom of the 12Palm (CA glue can be used if tubes are not able to friction fit)





42- Prep the WristSpool similarly to the servo one by threading a loop and bolting it down with a 6mm bolt.

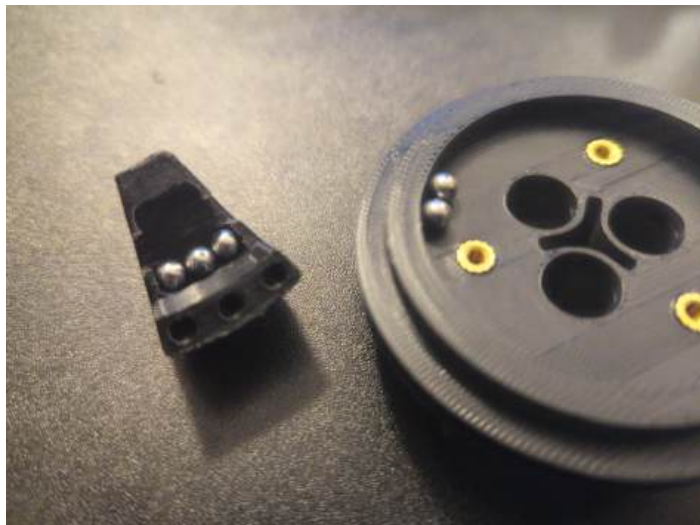


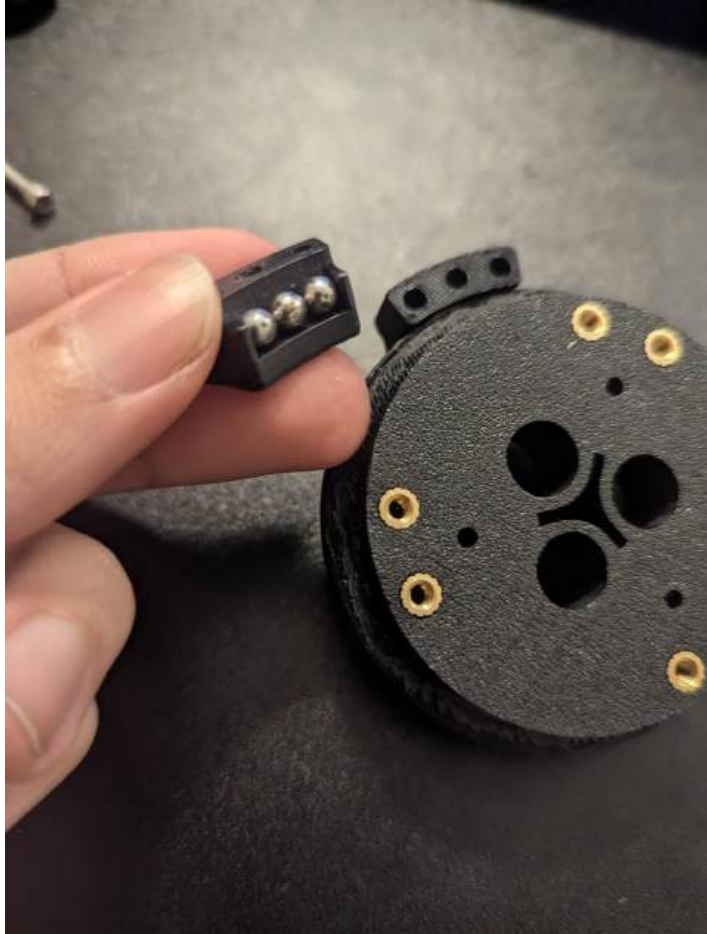


43- Then prep the MainDisk with inserts and thread the tendons as shown

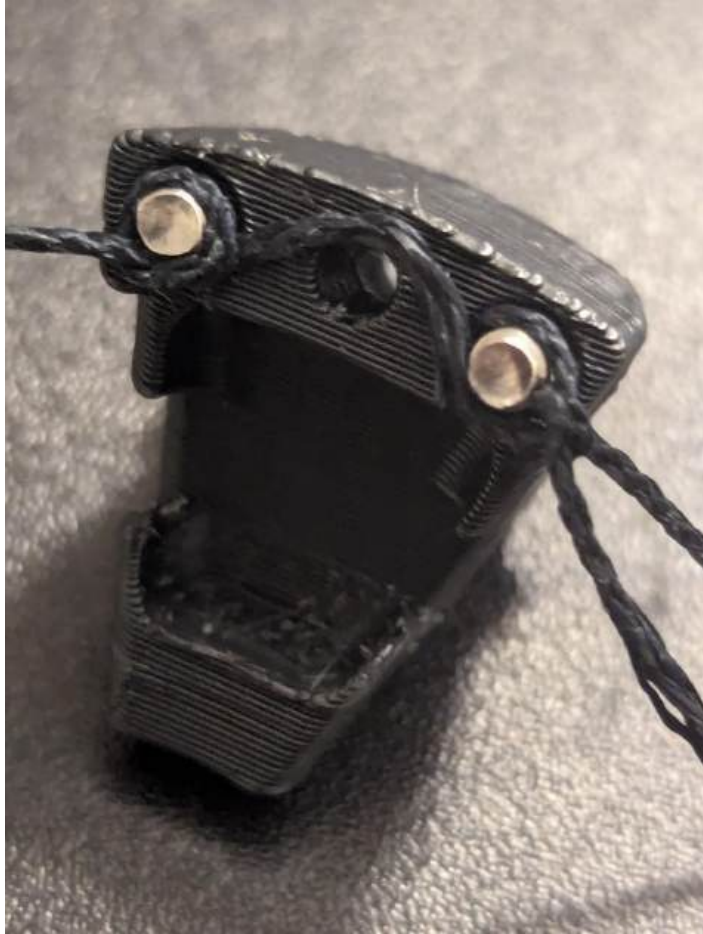


44- Prep the Partial bearing parts with 4.5mm bbs and inserts





45- loop and tie the stepper motor tendons to the PartialBearingA as shown



46- Then making sure the tendons are taught, you can bolt them together to the MainDisk with 18mm bolts



47- Prep three SPMBar with 3x10x4 bearings and 10mm bolts with hex nuts threaded, and bolt them to the PartialBearing assembly



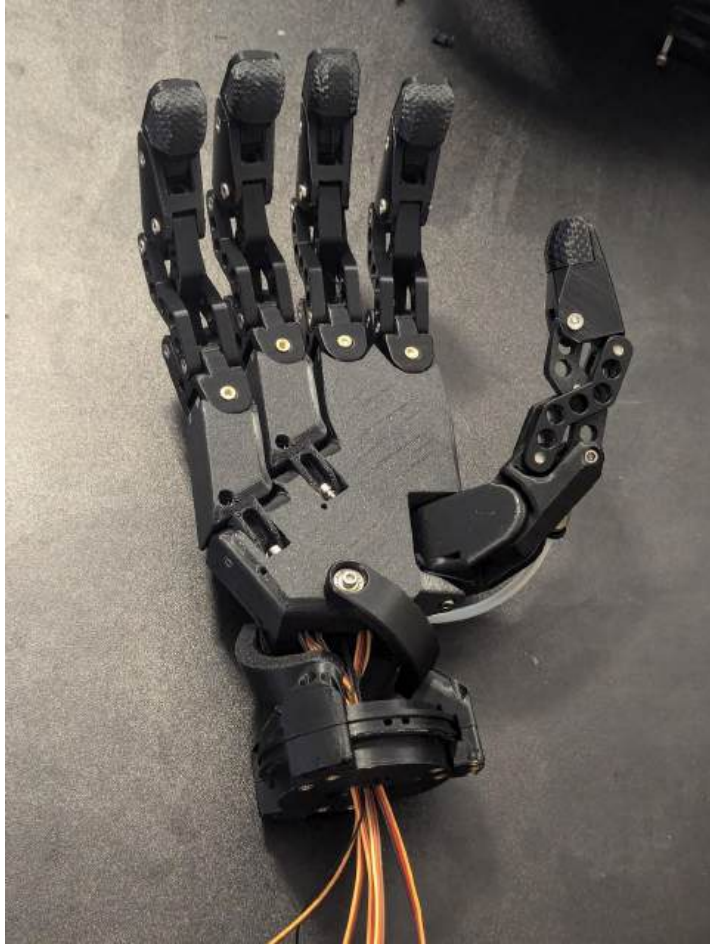


48- Thread all cables and tendons through the star shaped opening in the MainDisk

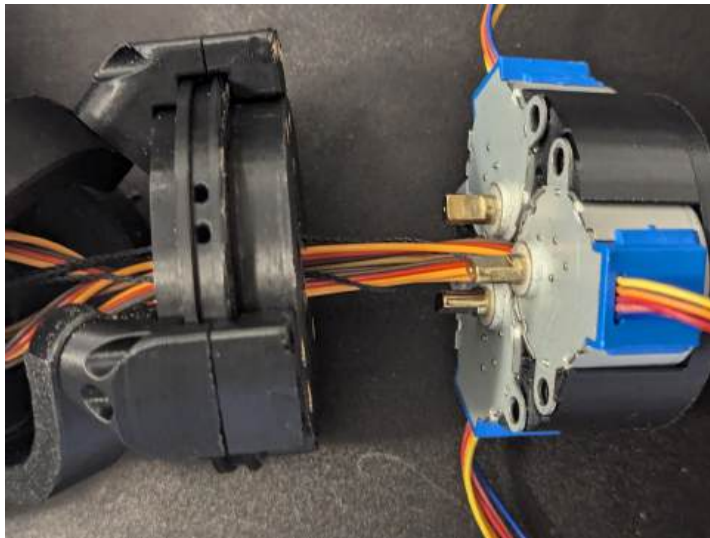




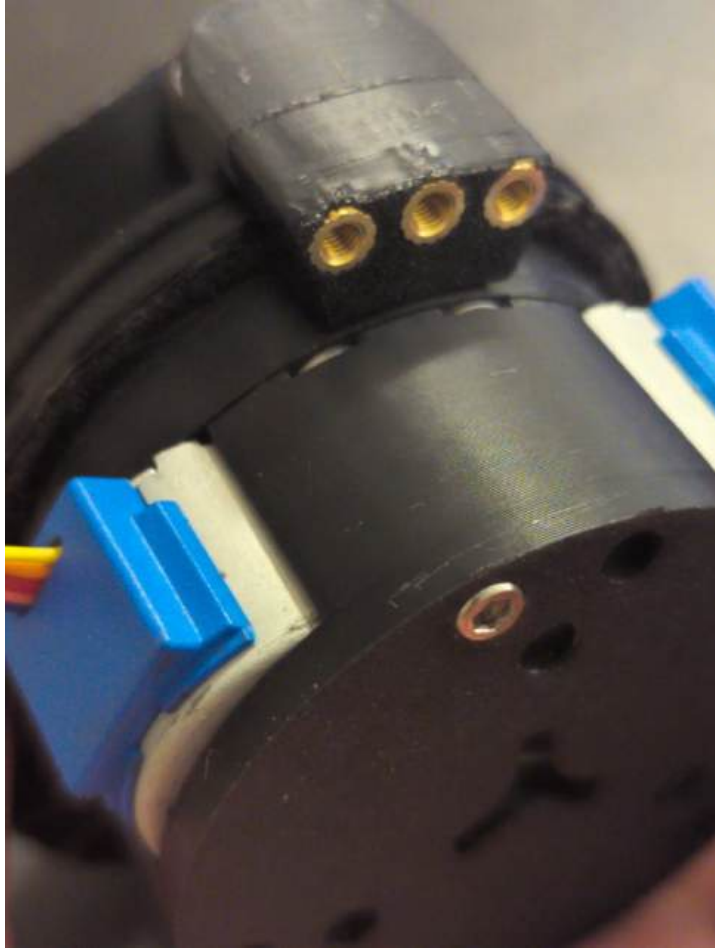
49- Bolt the uHand assembly to the wrist with 3 20mm bolts



50- Repeat and thread all cables and tendons through the WristBracket, affix stepper motors once in place



51- Bolt bracket to disk with 25mm bolts



52- uHand Is Complete!

