

Maya 2014 - Polygonal Modeling a Female Head

Humans are one of the most challenging things to model convincingly due to our acute ability to spot tiny imperfections. By working in Maya from reference images and establishing good polygon edge flow, we will work to create a virtual bust of a female head that brings a bunch of points, edges and faces to life! Be sure to also check out the tutorials on UV unwrapping and sculpting/painting with Mudbox to give your models that extra level of detail and realism.

Note: This tutorial assumes a basic understanding of Maya's interface and modeling features. Please watch the 1 minute startup movies if you are new to using Maya (available under **Help > 1 Minute Startup Movies**).



Aligning Front & Side Reference Images in Photoshop

- The first step to creating any model is looking at reference images of what you are trying to create. Prior to starting your model, look for images online which show facial form, structure and musculature from different angles to get a good sense of what you're trying to create.

- Included with this tutorial is a ZIP file with reference images of the **Front** and **Side (facing right) Angles** of a woman's face.

- You can find more reference photos of people of different genders, ages, ethnicities here:

<http://free-textures.got3d.com/natural/free-character-references/index.html>

- To use these images as reference within Maya, we first have to align them as best we can in Photoshop:

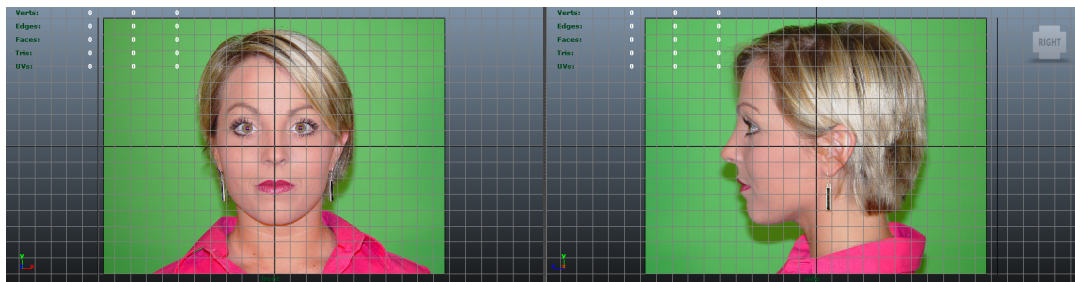


Put the two images on separate layers and change the **Opacity** of one of the top layer to 50%.

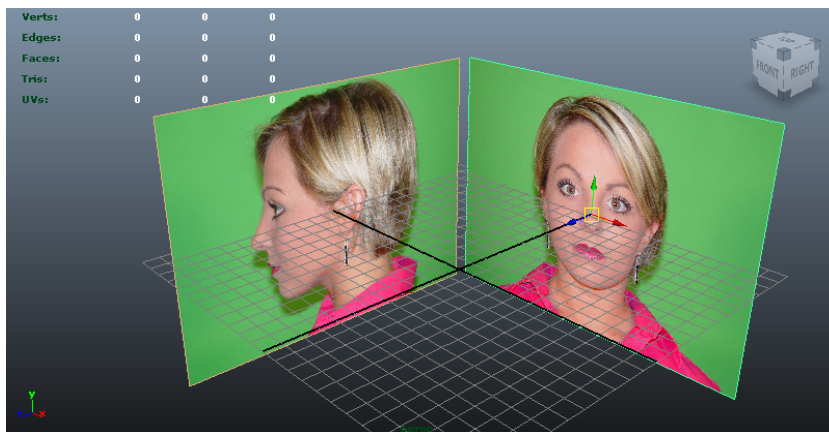
- Add in horizontal **Guide Lines** for the pupils, mouth, nose, top of the head, etc. by first clicking and dragging from the **Left Ruler (Command+R to toggle Rulers on/off)**. Press **Command+;** to toggle guides on/off.
- Scale, move and rotate the side view layer so that the pupils, mouth, head and ears line up with the front view.
 - Because of lens distortion, the views won't always line up 100%, but try to get as close as possible
- Export each layer as a separate image to have your perfectly aligned front and side reference photos. I've provided images for this lesson, but feel free to take photos of your own and use them in your projects!

Setting Up Image Planes in Maya

- Go to **File > Project Window**, press **New** and create a new project called **Female Head**. Use the default settings for folder names & location and press **Accept** to create the project.
- Copy the reference photos into your **projects/<project name>/sourceimages** folder. This is also a good place to save any other image reference we might want to use.
- Now, let's load the photos into our viewports so we can work from them while creating our model:
 - In the **Menu Bar** for the **Front Viewport**, go to **View > Image Plane > Import Image** and select the front reference image we created earlier.
 - Maya will add the image to your scene as a flat polygon which is aligned to the front viewport and visible in the **Perspective View**.
 - If you didn't do it earlier in Photoshop, move the front reference image in the front viewport so that the vertical **Y Axis Line** intersects the middle of the face along the bridge of the nose. This way, we can model one side of the face at a time and just mirror it across that axis.
 - Repeat the same process for the **Side Viewport**



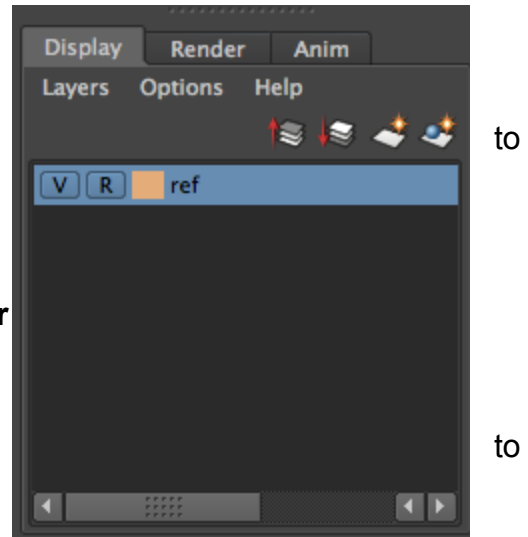
- I find it easier to see my model when the reference images aren't intersecting across the center, so go ahead and move the front and side images along the **X** and **Z Axes** so they form a box around where we will be creating our head.



- In the **Display Panel** on the bottom right, go to **Layers > Create Empty Layer**. Double click on the layer name and rename it **ref** (for reference images) and change the color if you'd like.

- **Marquee Select** your reference images (individually, because it won't let you select multiple at the same time), right click on the **ref** layer and select **Add Selected Objects** add them to our new layer.

- Since we don't want to accidentally select our reference layers while we are modeling, click on the box to the left of our **Layer Color** until it says **R**. This layer is now set as a **Reference**, so it will be visible but unselectable until you change the box back **Empty**.



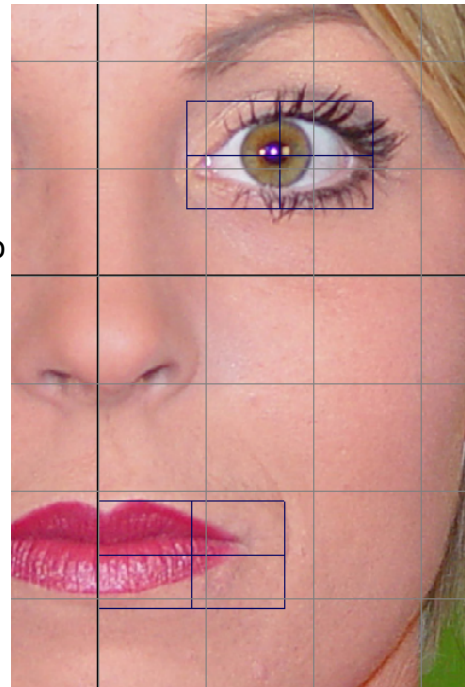
Blocking Out the Eyes and Mouth

- Now let's get started on some modeling! The most important parts of the face to get right are the eyes and mouth (especially the eyes), so let's start from those areas first and work our way outwards:

- Go to **Create > Polygon Primitives > Plane (options box)** and create a polygon plane on the **Z Axis** with **Width Divisions** and **Height Divisions** set to 2

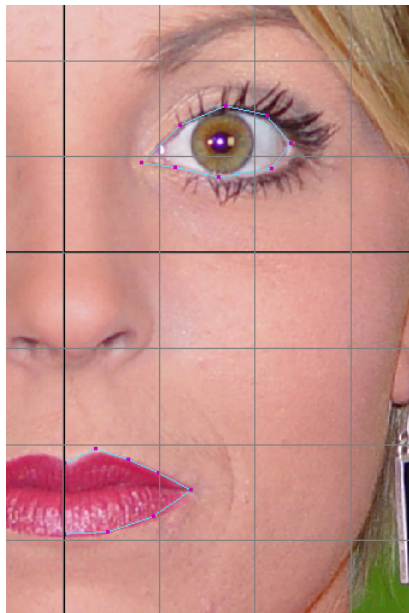
- In the **Front View**, move the poly plane into place and scale it so that it roughly overlaps the eye opening.

- With the plane selected, press **Command+D** to **Duplicate** it. Move and scale it to roughly overlaps the mouth opening.

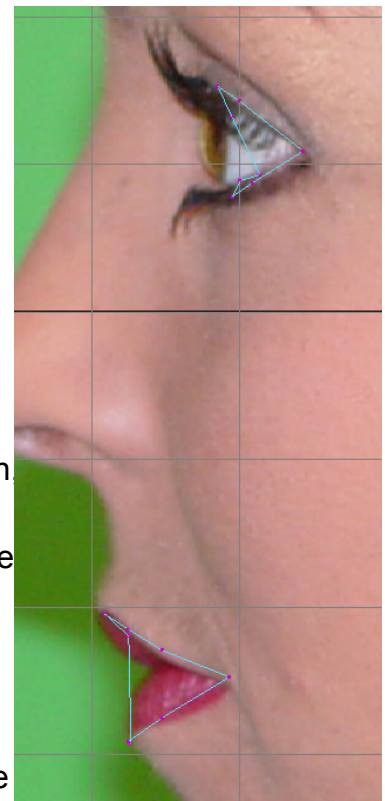


- Switch to **Edge Mode** by **Right Clicking > Edge** over our planes, shift select the inside edges on our poly faces and hit

Delete. The faces are now one solid polygon that we can work with.



- Switch to **Vertex Mode** from the **Right Click** menu and use the **Move Tool** to pull the vertices of the mouth and eye around so they match the shape of the edge of the eye and mouth.



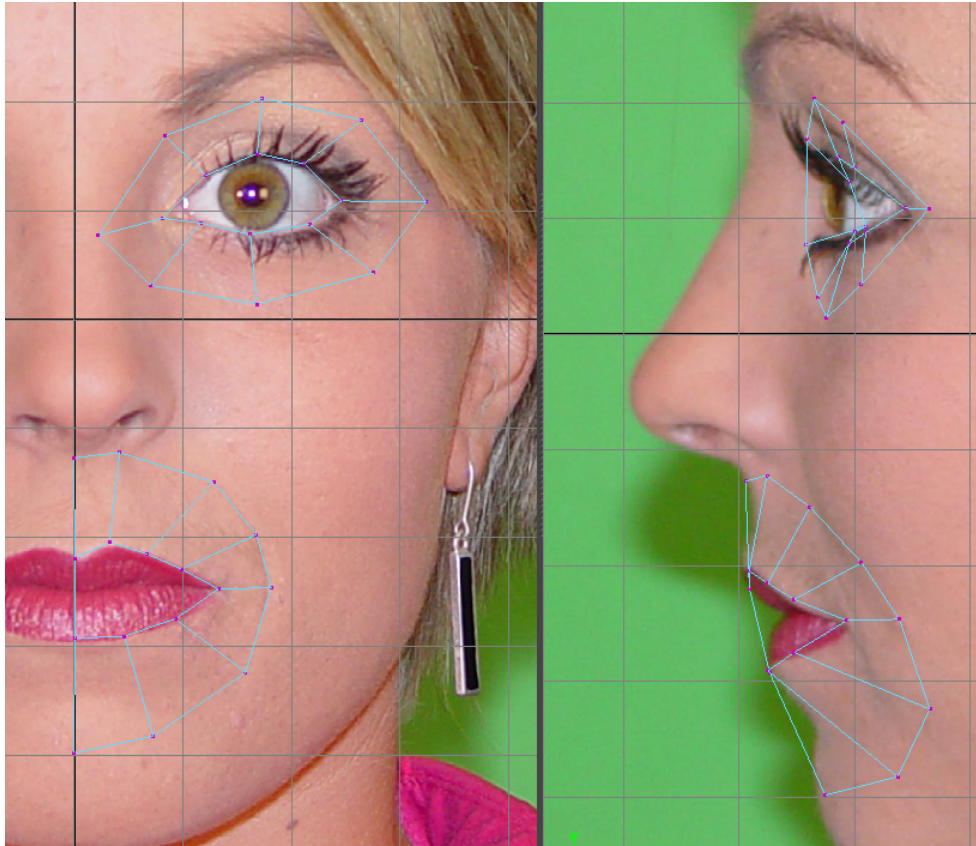
- Switch to the **Side View** and pull the vertices forward and backwards so that they roughly match up with the side reference. You'll notice that the two images don't exactly match so use your eyes and your judgement about what looks right.

- Pull back the corners of the mouth and eyes and shape the curves so that they look natural.

- Switching between the **Front, Side, Top** and **Perspective Views** is a good way to check your geometry so that it looks correct. Make it a habit to examine your model from all vantage

points frequently!

Extruding Edge Loops for the Eyes and Mouth



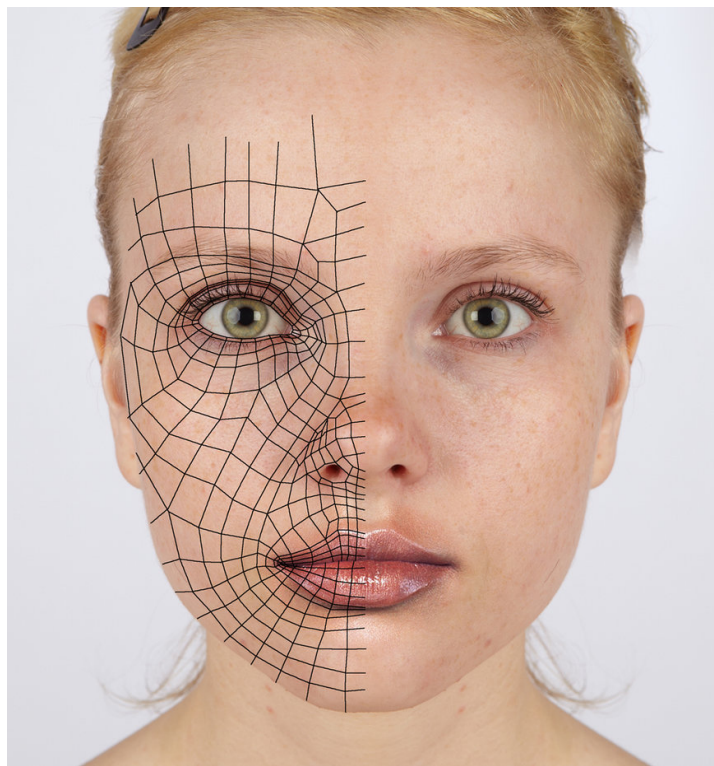
- Switch to **Edge Mode** and **Marquee Select** all of the edges around the eye polygon shape. Go to **Edit Mesh > Extrude** to extrude out a ring of polygon faces.
- Instead of clicking and dragging on one of the axes to extrude along it, switch to the **Scale Tool** (with those new edges still selected) and scale up the newly extruded shape.
- **Move** the vertices around in the **Front** and **Side Views** so that they match the reference images.
- Repeat the same extrusion process for the mouth shape and **Delete** the extruded polygons on the center of the face. Again, drag the points around so that they match the reference (as seen in the screenshot).

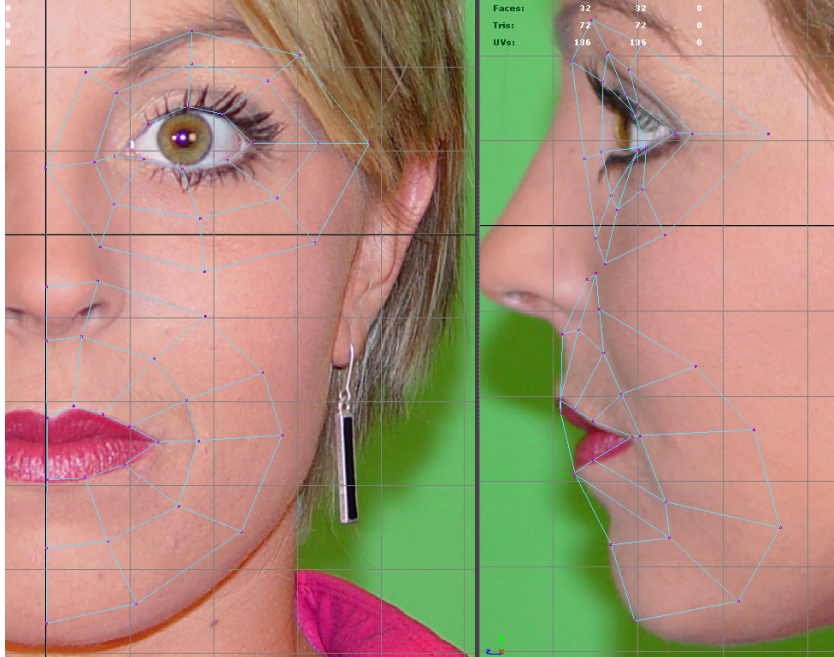
- The placement of our vertices is very deliberate: we are creating what are known as **Edge Loops**. These loops

define the curved structure of the face and enable our model to appear realistically smooth from all angles, or when deformed while being animated. The length and direction of these loops are derived from the musculature underneath the face.

- Ideally, you want your model to use only four sided polygons (**Quads**) as opposed to three side polygons (**Triangles, or Tris**).

- Good edge loop placement is the key to a clean, realistic looking model. You want to avoid spots where 5 or 6 edges come together at the same point, or when edges switch directions irrespective of the face's shape (such as the "five point star" on this photo's forehead and on the edge of the chin) as much as possible.





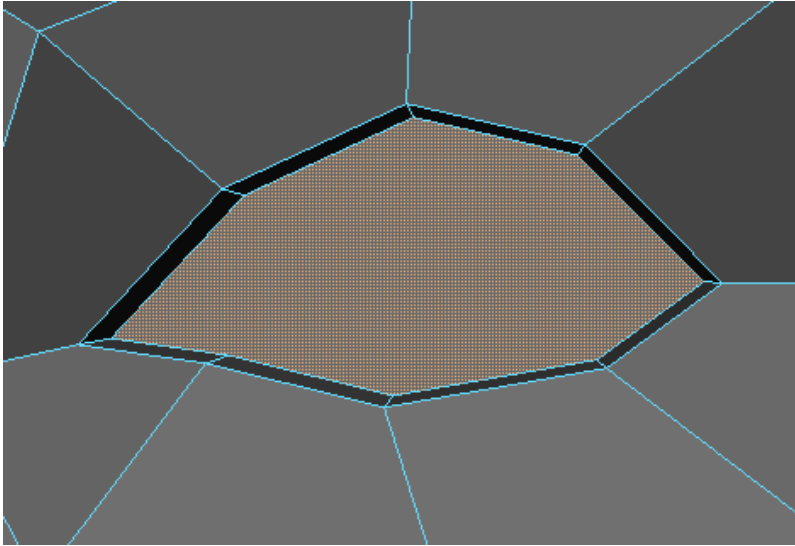
- Extrude out another ring of faces around the eyes and mouth, making sure not to extrude the edges along the **Y Axis** for the center of the mouth.



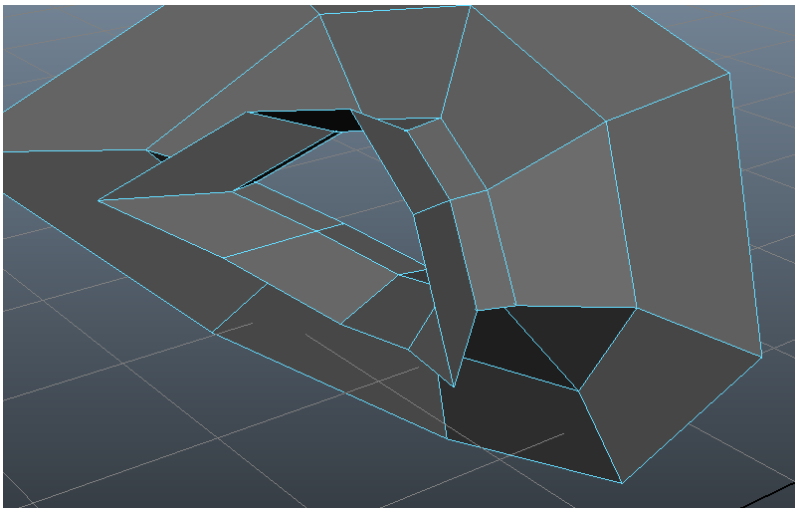
- Continue to push and pull points around to match your image reference. Looking in the **Perspective View**, you can start to see the shape of the face coming together.

- Don't worry about the lack of a nose; we're going to extrude that out later.

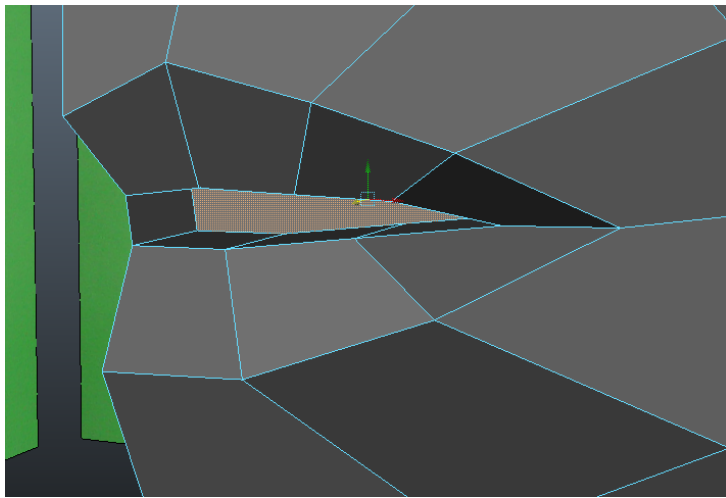
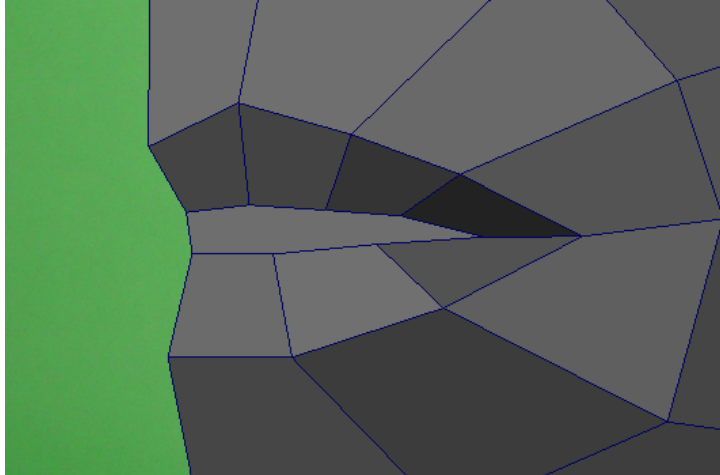
Adding Detail to the Eyes and Mouth



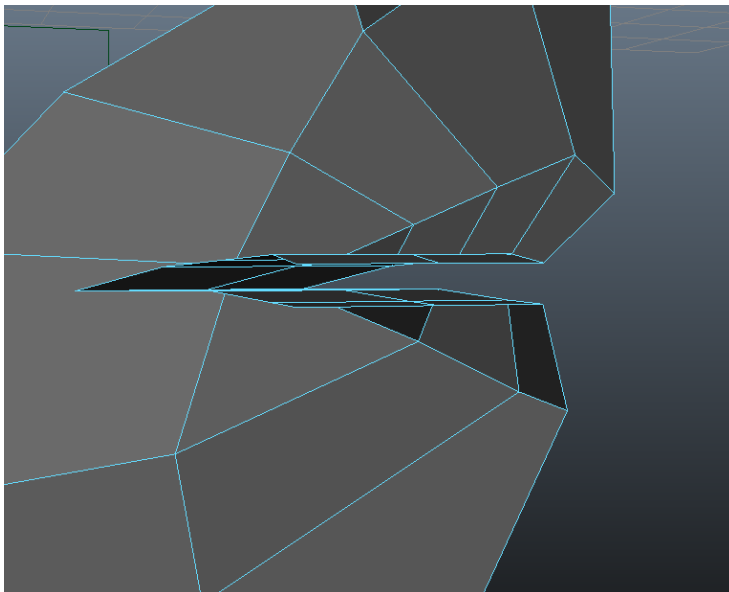
- Switch to **Face Mode** and select the poly face of the eye. **Extrude** this face and switch to the **Move Tool** to move it backwards along the **Z Axis** to create the eye socket. **Scale** the face down slightly as well.



- **Extrude** the eye face in once more and scale it up to give some room for an eyeball which we will add later. **Delete** the poly face for the back of the eye. This view is from the back of the eye.



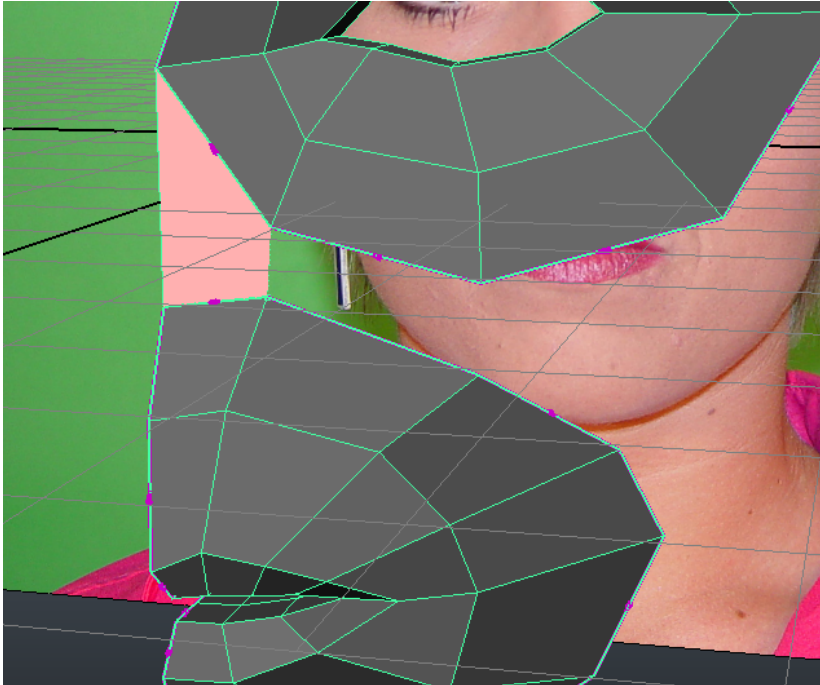
- Similar to the eye, **Extrude** in the mouth shape a couple times and tweak the vertices so it has the proper angles and shape.



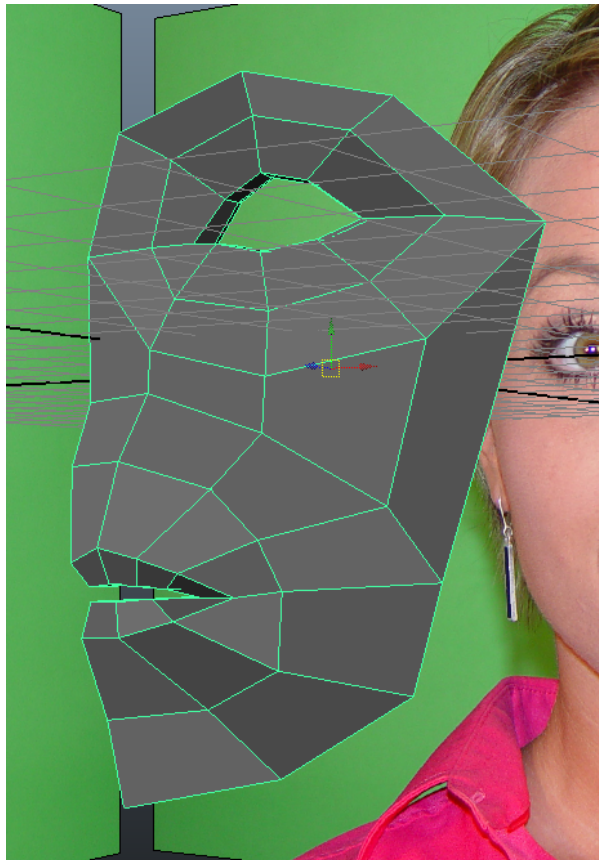
- Delete the inner and back polygon faces of the mouth so that when we mirror half of the face over to the other side, those faces aren't there.

Combining the Eyes & Mouth

- **Shift Select** both the eyes and mouth objects and go to **Mesh > Combine**. Our two polygon objects are now combined into one so that we can select the shapes together.



- With the new shape selected, go to **Edit Mesh > Append to Polygon Tool**. With this tool, you can click on edges to create a new polygon that connects between them. The new polygon appears pink until you confirm by hitting **Enter**. Click on the two edges shown above and press **Enter** to append a polygon between them.



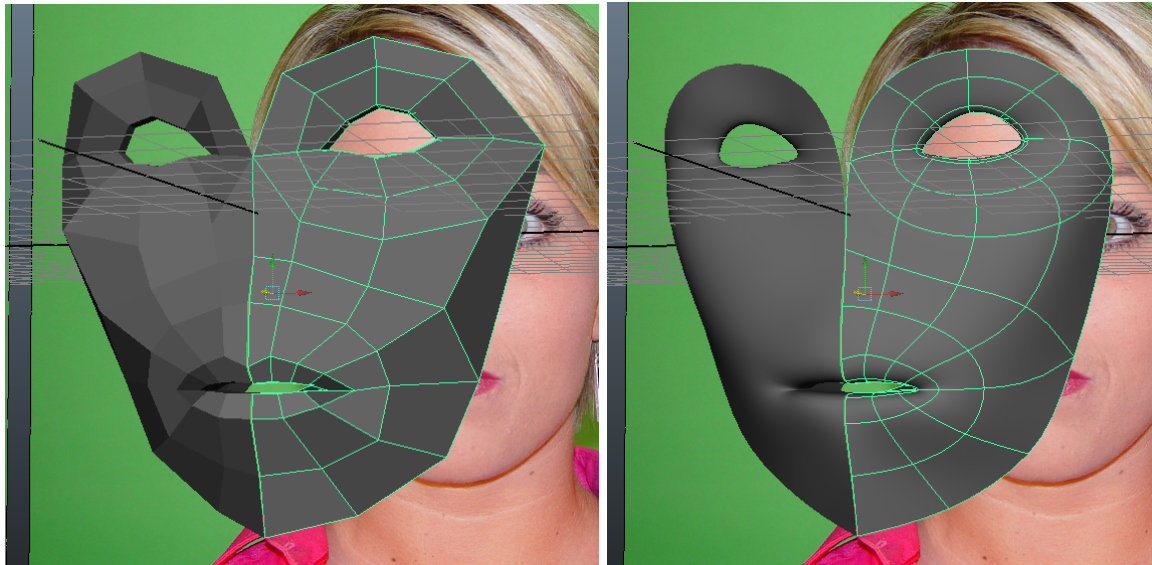
- Repeat this process to connect the top and bottom shapes together into one face shape.

Mirroring The Face

- Now that our face shape is a lot more cohesive, let's mirror it over the center axis

so that we can see both sides at once.

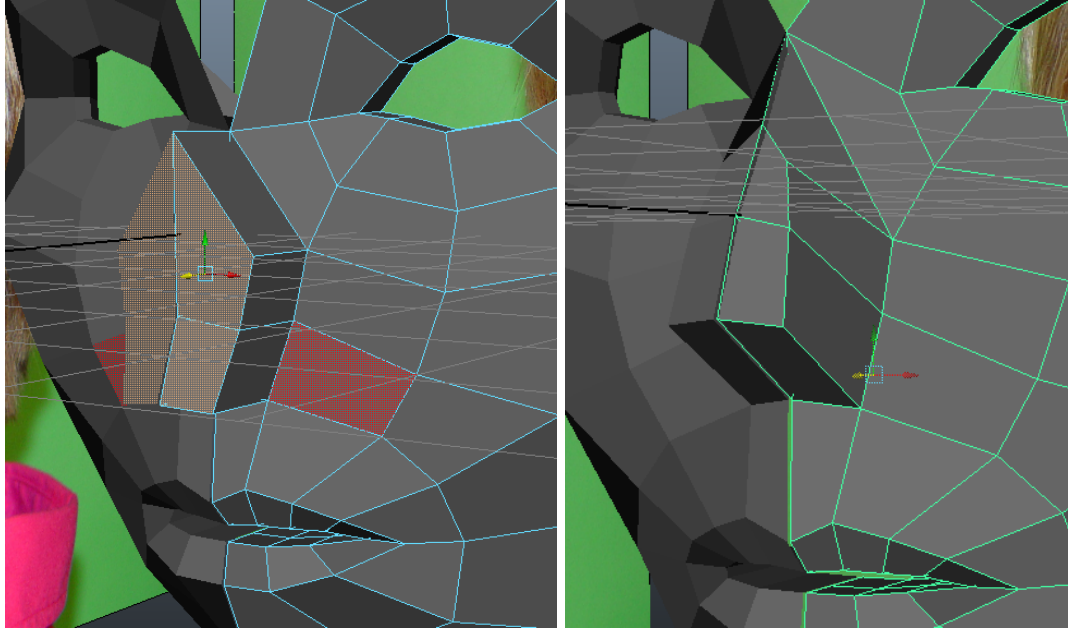
- Select the face object and go to **Edit > Duplicate Special (options box):**
 - Set **Scale** to **-1** to mirror the duplicate copy across the **X-Axis**
 - Enable **Instance leaf nodes** so that the copy will inherit all of the tweaks and modifications we apply to our head mesh.
 - Press **Apply** to create the duplicate copy.



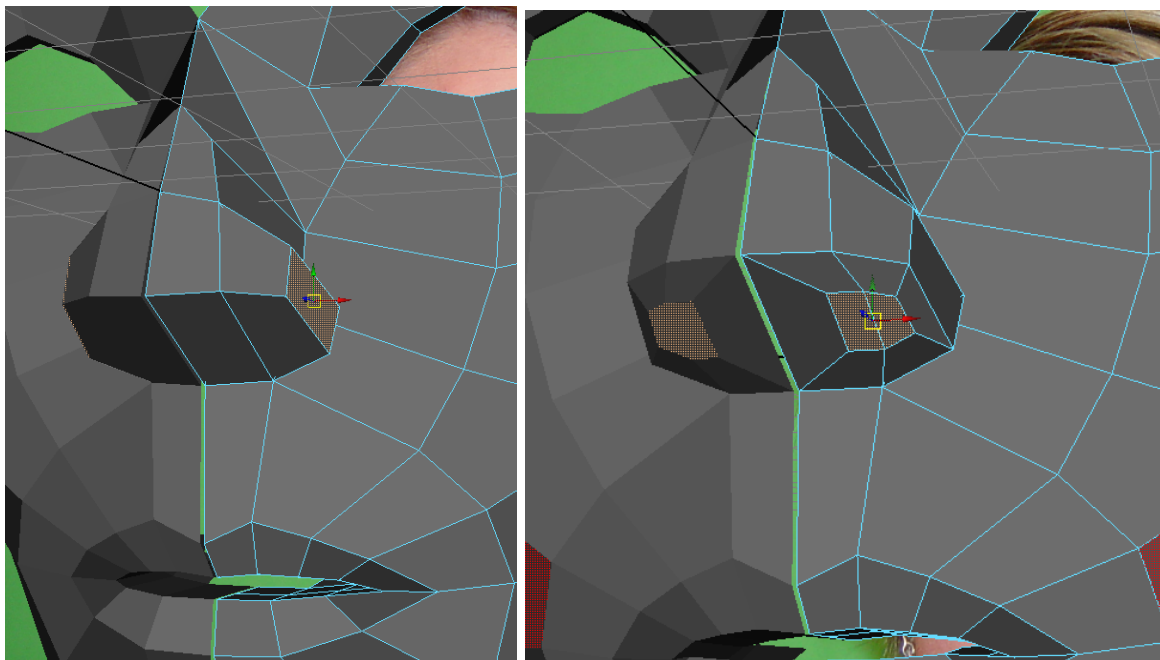
- We can now see how both halves of the face come together to make our female head take form.
- With your head selected, Press **1** and **3** to switch between **Unsmoothed** and **Smoothed** versions of your geometry.
 - This is an useful habit to develop for previewing your model, since subdivision results in a noticeable reduction in the mass of your geometry.

Extruding and Shaping the Nose

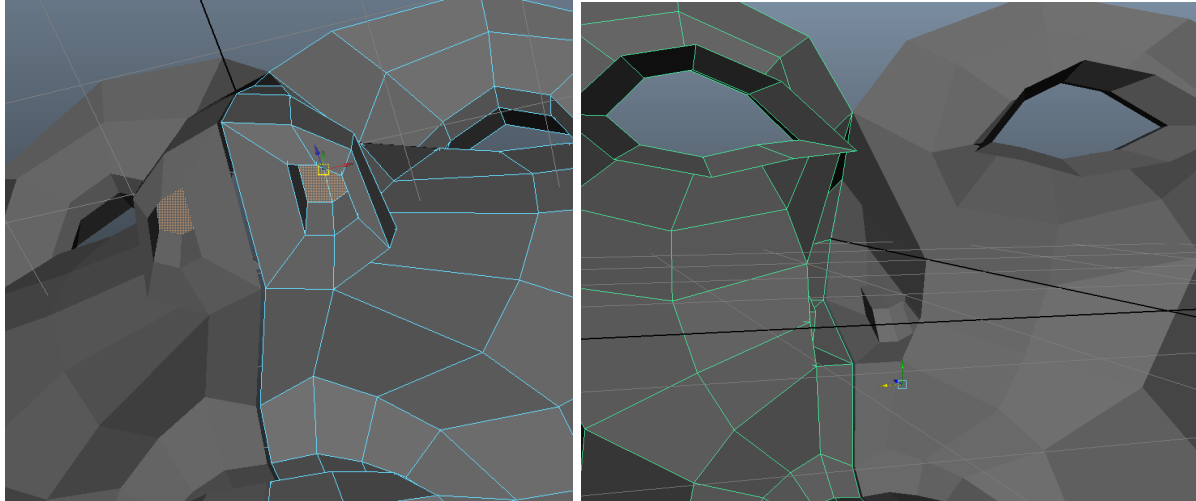
- **Select** the two polygons in the center of the face over where the nose should come from.



- Run an **Extrude** and **pull out** those polygons after switching to the **Move Tool**
- Shape the nose geometry to more closely match the reference



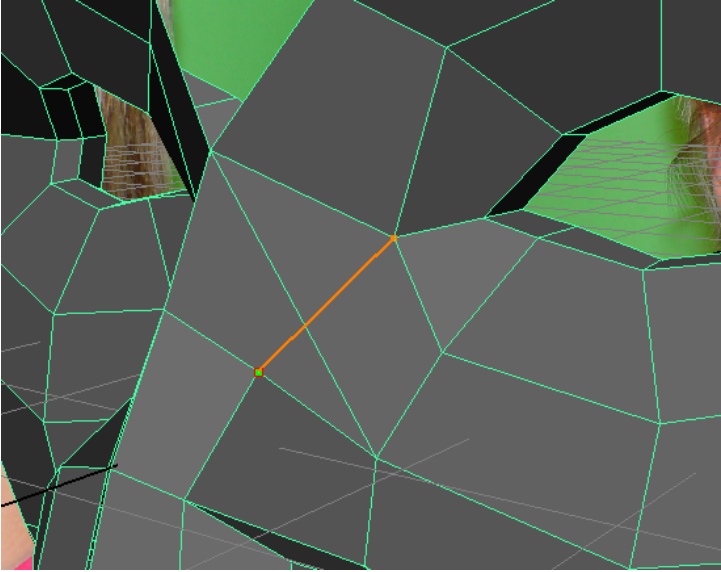
- **Select, Extrude, pull out and Scale Down** these side polygons for the bottom area of the nose around the nostrils and further shape the nose.
- **Select and Extrude** the two polygons on the bottom of the nose, then **Scale Down** and **Move** them off to the side to define the nostril openings
- With those same extruded polygons selected, **Extrude** again and pull up on the **Y-Axis** with the **Move Tool** to push the nostrils into the nose.



- Tumble the **Perspective View** around the back of the face and **Delete** the faces on the inside of the nose in the center so that our face subdivides correctly when the two halves are merged.

Rerouting Facial Edge Flow

- Often, we will want to change the direction of some of the edges of our model to more closely match the natural curves of the face. Let's introduce a new tool to accomplish this:



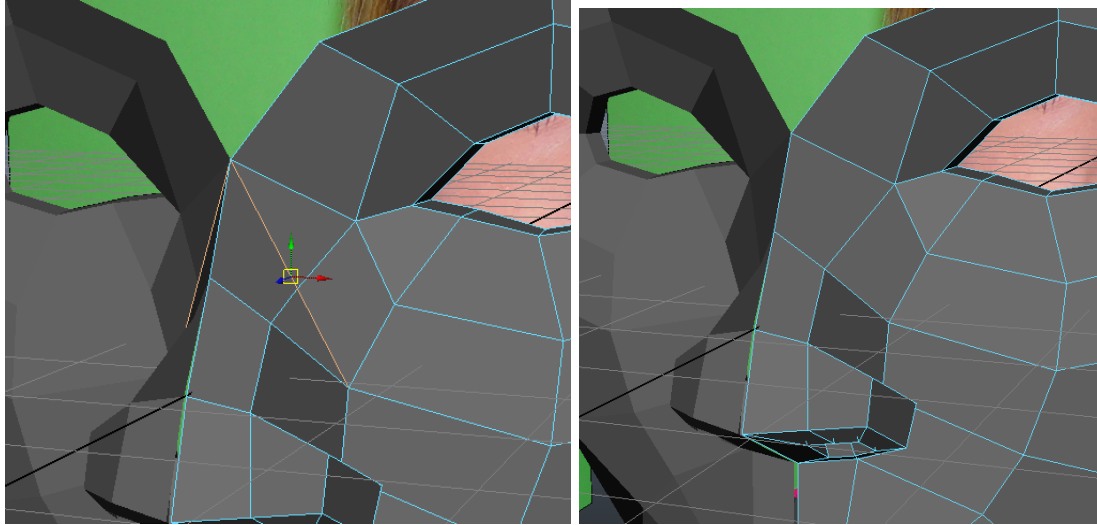
- With your model selected, go to **Edit Mesh > Interactive Split Tool (options box)**

- This tool allows you to split polygons along edges you define by clicking on a vertex or on the middle of a polygon edge. Each click defines a new split line, and the line is shown in orange.

- Reduce the **Magnet Tolerance** if you want to cut along an edge at a place besides the midpoint of the edge.

- Cut across the two faces shown to

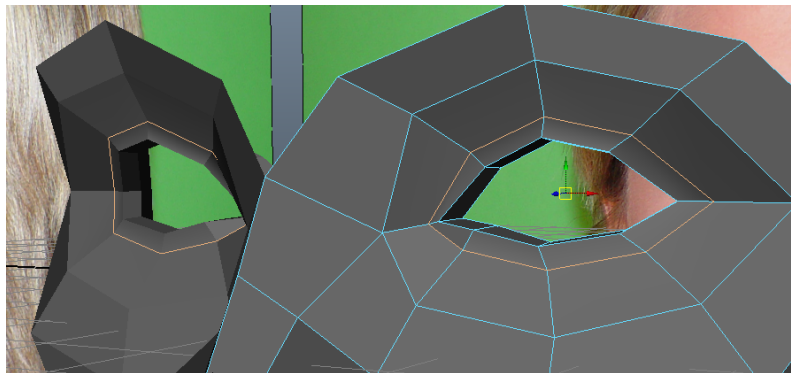
the left and press **Enter** to finalize the split.



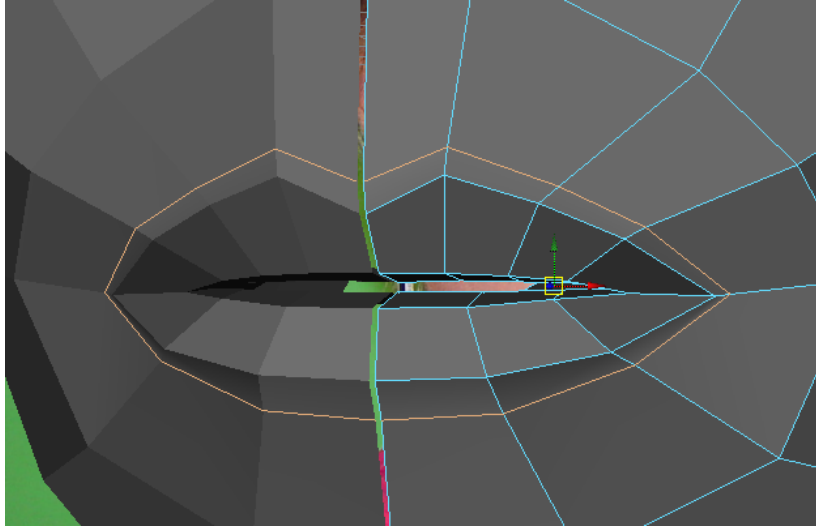
- Now we need to remove the two edges that we just cut over. **Select** these two edges and go to **Edit Mesh > Delete Edge/Vertex** to remove both the edges and vertices you have selected from your model.
- The edges around the bridge of the nose now have a much better flow.

Inserting Edge Loops for the Eyes and Mouth

- To better define the eyelids, let's insert an edge loop around the eyes.
- Go to **Edit Mesh > Insert Edge Loop Tool (options box)**:
 - Using this tool, click on a loop of edges to insert a ring that loops through those edge loops.
 - Under **Maintain position**:
 - **Relative distance from edge** allows you to click and drag along a given edge to place the edge loop manually.
 - **Multiple edge loops** allows you to insert one or more edge loops with an equal distance between all inserted loops.

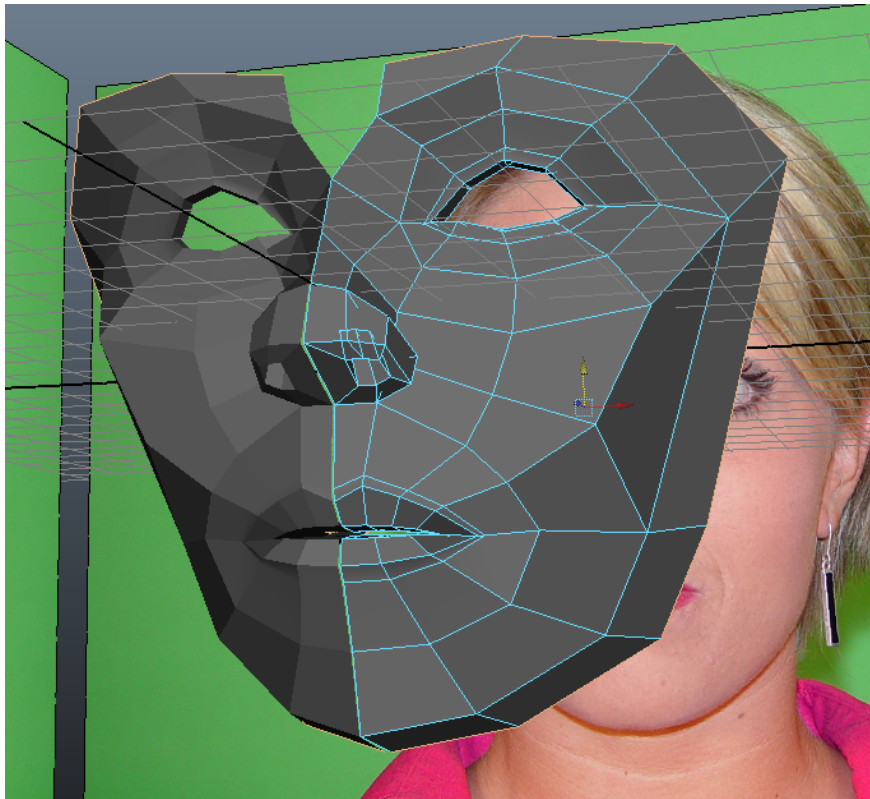


- Using **Relative distance**, insert a loop around the eye opening and **Move** that edge backwards to push in the eyelids.

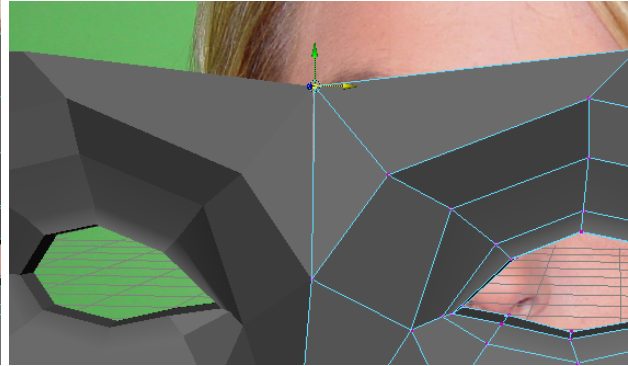


- Repeat the same process for the mouth geometry to add a sharper edge around the lips. The bottom lip has a much softer edge than the sharp crease which defines the upper lip.

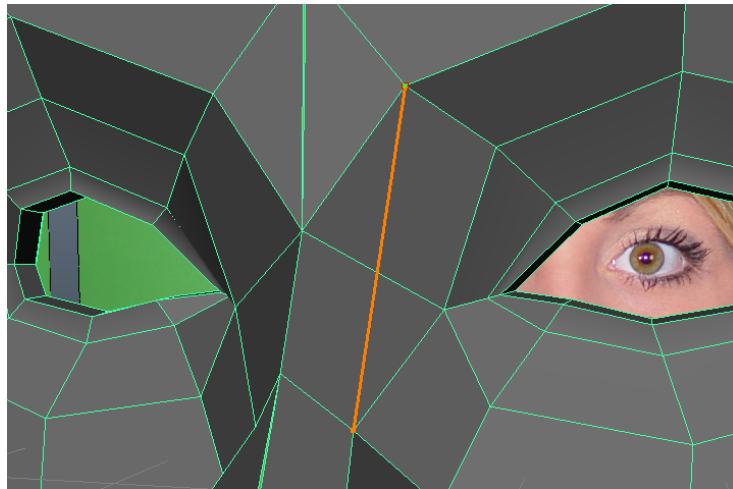
Extruding the Face and Fixing the Nose Edge Flow



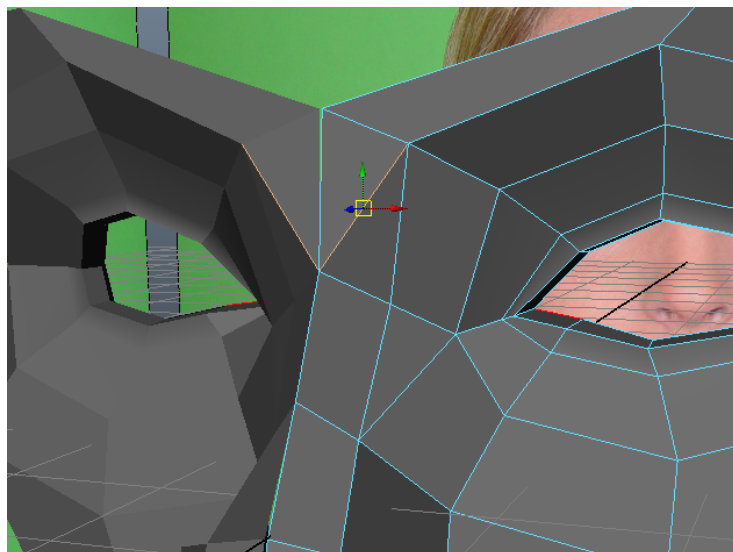
- Select the edges around the edge of the face (shown above), **Extrude**, **Scale Up** and **Move Back** to further define the cheeks, chin and forehead. Shape the resulting points to match the reference.



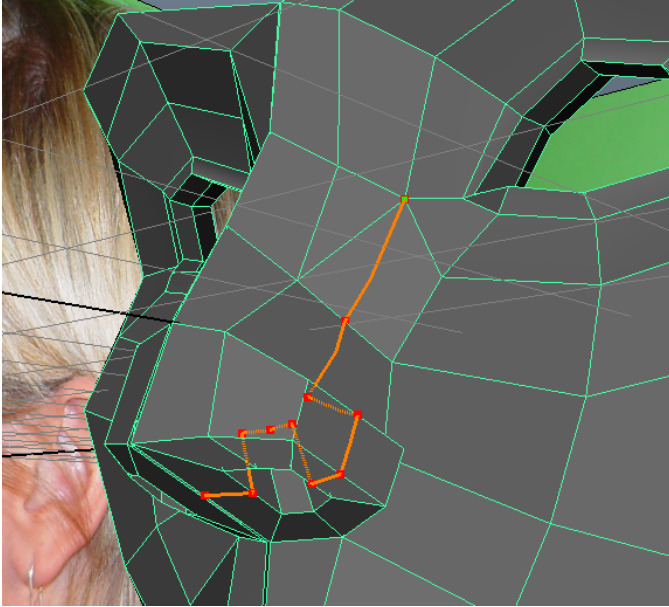
- To remove that ugly gap in the center of her brow:
 - Use the **Append to Polygon Tool** to create a triangle across these two edges
 - Enable **Snap to Grid** and **Move** this point to the center **Y-Axis** (you may have to use the **Front View**).
- That looks better, but we can still change the nose and brow edge flow to make it work better:



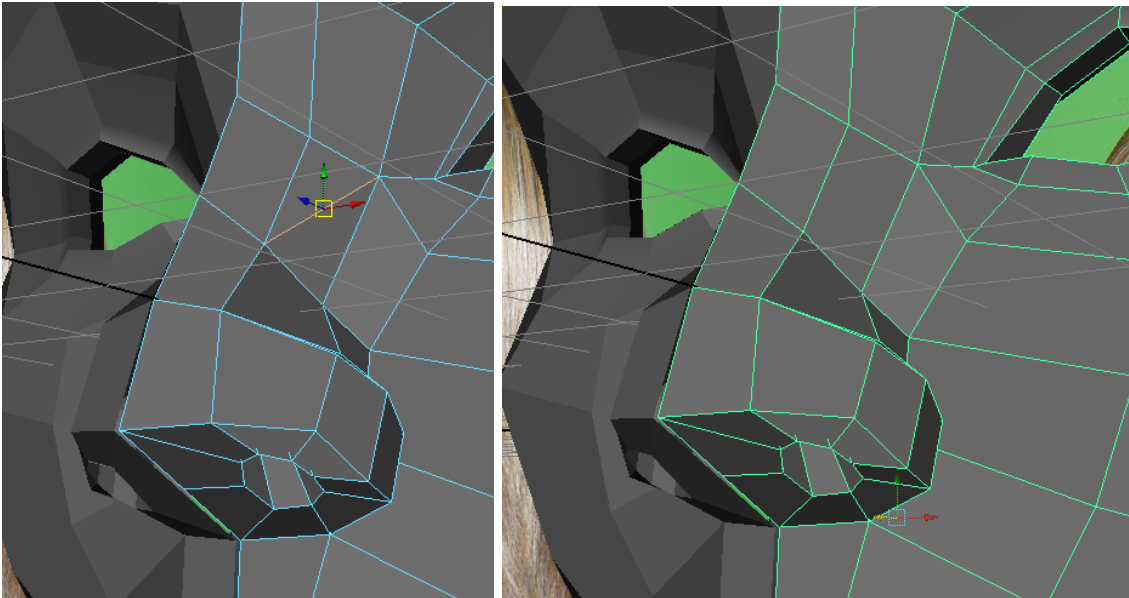
- Use the **Interactive Split Tool** to cut across these two polygons between the eyebrow and nose. Press **Enter** to confirm.



- **Select** and **Delete** this edge to convert these two triangles into a four sided poly.

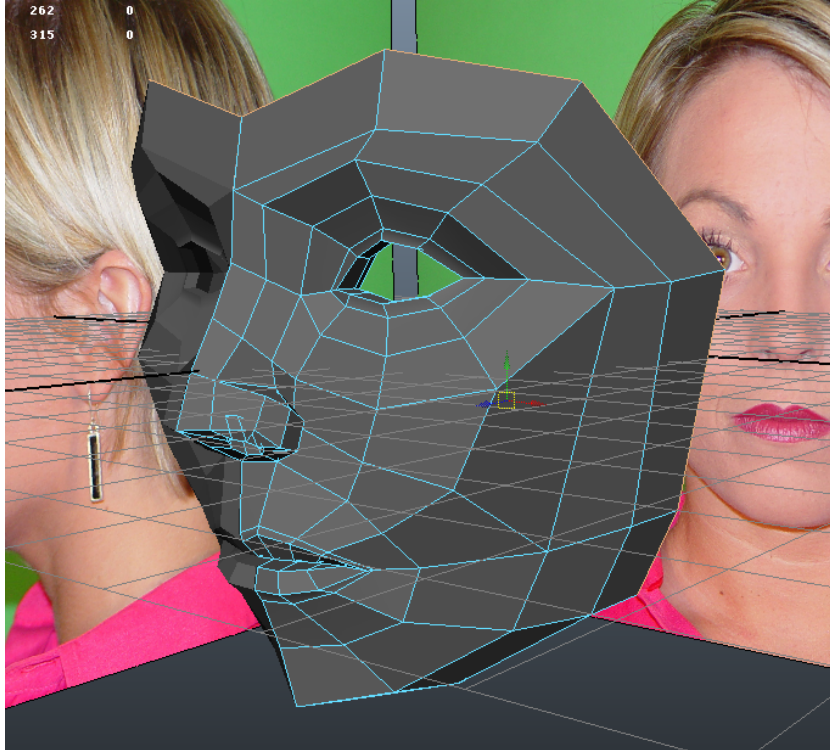


- Once again, use the **Interactive Split Tool** to cut from this point down across the center point of all of these polygons all the way down the nose, into the nostrils and back out to the bottom.

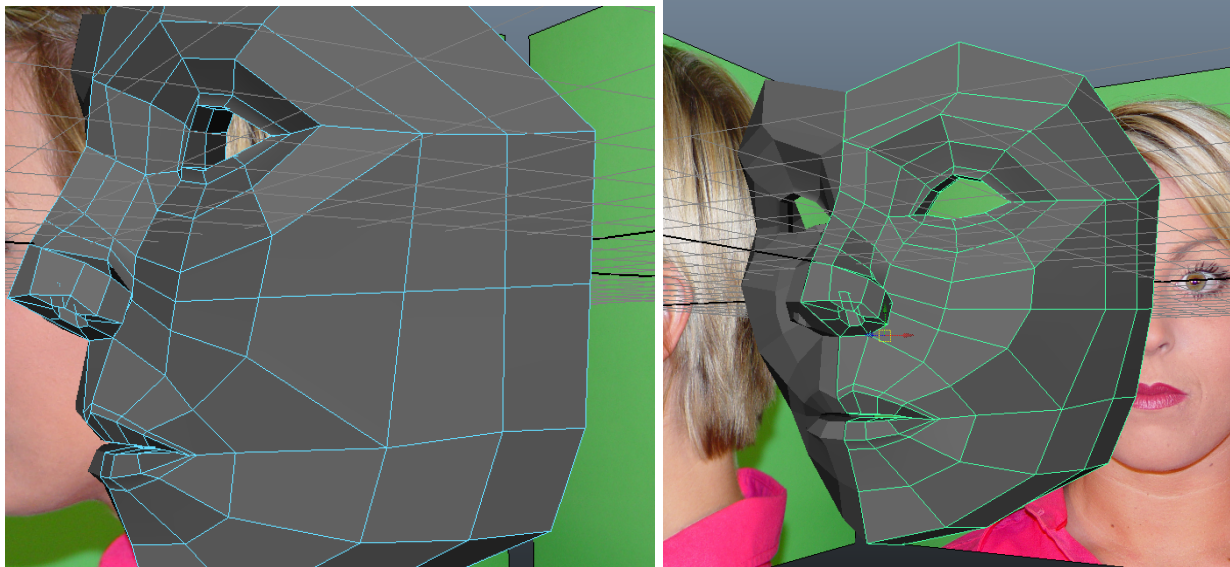


- **Select** and **Delete** this edge to convert these two triangles into a quad and finish our work cleaning up the nose edge flow.

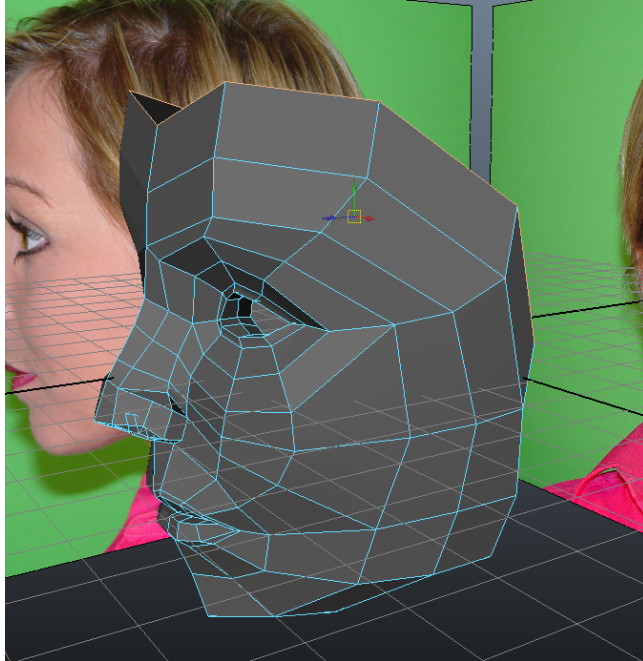
Extruding the Head and Neck



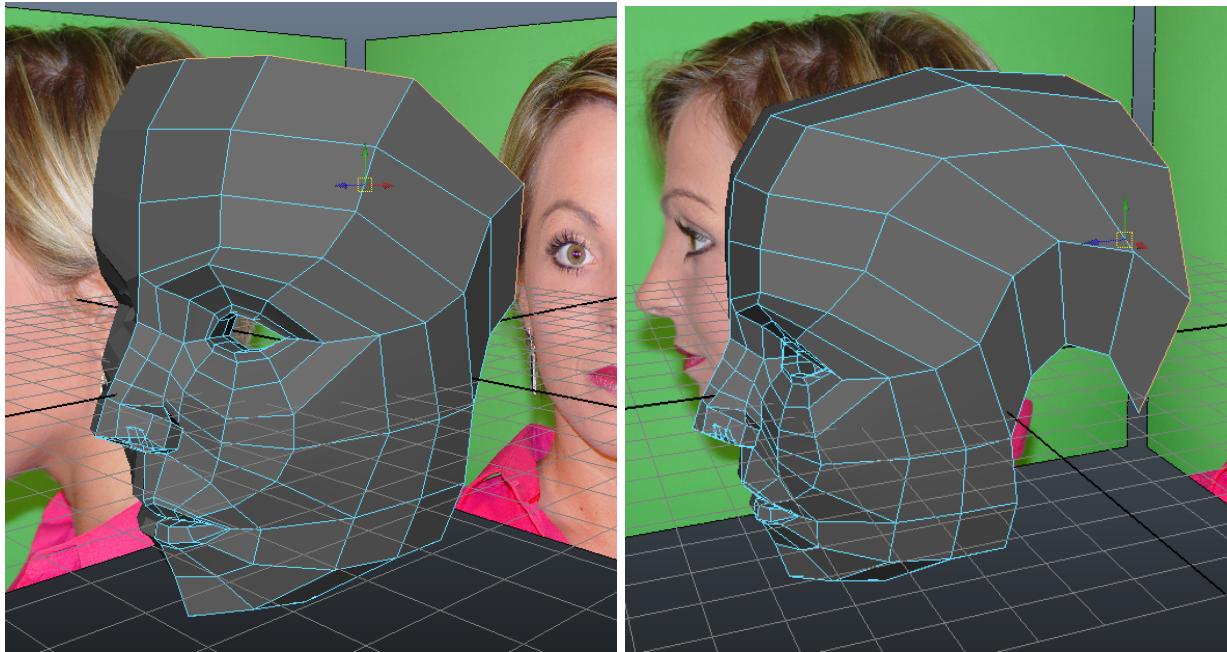
- **Select** the ring of polygons around the edge of the face, **Extrude** and **Move Back** again to further shape the curves of the head.



- Insert an edge loop right above the nostril, going from the nose to the chin, with the **Insert Edge Loop Tool**. Reshape the face so the curves flow more naturally.

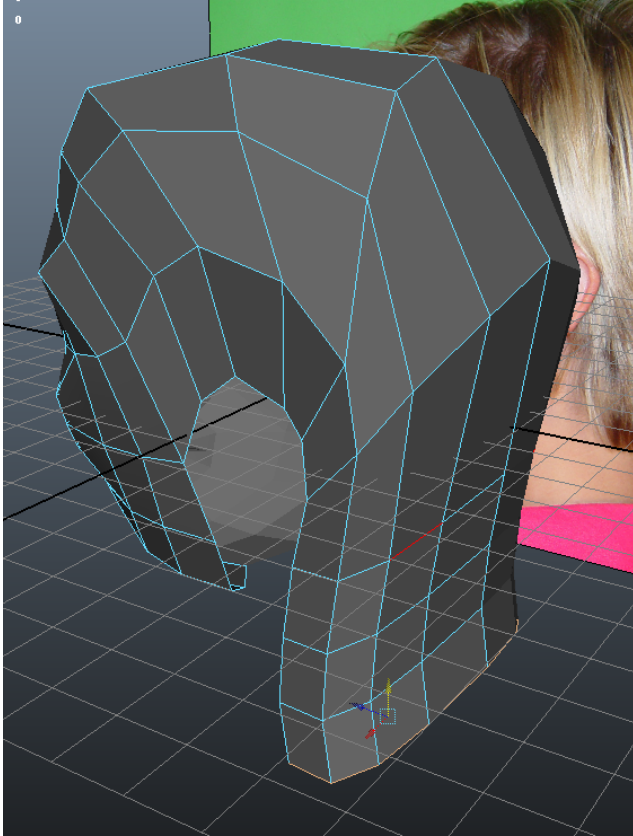


- **Select** the top four edges of the forehead and **Extrude & Move Back** to follow the curvature of the skull.

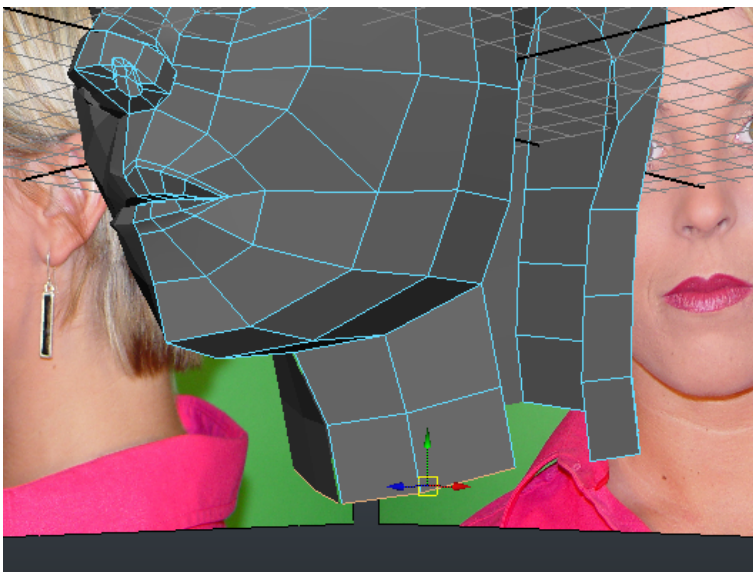


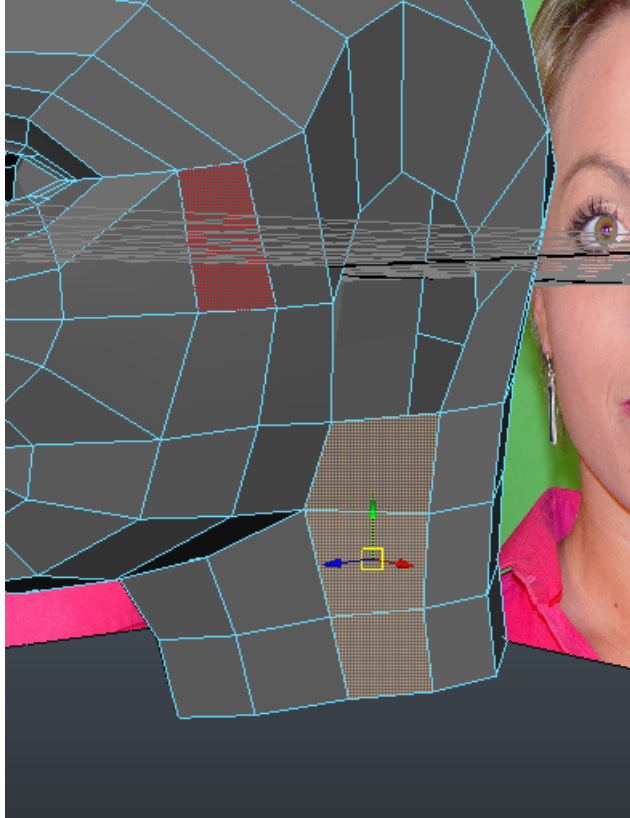
- Continue to **Extrude, Move** and **Reshape** these edges so they go around the back of the head, down the neck and around the ear, always following the reference images.

- By the end, it should look something like this:

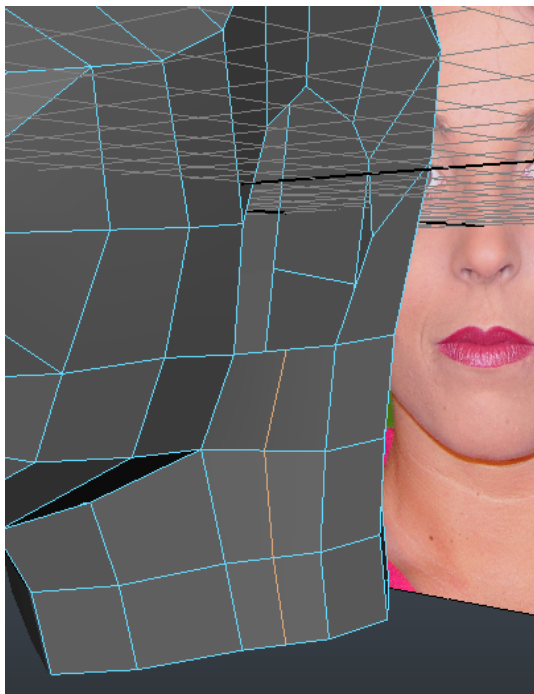


- Let's do the same procedure for the front of the head, **Extruding & Moving Down** two rows of edges so that they match up with the back of the neck:





- Use the **Append to Polygon Tool** to connect up the three rows of polygons on the bottom of the neck. Now our head is finally all connected together!

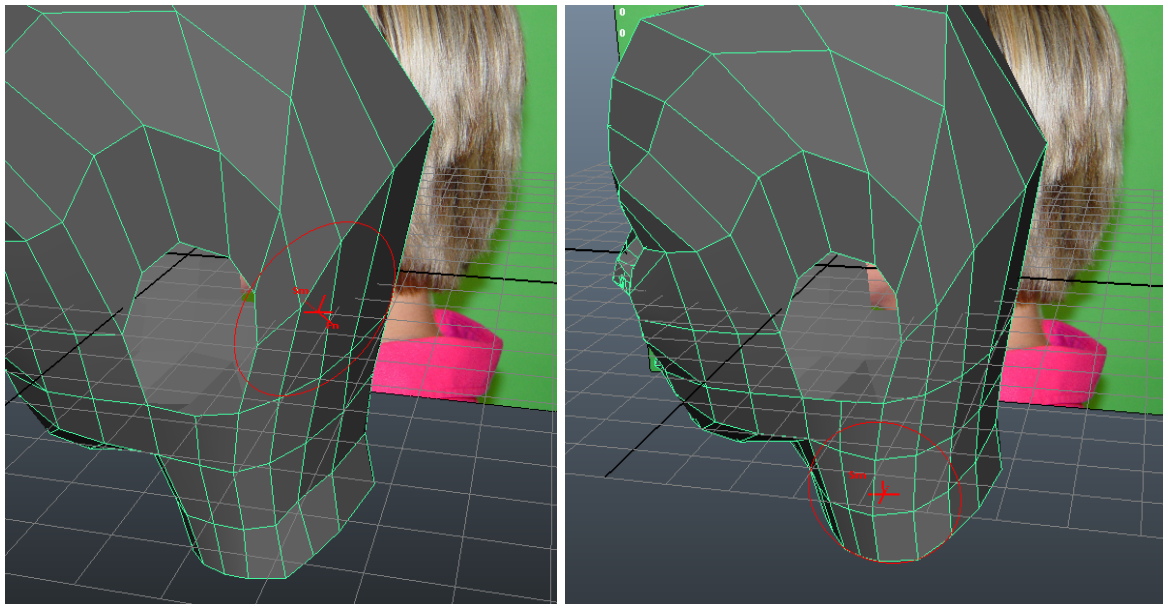


- To add some more geometry for the ear (our next step), use the **Insert Edge Loop Tool** to add an edge loop on the polygons we just appended.

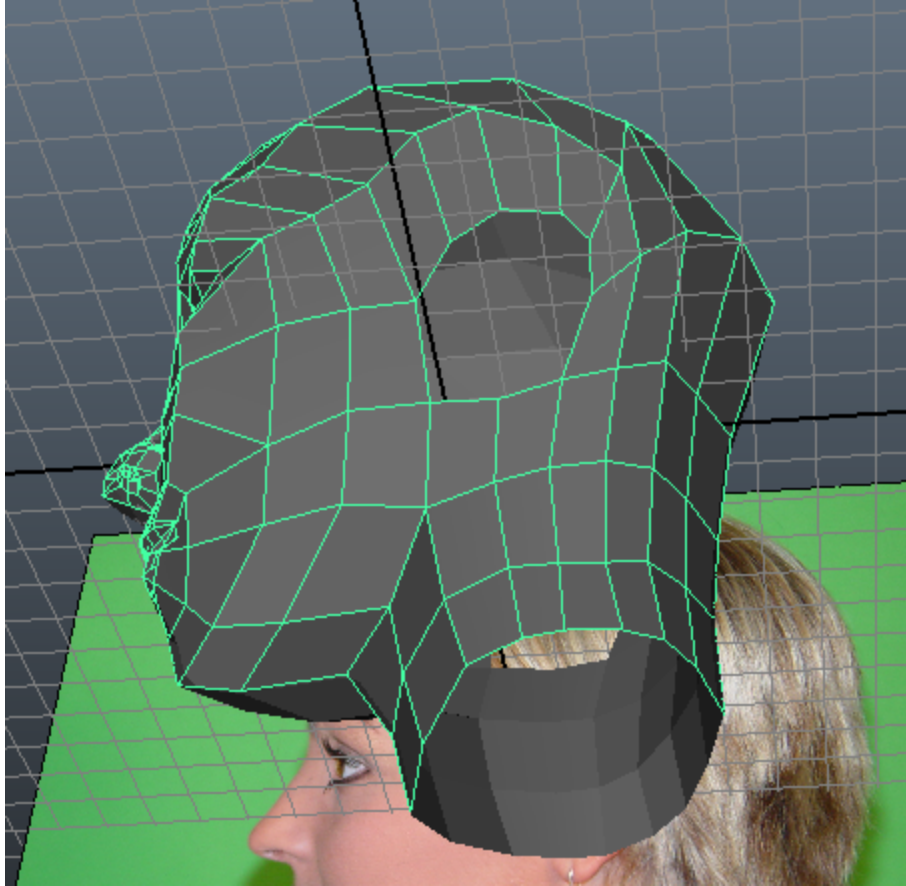
The Sculpt Geometry Tool

- Our head is really coming together! But the neck and head geometry look pretty weird and need some reshaping. Rather than pulling all of those points around by hand, let's introduce a new tool:

- Select your mesh and go to **Mesh > Sculpt Geometry Tool (options box)**
- This tool allows us to sculpt geometry by clicking and dragging over our mesh.
- There are a number of important options for this tool:
 - **Radius (U) & Radius (L):** The upper and lower limits of the radius of your sculpting brush.
 - **Opacity:** The intensity of the sculpting being performed.
 - **Profile:** Choose between different brush shapes (like in Photoshop)
 - **Operation:** Choose between different sculpting operations.
 - **Push:** Push down geometry
 - **Pull:** Pull up geometry
 - **Smooth:** Smooth our geometry
 - **Relax:** Relax geometry
 - **Pinch:** Pinch geometry
 - **Slide:** Slide geometry on surface
 - **Erase:** Erase sculpted detail created with tool



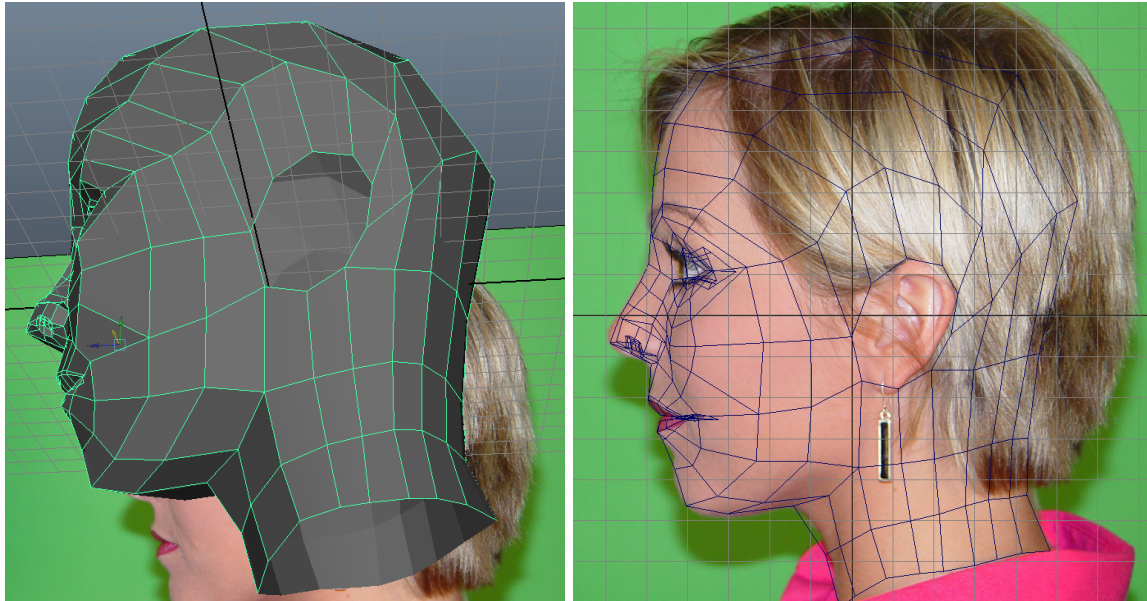
- Adjust the settings and use this tool to smooth out areas of your model which may appear square or flat, such as the back of the head or neck. Often, setting your **Opacity** and **Radius** to a low value can be beneficial for slowly sculpting out your geometry surface.
- You can of course always pull the points around manually when the Sculpt Geometry Tool lacks the precision you require.



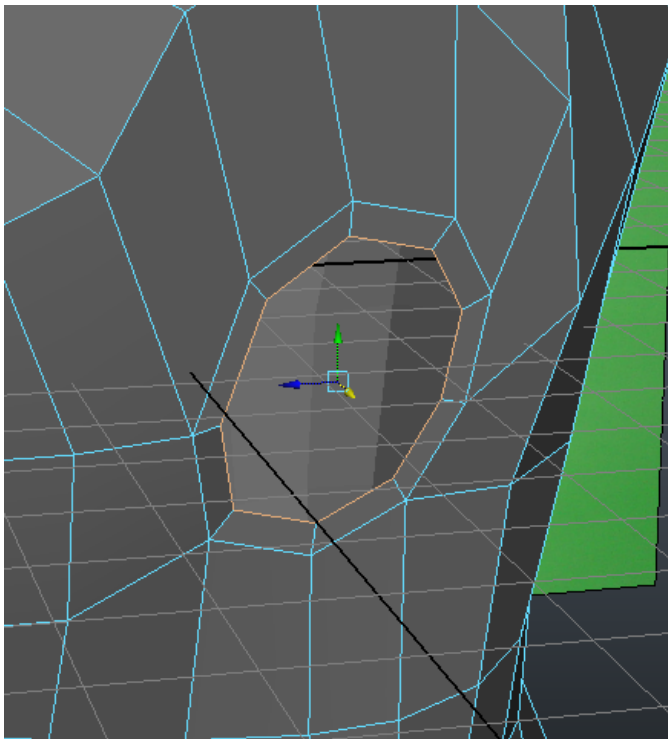
- After sculpting, our head should look a lot more rounded and realistic.
- Be sure to continuously be sculpting points out around the head while you notice problems with shape and edge flow.

The Ears

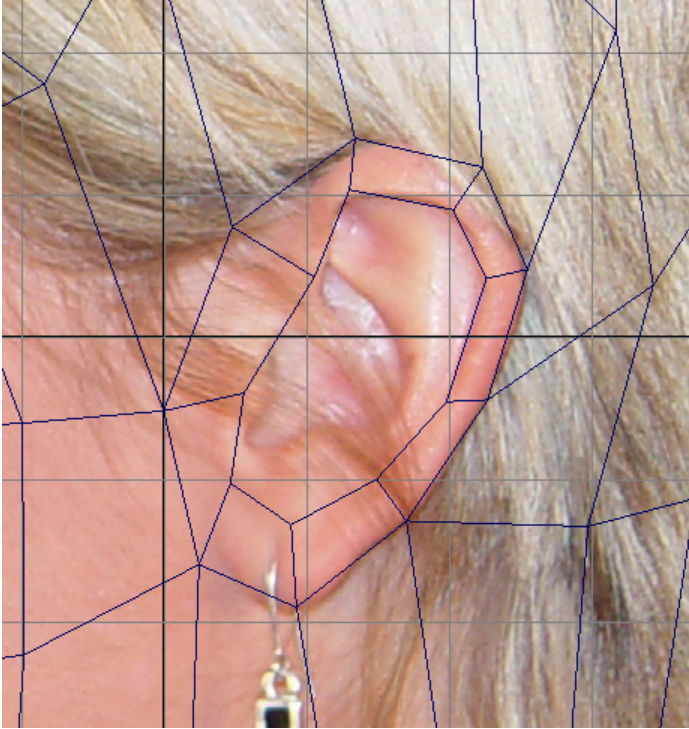
- The ears are one of the most challenging aspects of the head to model due to the complexity of the edges and curves involved. Here's how we can do it:



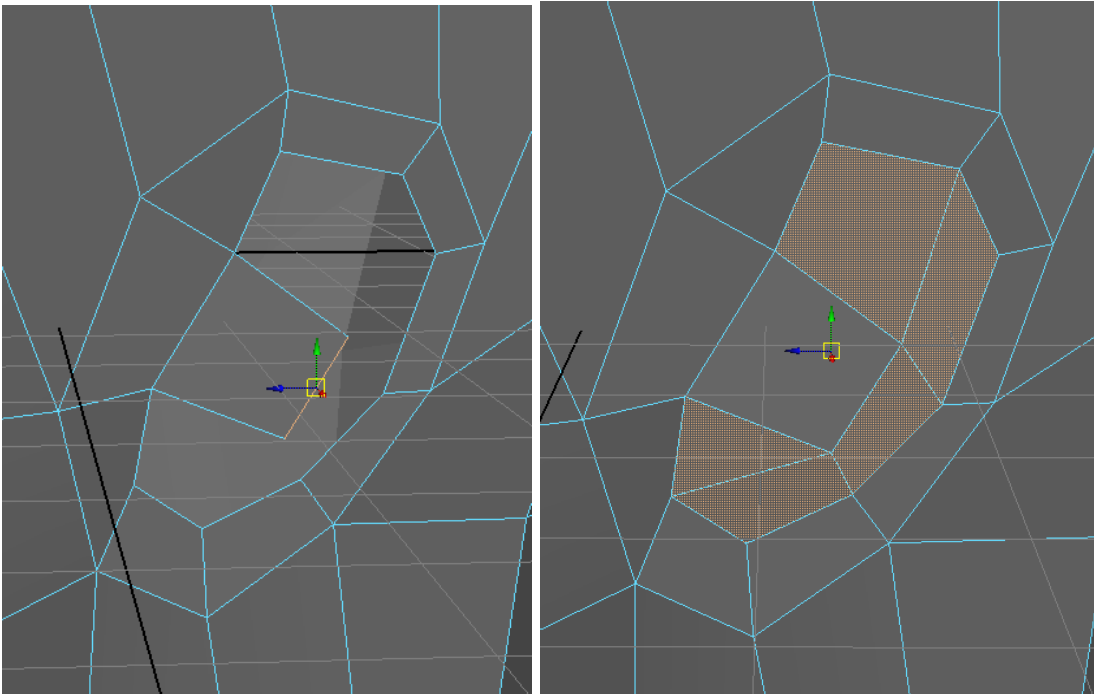
- Reshape the hole around where the ears will go to more closely match the reference. Using the **Side View** can be beneficial for this step.



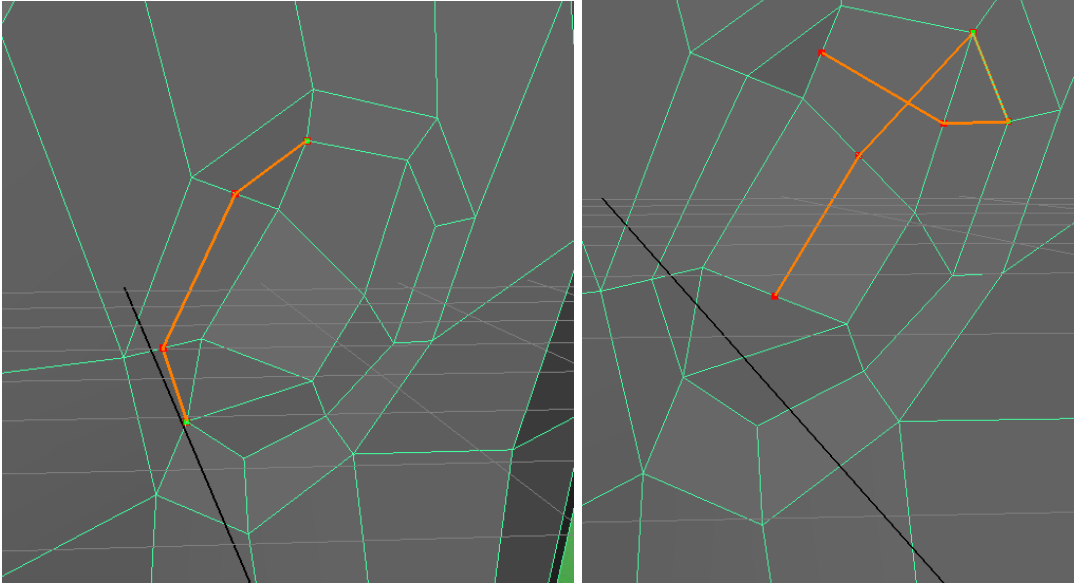
- **Select** the ring around the ear, **Extrude** and switch to the **Scale** tool to scale down the new edge ring we just created.



- In the **Side View**, use the **Move Tool** to pull the ear vertices around so that they match the shape of the ear lobe and outer loop.

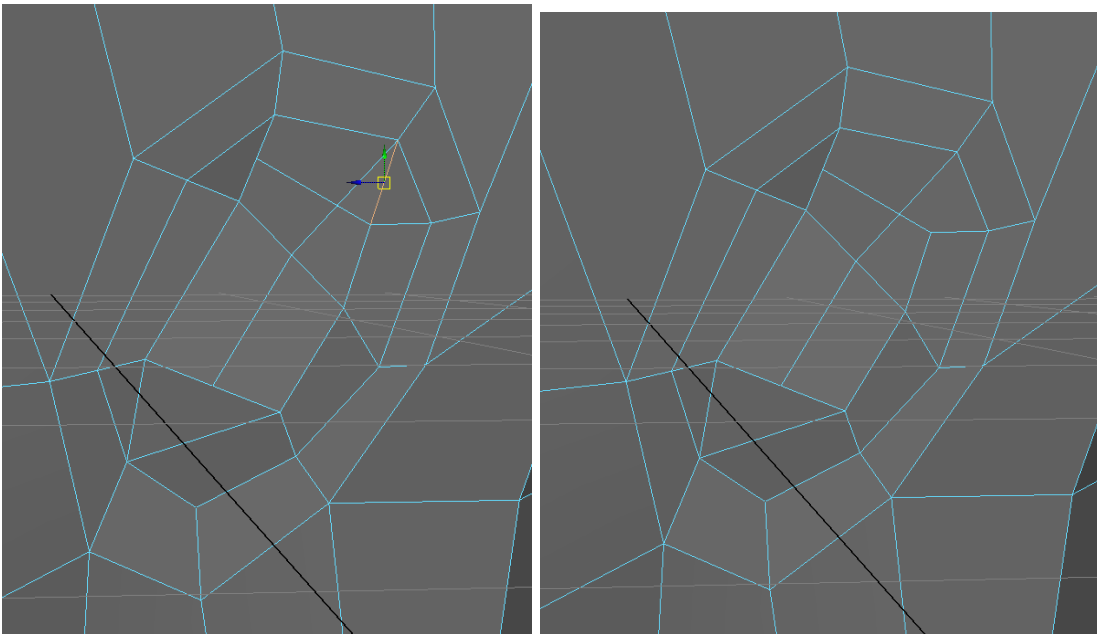


- **Extrude** out this polygon in the side view, which will represent the inside of the ear.
- **Append** the other surrounding polygons (highlighted above) to close up the ear opening.

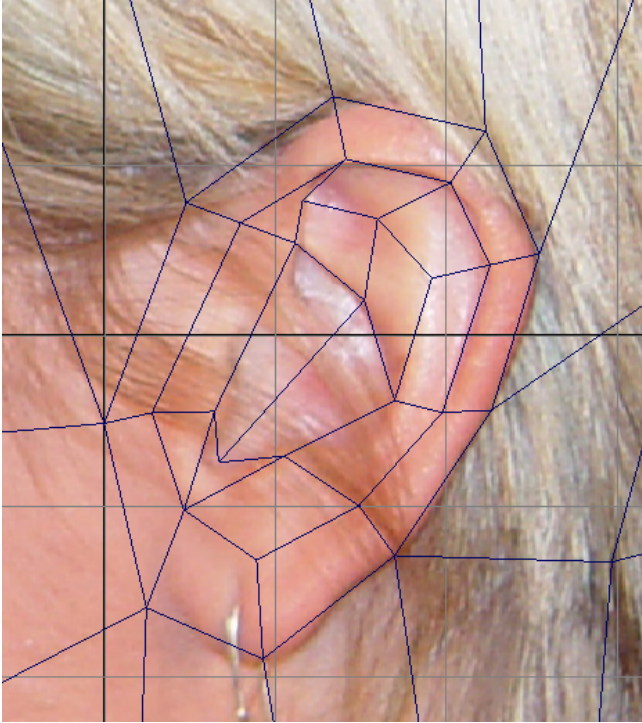


- Use the **Interactive Split Tool** to cut in some new geometry according to the above screenshots.

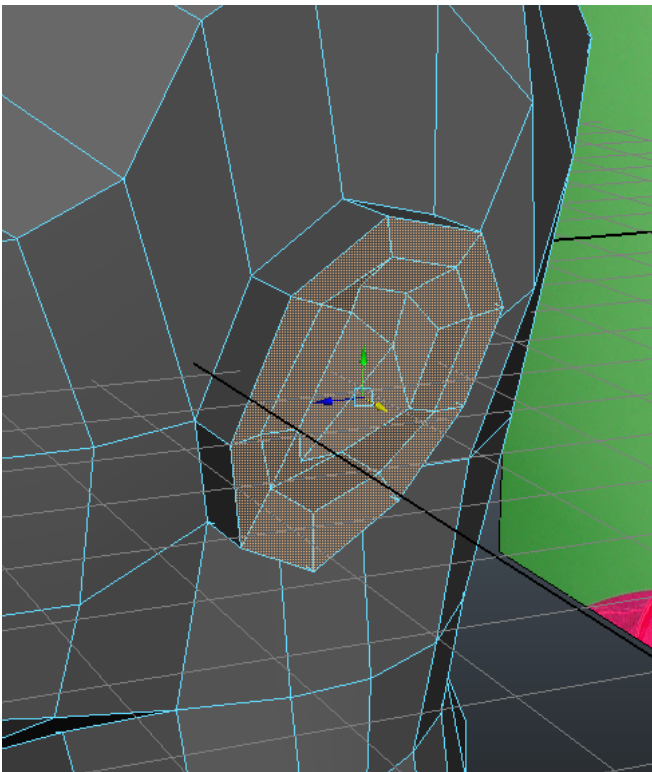
- Notice that you can actually cut over an existing line and it will not break the edge flow.



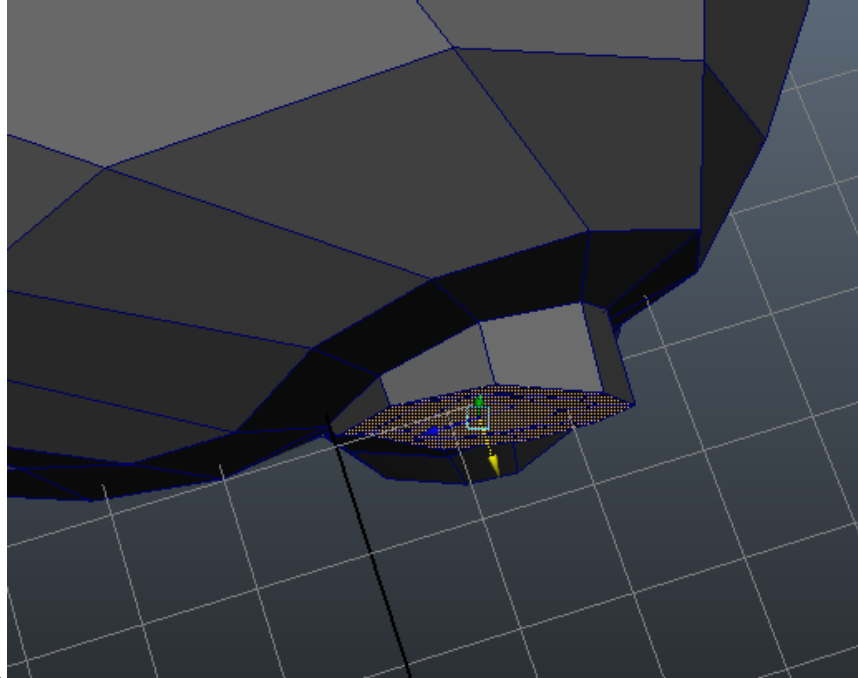
- **Delete** the edge shown above.



- Now you can reshape the ear geometry to match the reference image in the **Side View**.

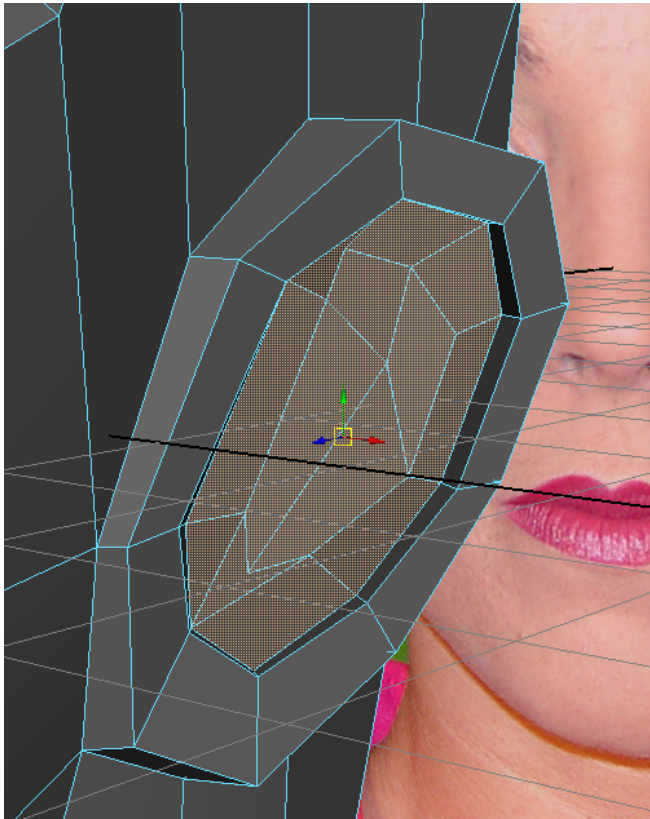


- **Select** the entire ear geometry, **Extrude** and **Move Out** from the head to give the

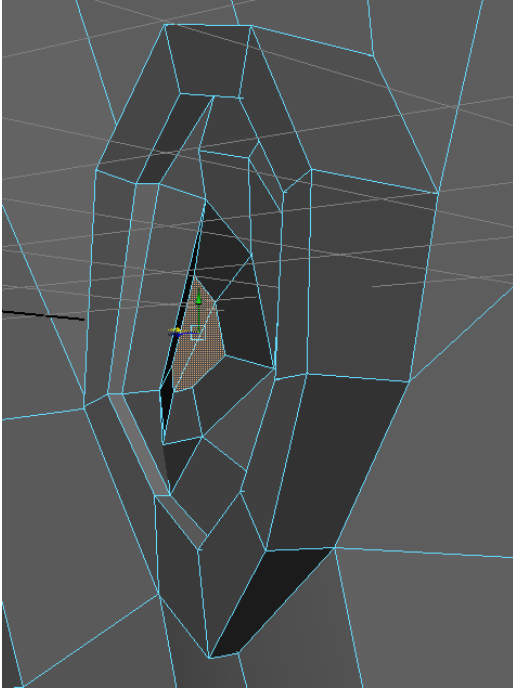


ears some volume.

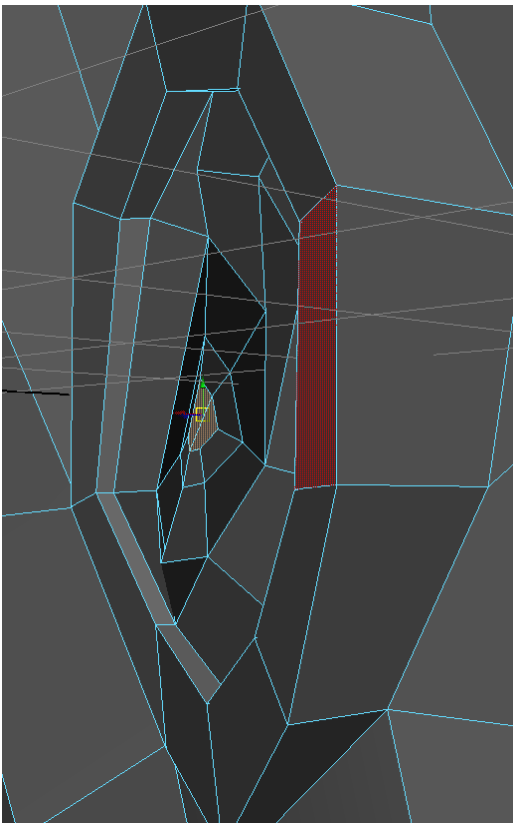
- With those polygons still selected, **Rotate** the ear so it slants inwards as it naturally does.



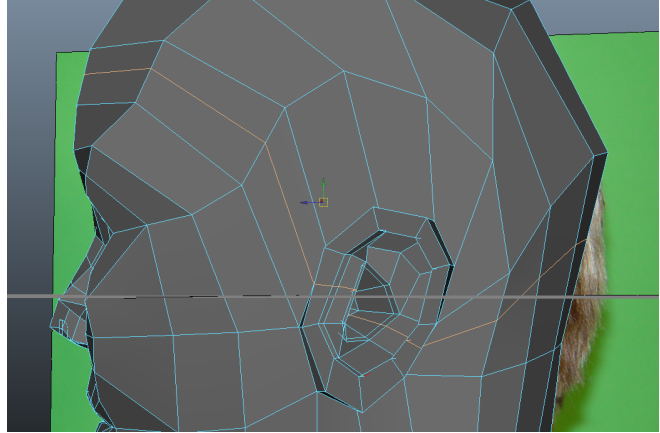
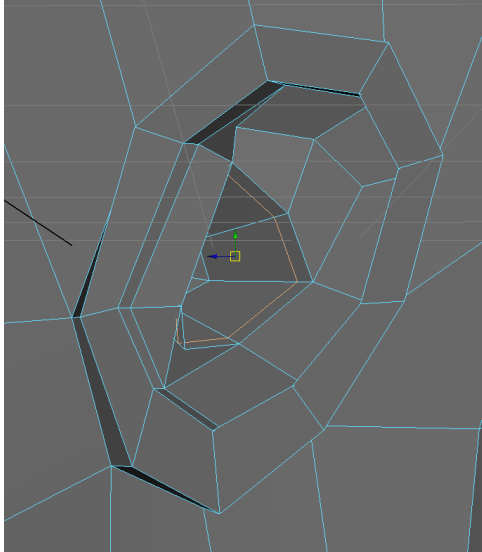
- **Select** these interior polys, **Extrude**, **Move** & **Rotate** them inwards to form the interior part of the ear.



- **Select** these interior polys, **Extrude**, **Move** & **Scale** them down to make the ear hole. **Move** them forwards inside the ear quite a bit so that from the side they are not visible.

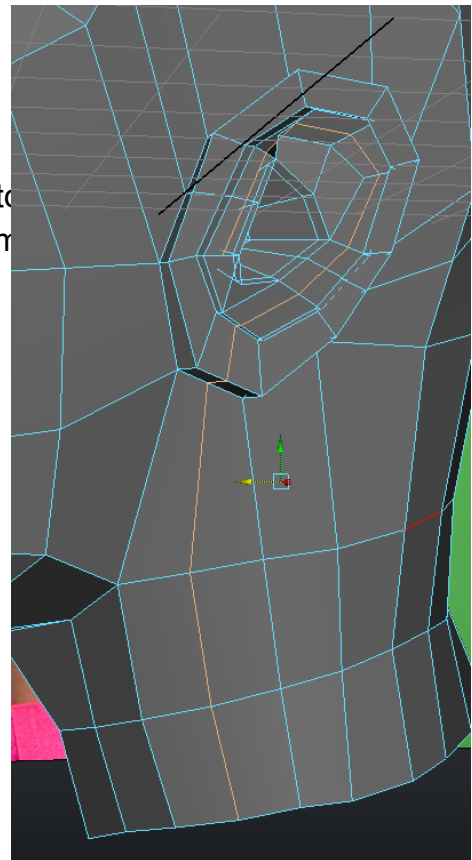


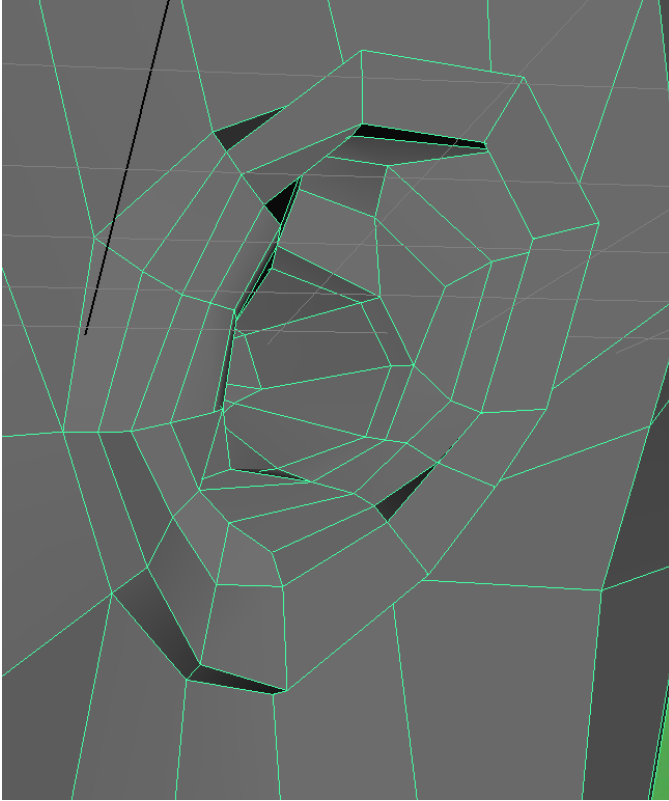
- **Extrude In** and **Scale Down** one more time to complete the ear canal.



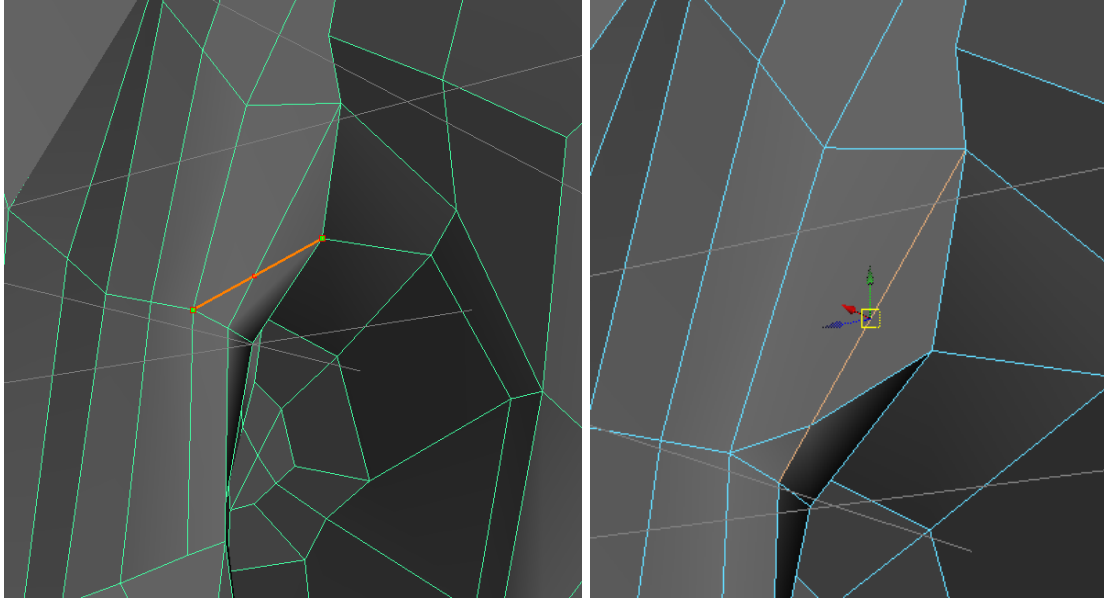
- **Insert Edge Loops** at the places shown here to give us some extra detail in the ears to work from as well as in the neck and head.

- Shape the extra loops around the neck and forehead to further refine those areas.

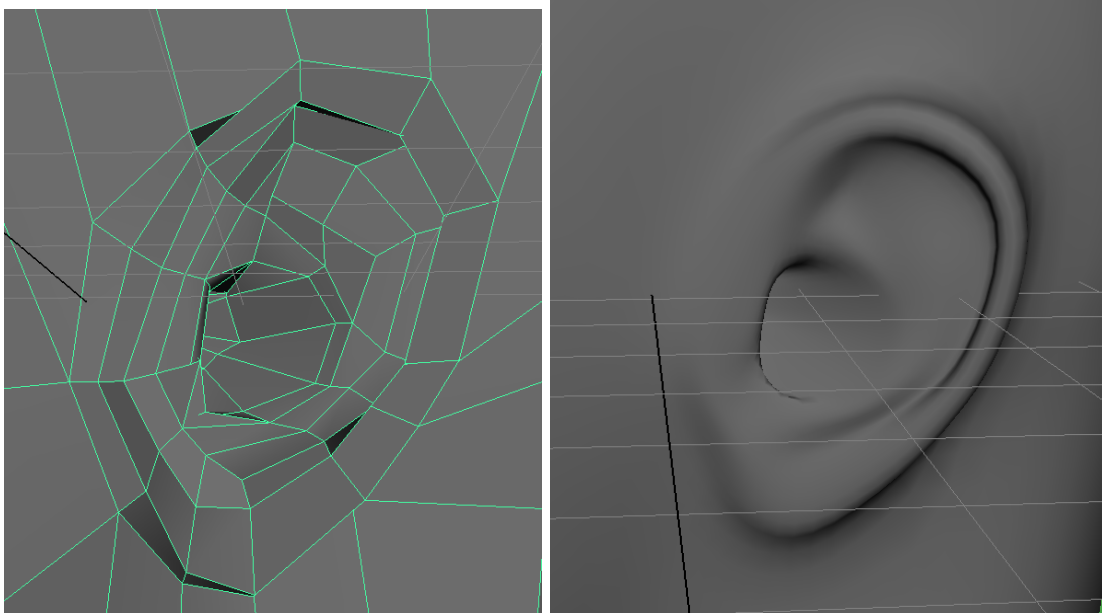




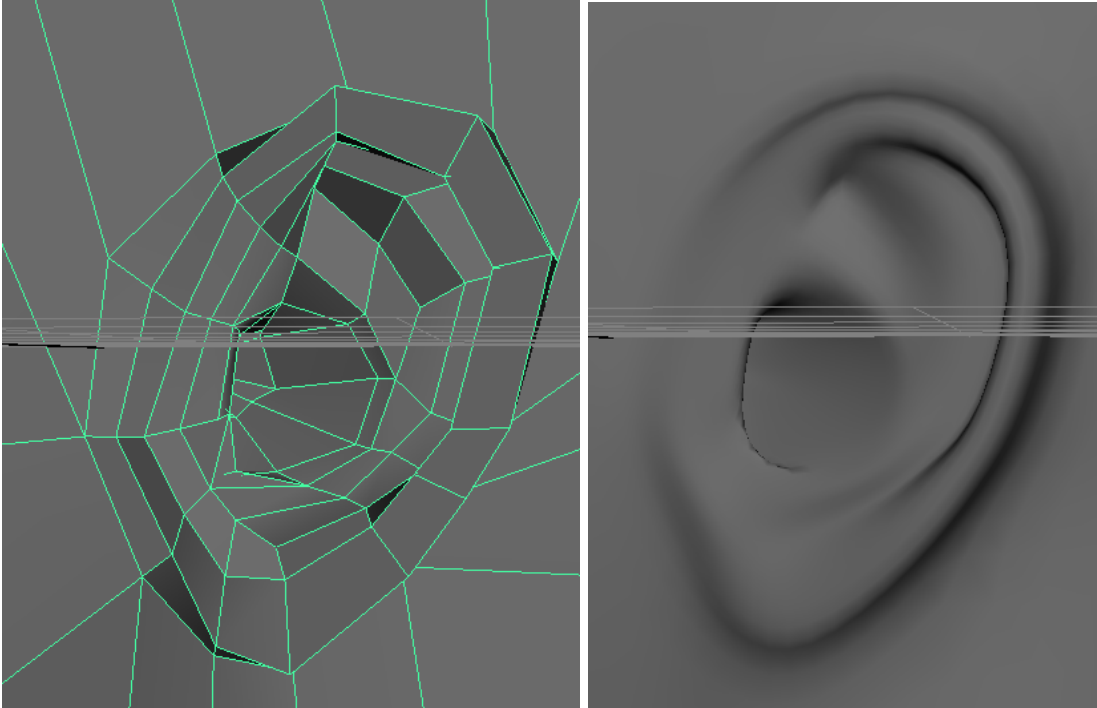
- Continue to shape and mold the ear according to the reference images. Pay attention to the intricate curves and bends of the ear and move your points around to reflect that.



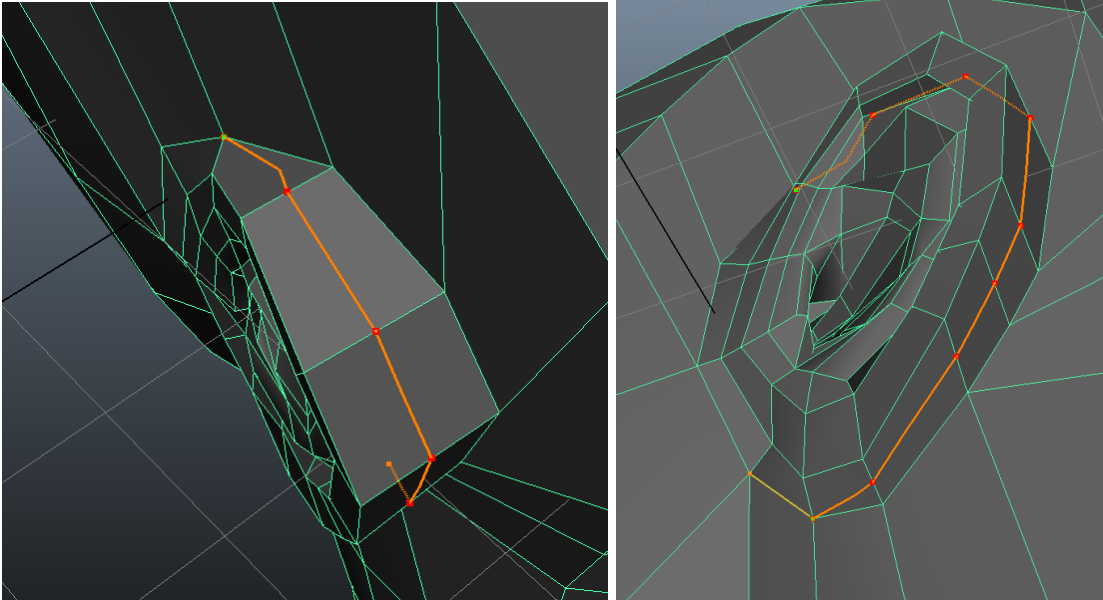
- Use the **Interactive Split Tool** to add the above edge and the **Delete Edge/Vertex Tool** to remove the edge in the second screenshot.



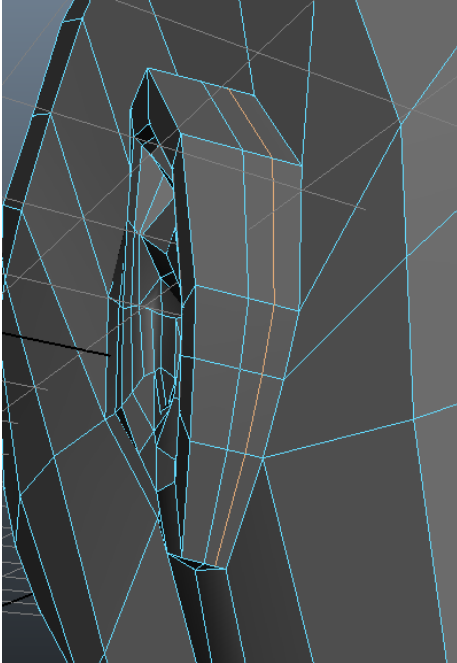
-This change in edge flow makes the transition area from outside the ear to inside look better when we reshape and then **Smooth Preview (3)** our mesh.



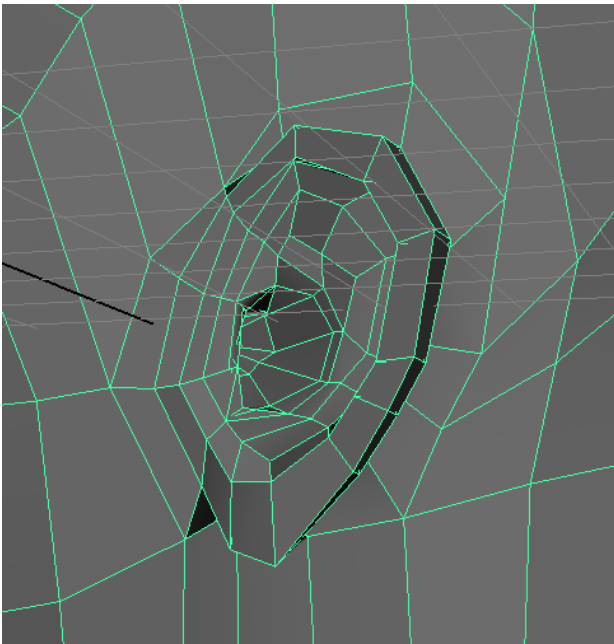
- Using our existing geometry, refine the area on the top of the ear where there is an indentation so that it matches the above screenshots. Little details like this really add to the realism of your finished model.



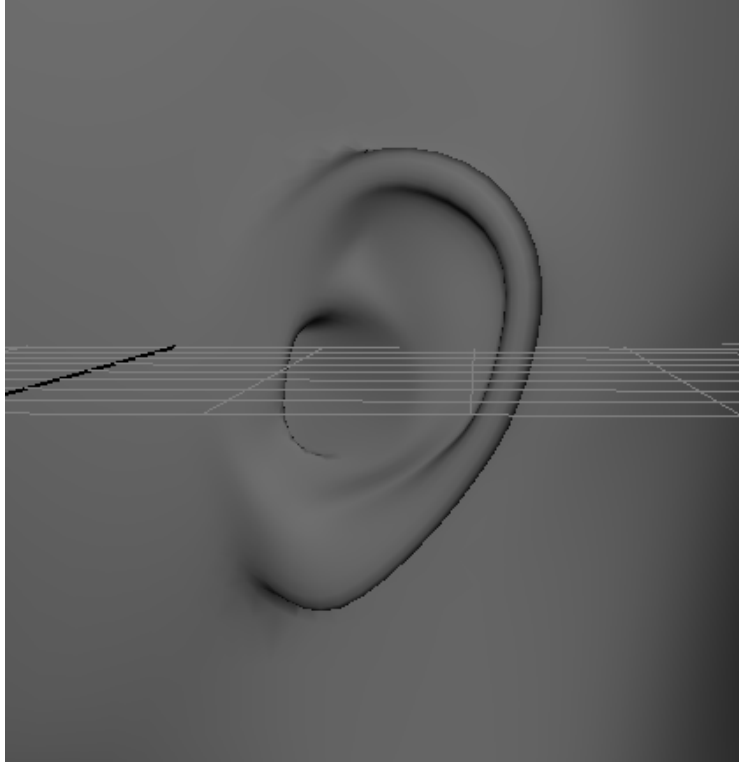
- Almost done with the ear! Add an extra loop with the **Interactive Split Tool** behind the ear.



- Behind that loop we just made, insert an additional edge loop with the **Insert Edge Loop Tool**.



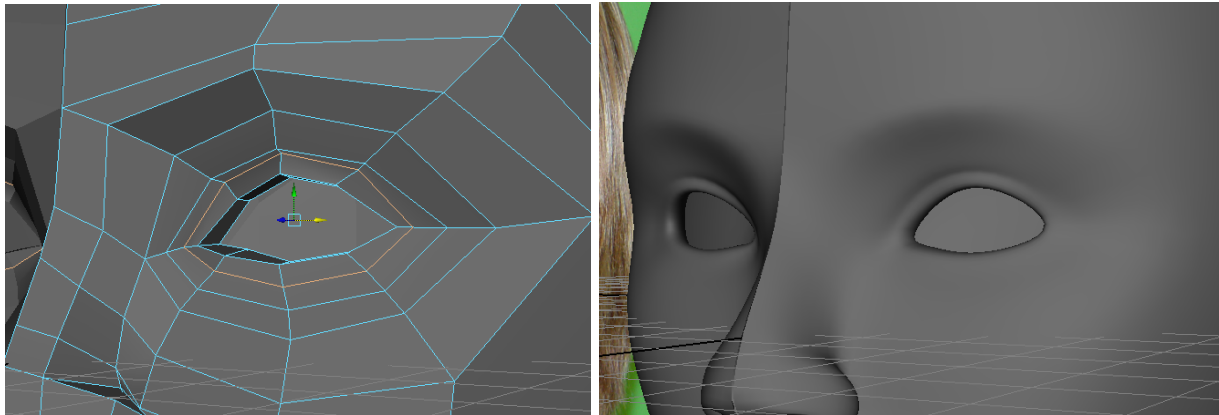
- Spread out the outer edge loop and pull in the next loop closer to the ear, tweaking and refining until you get an ear that finally sticks out from the side of the head.



- Hooray, we have finished the ear! A bit more detail and we'll be done with the head!

Adding Eye and Mouth Details

- Our eyes look pretty good, but they could add some more detail around the eyelids.

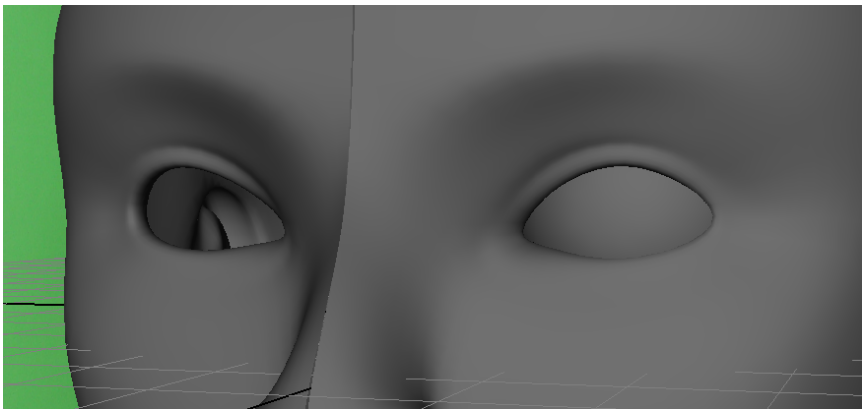
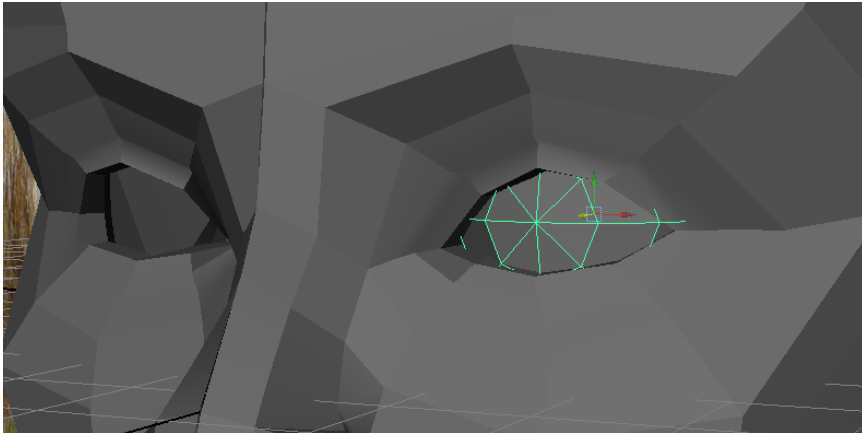


- Use the **Insert Edge Loop Tool** to add an extra loop around the eyes, and then tweak the vertices around the eyes and cheek so they look more natural.

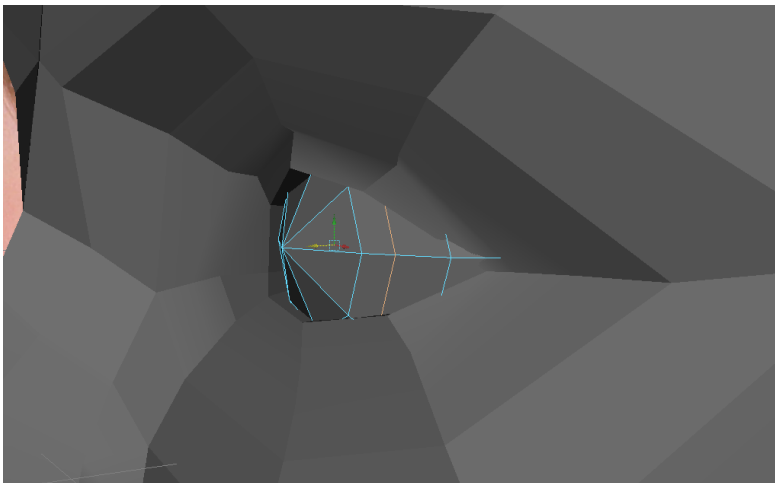
- There is a sharp crease around the top of the eyelid that smooths out closer to the edge of the eyes. The bottom of the eye is much smoother by comparison.

- Go to **Create > Polygon Primitives > Sphere (options box)** and create a sphere with

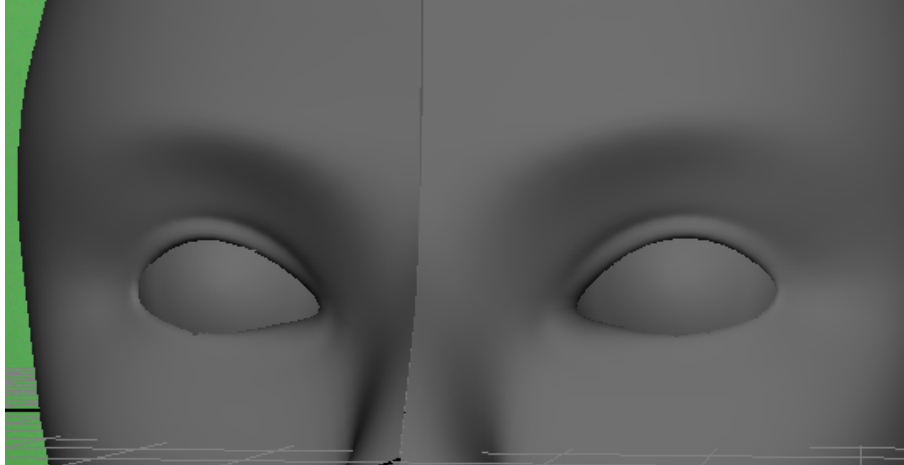
8 Axis & Height Subdivisions.



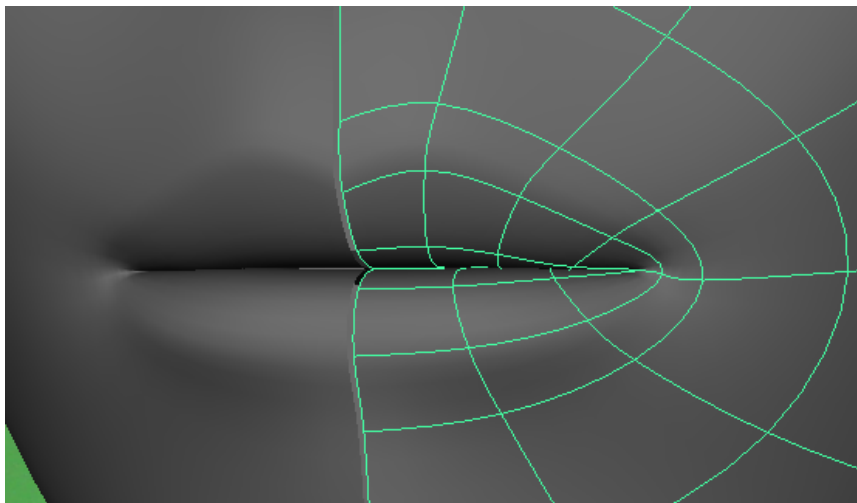
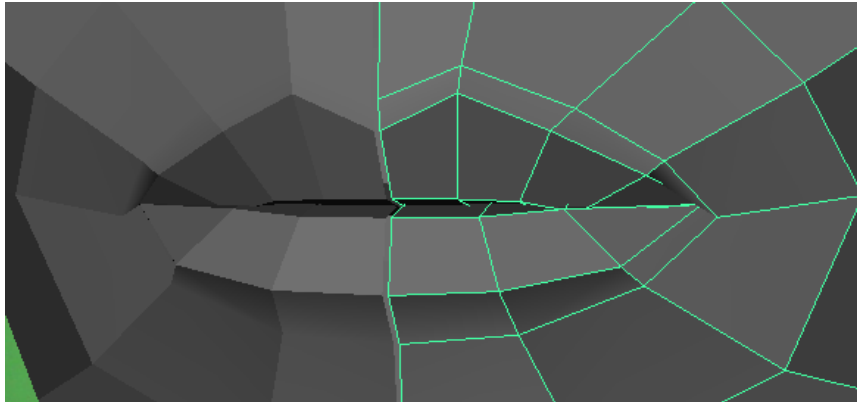
- **Move** and **Scale** it into place so that it rests in the eye socket. You will probably have to tweak the eye vertices a bit so that they match the shape of the eyeball.
- **Smooth Preview** (3) the eyes and face to see how far along we've come!



- To make the eyeball even more accurate, add an edge loop around the iris area and pull the center point out to model out the cornea.



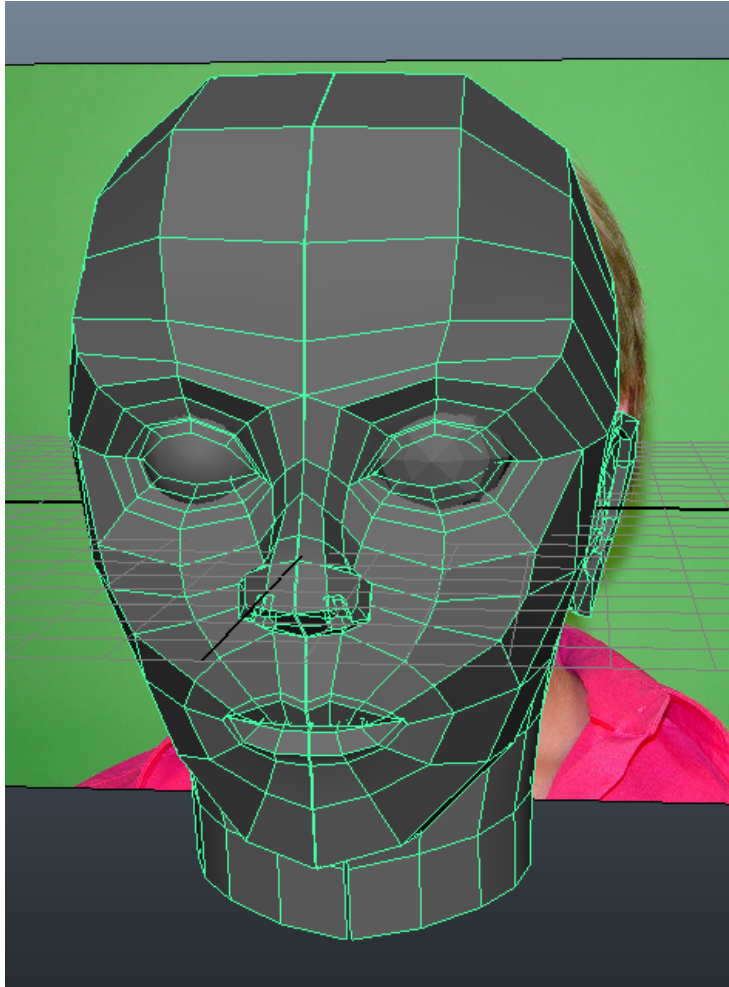
- **Select** the eyeball, **Group** it (Command+G), **Duplicate** the group (Command+D) and change the **Scale** of the new duplicate group to **-1** to mirror the eyeball across the **X-Axis** into the other eye socket.



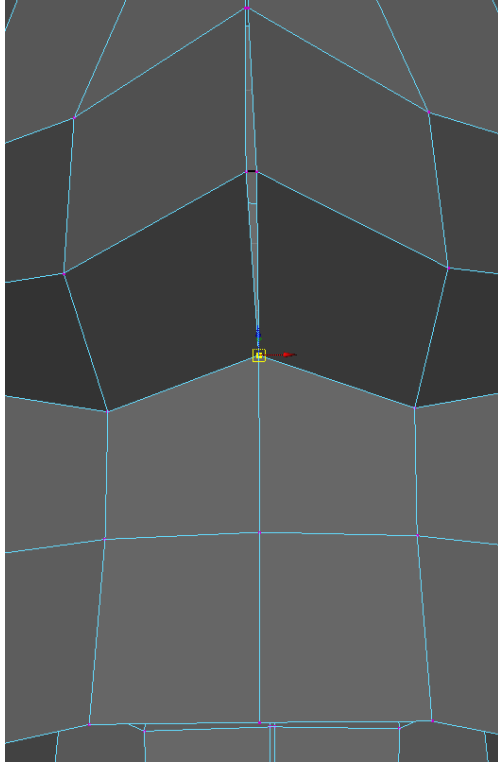
- If you haven't already, spend some extra time tweaking the mouth so that the lips are closed (since we're not modeling teeth in this tutorial) and the edges of the mouth are pinched in.

- Adjust any other areas of the head which might need work, such as the brow line, skull and neck shape.

Bringing the Two Sides Together



- Select both sides of the head and go to **Mesh > Combine** to unite them into a single, solid object.
- Now that our head is one solid object, transformations on one side of the head will not automatically be reflected to the other side. To enable reflection:
 - **Double click** on the **Move Tool** in the **Left Sidebar**, go down to **Reflection Settings** and turn on **Reflection** on the **X-Axis**.
 - Now, any changes made to one side of our mesh will be reflected to the other!



- To merge together the vertices along the seam going down the middle of the head, go to **Edit Mesh > Merge Vertex Tool (options box)**:
 - Using this tool, **Left click** on one vertex and drag it to another to merge the two vertices into one when you release the mouse.
 - Vertices will appear **Red** when you hover over them.
 - This tool has two settings:
 - **Merge to Target Vertex**: The first vertex selected is merged to the second selected.
 - **Merge to Center**: Both vertices are merged together.
- Set the **Merge Vertex Tool** to **Center** and merge all of the center vertices together so that our mesh is one solid object.



- Continue to refine and add detail as you see fit, using all of the tools I've shown you.
- Congratulations, we've finished the head tutorial! Feel free to add in extra details yourself, such as:
 - **Eyelashes:** Go to **Create > Polygon Primitives > Cylinder** and create a bunch of tiny cylinders to represent the eyelashes
 - **Eyebrows:** Create a **Cube Polygon Primitive** with a few divisions and **Move** the vertices around to match the reference.
 - **Hair:** **Extrude** out the top of the head, **Move** the polygons around and add loops as you see fit.
 - Maya has a built in fur and hair effects engine which is worth looking into as well, though it will not be covered in this tutorial.
- Check out my other tutorials if you want to take your models and add color, texture, lighting and render out images of them!