

Lesson 1b: Hand Modeling

Goal

To introduce you to the subdivision surface modeling paradigm.

Prerequisite Exercises

- [Polygon Selection](#)
- [Polygon Editing](#)
- [Modeling Toolkit](#)

Resources

- [Demo Outline](#)
- [Demo Handout](#)
- [Hand Reference](#)

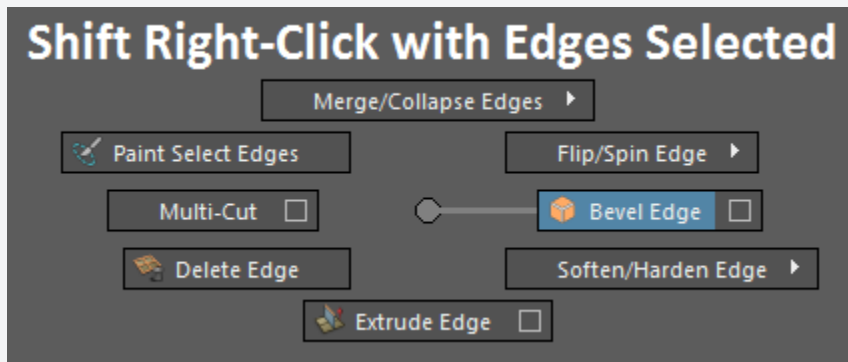
Relevant Hotkeys/Tools

General

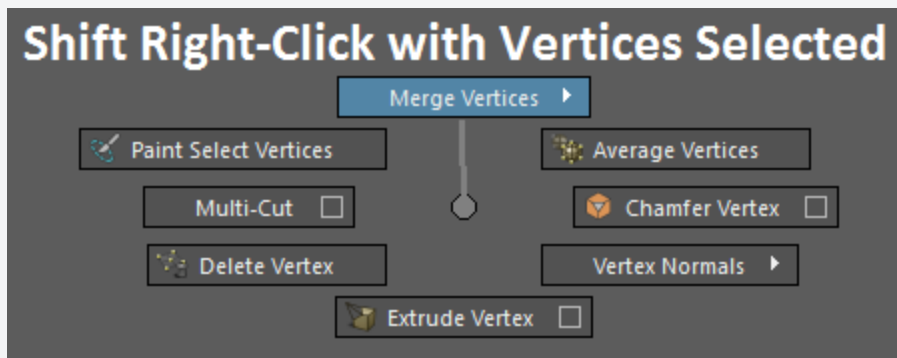
- **1** - Default polygon mesh
- **3** - Smooth preview
- **Alt + b** - Cycles the background color.
- **Ctrl + h** - Hides the currently selected object[s]. The object can still be selected in the Outliner, though its name will be grayed out.
- **H** (*Shift + h*) - Un-hides the currently selected object[s].
- **Display → Show → All** - Unhides everything.

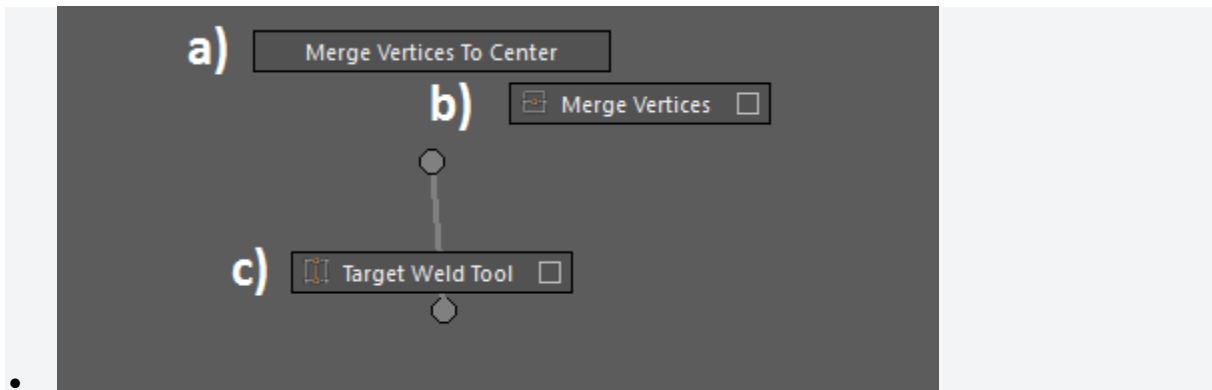
Mesh Editing Tools II

- **Edit Mesh → Extract** - Makes the selected faces their own separate object.
- **Bevel Edge** - Split selected edges apart into multiple edges/faces. Select the box to open up the Bevel Edge options to adjust the width between the new edges.



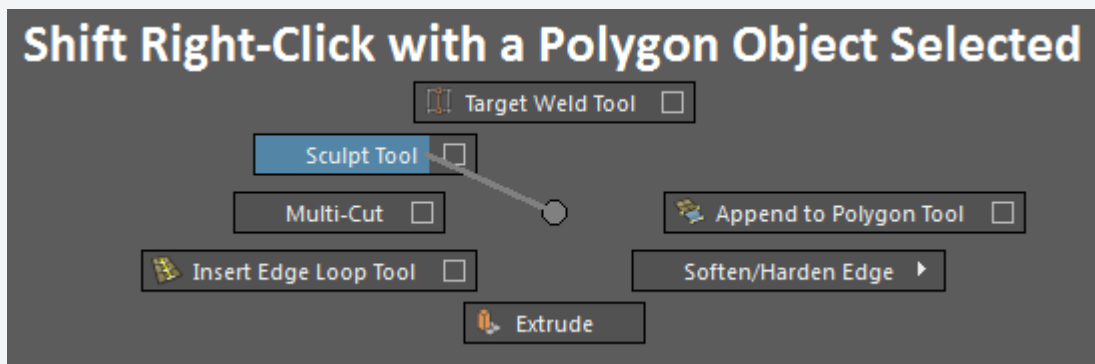
- **Vertex Merging Tools:**





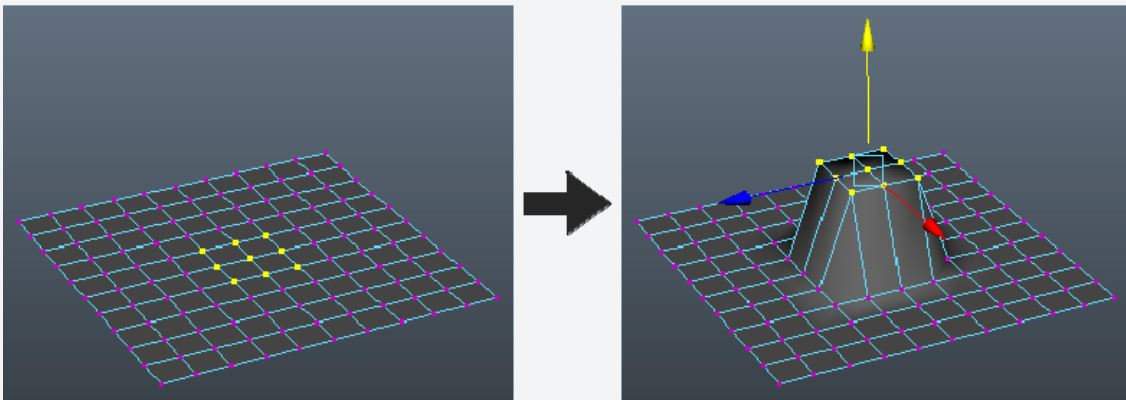
- a. **Merge Vertices To Center** - Merges selected vertices to their center.
- b. **Merge Vertices** - Merges selected vertices within a certain distance threshold together. Select the options box in the marking menu to change this threshold.
- c. **Target Weld Tool** - Left click and drag one vertex to another to snap and merge the first to the second.

- **Sculpt Tool** - This tool has a lot of different sculpting options within it, like pinch, scrape, smooth, and relax. Relax distributes polygon faces more evenly across a surface while maintaining an object's shape. In the Tool Settings, change the Opacity value to change how much of an effect it has. You can hold the 'b' key while the tool is active and left-click drag to modify the brush size.

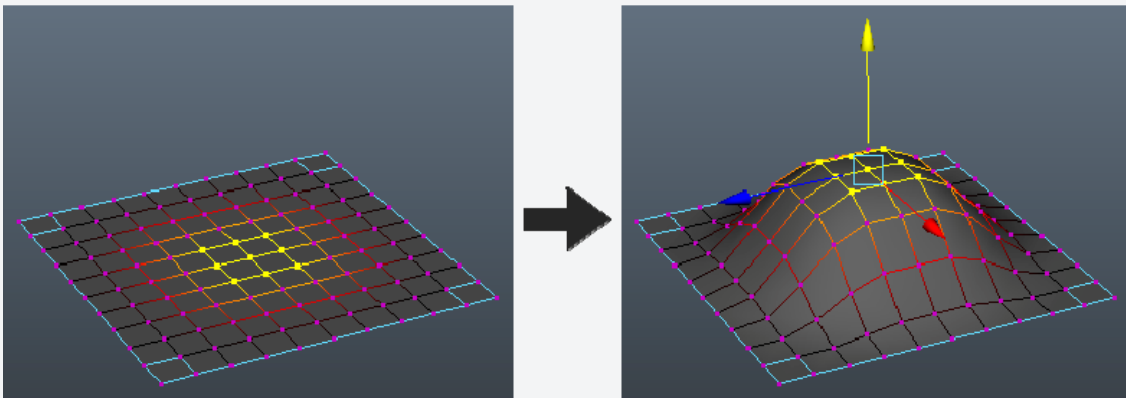


- **Soft Selection** - Soft selection is simply the "partial selection" of surrounding geometry. For example, if you select some vertices, surrounding vertices will be partially selected. Moving the selected vertices will also move the partially selected ones slightly.

Hit '**b**' to toggle soft selection on or off. When on, you can hold the '**b**' key and left-click drag to change the soft selection falloff. Before using soft selection, go to its Tool Options and change the Falloff mode to "Surface".



Soft selection OFF



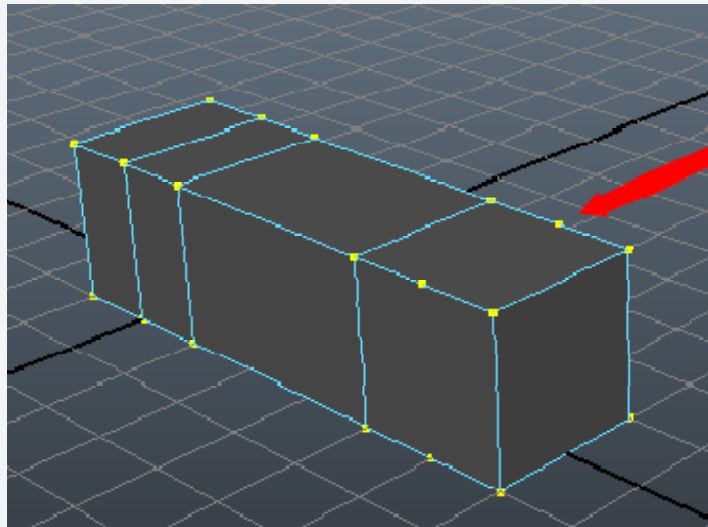
Soft selection ON
[same vertices selected]

- **Mesh → Smooth** - Puts a "smooth node" on the selected mesh, subdividing it.

-

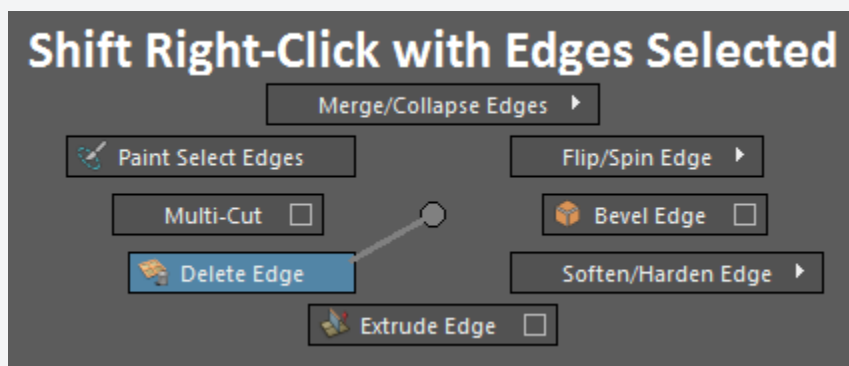
- **Deleting Edges:**

- If you find yourself with too much geometry and need to delete edges, don't just select them and hit the Delete key. Doing so may leave behind stray vertices. The resulting geometry will appear to be quads but will actually have n-sided polygons.



Stray vertices making a 6-sided polygon instead of a quad. This will break the Insert Edge Loop Tool.

Instead, select the offending edges and use the **Delete Edge** marking menu command. This will delete both edges and vertices.

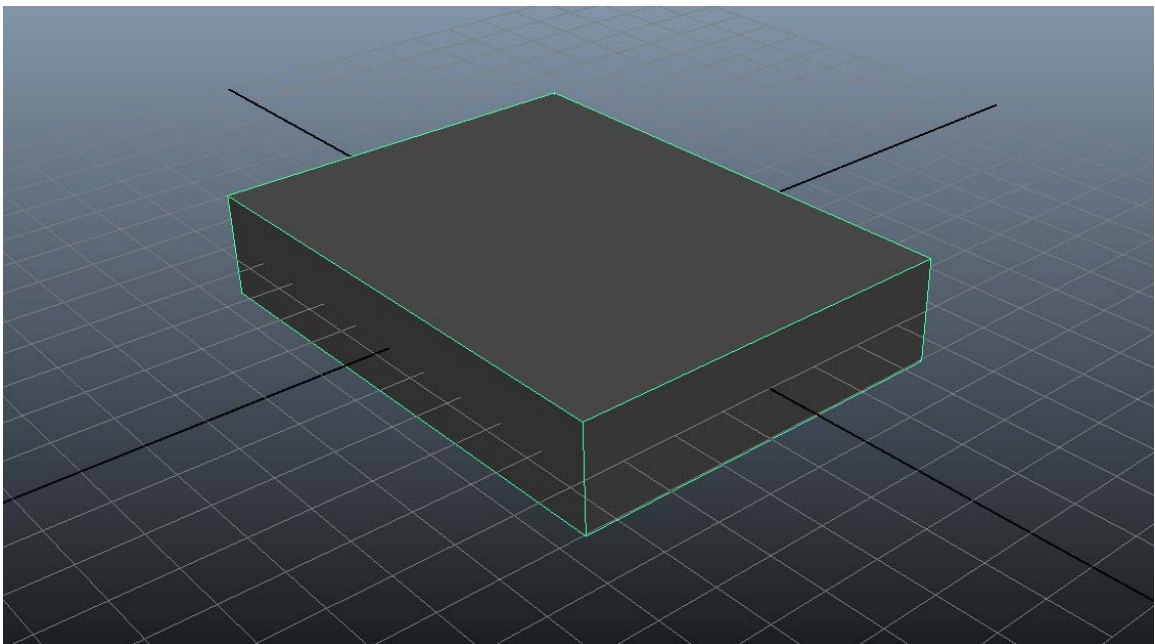


In this project we will create a subdivision surface hand using polygon tools. For this project we will be working in the Polygons menu set. Create a new Maya file to begin.

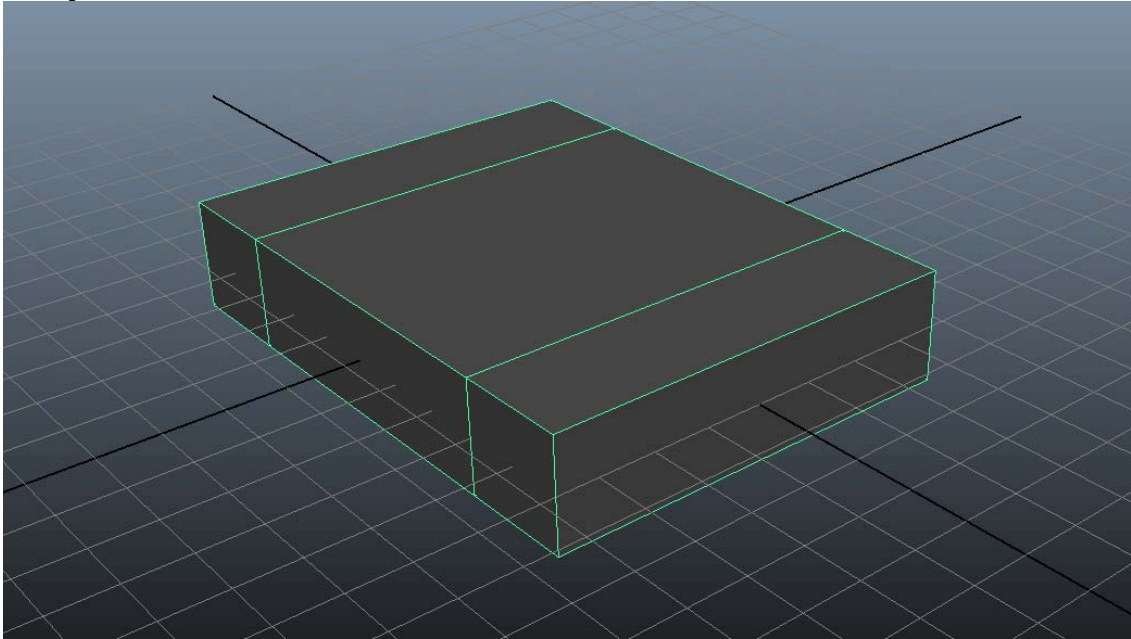
It is a good idea to start modeling from reference at the beginning as it will make it easier to tweak the overall form once the topology is set. The use of reference will be fairly informal this time around (we will set up reference planes in Maya for the next assignment). Use images provided in [hand referenced folder](#) and most importantly use your own hand!

Be sure to constantly change your view as your working as well as checking the smooth preview by hitting '3' and editing the default polygon mesh found by hitting '1'.

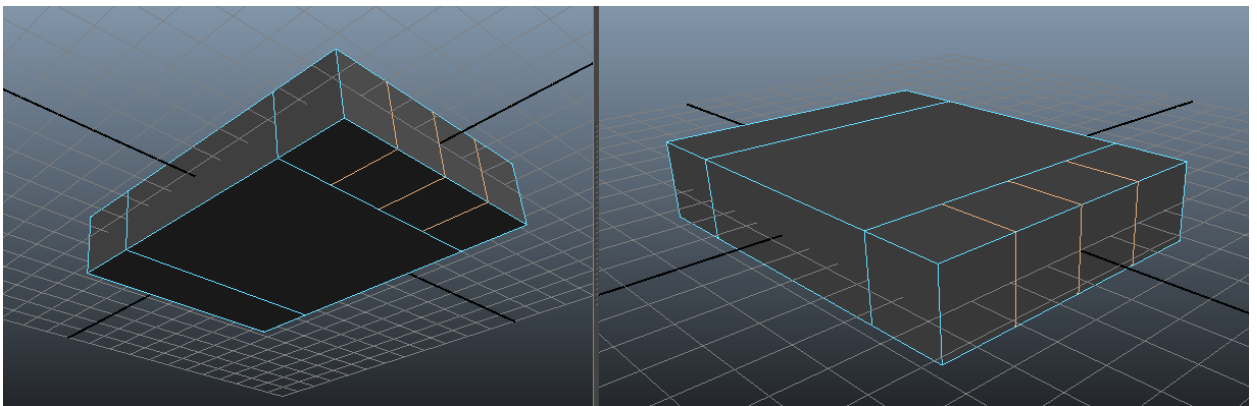
1. Create a new cube and resize it to the proportions below. This will be the starting point for the body of the hand.



2. Add two edge loops around the width of the palm using the Insert Edge Loop Tool.

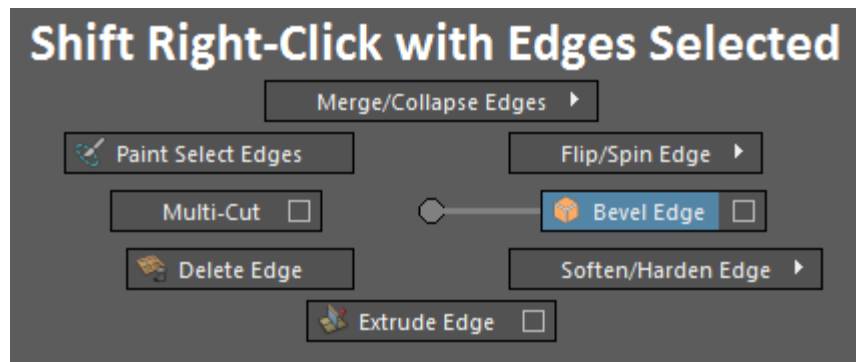


3. Use the Multi-cut Tool to add some edges around the knuckle area. Distribute these splits evenly. Start by adding the center edges, holding **Shift** to snap the cut at the 50% mark. Go into the Multi-Cut Tool Options and change the Snap Step to 50%, if it is not already set to that value. Then divide the two halves once more for three total cuts. Make sure these cuts wrap under the hand. We will soon build the fingers from these faces.

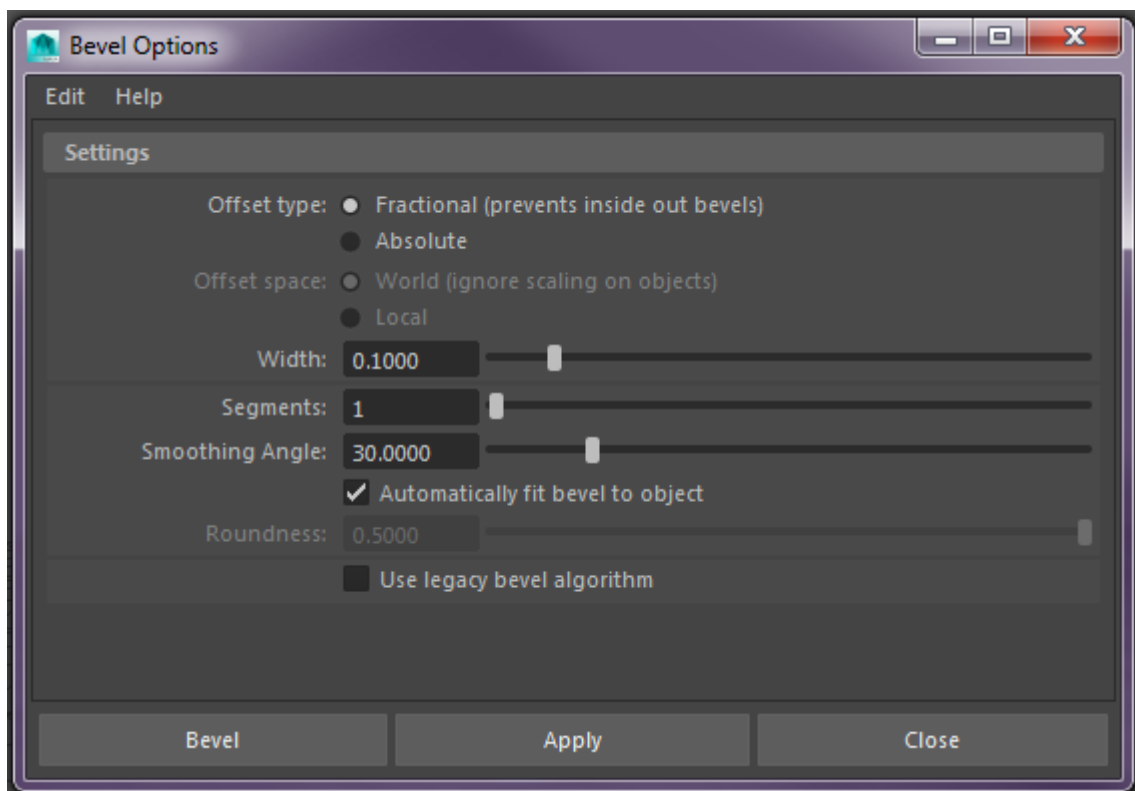


4. Select the edges made in the previous step and use the marking menu to access Bevel Edge Options. The little square to the right of bevel (and

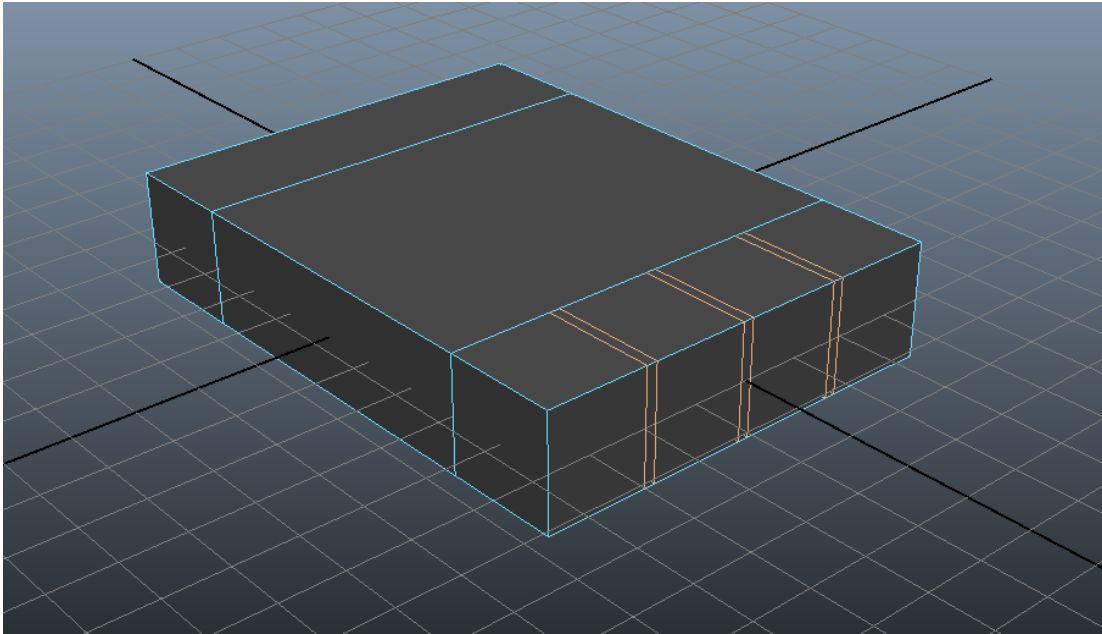
any other command/tool) pulls up an options box for that command before it is executed.



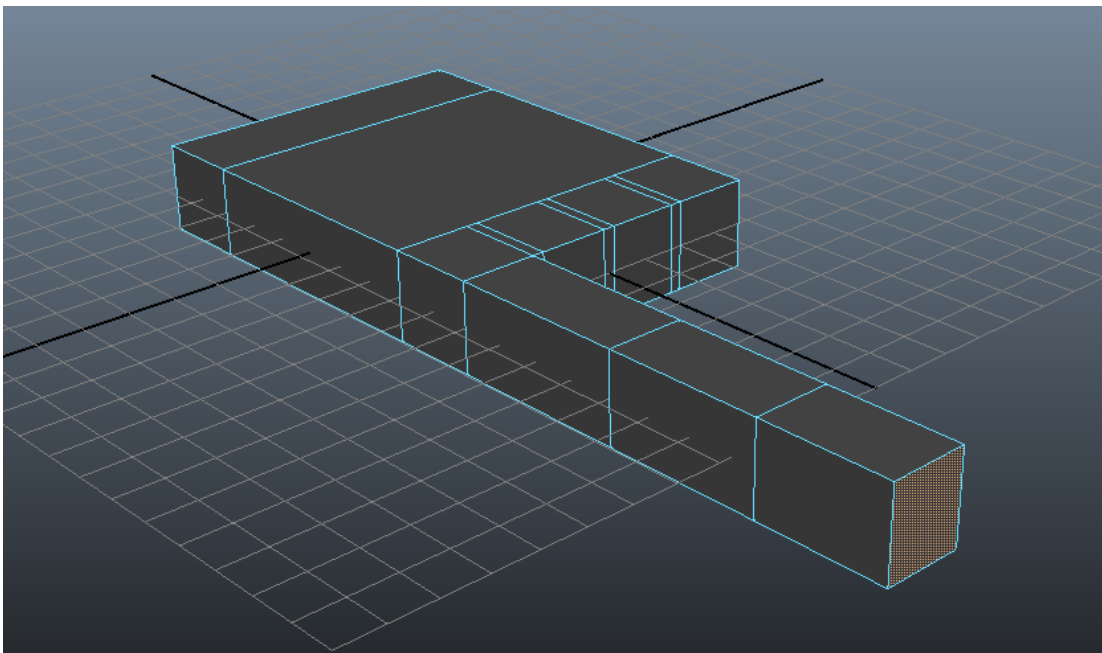
Bevel will allow us to evenly split the selected edges and set up the space in between the fingers. However, we need to tweak the options first.



Change the width to a value suitably small and hit "Apply". If the gap is too wide undo, try a different value, and hit "Apply" again until it looks good.



5. Extrude the face corresponding to the index finger out three times. Note that for the sake of consistency you will be modeling a left hand.

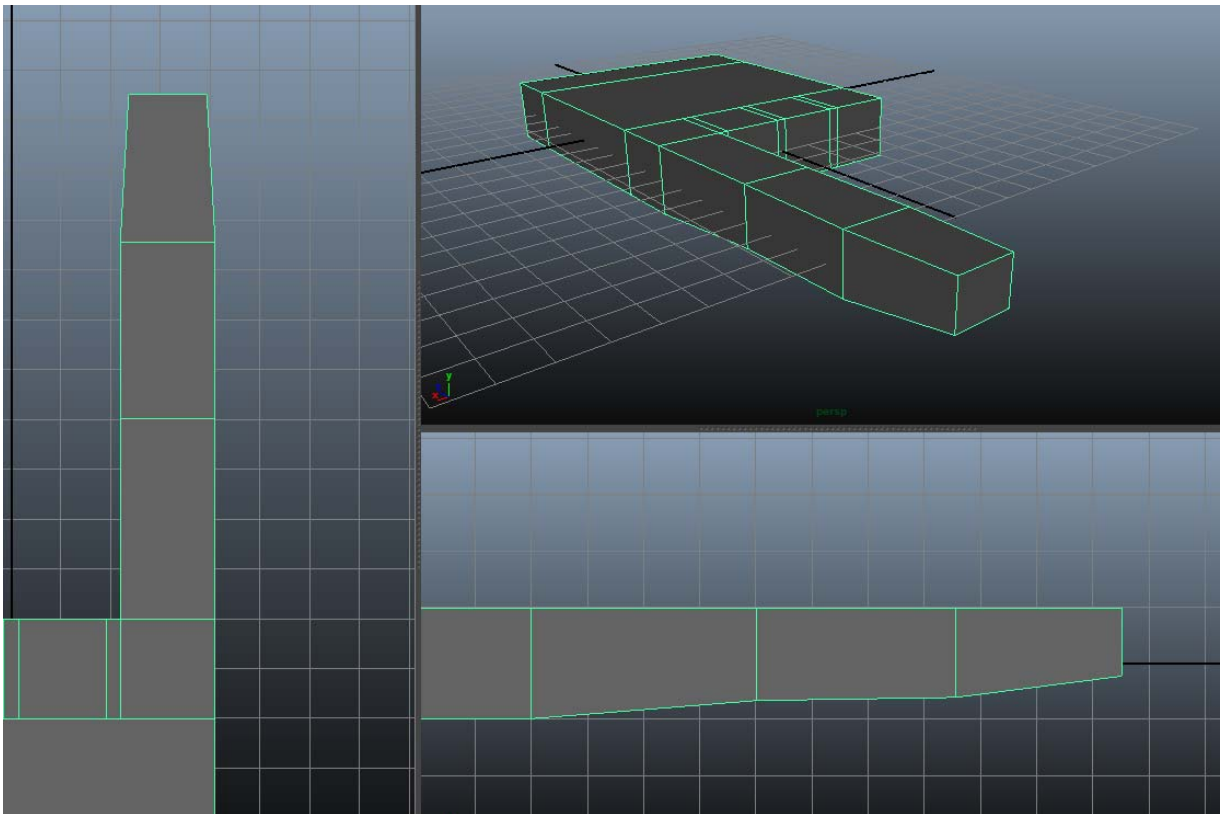


6. A pretty reliable modeling workflow can be summarized as thus:

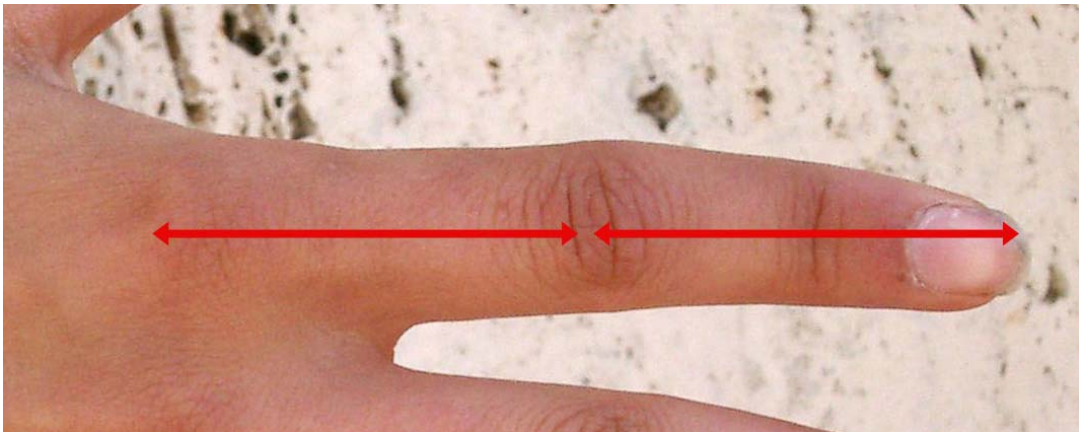
1. Add some geometry.
2. Shape said geometry to the desired form.
3. If the subdivided version of the model (a result of hitting '3') needs more definition, repeat steps 1-3 until it looks good.

Basically you block in the broader shapes first and then refine down to the details. Using this approach will help you avoid adding an unnecessary amount of extra geometry, which only makes it more difficult to shape your models. Every edge loop and extrusion has a purpose!

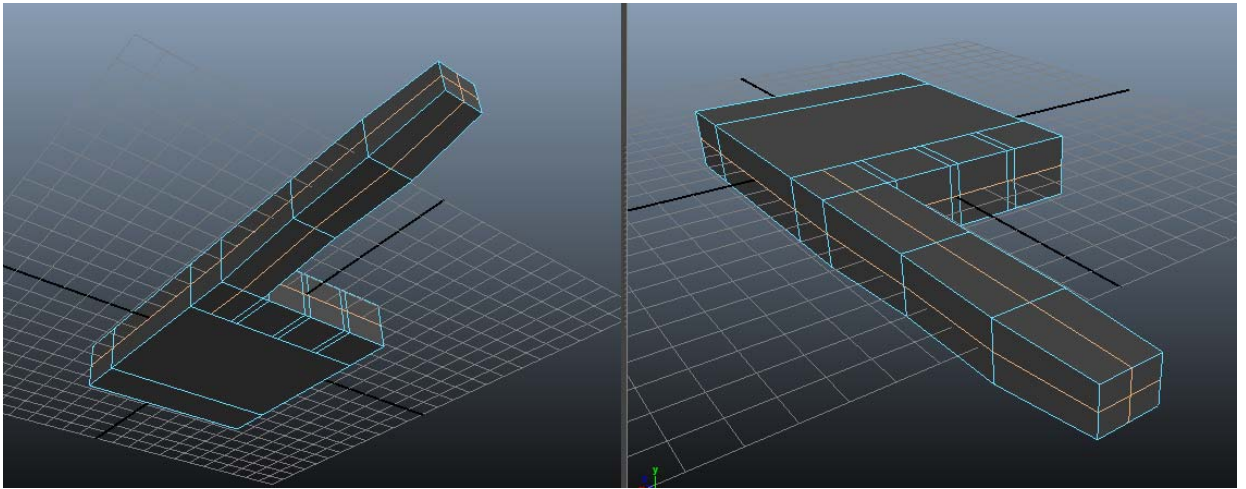
The finger is an example of how this approach works in practice. First, use the existing geometry to rough in the finger's form.



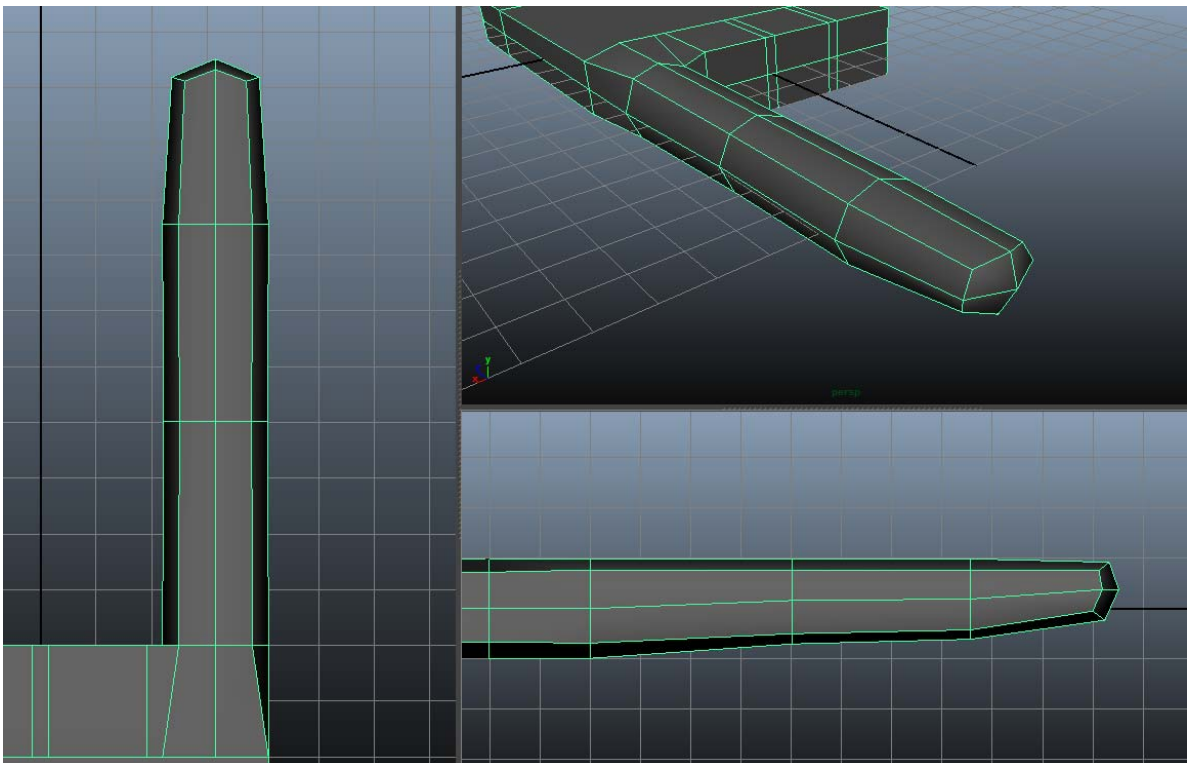
Pay close attention to the relative proportions. Use your own hand as reference for this. The base of the first knuckle to the next is approximately the same length as both end finger joints.



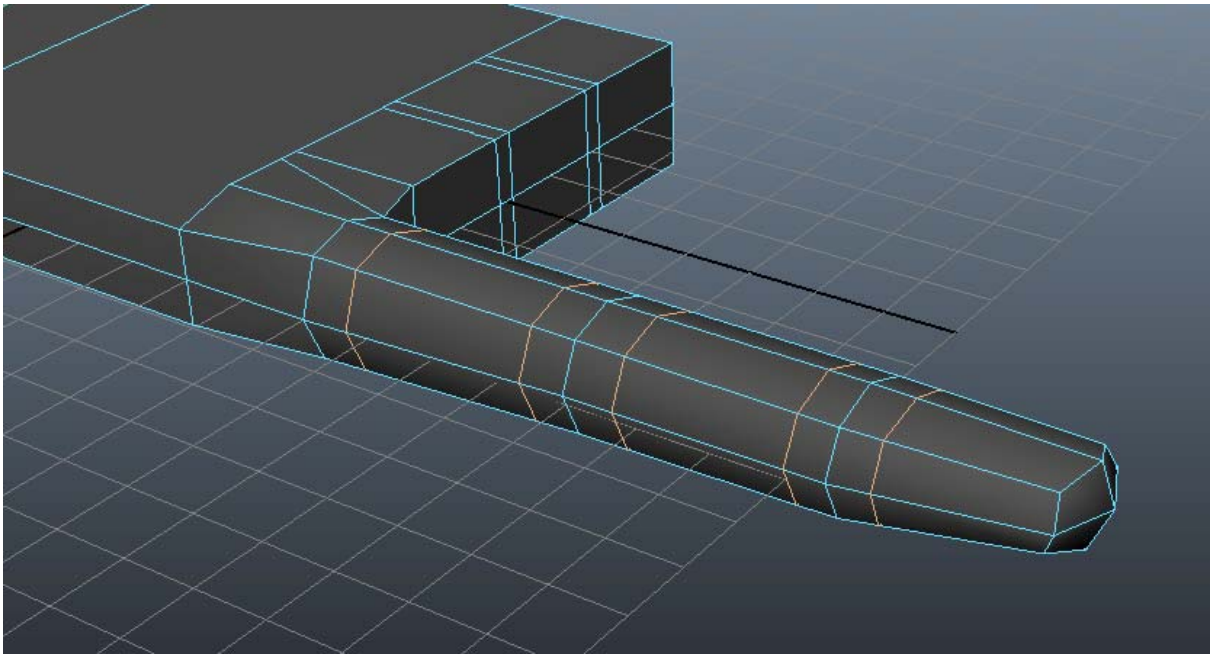
7. Add two edge loops: one along the top and one along the side of the finger.



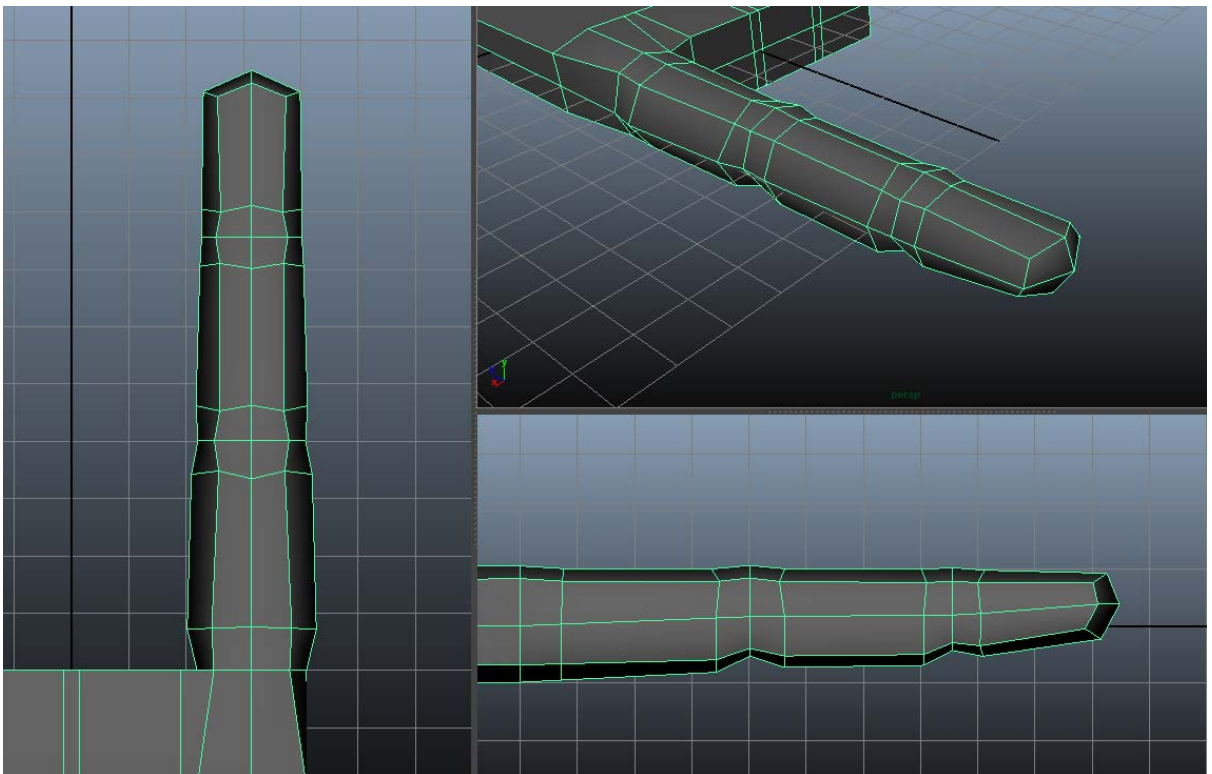
Currently each edge loop going down the finger is square shaped. They will need to be rounded out and sculpted. One quick way to get started is select the four corners of a given square shaped loop and use the Scale Tool to shrink them in.



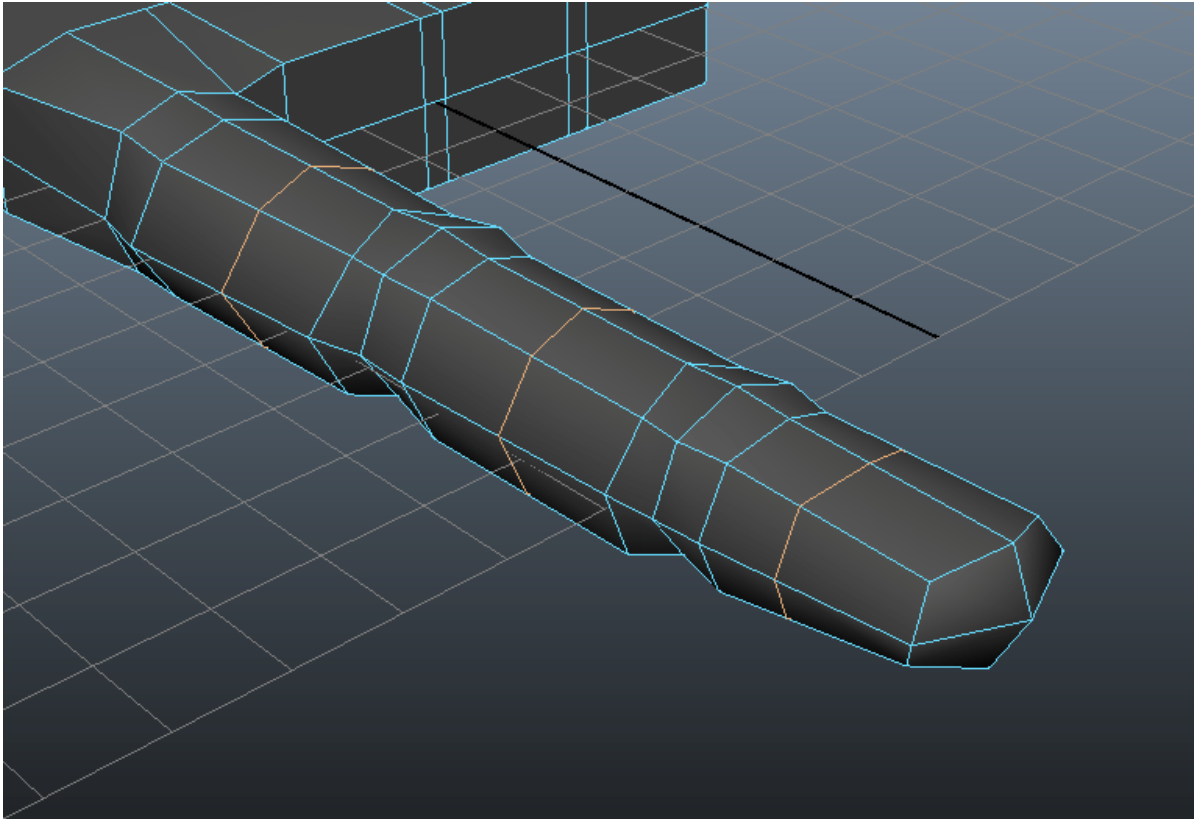
8. Add the highlighted edge loops near the knuckles.



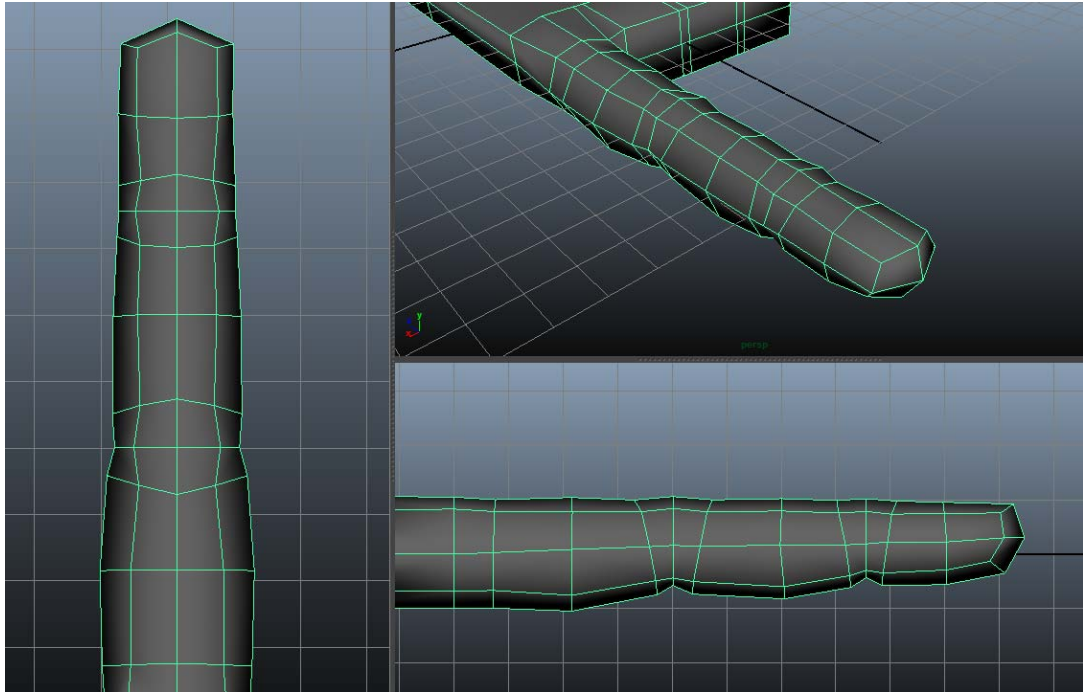
As before, use these new edge loops to sculpt more detail into your model. This time the areas around the knuckles are the focus.



9. The finger segments are fairly tube-like right now and will need additional geometry to be sculpted out more organically. Add edge loops in the middle of each segment.

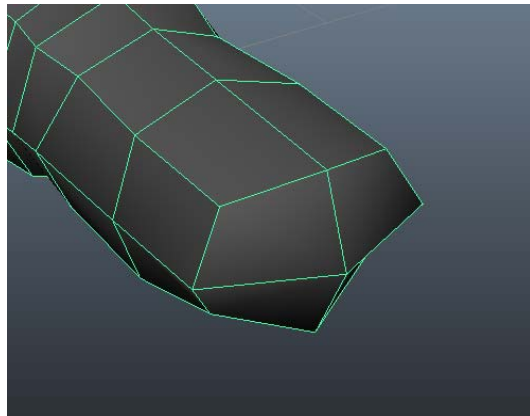


Everyone's finger is different! Exaggerate the shapes more than what is indicated in the images below if necessary. You also may find that you are going back and tweaking some of the geometry that you added in previous steps. That is completely fine! Modeling isn't strictly a linear process.

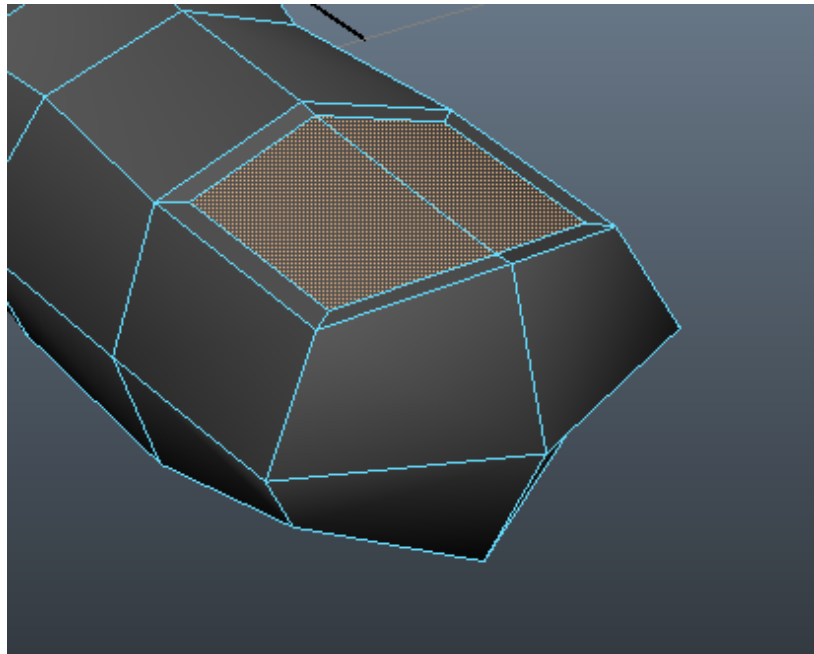


10. Now it's time to add finer details to the finger starting with the nail.

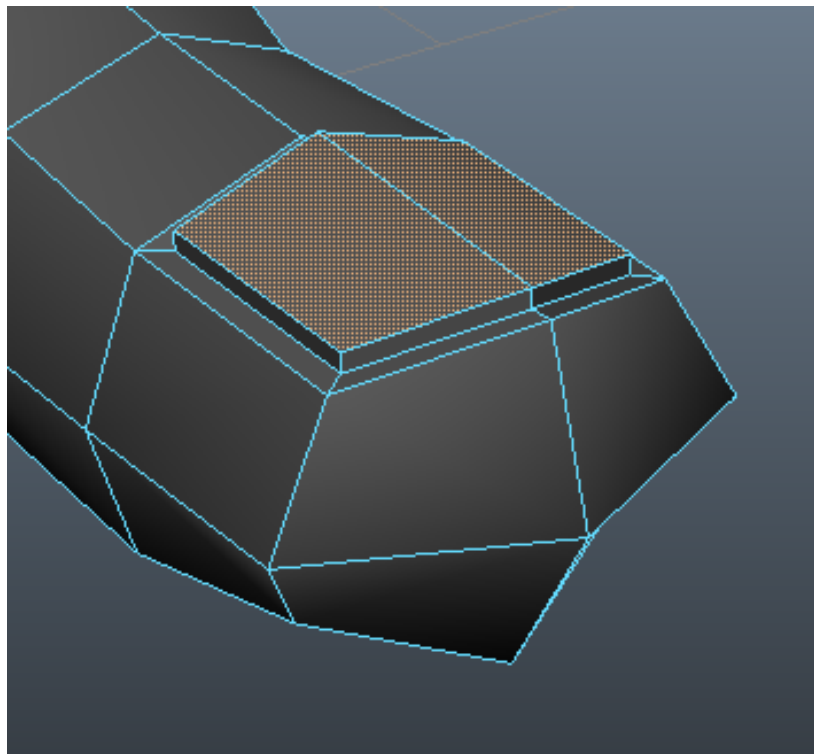
a. Initial geometry



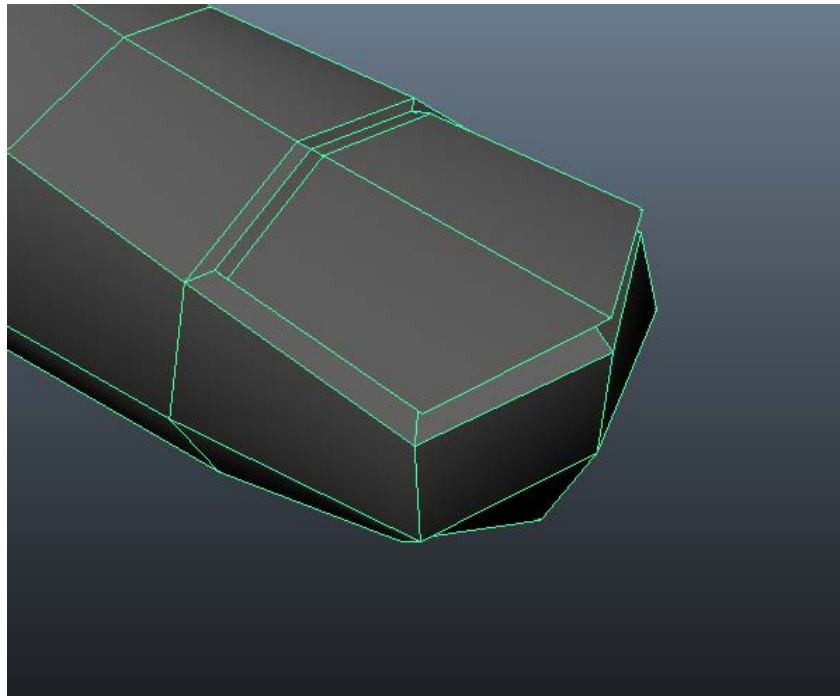
b. Extrude the two faces in.



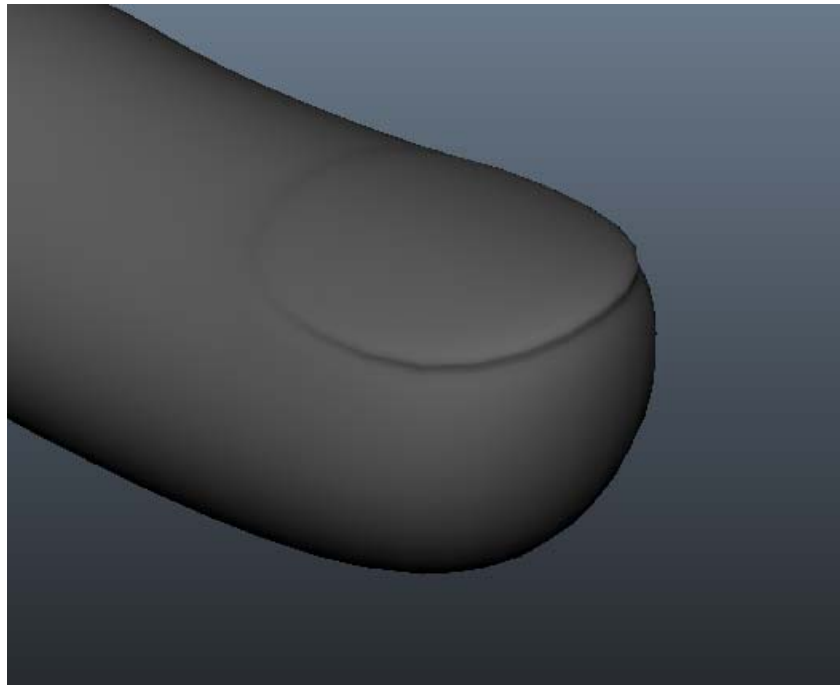
c. Extrude them up.



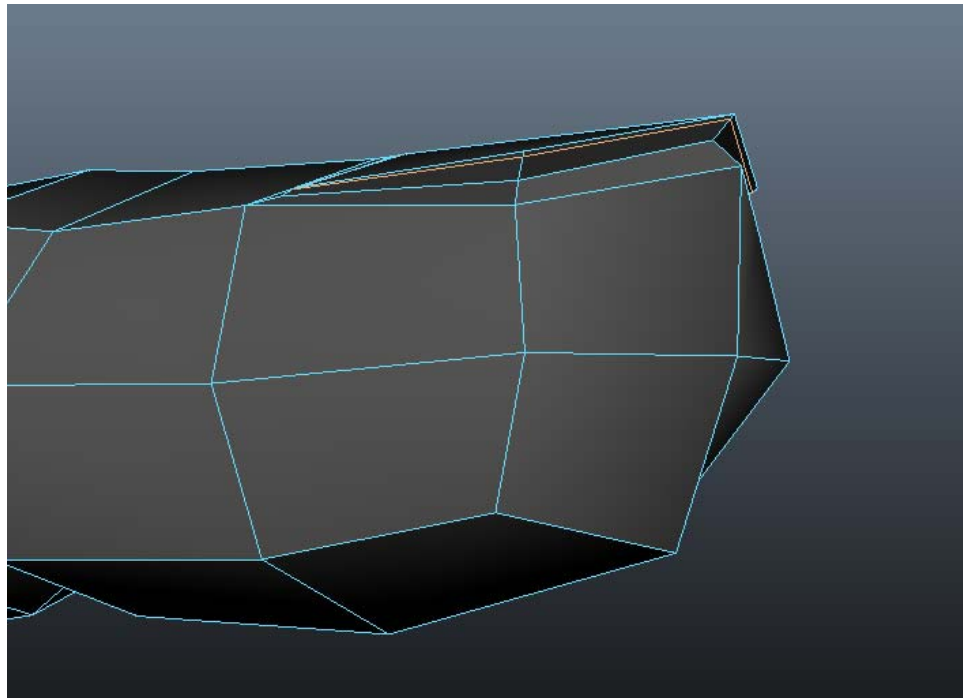
d. Shape the two faces from the previous step.



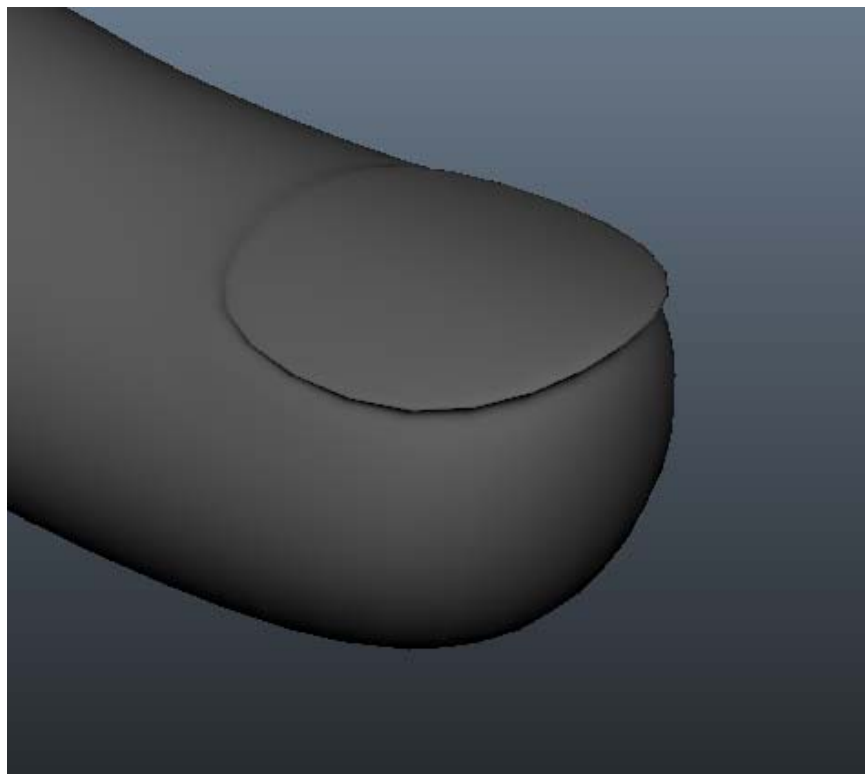
e. When you hit '3' to smooth the finger the nail looks fairly soft.



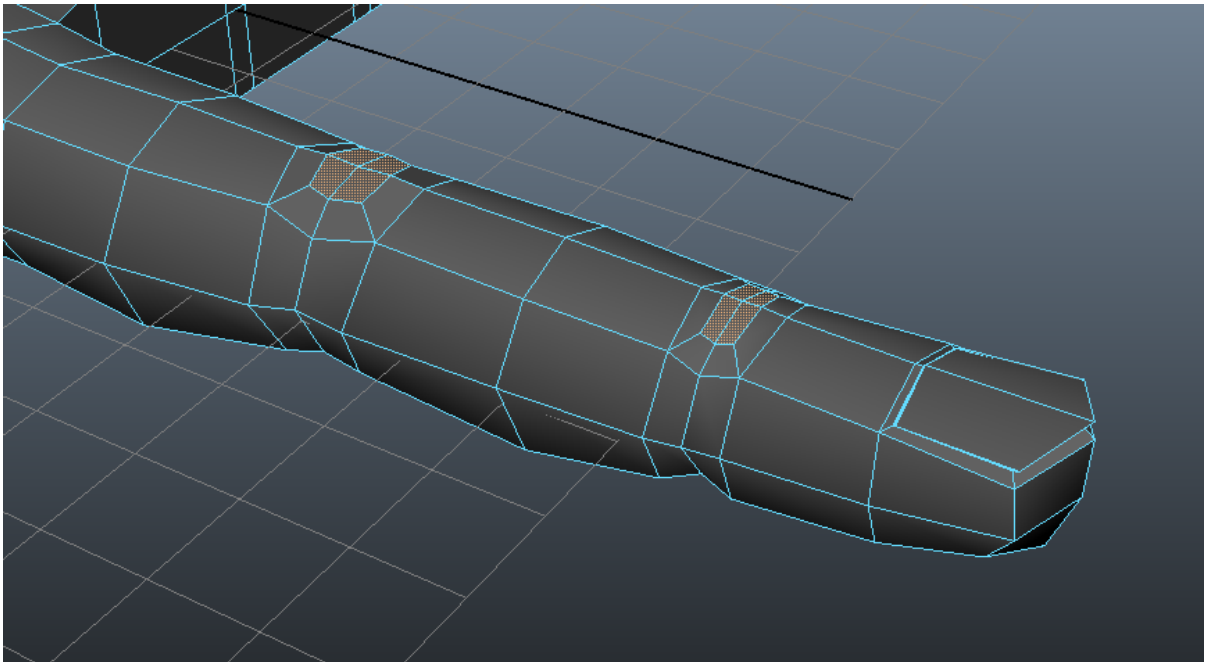
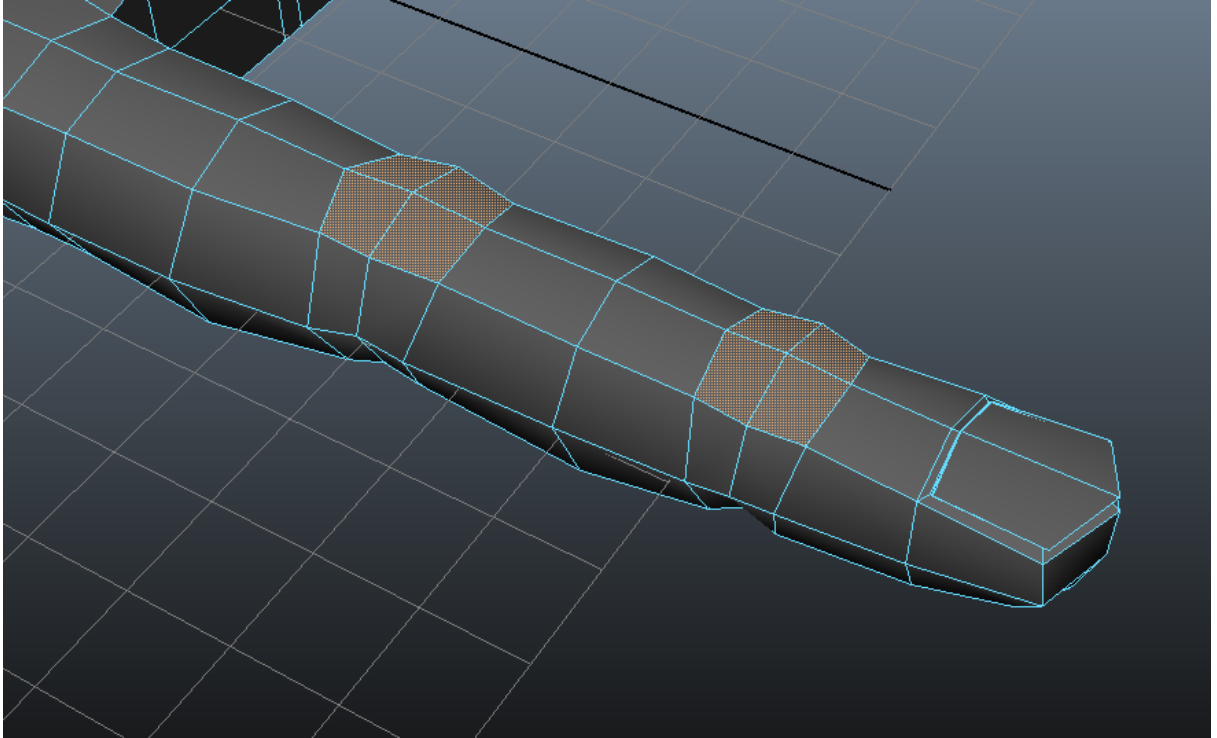
f. To sharpen it add a control edge loop under the nail's top faces.



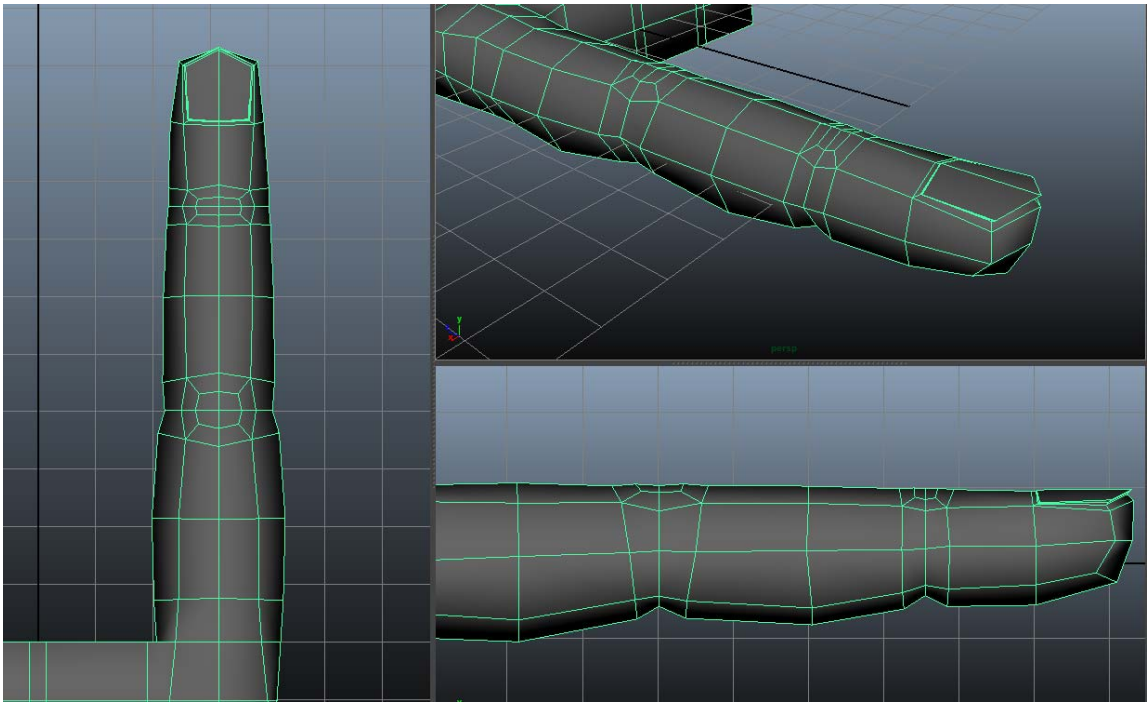
g. When smoothed it should look sharper now.



11. The next bit of detail will be a couple of the knuckles. Select the following faces and extrude them inward. Be sure to only do this one knuckle at a time.

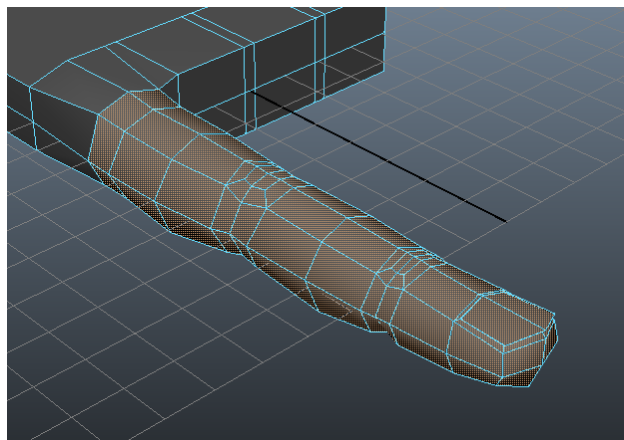


Be sure to spend some time sculpting them.

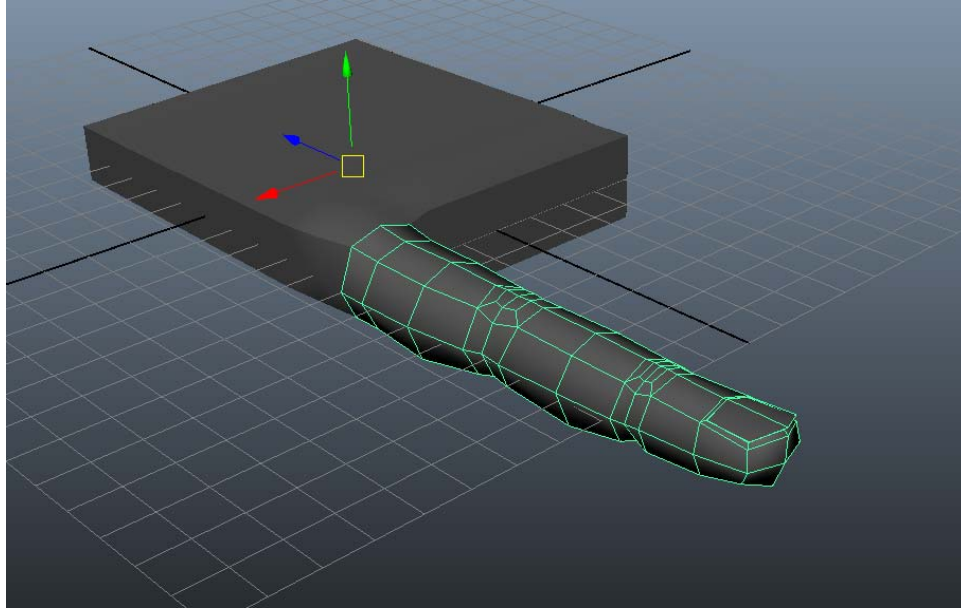


12. Now that you have crafted a pretty good finger, it's time to do this *three* more times! Just kidding. To save work you will be duplicating the index finger and resizing it to create the middle, ring, and pinky fingers. First you will need to do some preparation.

Select the finger's faces.

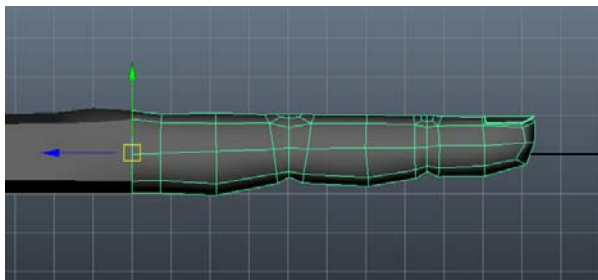


Hold **Shift** and right-click to bring up the marking menu. Below the radial menu is a more standard menu item list. Choose "Extract Faces" from that list.



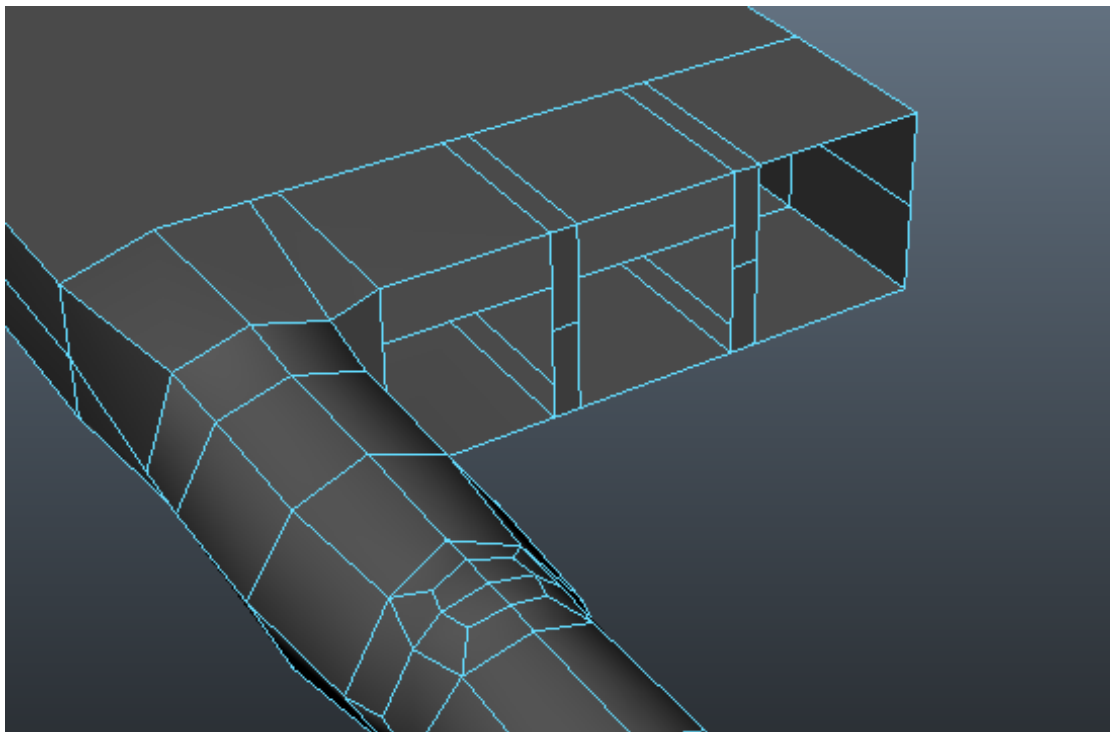
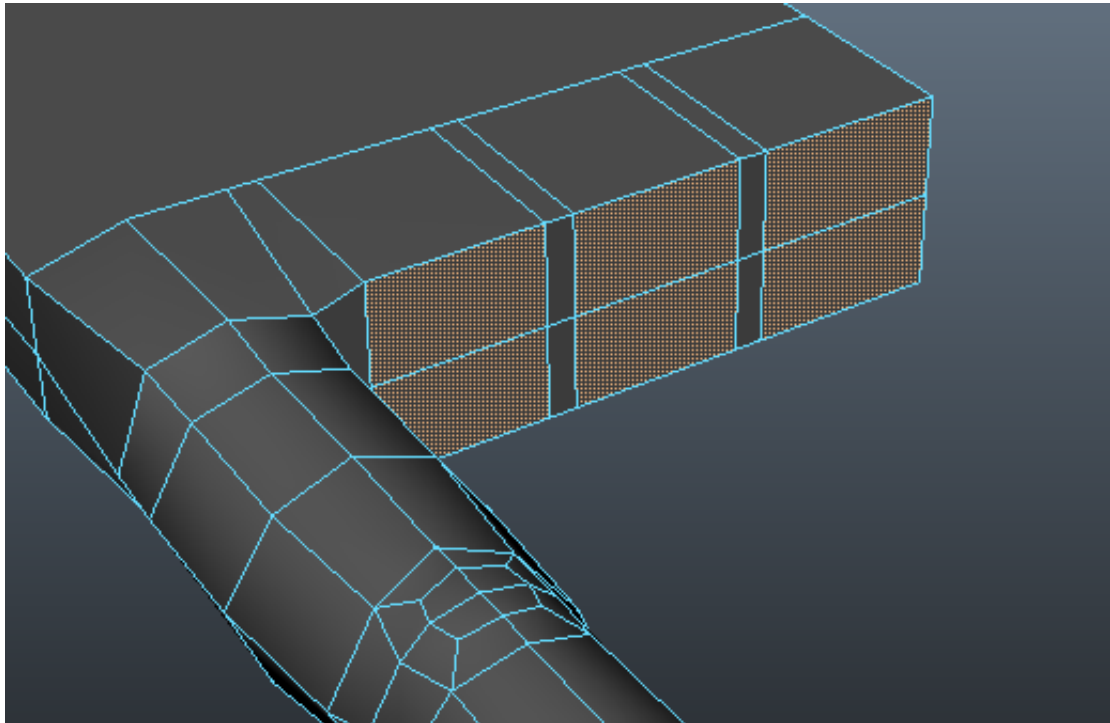
This removes the faces from the hand and creates a new object with its own transform. The default object pivot becomes the center of the scene, which will make it a bit awkward to move and rotate the finger once duplicated. In the main menu go to **Modify** → **Center Pivot**. It's better but not quite in an optimal location yet.

Go to the side view. Now hit the **Insert** key to toggle on the pivot editor. Hold '**v**' for vertex snap, grab the axis handle aligned horizontally (in the example it's the Z-axis), then hover the mouse pointer over a vertex at the base of the finger. Push **Insert** again to finalize your pivot changes.

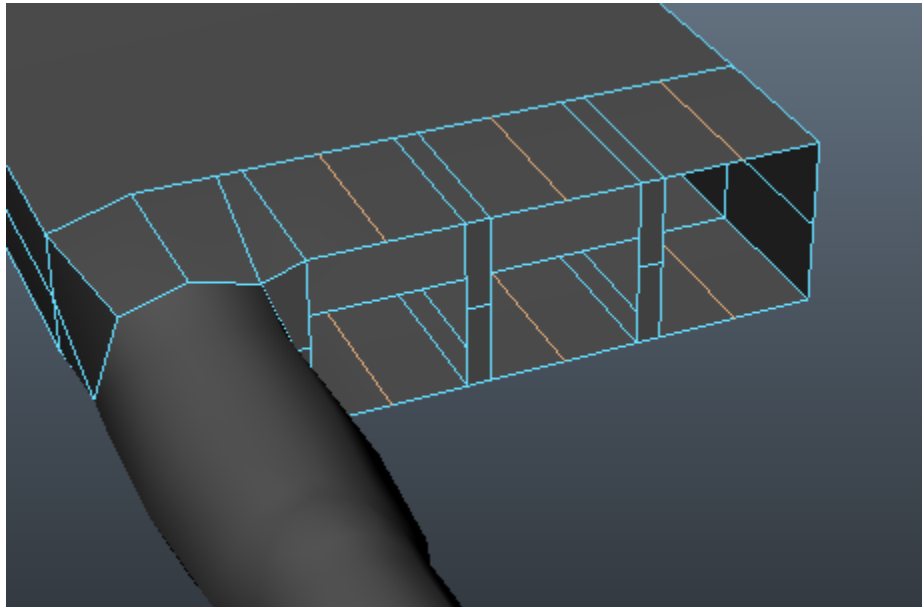


The pivot should now be at the base of the finger.

13. Now we want to prepare the other knuckles for their eventual finger attachments. Select the highlighted faces and delete them.

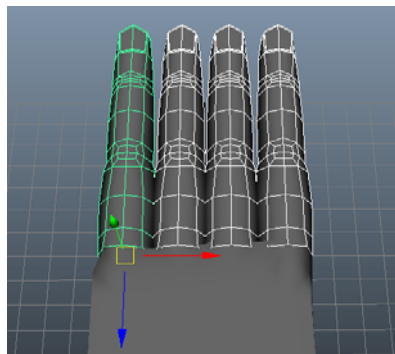


Next, add in the edges below so the fingers will each have 8 sides to connect to.

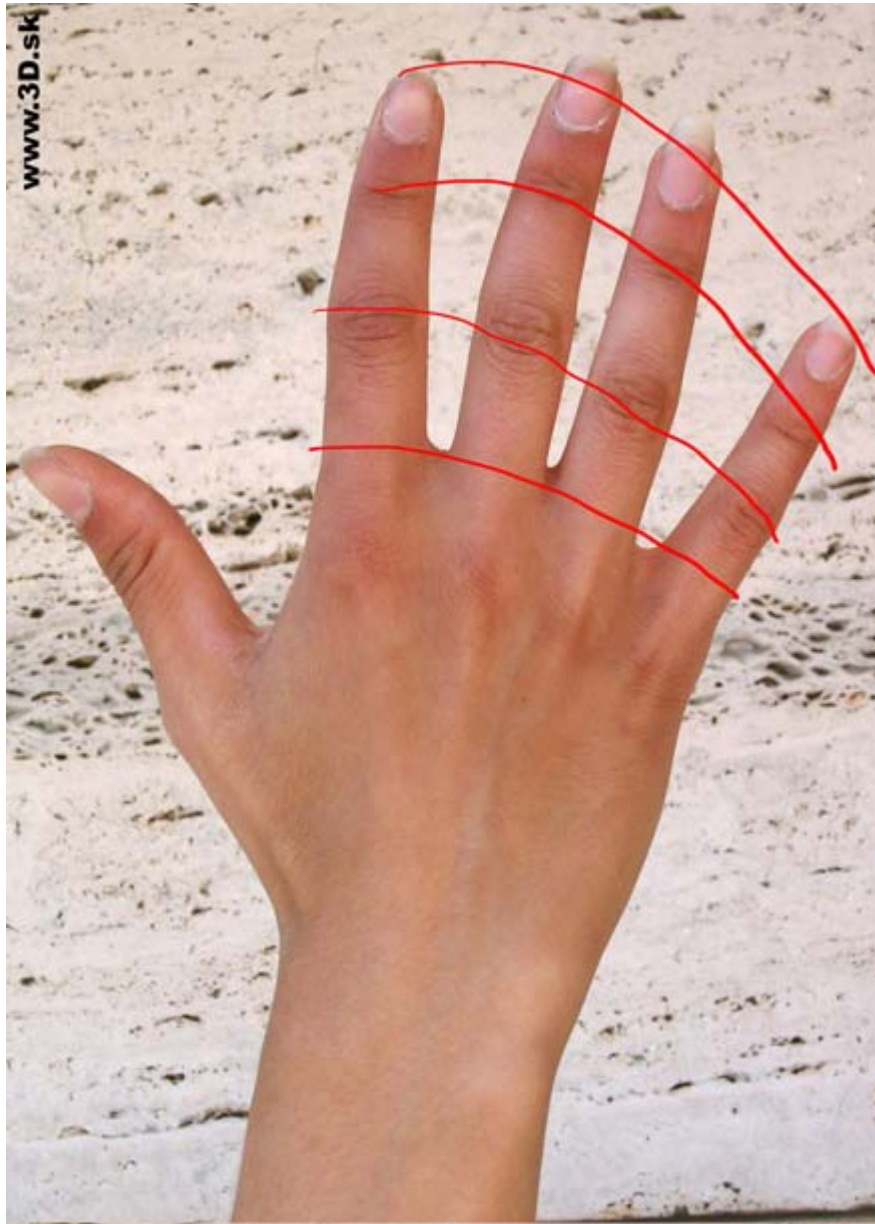


A simple way to do this is using the Insert Edge Loop Tool. In the Tool Options just pick "Multiple edge loops" and set the number to 1. Now you can drop in perfectly centered edges. Note that this works because the loop isn't able to continue down the back of the hand because it's currently a giant "n-gon" (polygon with greater than four sides).

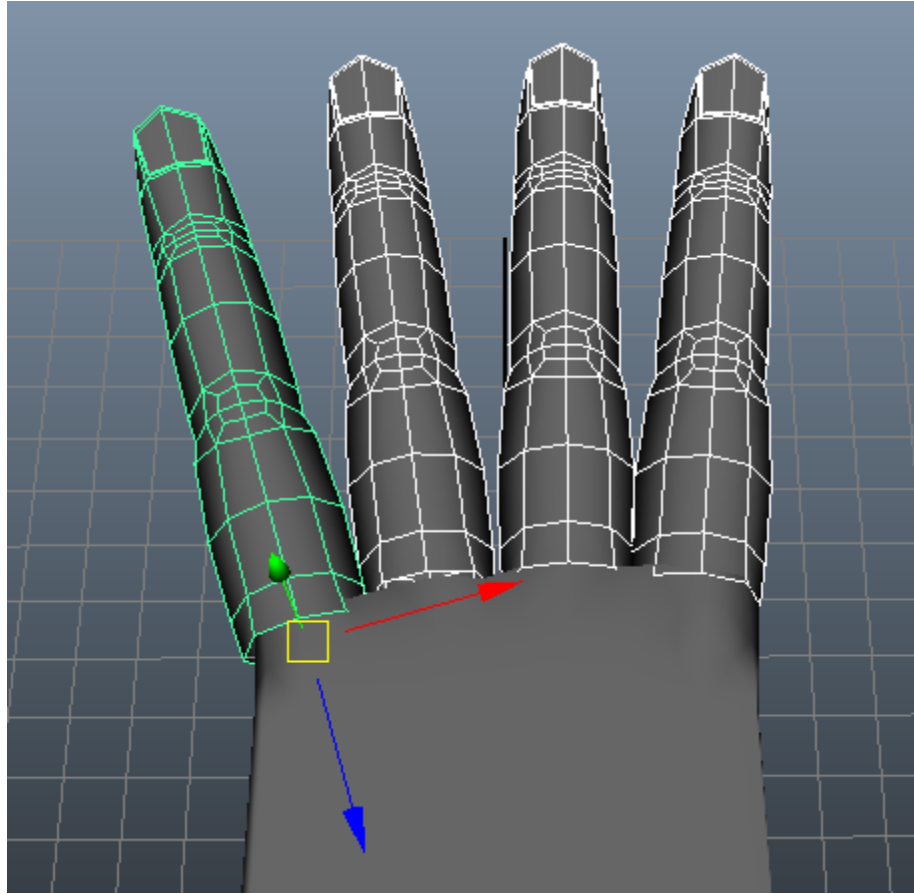
14. Select the index finger in Object Mode and press **Ctrl+d** to duplicate it, then move it over to one of the open finger slots. Do this two more times for the remaining fingers.



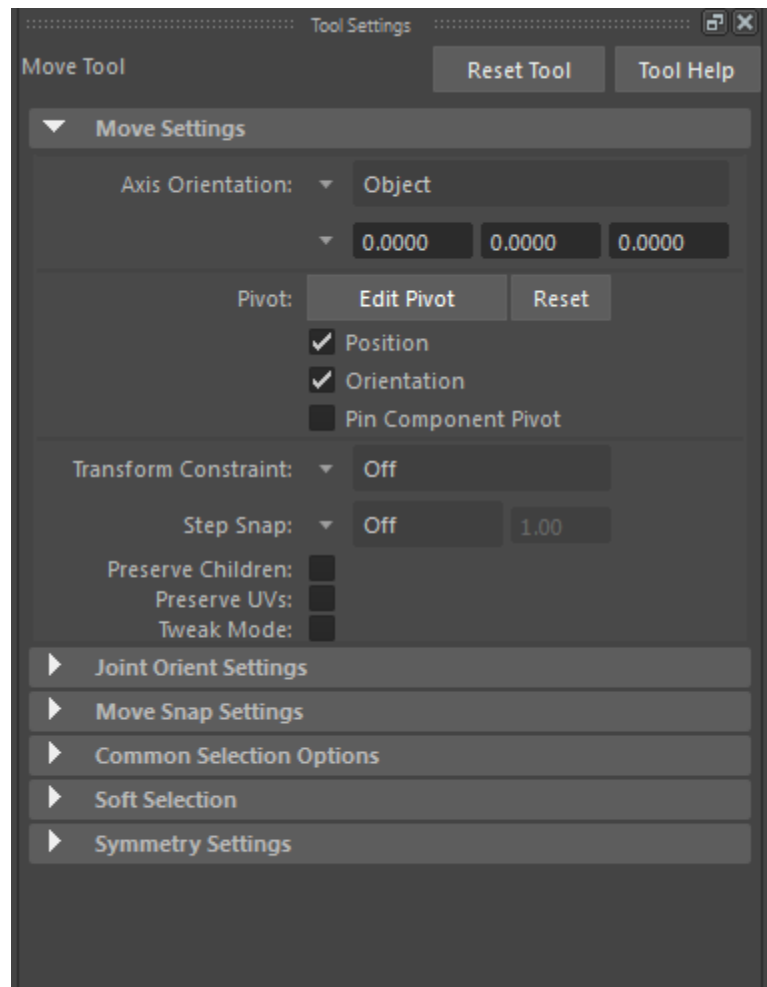
Fingers have a natural curve in their positioning and orientation as demonstrated below.



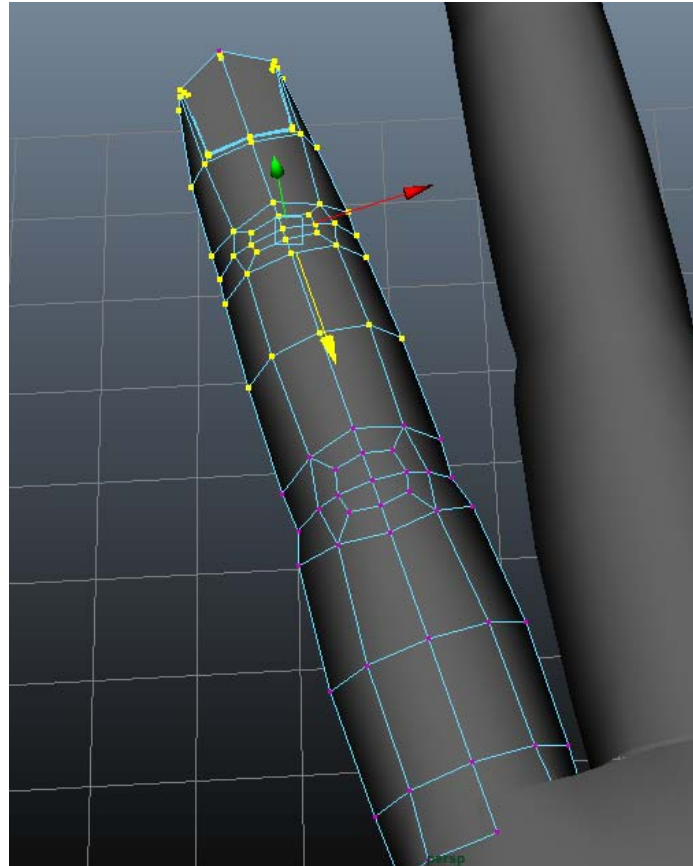
Replicate this by translating and rotating the fingers. They will most likely go through the body of the hand, but ignore that for now (it will be fixed soon).



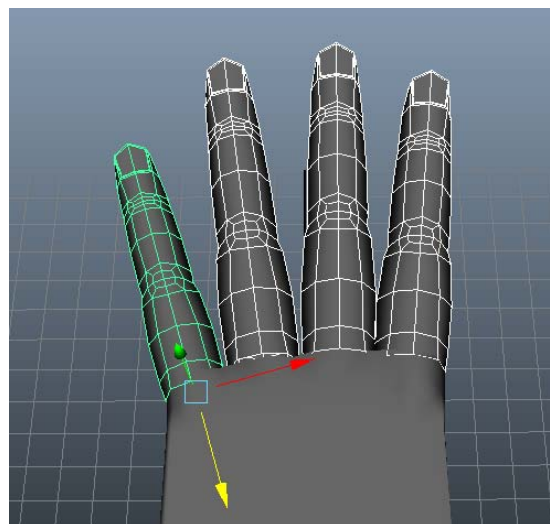
It's time to resize the fingers. This will be done mostly through the Move Tool. Before getting started, activate the Move Tool and go to the Tool Options, then make sure the Axis Orientation is set to "Object".



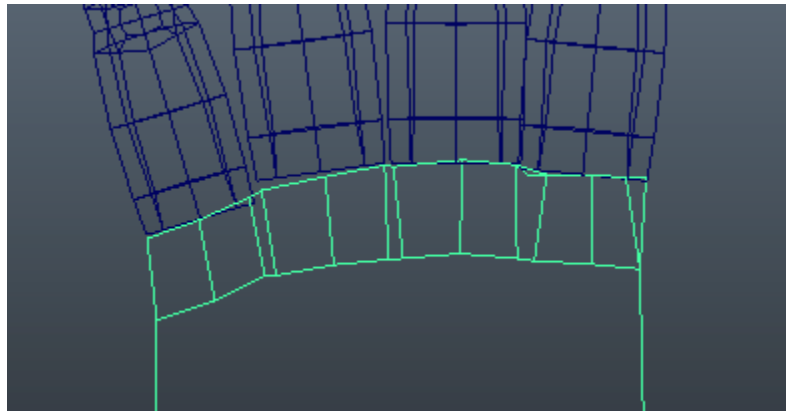
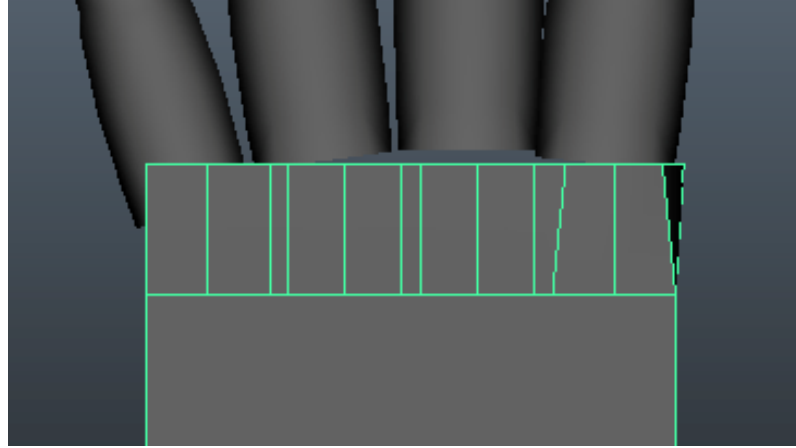
Select entire sections of the finger one at a time and move them down or up. Use only the tool axis pointing down the finger.



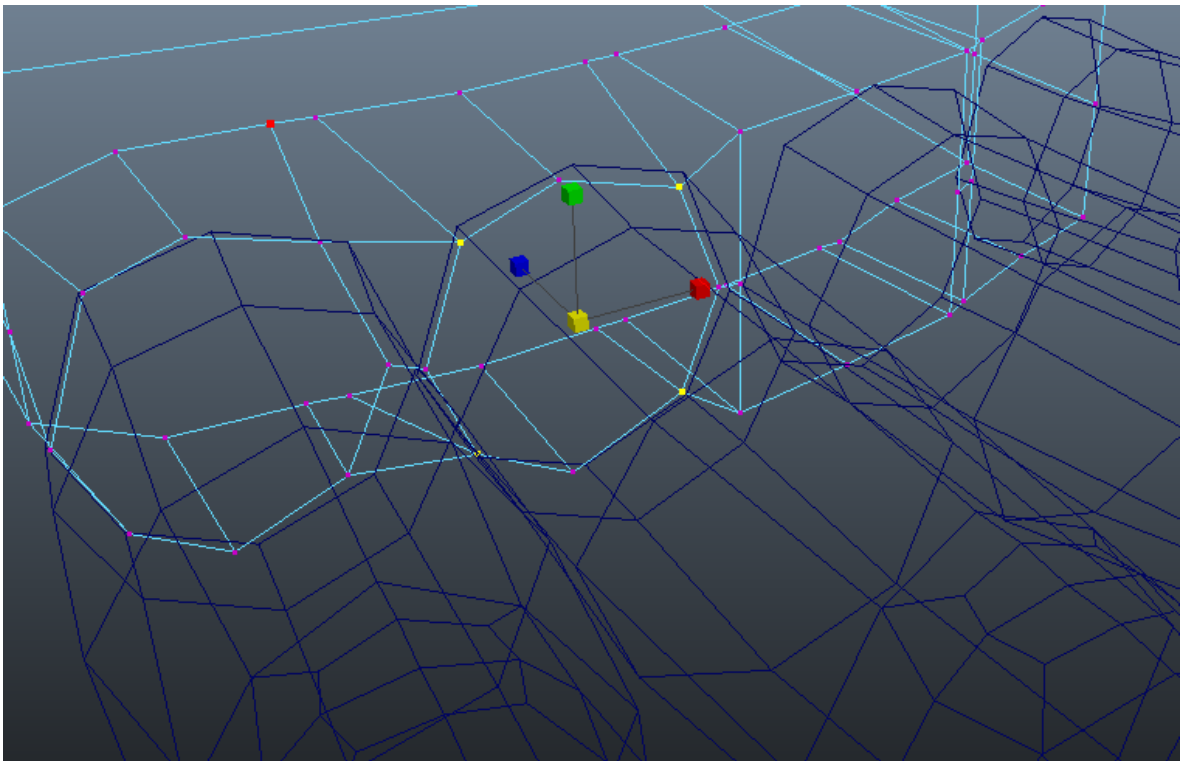
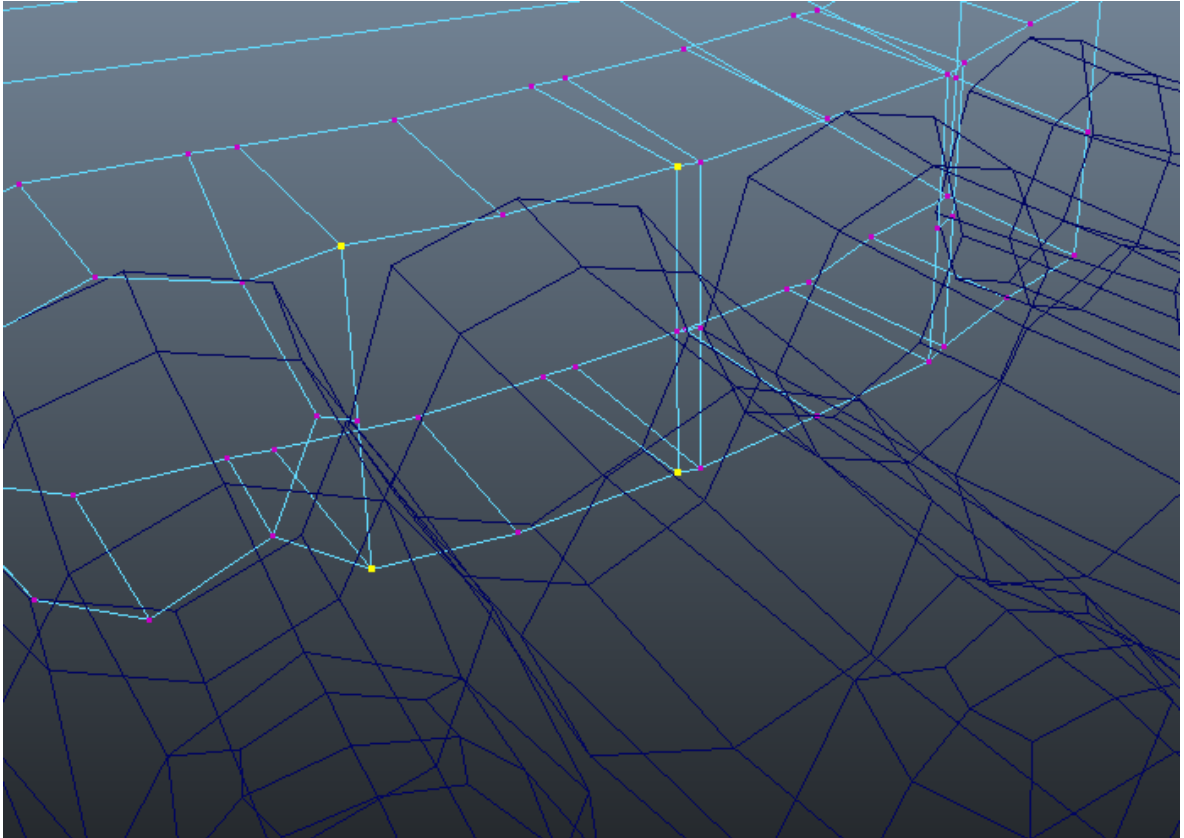
Don't change the length of the index finger, however! Use it as a relative baseline for what should be shorter or longer. The only finger that needs to be shrunk down with the Scale Tool is the pinky. And only by a little bit at that.

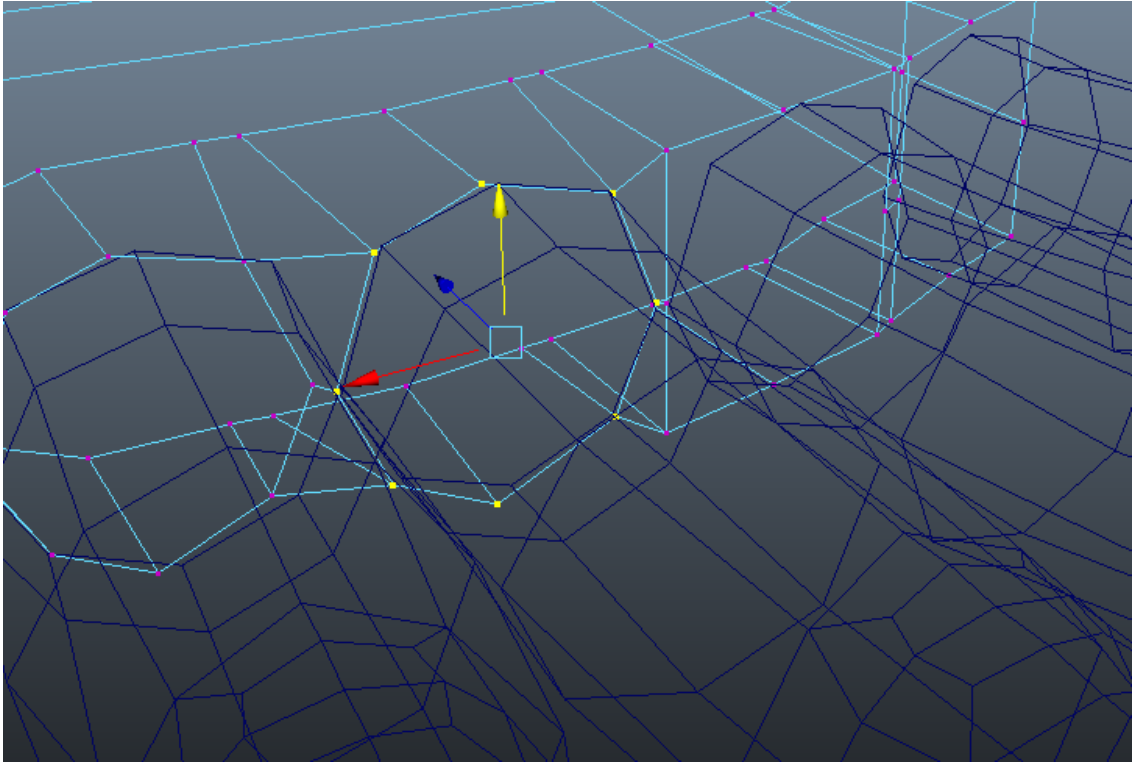


15. Now to shape the main knuckle area of the hand. Go to a top camera view and move the vertices so they line up better with the new finger positions.

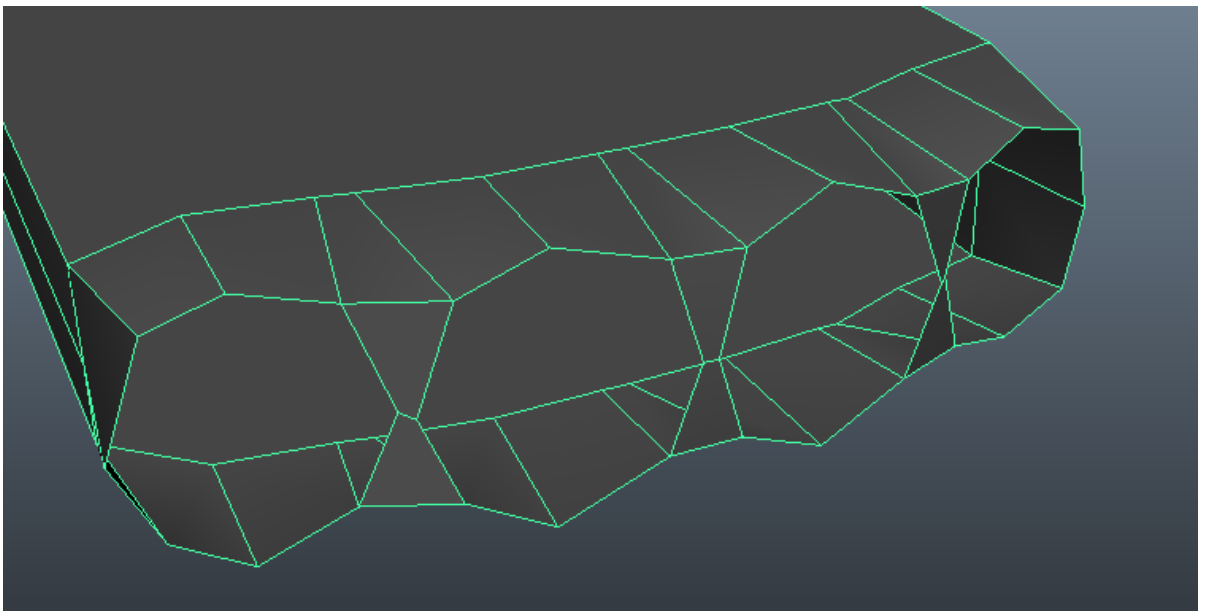


Now, go back to the perspective view and sculpt each finger opening to better match with their corresponding fingers. It will be easier to do this in wireframe mode. Similar to how you may have rounded out the fingers earlier, select the four corners of each square and scale them in. Then move and scale all eight vertices/edges until they line up with the finger. It doesn't have to be exact.





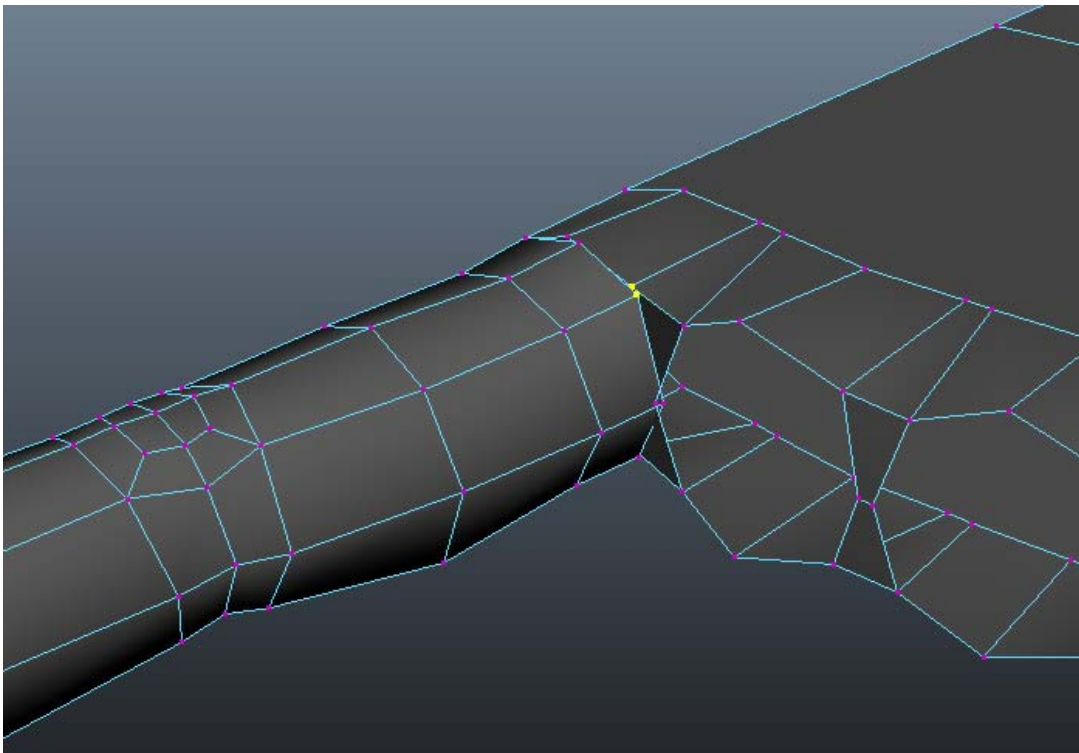
The finished openings will look something like this:



16. It's time to finally merge the fingers to the hand. You will want to merge them one finger at a time, starting with the index finger. So the other fingers don't get in the way, select them and hit **Ctrl+h** to hide them. You can show them again later by going to **Display → Show → All**.

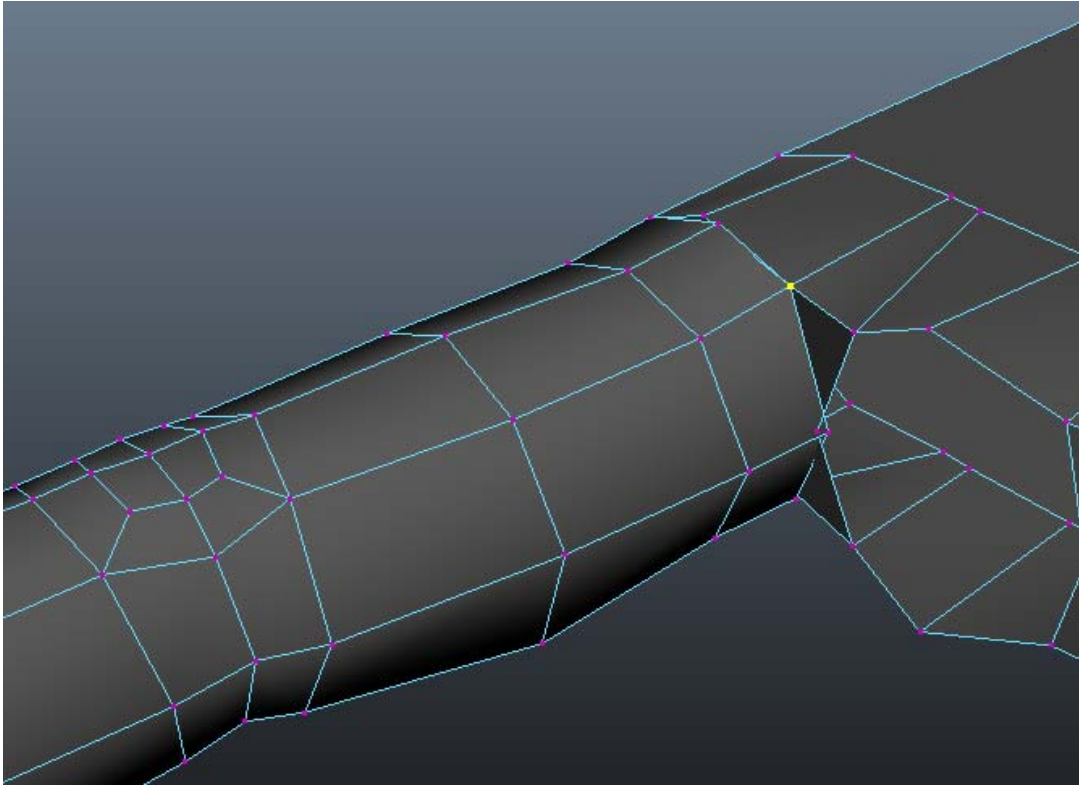
To attach pieces of geometry together they need to be part of the same object. Select the hand and index finger then go to **Mesh → Combine**.

Now, select a pair of vertices: one on the finger and its companion on the hand.

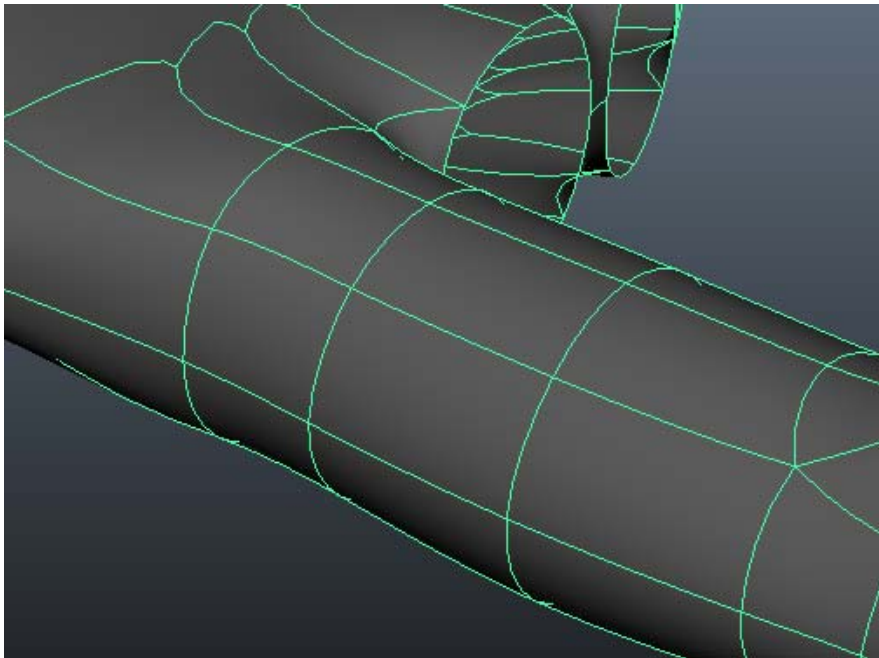
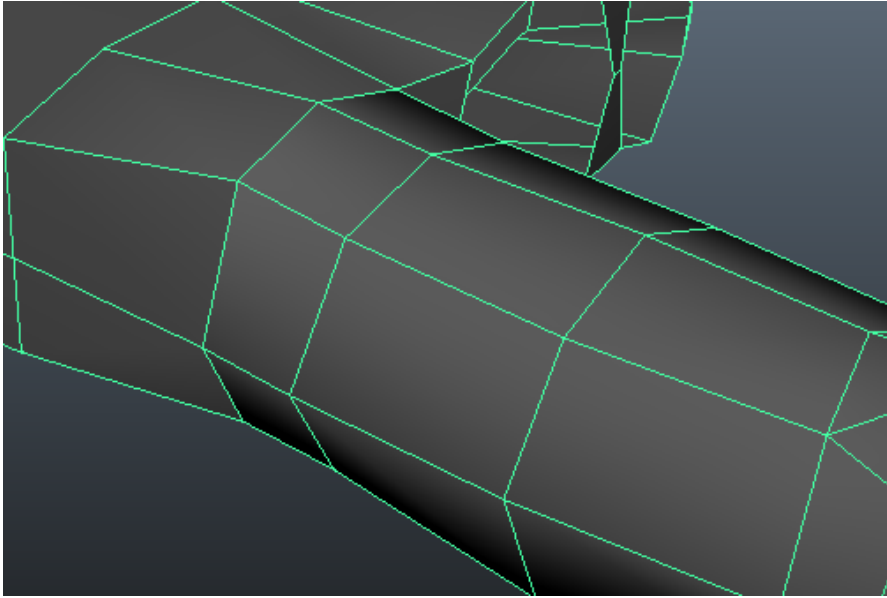


Then press Shift and Right-Click to access the marking menu and Merge Vertices To Center.

Both vertices become one!

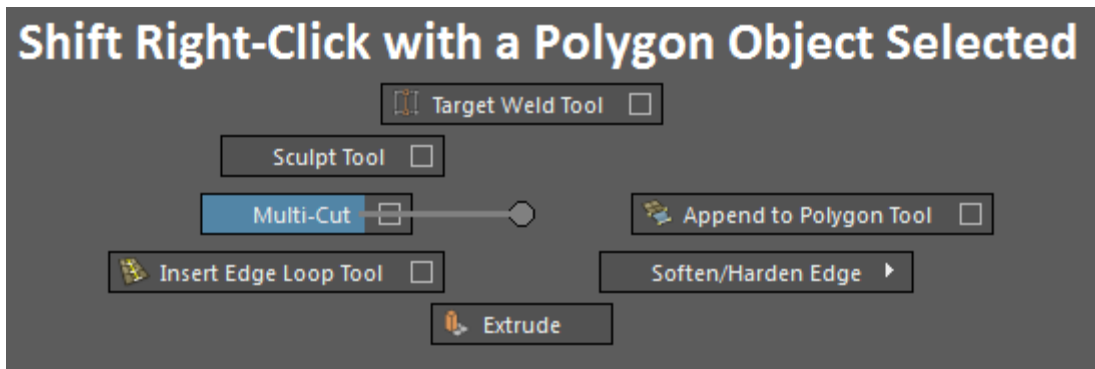


Do this for the remaining seven pairs of vertices. Remember that you can hit the 'g' key to repeat the last action, so you don't have to pull up the marking menu for each merge. The finger should be completely attached now. To verify hit '3' to turn on smooth mode. If the geometry smoothes out completely at the base of the finger with no breaks in it everything should be merged correctly.

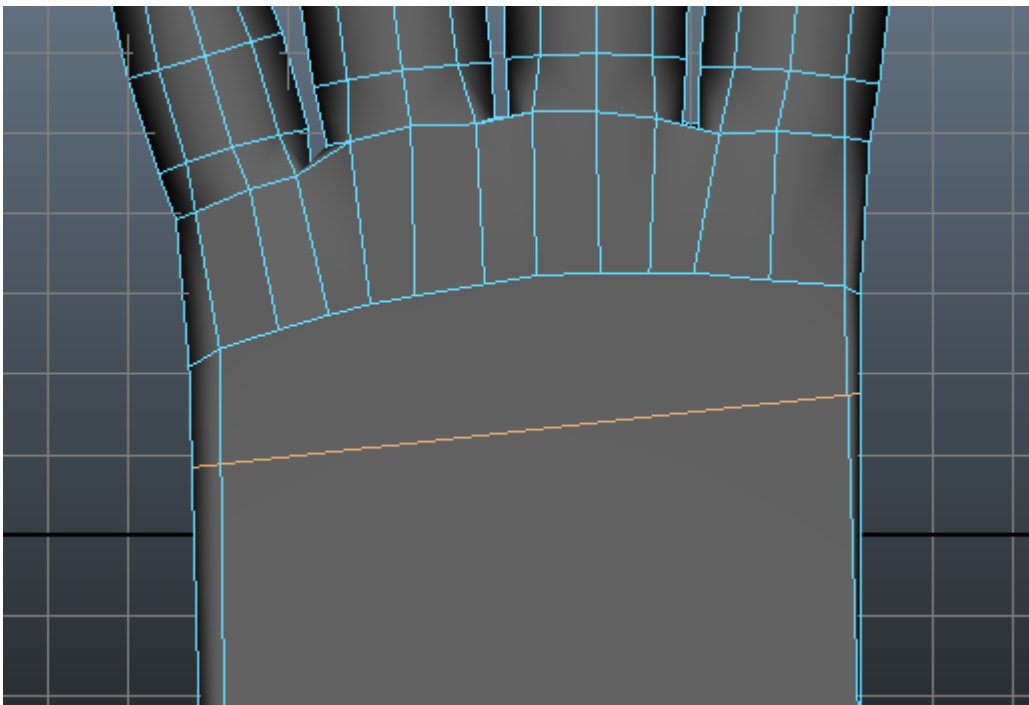


Continue this process until the rest of the fingers are merged. You may have to tweak the geometry around the merge points to get it to look more naturally.

17. From the top view and with the hand object selected, activate the **Multi-Cut Tool**.

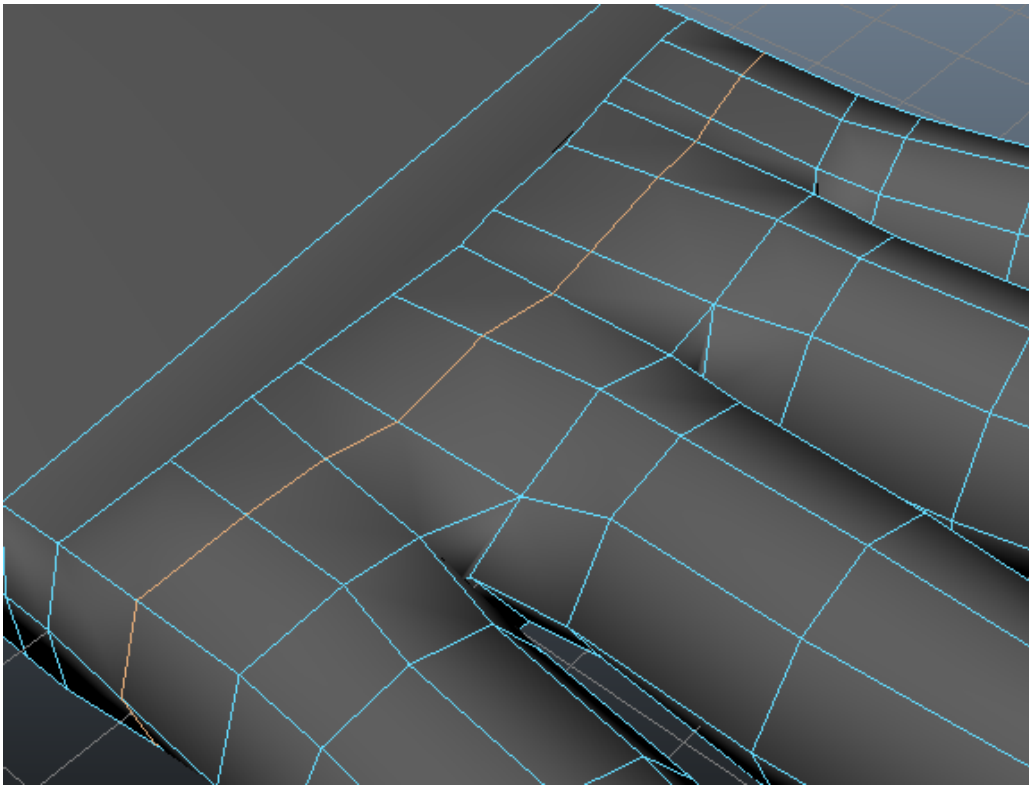


This tool allows you to middle-click and drag across the screen to draw a line and cut a cross section of edges into an object. We are using it here since the Insert Edge Loop Tool won't work because of the n-gon. Cut the cross section shown into the hand. This is an edge loop that will be used a little later.

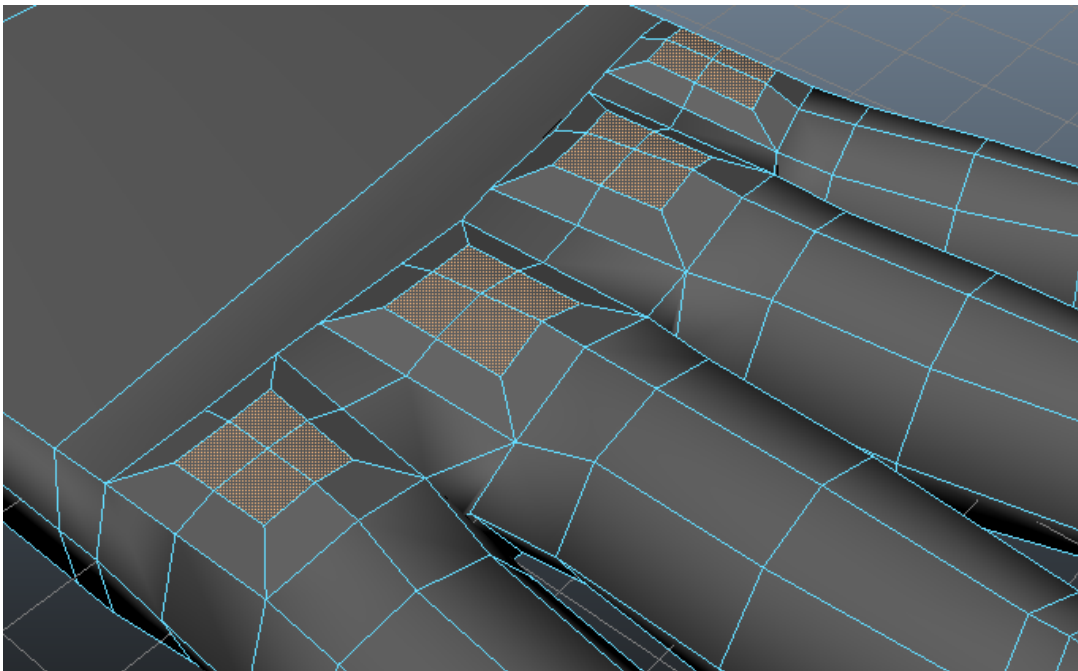


18. Now that the fingers are all joined you can sculpt the root knuckles. You will use the same technique as you did on the finger knuckles.

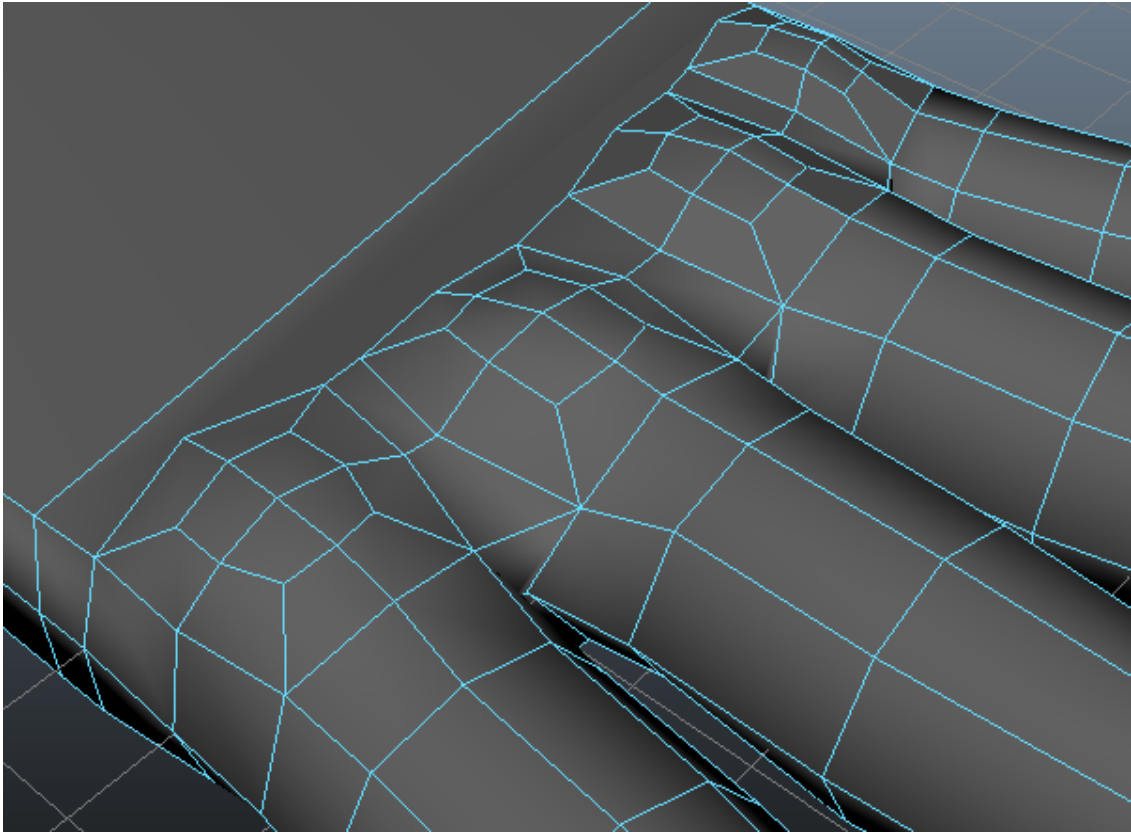
Add the highlighted edge loop.



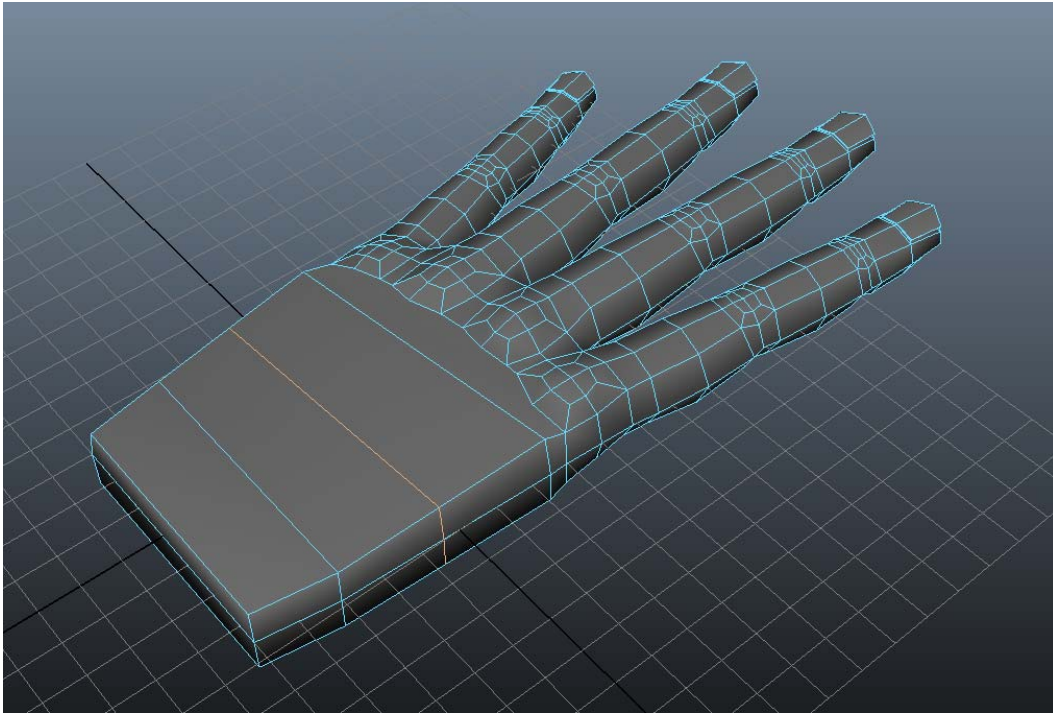
Extrude in each set of four faces.



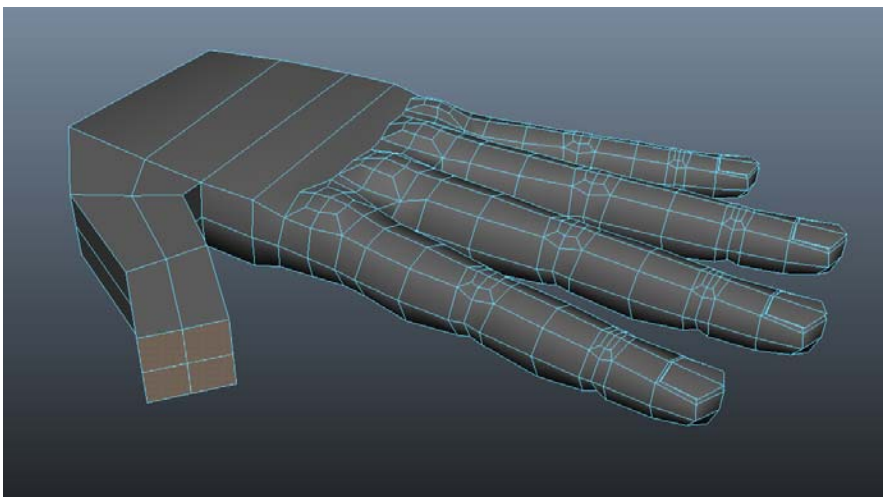
Sculpt them. Unfortunately there's no shortcut to doing them all at once. There's at least one bright side to this: Each individually sculpted knuckle will be slightly different, thus contributing to a more organic look.

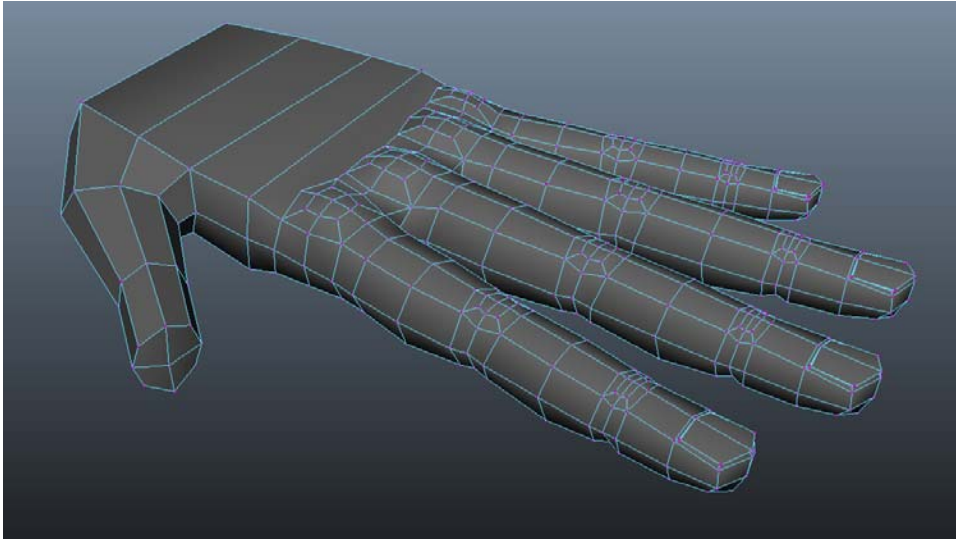


19. There's still one digit yet to model. Before moving onto the body of the hand it's time to give the thumb some attention. Add in the shown edge loop to prepare the set of four faces at the base of the hand from which the thumb will sprout out.



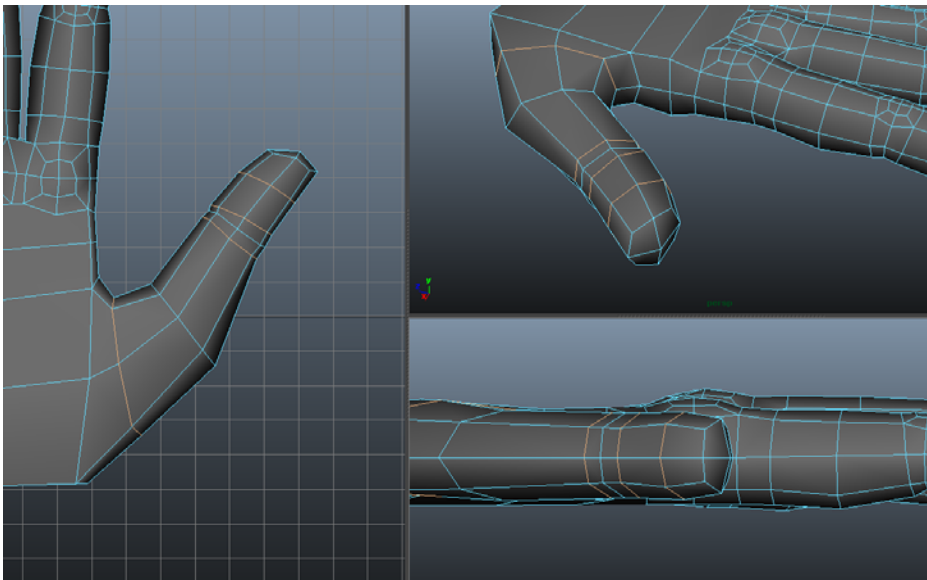
20. Extrude those four faces at the base of the hand out three times and block in the shape of the thumb. Note that the thumb will be modeled at a 90 degree angle relative to the fingers. The nail will point away from the hand.



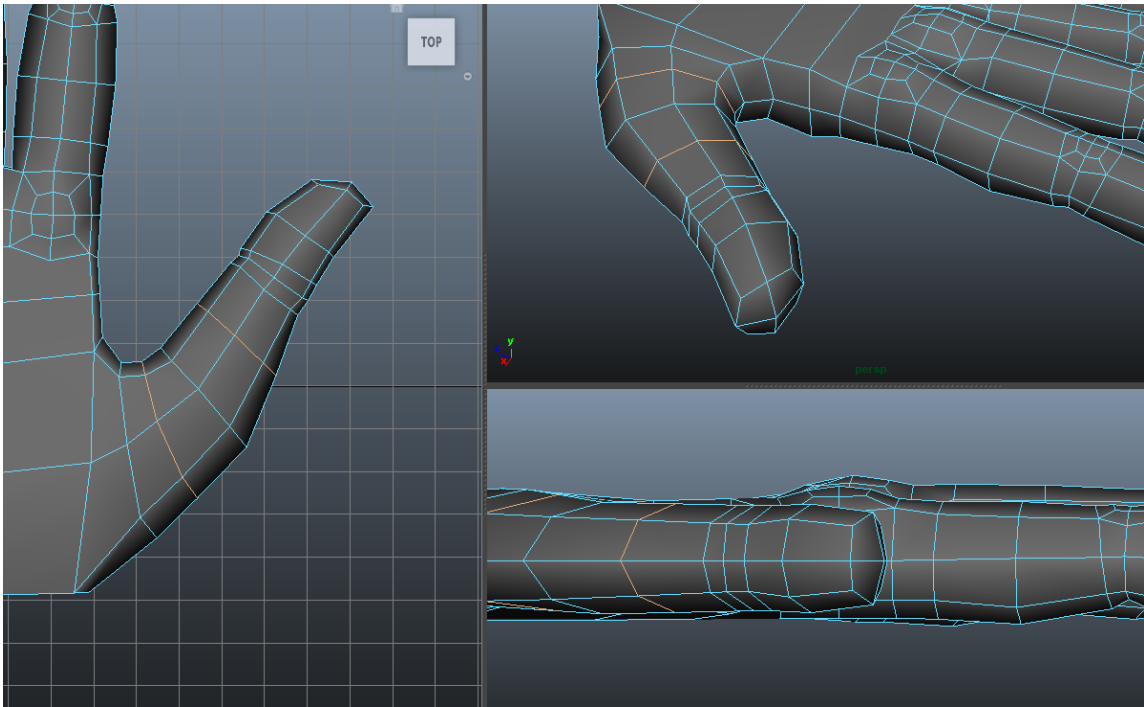


The thumb proportions are pretty tricky to hammer down. Use your own hand and the provided images for reference as much as possible. Even then you may find yourself tweaking the proportions every step of the way. Even throughout the rest of the tutorial the thumb shape fluctuates a bit until it approaches equilibrium, so use your best judgment.

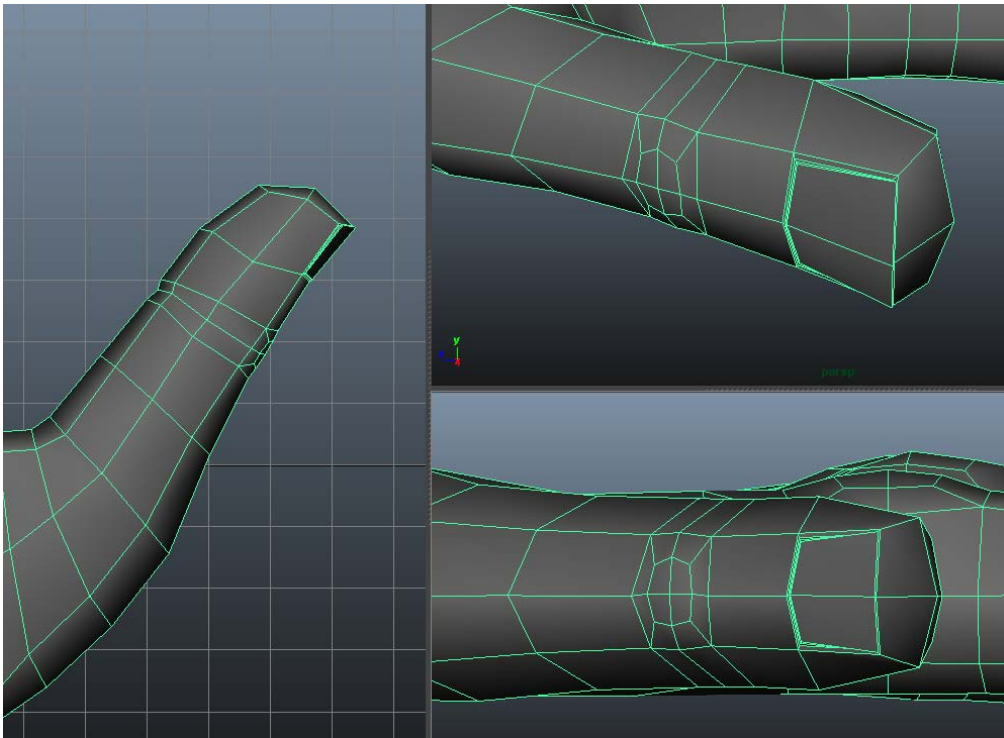
21. Add and tweak more edge loops for detail.



22. Add a couple more edge loops to better form the finger segments.

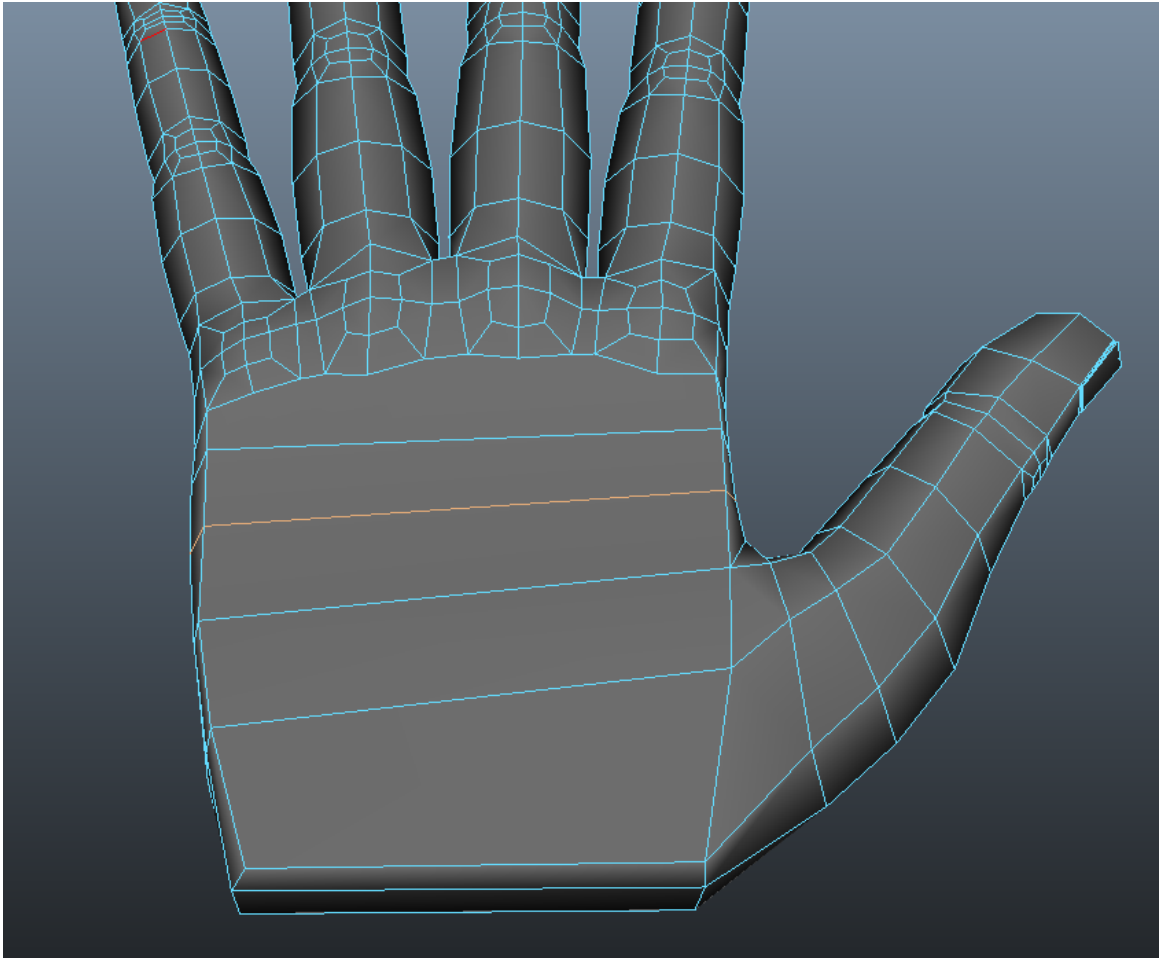


23. Model the nail and detail the knuckle using the same techniques used on the finger.

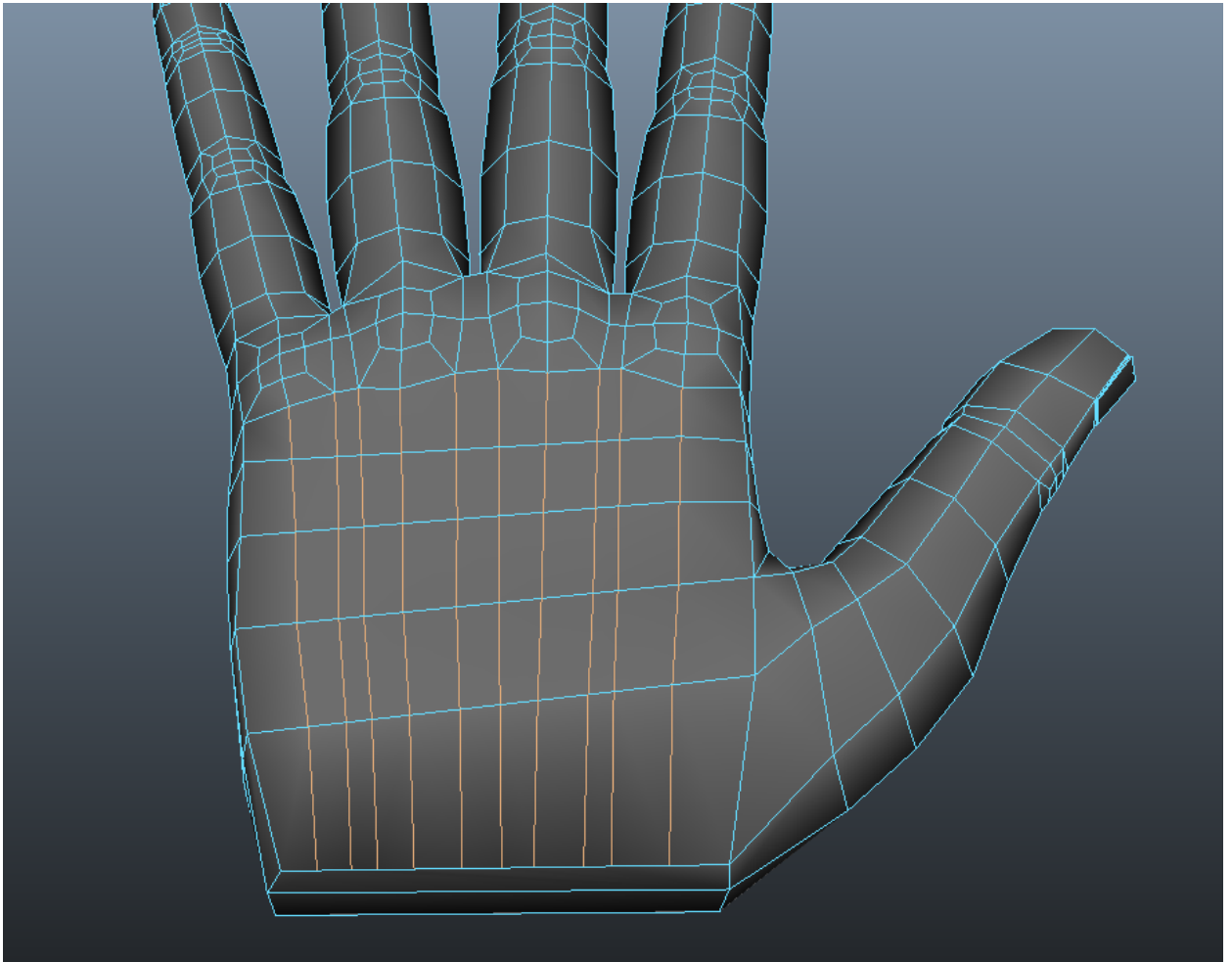


24. Time to work on the back of the hand. We're defying the subdivision modeling workflow a bit for this part, as you will add bunch of geometry all at once then sculpt it afterwards.

Start by adding one more edge loop here.

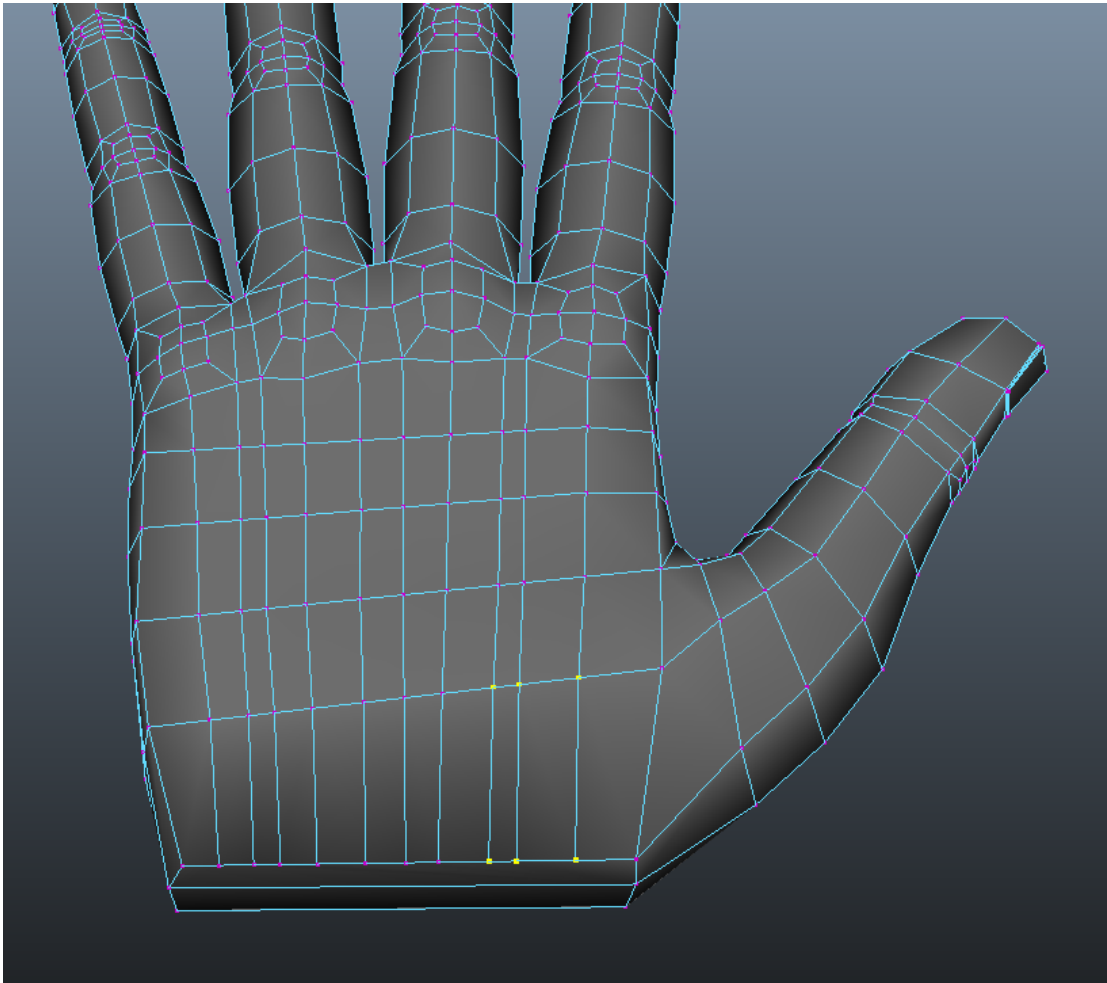


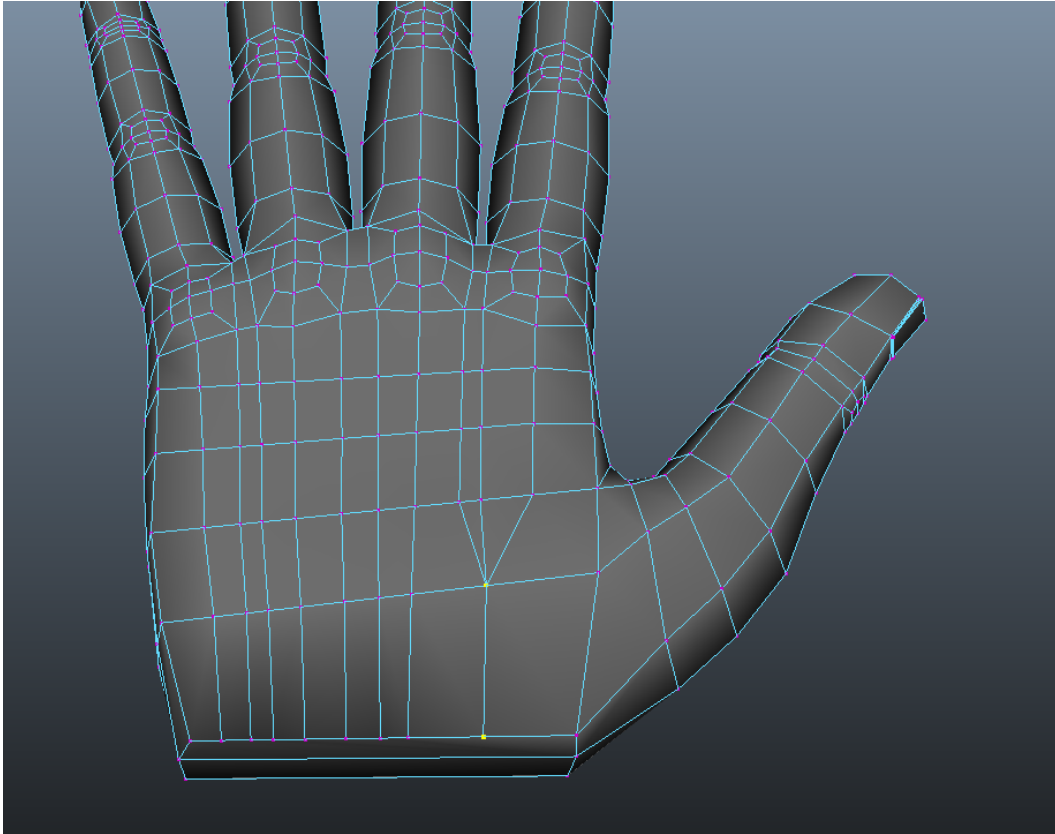
Use the Multi-cut Tool to split each vertex along the knuckles all the way down to the wrist. Remember you just need to select the start and end points, you don't need to click every single edge all the way down to the wrist.



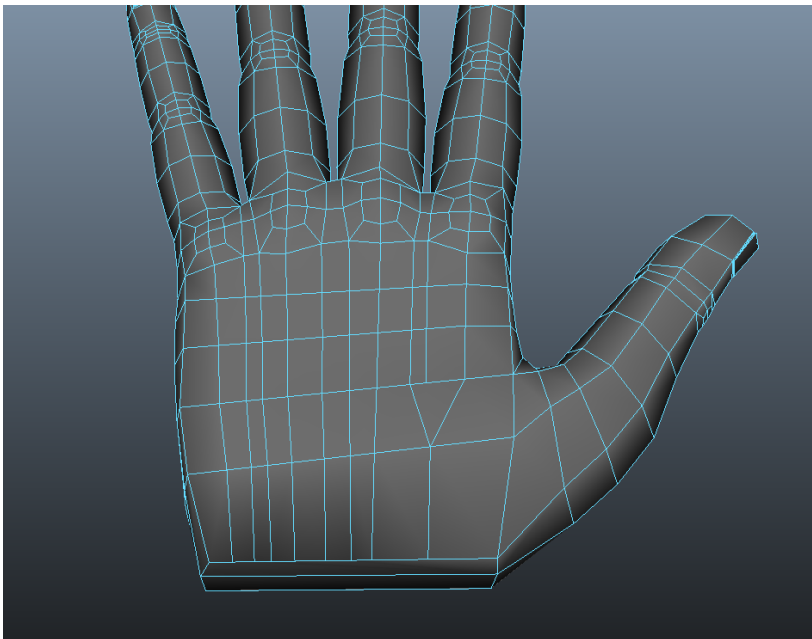
You may be thinking that the back of the hand is now one big scary mess of geometry. Worry not! Remember that every edge loop has a purpose. In models, areas that require a lot of detail require denser mesh. And the wrist is most definitely ***not*** one of those areas.

The goal now is to reduce geometry as it flows toward the wrist while also keeping the model all quads. This can be done by sewing vertices together from the wrist up. Select and merge the two sets of three vertices highlighted below.

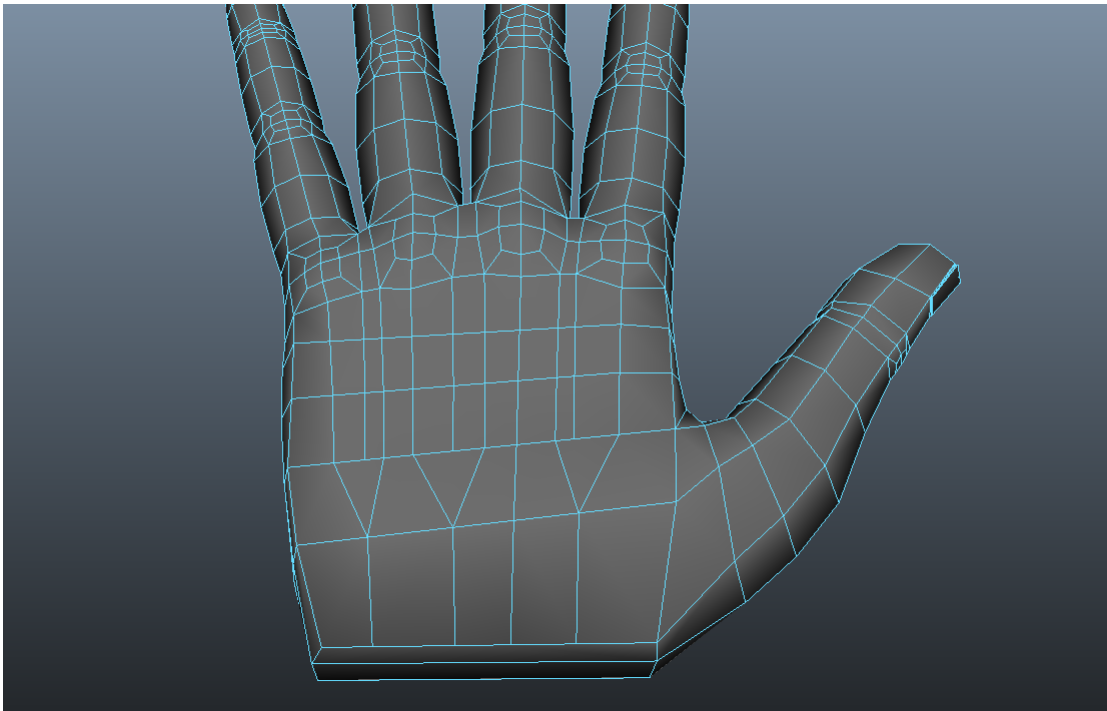




Now delete the edge sandwiched between two triangles to make a quad face.

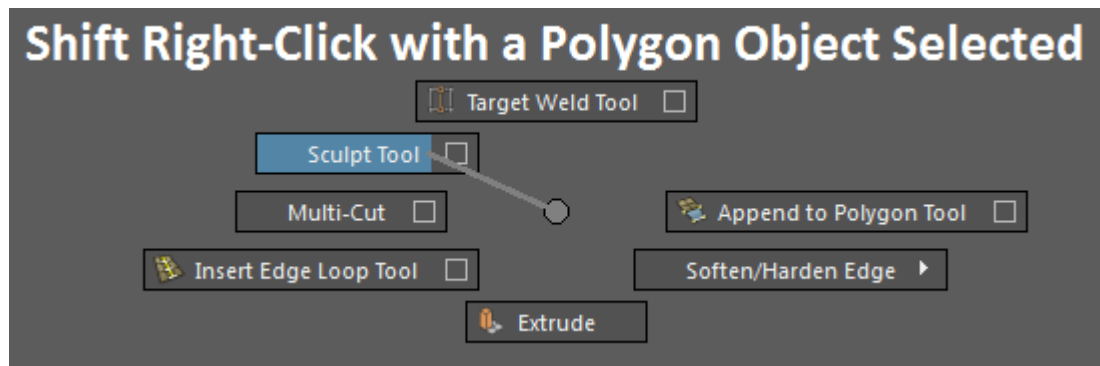


Continue to sew up the other two areas shown below.



The back of the hand's topology is there; now it just needs to be sculpted. It would be fairly impractical to sculpt it vertex by vertex, so luckily Maya has some tools that will make things easier.

25. The first tool is the Sculpt Tool.

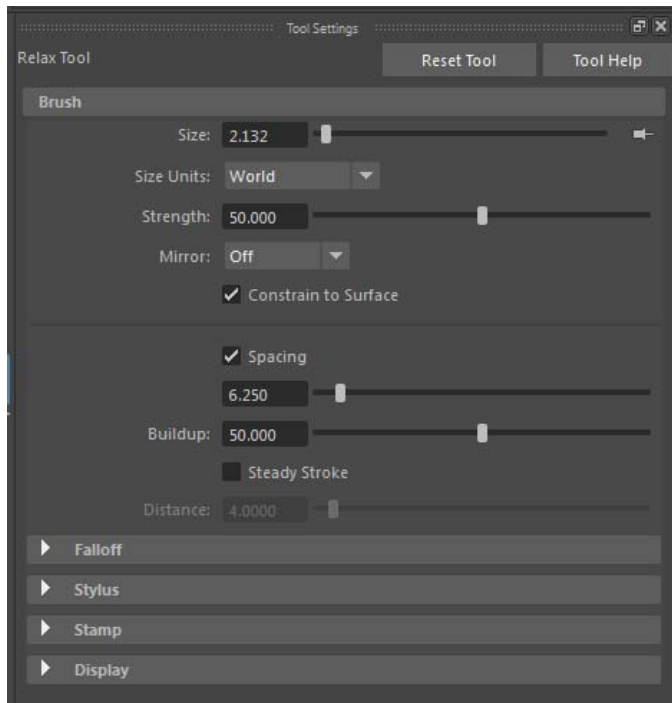


This tool can manipulate geometry in a wide variety of ways. Its best use is "relaxing" geometry though, which distributes polygon faces more evenly across the surface while maintaining the same shape. The

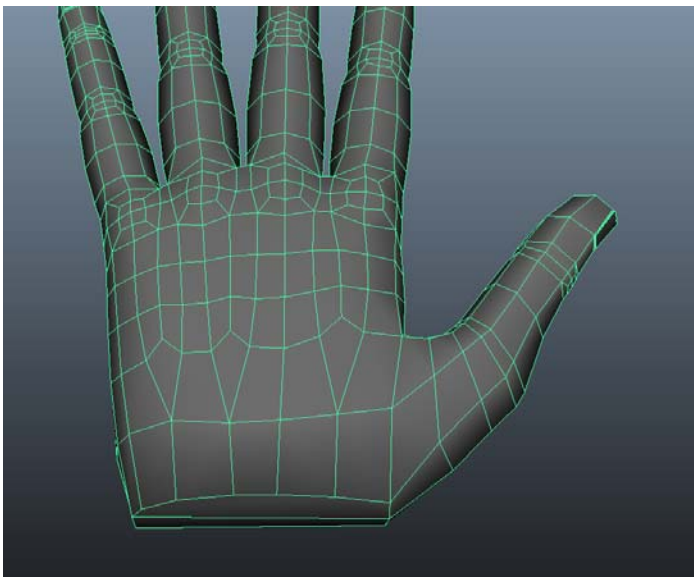
marking menu below is access by holding Shift and right-clicking with the Sculpt Tool active.



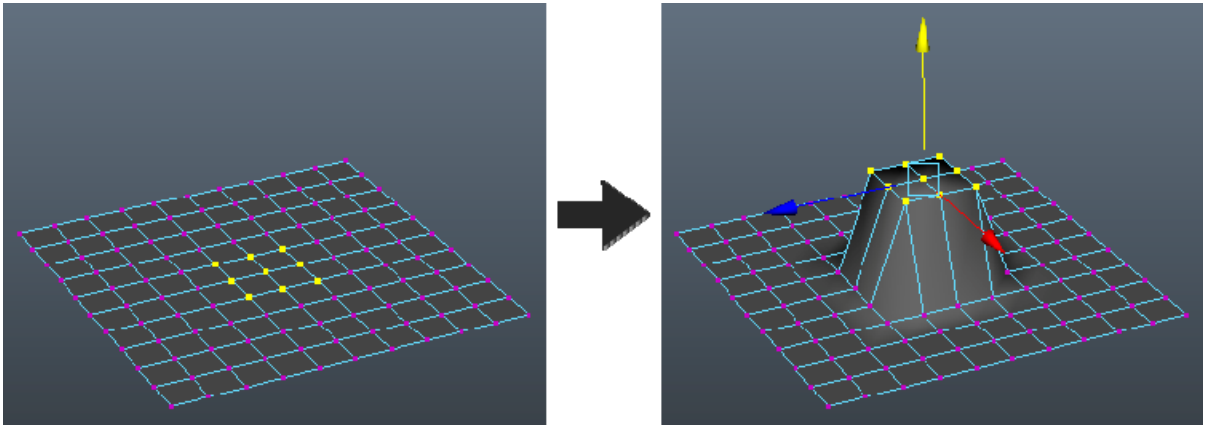
Select "Relax" from the above marking menu and go to the Tool Settings and change the settings to what's shown below.



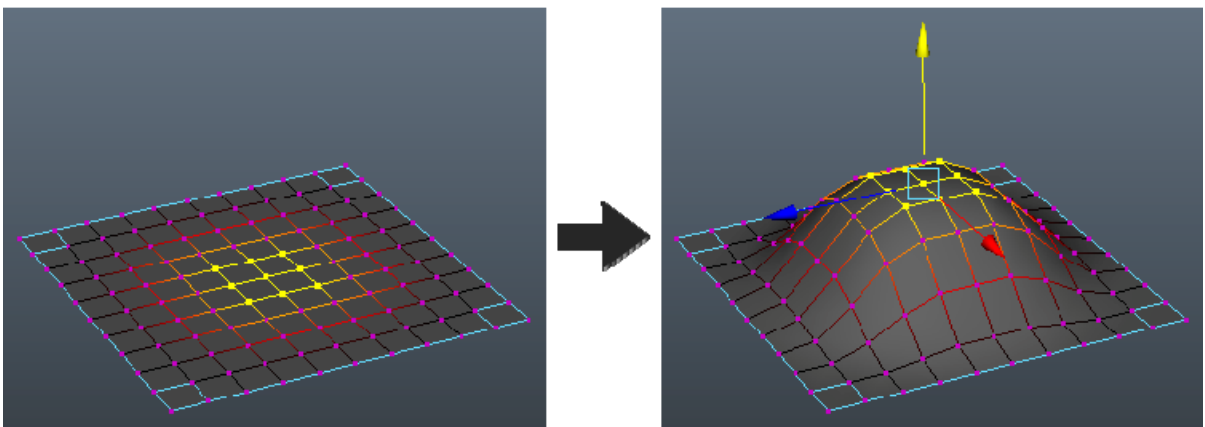
Dab the back of the hand with this tool until the geometry looks more nicely distributed. Just left click to do so. You may need to play around with the Strength value since it's usually pretty strong to begin with. Additionally, you can modify the brush size by holding down **b** and left-click dragging back and forth.



26. The second tool is soft selection. Soft selection is simply the "partial selection" of surrounding geometry. For example, if you select some vertices, surrounding vertices will be partially selected. Moving the selected vertices will also move the partially selected ones slightly.



Soft selection OFF

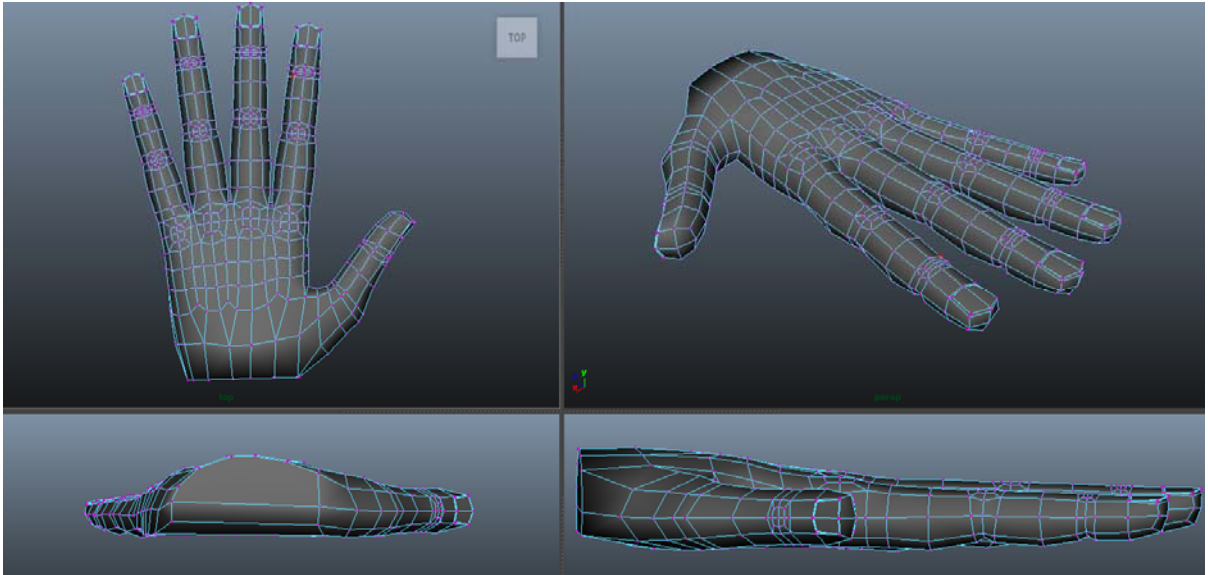


Soft selection ON
(same vertices selected)

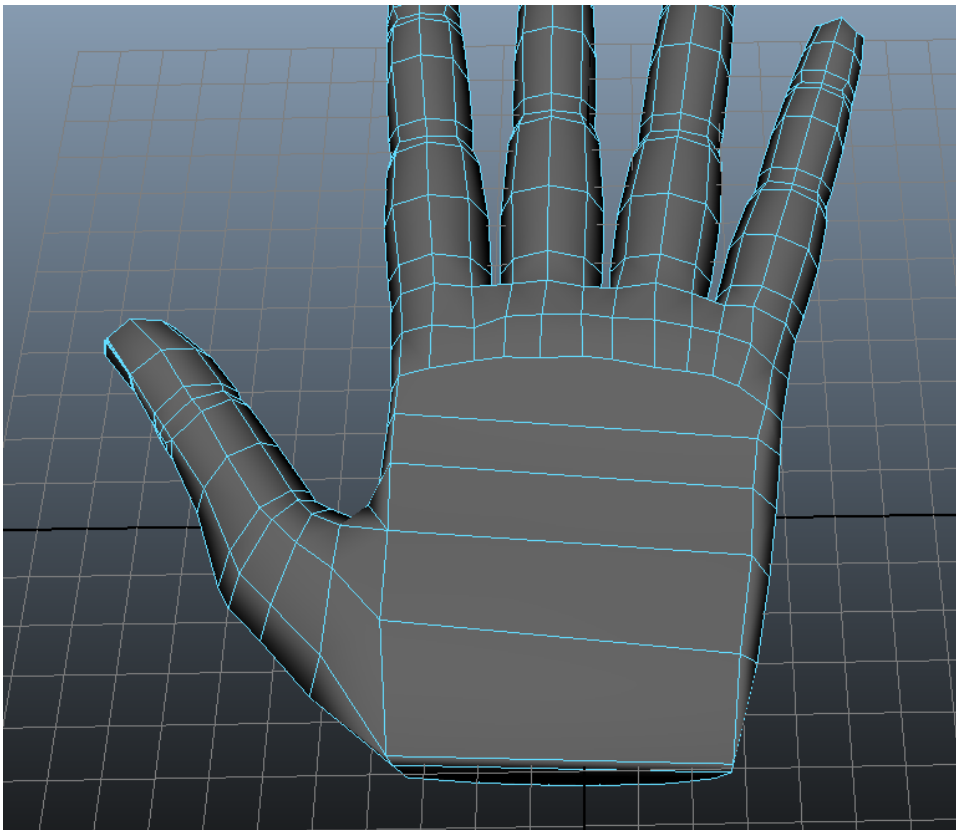
It's a good way to change the overall form of a model with a lot of geometry.

Hit **'b'** to toggle soft selection on or off. When on, you can hold the **b** key and left-click drag to change the soft selection falloff. Before using soft selection, go to its Tool Options and change the Falloff mode to "Surface".

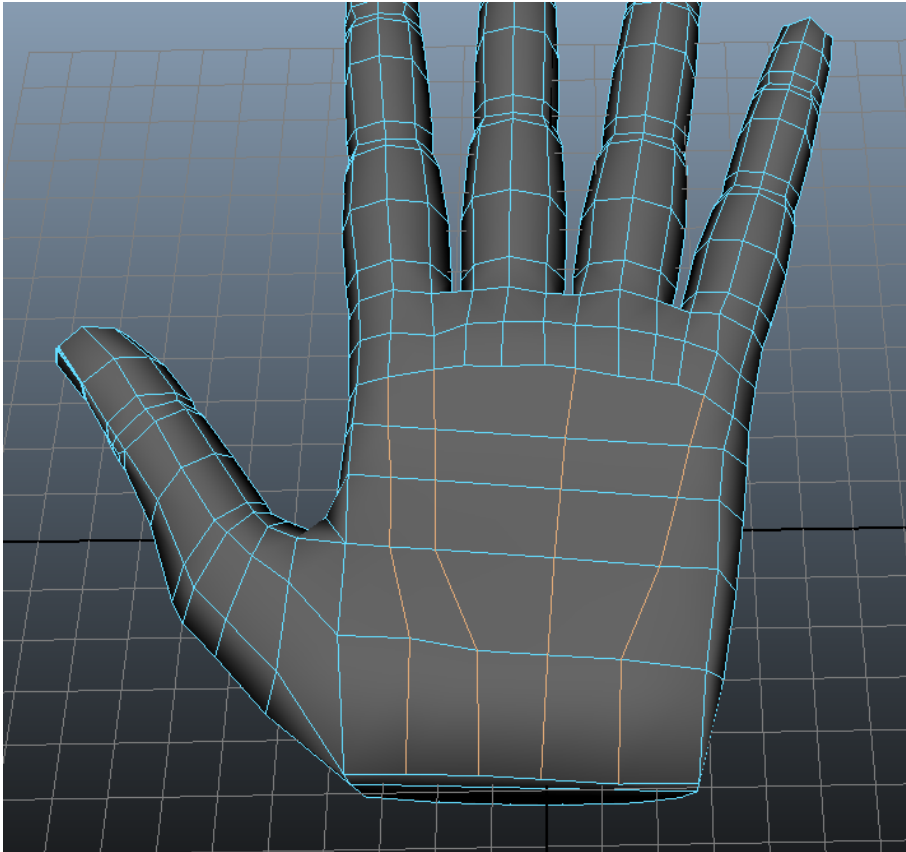
Use the Move Tool and soft selection to add some meat to the back of the hand.



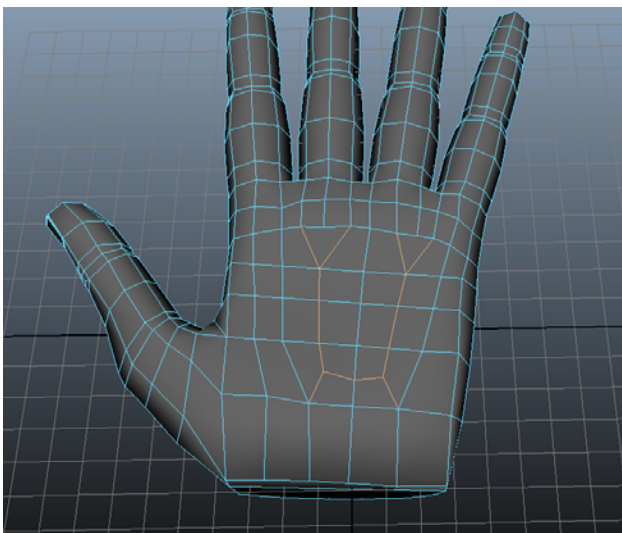
27. Now for the palm of the hand.



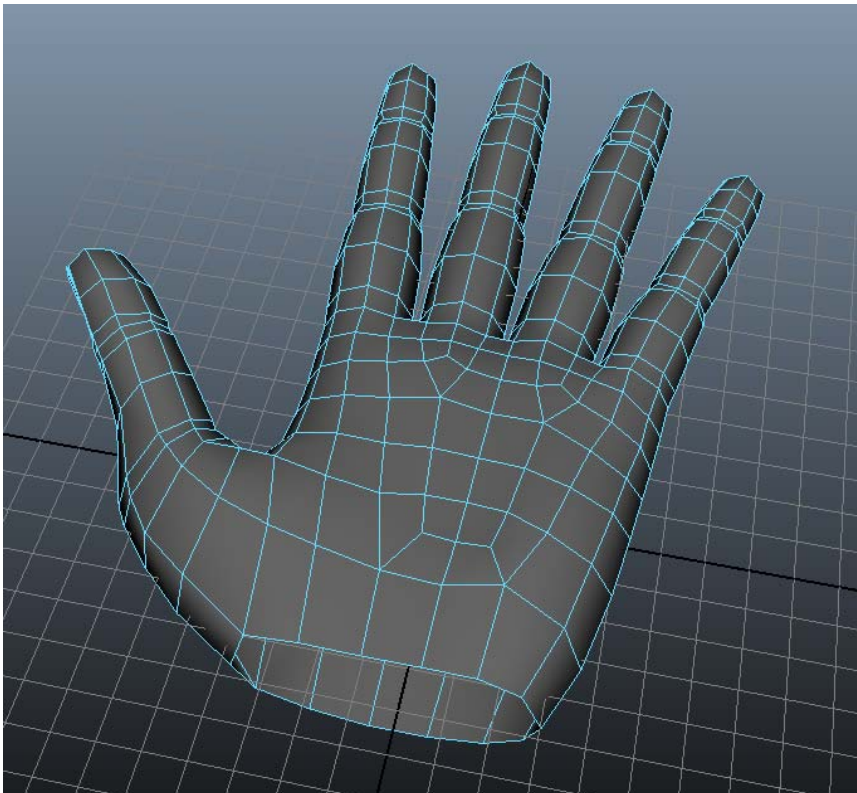
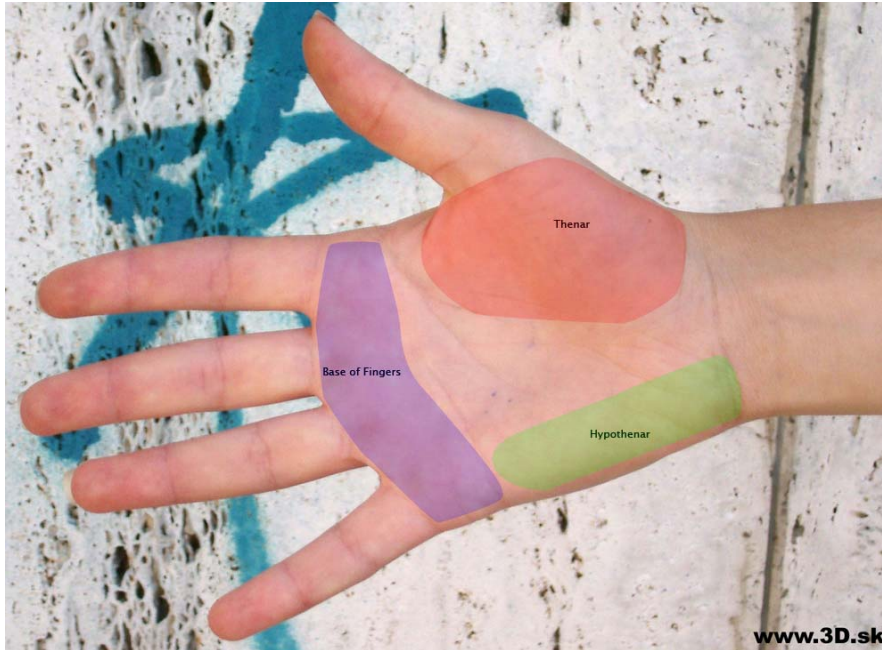
Instead of sewing edges, this time you will just drop them on the palm using the Multi-cut Tool. The first set goes straight from the pads under the knuckles down to the wrist.



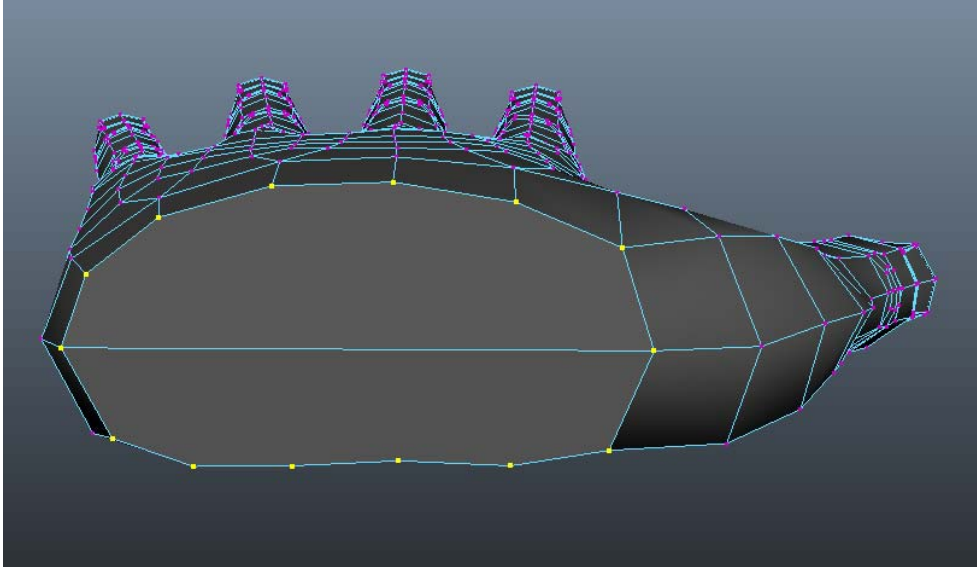
The second set fills in the center of the palm while maintaining quads.



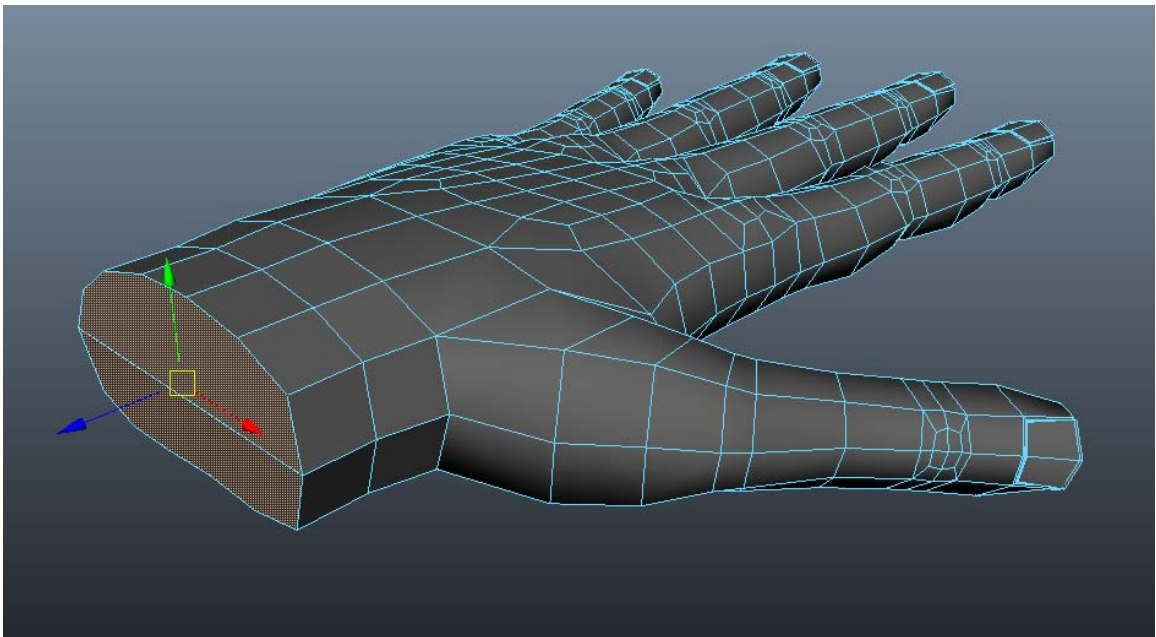
Now use a combination of the Sculpt Geometry Tool and soft selection to form the meat of the palm. It's very easy to leave the palm (and back of the hand) flat, so exaggerate if you need to and reign it in if its too much. These areas in particular are ones to pay attention to:



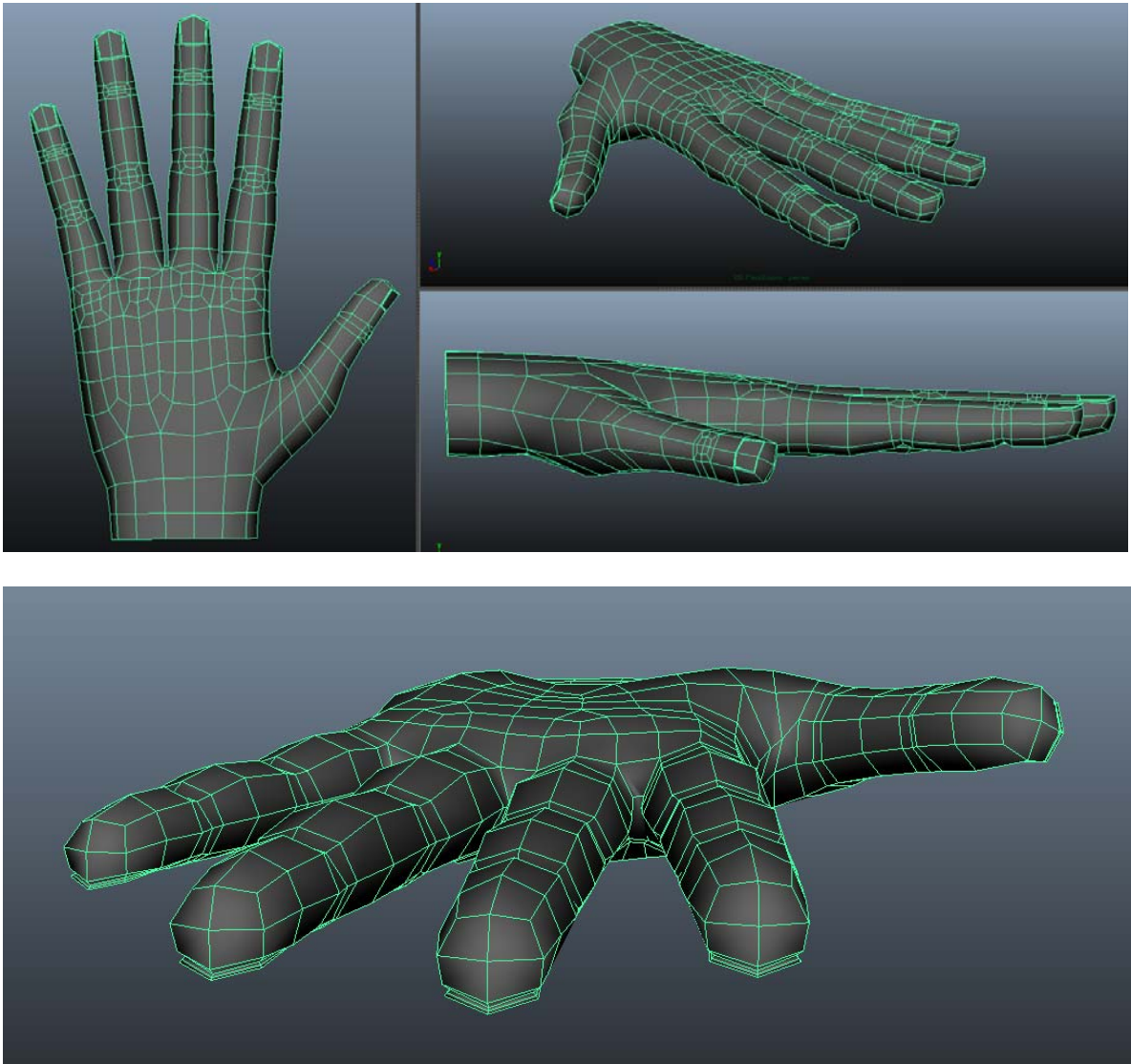
28. Make sure the cross section of the wrist is shaped nicely. Each vertex at the top should have a corresponding vertex it's lined up with at the bottom.

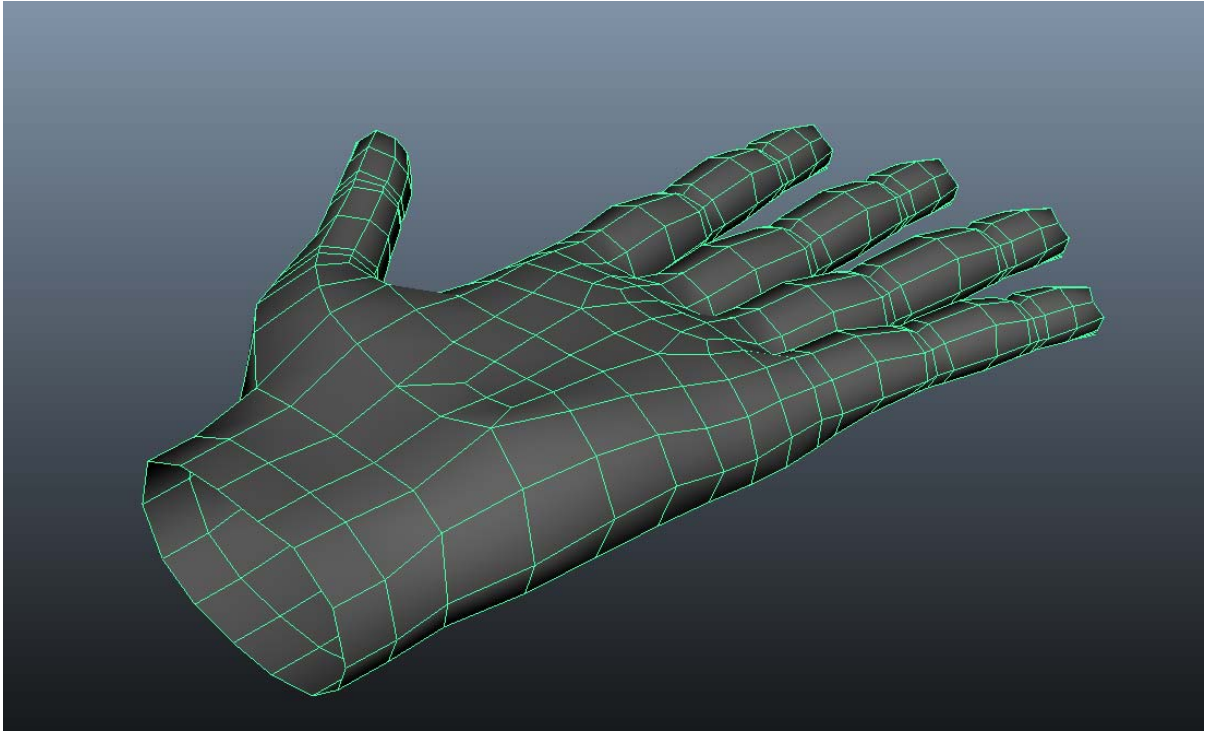



Extrude the wrist out twice and form its connection to the arm. After you have done this delete those two n-gons.



29. All of the hand topology is there. Now it's just a matter of sculpting it until it looks good. Use soft selection for broad tweaks. Since you're done modeling the thumb you can rotate it down a bit so it rests more naturally, then rotate it up so the nail faces more up toward the back of the hand. Make sure the hand has depth from the front and side.





30. Congratulations, you're almost done! Be sure to delete History, clean up your Outliner, and rename your hand to something reasonable. To create a render of your hand, first **Smooth** your model (**Mesh** → **Smooth**). **DO NOT** delete history after smoothing it! Click the Render button to render the current view (). In the Render View that appears go to **File** → **Save Image...** and save the image as a PNG.

Make sure that in the Maya file you turn in, your hand is NOT smoothed.

Turn In

You will be graded on the following:
Following instructions

- Correctness of relative hand proportions and shape
- Good mesh topology: All quads, no unmerged vertices, clean mesh, smooths correctly
- Clean Outliner, deleted History
- A Maya file containing your finished, *unsmoothed* model: **lesson1b.ma**
- A render of the smoothed hand: **lesson1b_hand_render.png**