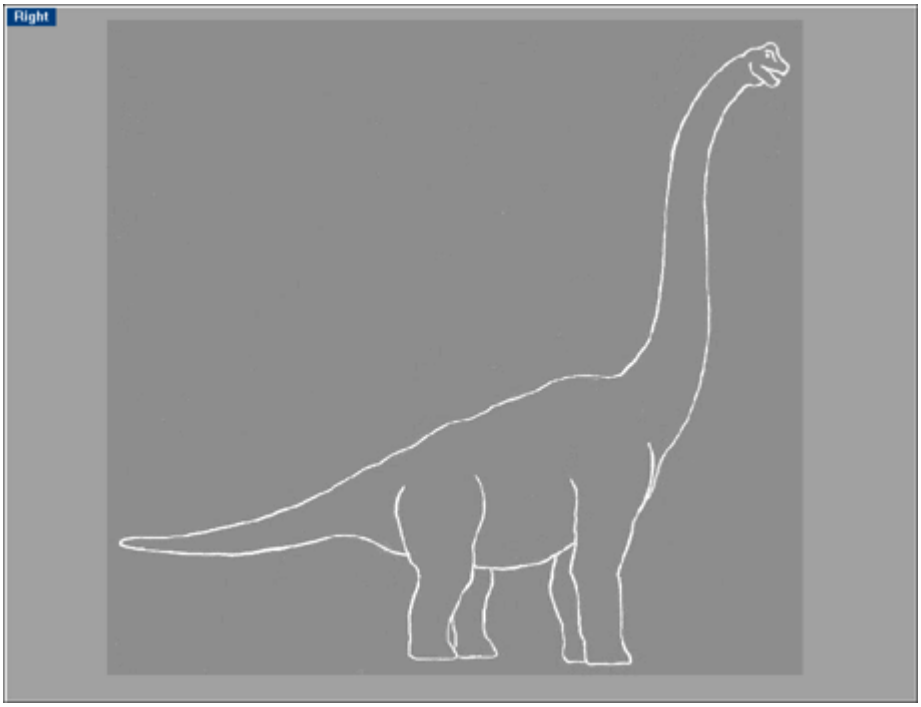
Modeled & Rendered by Daniel Ljunggren

Modeling a Brachiosaurus

By Daniel Ljunggren

This tutorial is the most basic and easy-to-follow in Secrets of Rhinoceros, but it is still recommended that you have some experience with Rhinoceros before attempting it. The tutorials that come with Rhinoceros and information in the Rhinoceros manual are the best starting point for beginners who are new to the program. This tutorial describes how to build a Brachiosaurus in Rhinoceros, to produce models that could be used in a rendering as shown above. The tutorial includes a reference image to trace over, and sample files showing intermediate and final versions of the model, so it should be easy to follow. Please allow two hours to complete this tutorial.

As visual reference for this tutorial, load a picture of a Brachiosaurus, **`Brachio.jpg`** from the dino directory of the CD-ROM. Place the image in the Right viewport with the 'PlaceBackgroundBitmap' command. Place the 'First corner' in the top right of the viewport and the 'Second corner or length' as close as the bottom of the viewport as possible. Then move it ('MoveBackgroundBitmap' command) to the middle of the viewport, positioned as shown below. If you have a grid visible in the right viewpoint, hide it with command 'ShowGrid.' (You can just type ShowGrid at the command prompt and press enter.)



Using the picture as reference, draw an outline of the body of the Brachiosaurus. (Do not trace the legs and head for now - they will be modeled separately later.) Double-click on the viewport title of the Right viewport to maximize it, and draw two curves (InterpCrv command) of the outlines of the dinosaur as shown below.

Use the command PtOn to see the CV's. (CV stands for Control Vertex, which are also called Control Points.)

For the sake of efficiency, try to use as few CV's as possible. Even if you like to draw a curve in a very detailed way, you can still come back and delete any points which seem as if they can be deleted without loss of detail. Often you may need to move points after you've drawn them, in order to best define the shape with a small point count.

Open the Osnap dialog box by clicking on the "Osnap" panel in the status bar at the bottom of the screen. To have the curves snapped to each other at the tail end, use the Object Snap 'End.'

Uncheck the snap when editing the CV's.

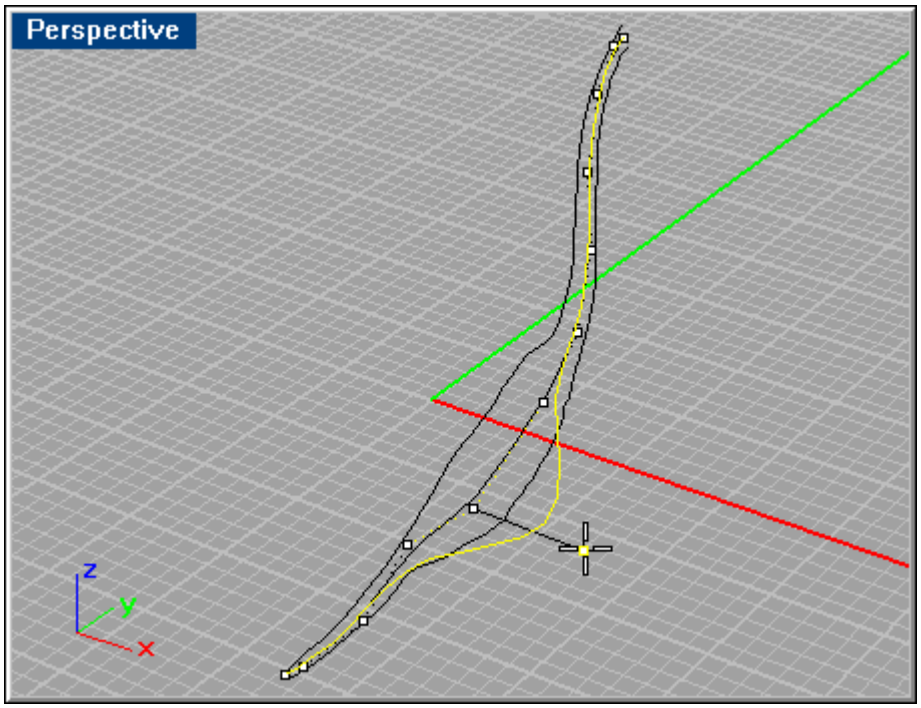
NOTE: There's a slighly faster way to use the end osnap, without calling up the full dialog box. Just type "e" and then push the space bar to activate a "one-shot:" object snap where the endpoint object snap will only be in effect for that single next point pick, and then will automatically turn off.

The outline curves of the dino are only two-dimensional. A middle curve of the dino will become the first three-dimensional cross-section curve, beginning to define the dino's side.

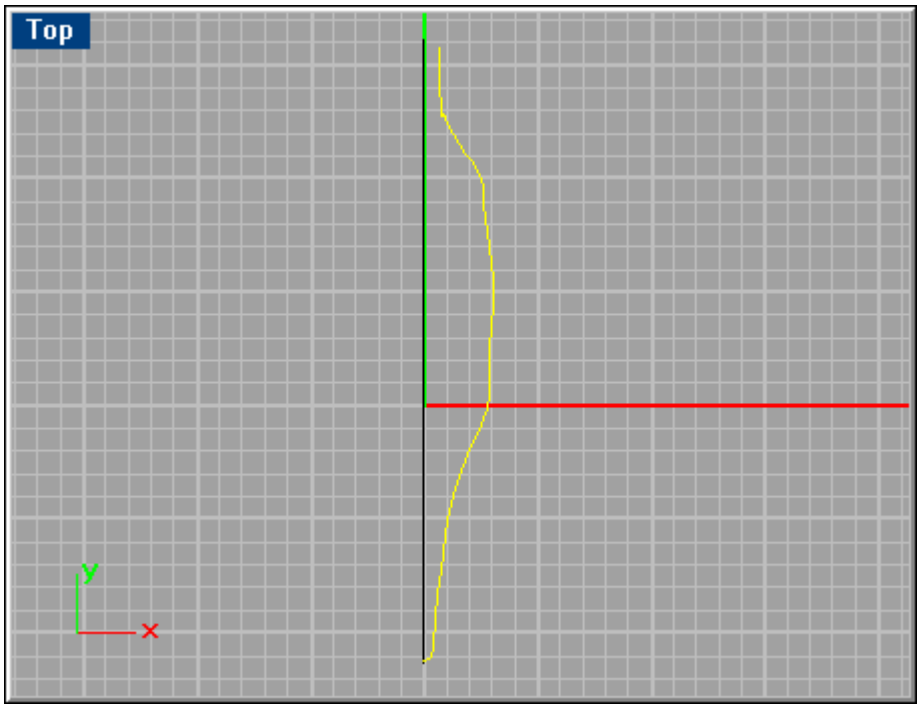
Make sure 'End' Object Snap is on when making the start of the curve at the tail end. Using only the Right view, draw a middle curve something like this:

This middle curve still needs to be pulled outwards, to gain depth along the X axis. Select the middle curve, make the CV's (Control Vertices, also known as Control Points) visible with PtOn,

and move CV's out from the middle as shown below. (To move points in Perspective viewport in one axis, hold Shift button as you move.)

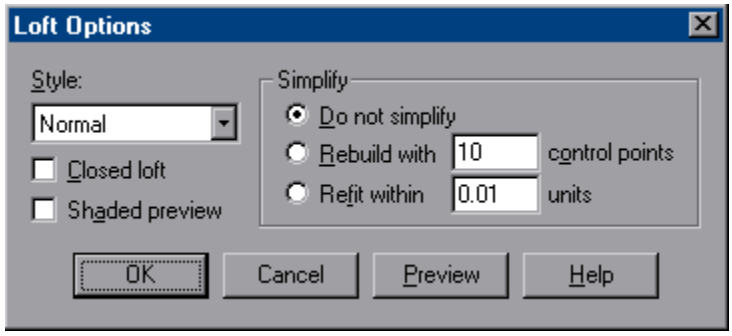


Continue the fine-tuning of the middle curve from the Top viewport. In this step you might need to add some points ('InsertKnot' command) to get a satisfying result. When finished it should look close to this:



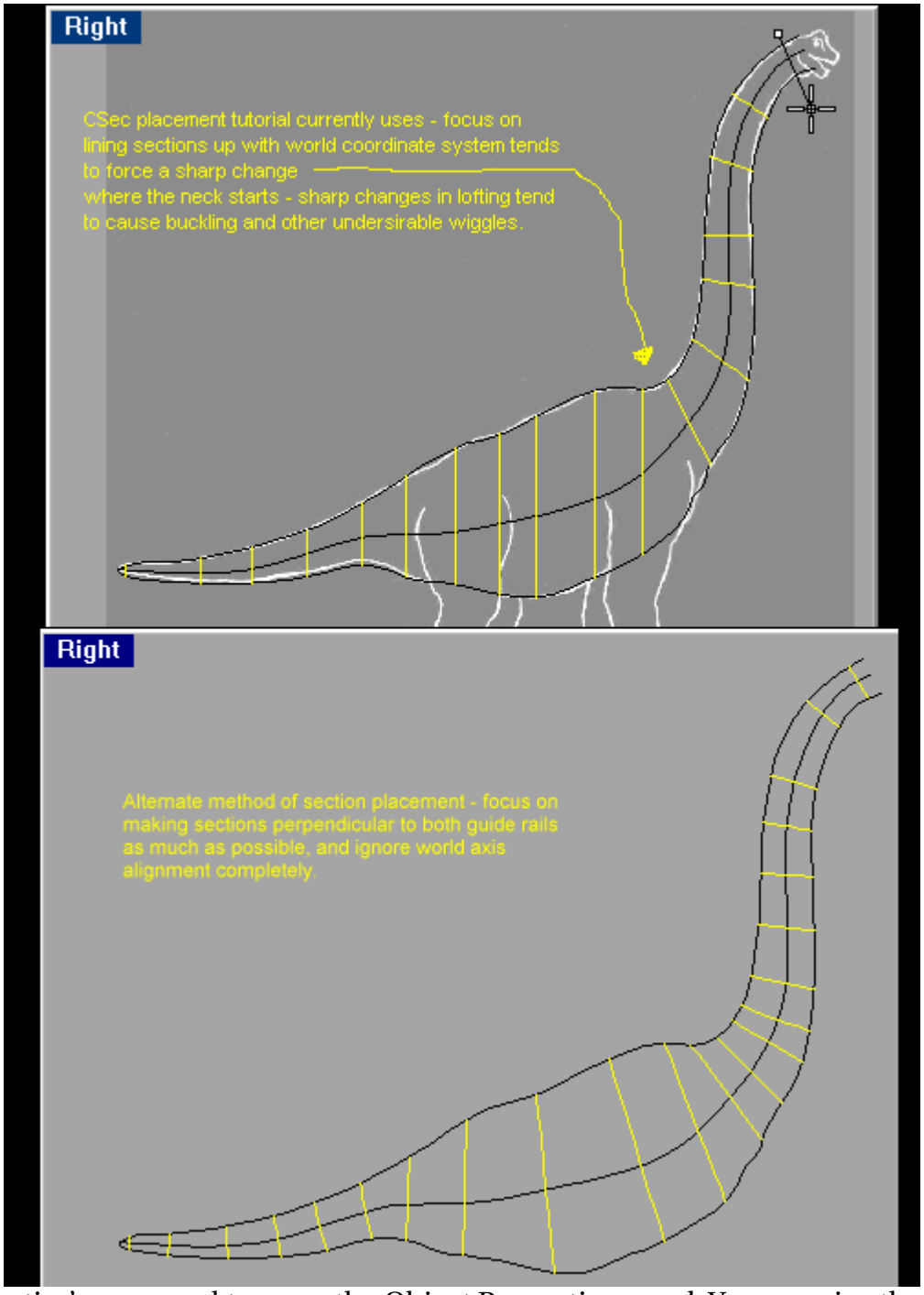
Maximize the Right viewport, and use the command 'CSec' to get profile curves out of the three curves. When prompted, select the curves in order, from top to bottom, and hit Enter, type C and push enter to toggle the Closed option to read Closed=No, and begin drawing the curves as seen below. (The result should be similar to the sample file 'Brachio1.3dm' from the CD-ROM).

Now you have the curves for a rough shape of the dinosaur body. The curves automatically stay selected after the CSec command, so you can use ‘Loft’ to skin them together. Execute the 'Loft' command, and in the ‘Loft options’ panel use the default settings, and hit OK.

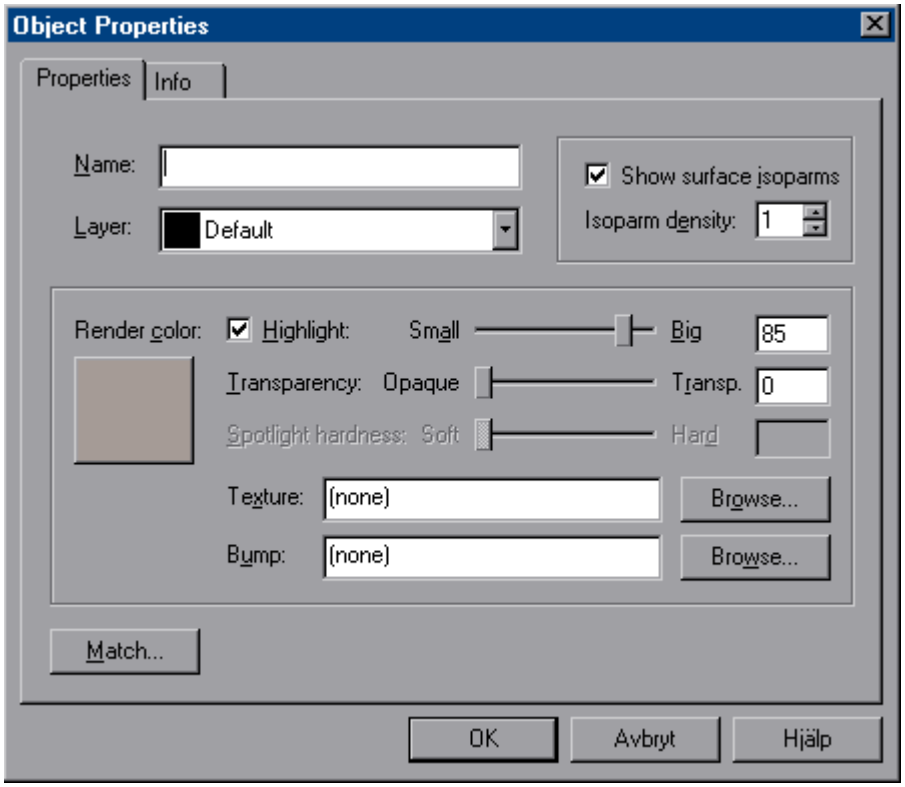


Optional Notes:

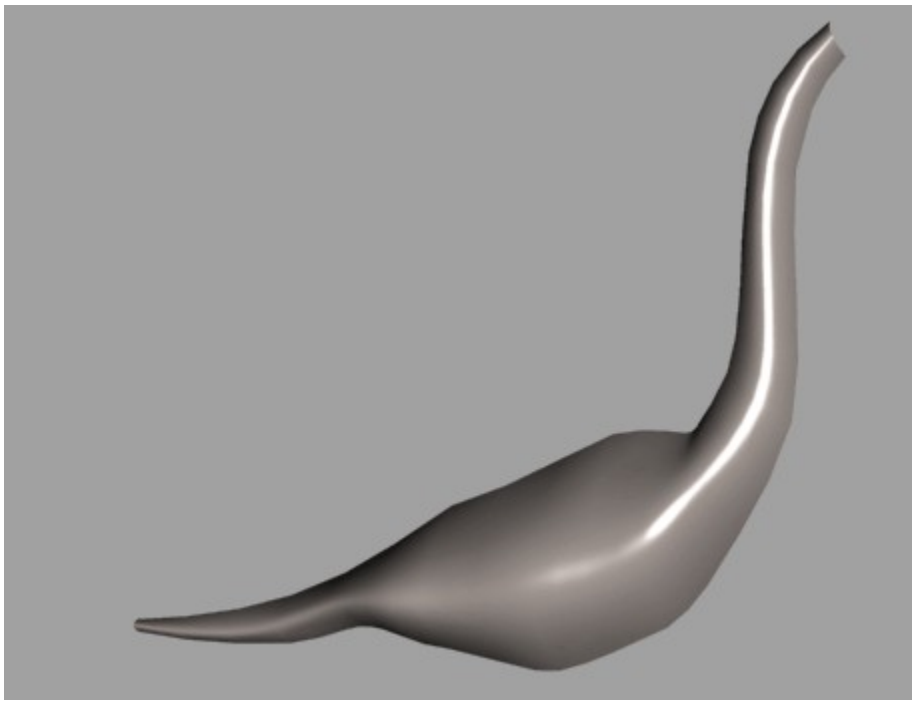
Michael Gibson (one of the original Rhino developers) volunteered the following comments about optimizing the use of CSec after he read this tutorial. We are grateful to Michael for all of his feedback, some of which appears in the edited text of the tutorial.



Use the 'Properties' command to open the Object Properties panel. You can give the surface an appropriate color and highlight as seen below, or pick any other color you like.

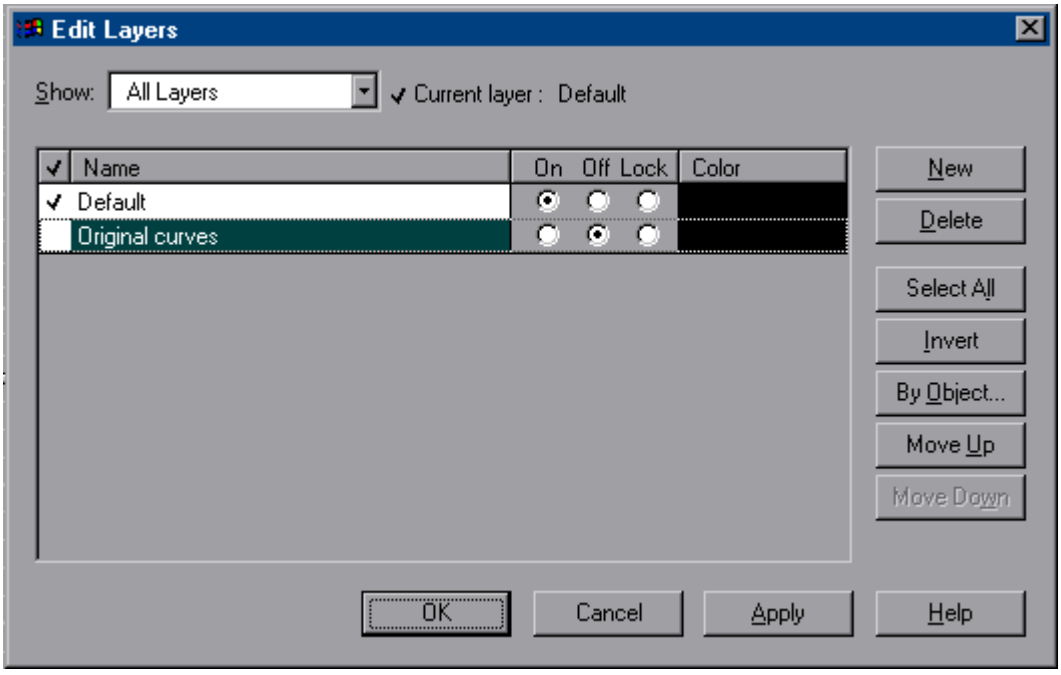


Render the dino to see what the body looks like so far:

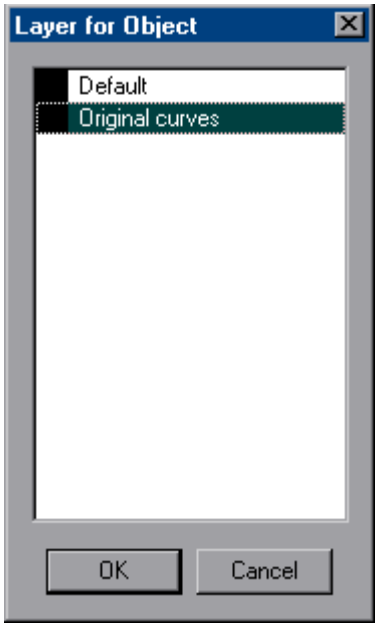


You can see that the shape of the surface is not round enough, and will need some more work. Before editing the surface, your scene can be made more manageable by putting the different objects into different layers. Use the 'Layer' command to see the layer panel.

In the Edit Layers panel, choose 'New', name the new layer to 'Original curves', and set it to 'Off.' Click OK.



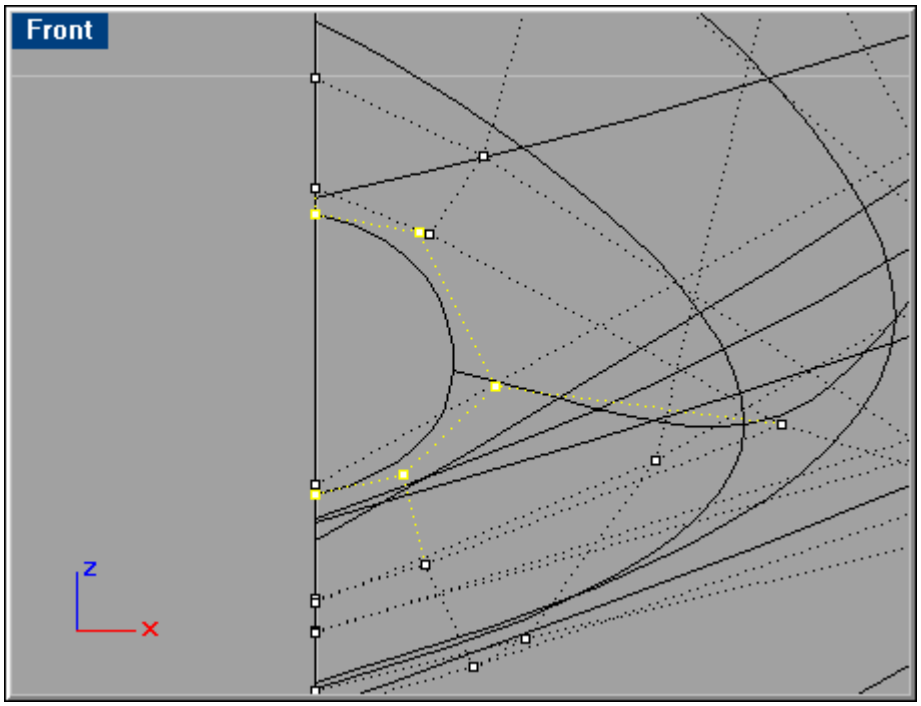
Select all the curves in the scene with 'SelCrv', and then use 'ChangeLayer'. Choose the 'Original curves' and the curves are moved into that layer and disappear from viewports (because the layer is set to Off.)



Now the surface can be edited by itself, without any risk of accidentally selecting the original curves. Putting curves away into another layer is preferable to deleting them, because you always might need construction curves again in unexpected revisions to a project, or in starting other models or projects.

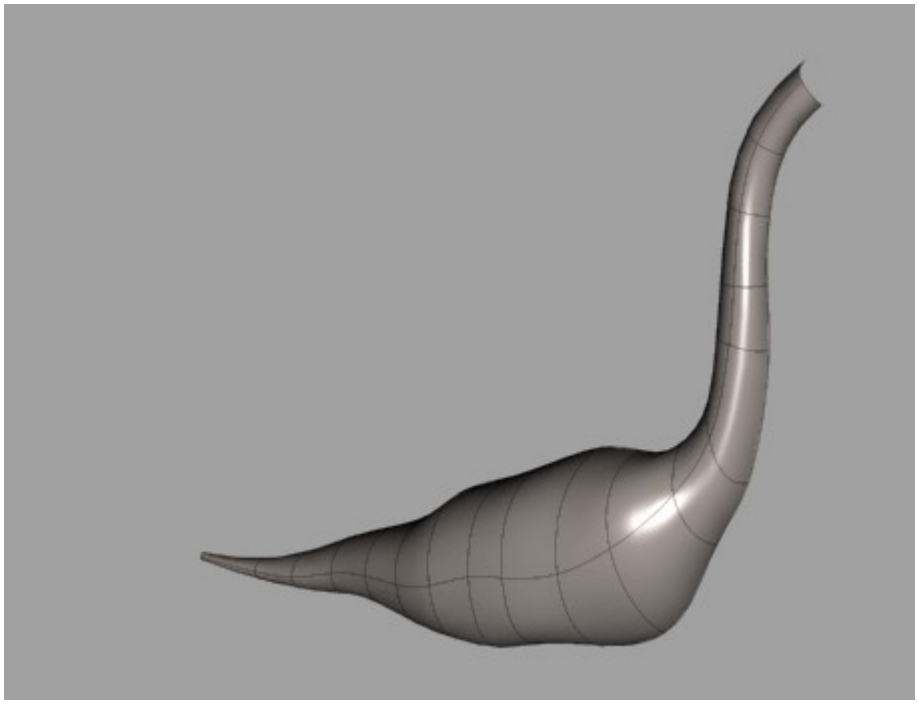
In order to make the current body surface rounder (and more "Brachiosaurus-like"), you need to move the outer row of CV's. Use DynamicShadingPerspective to see a shaded surface in Perspective viewport as you are editing. In the front viewport, zoom in on the end and move the CV's until the surface looks more round, basically that means moving the CV's until the cross sections looks like half of a circle for the tail and neck (the figure below shows the first curve rounded) and almost as round in the torso area. When moving CV's in the neck area, use the Top viewport, and view your results in the Perspective viewport so you can get a good look on the

surface from different angles. (NOTE: Don't move any of the outer rows of CV's off the central axis, because you will need to mirror the surface in order to make the full body later on).



The first cross section modified to a more rounded look, compared to the larger ones behind.

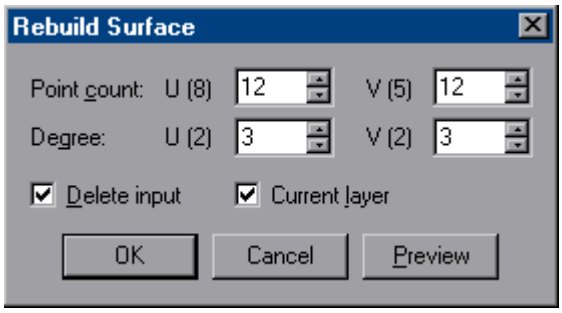
The figure below shows what it should look like after the CV manipulation. After this step, your scene should be similar to the sample file 'brachio2.3dm' from the CD-ROM. (Show here with render wireframe activated.)



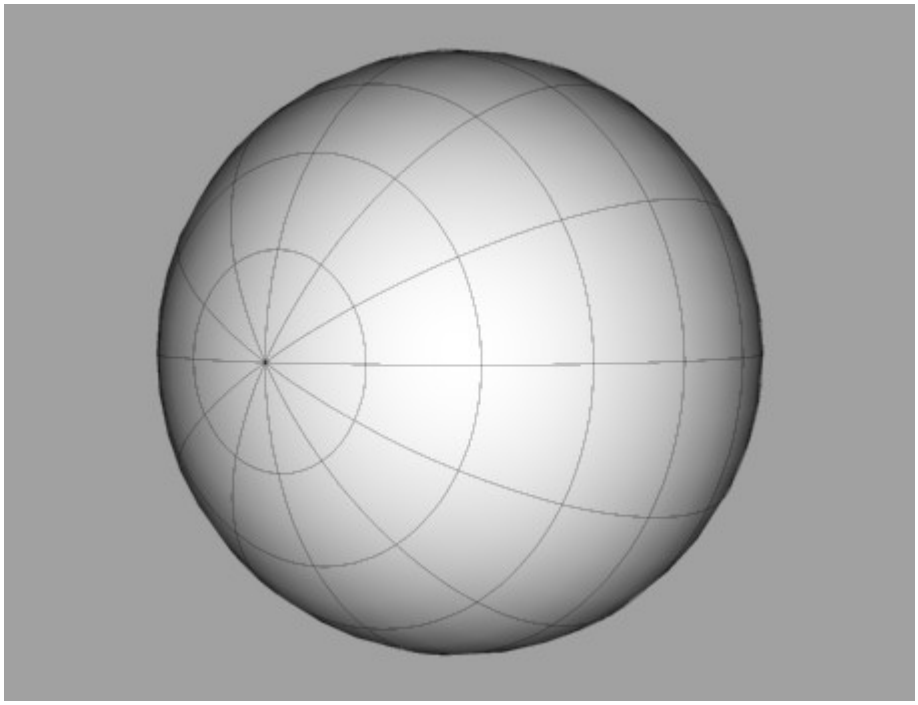
To start building a head, begin with nothing else visible: Create a new layer called Body surface, and check 'Off' to make it hidden. Change the body surface to this layer (as was done with the curves on Page 4.). Hide the background in the Right viewport with 'HideBackgroundBitmap' command.

Make a sphere ('Sphere' command) in the Front viewport about the center of the axis.

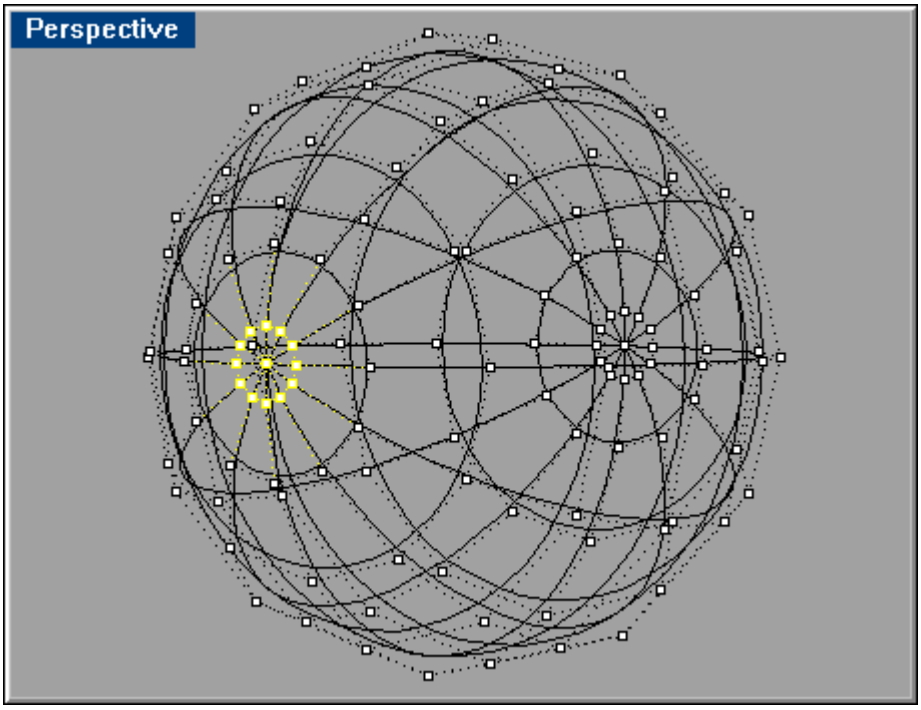
To make the sphere more dense, use the ‘RebuildSrf’ command, and in the ‘Rebuild Surface’ dialog box use a point count of 12 in both directions. This will give you enough points to squash, manipulate, and reshape the surface by dragging selected CV's.



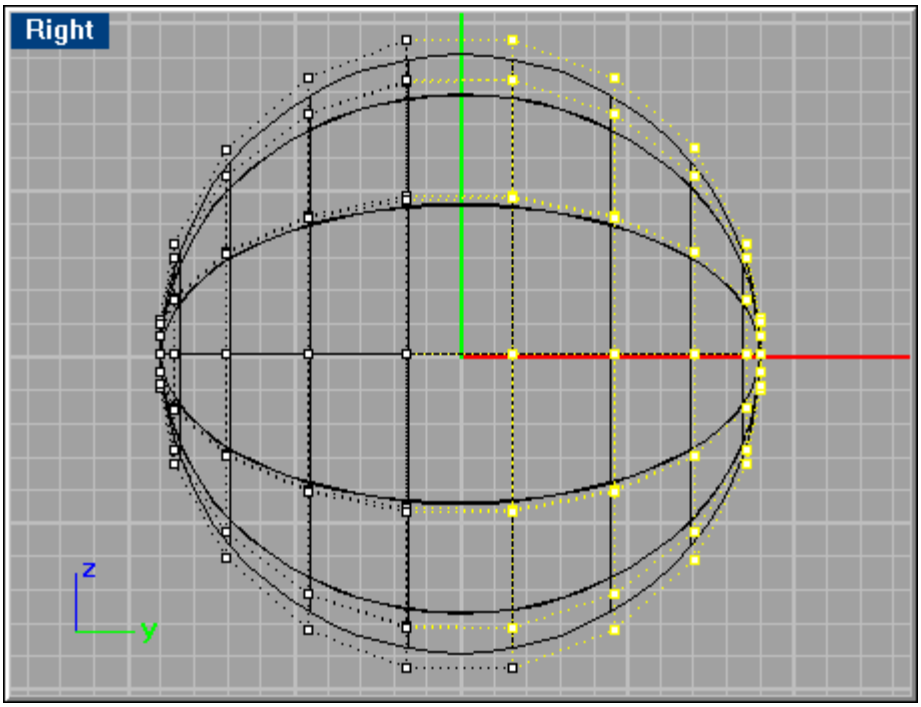
Rotate the sphere so the left end (seen from the Right viewport) is facing you in the Perspective viewport as shown below.



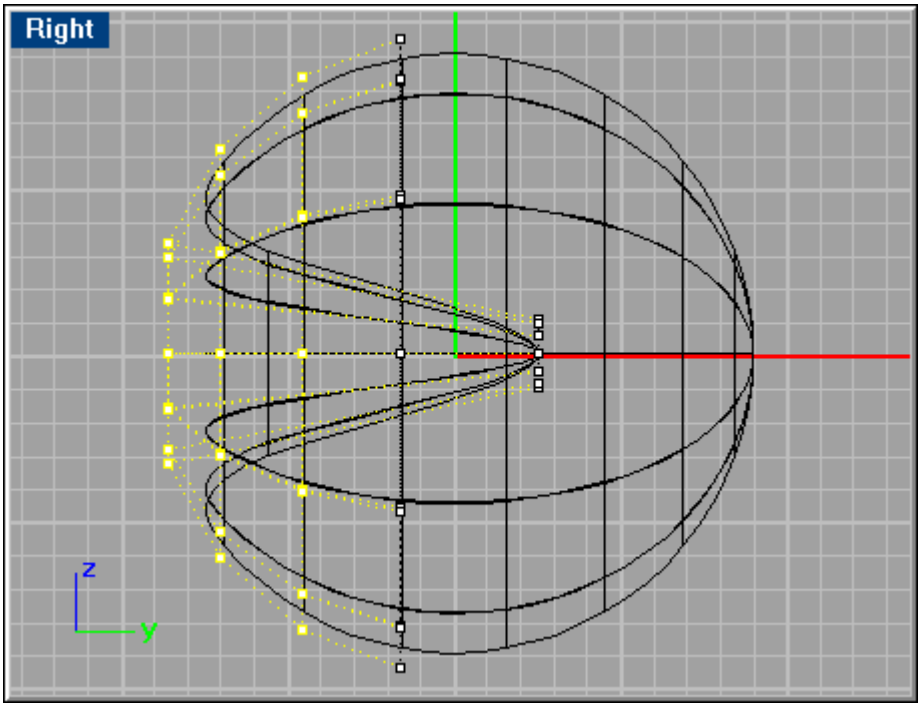
Make the CV’s visible with ‘PtOn’ and in the Right Viewport. As shown below, select the CV’s in the middle and pull them inwards as a start for the basic shape of the mouth. Use ‘DynamicShadingPerspective’ to see the shading while editing.



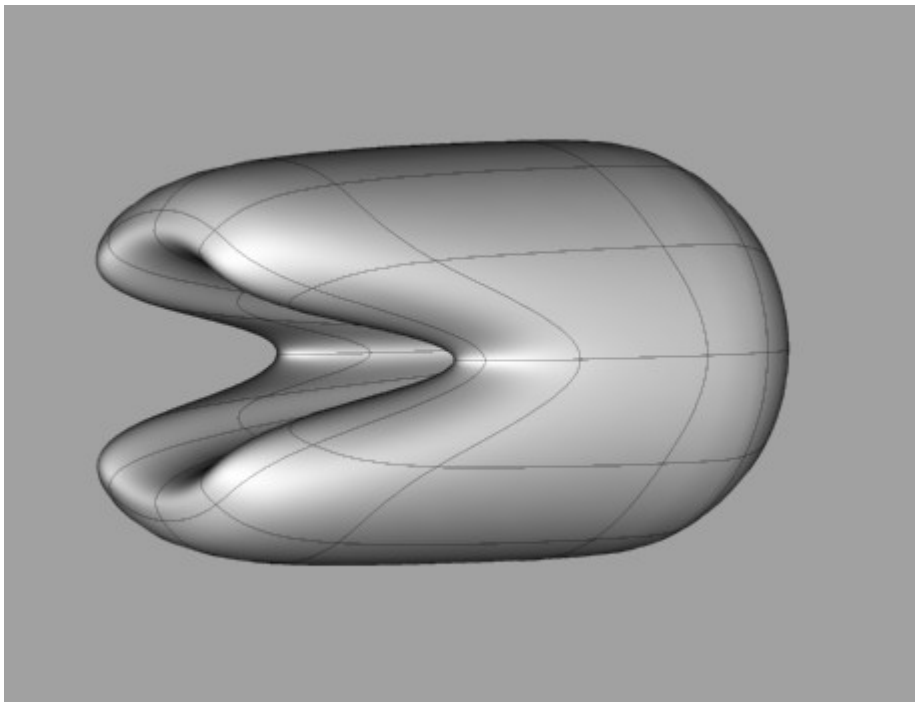
To make editing easier, select the CV's shown below, and use 'HidePt' command to hide the selection of CV's. This will reduce the amount of visual clutter on the screen, and reduce the risk of accidentally picking points on the back of the surface when you are trying to pick points in the front.



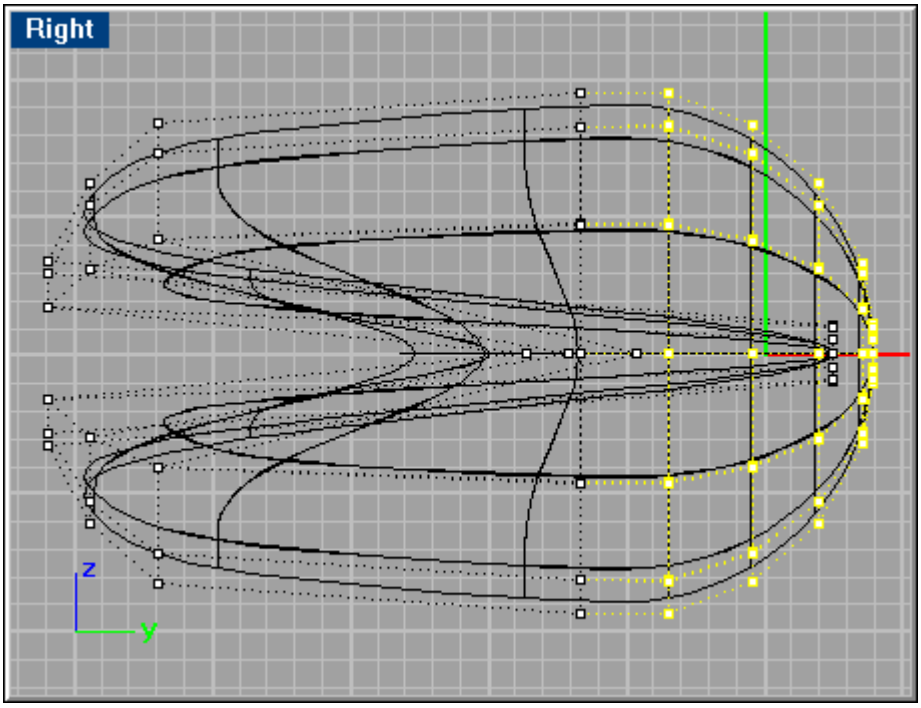
Select the CV's shown here:



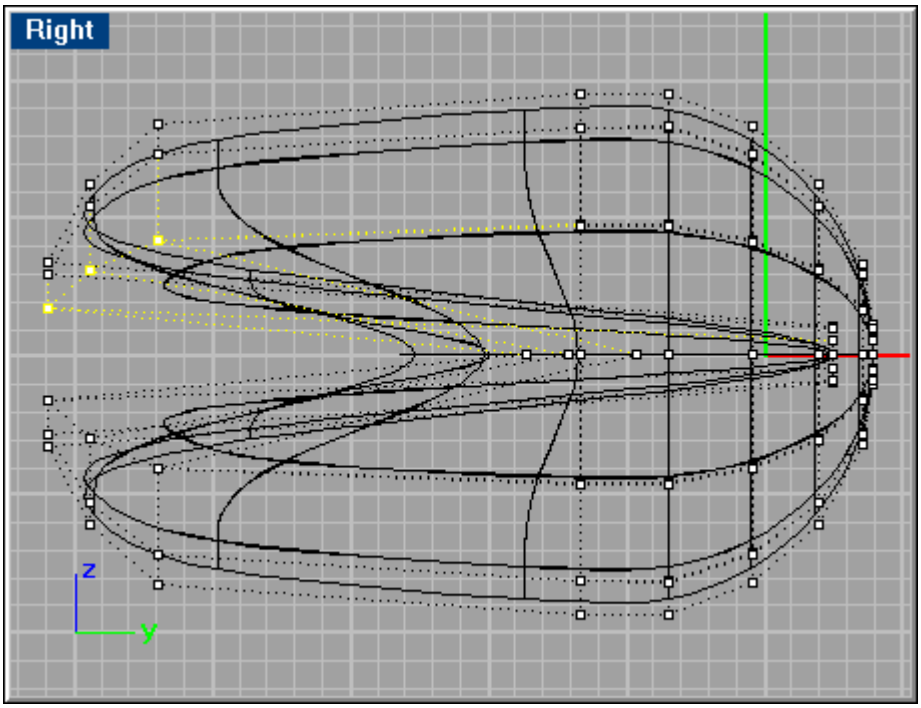
Move the selected points outwards to make the shape of the jaws:



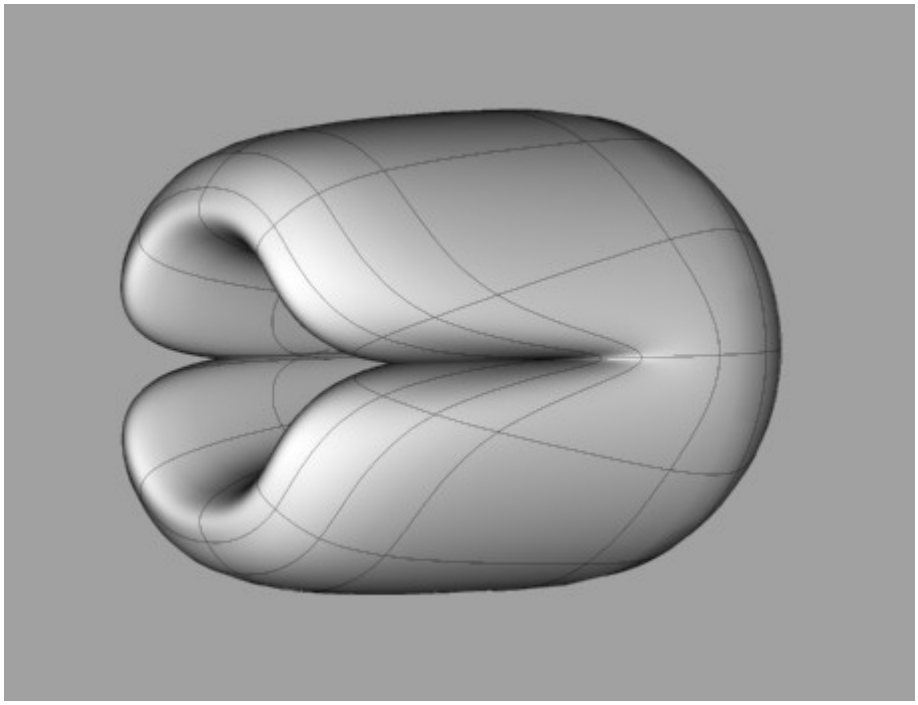
Make the hidden CV's visible again with 'ShowPt' command, select them along with the CV's of the jaws that weren't moved, and move them to the left (seen from the Right viewport) so the back of the head becomes shorter relative to the overall shape:



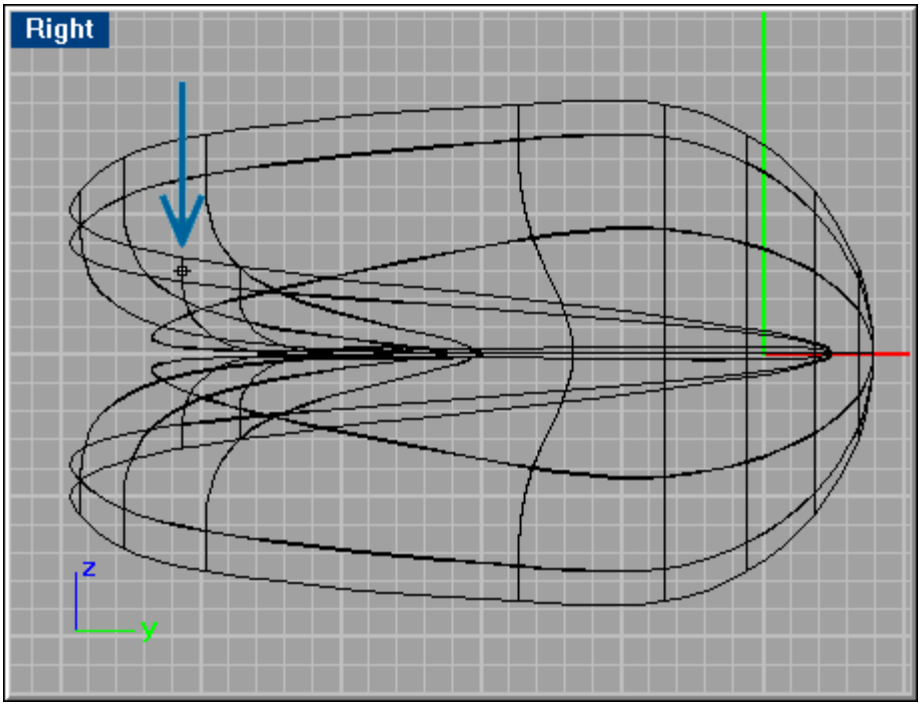
The jaws are wide open, therefore select the CV's highlighted below, and pull them down.



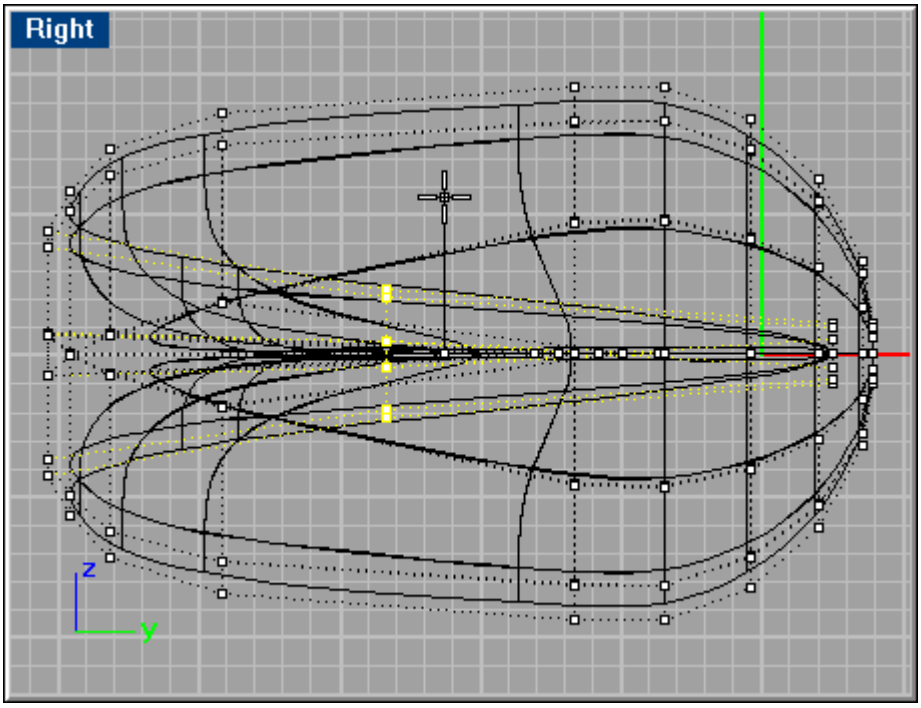
Select the CV's on the lower jaw equivalent to the ones on the upper jaw and move those up. The result (shown below) should be similar to the sample file 'brachio3.3dm' from the CD-ROM.



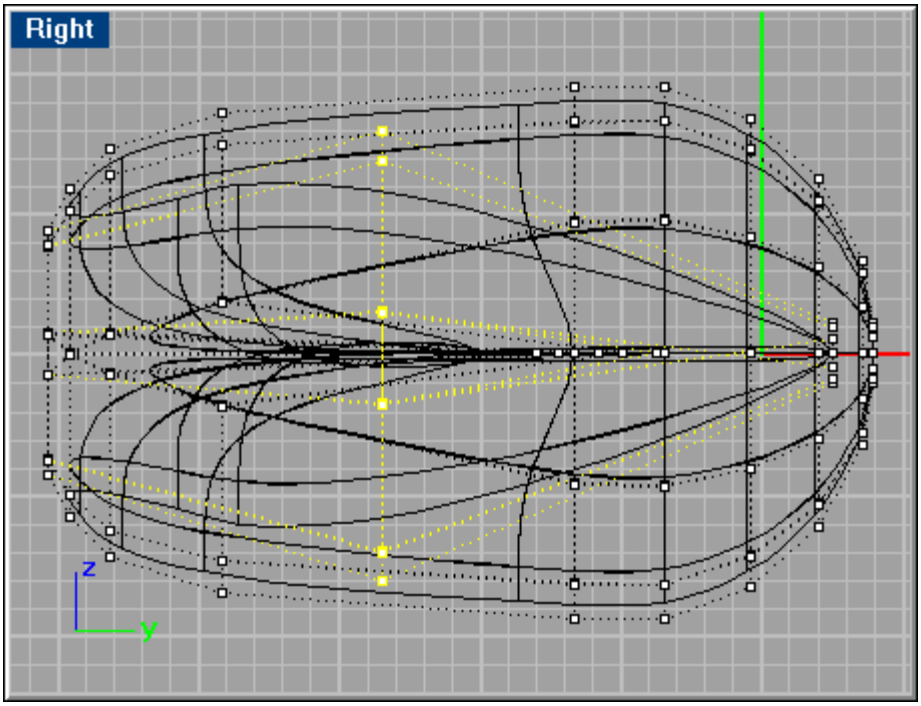
To help better define the mouth shape, an extra isoparm needs to be inserted close to the mouth opening. Use ‘InsertKnot’ command in the Front viewport, enter U to choose the U direction, and place the isoparm as shown below. (The two directions of the isoparms on a sphere, U and V, are similar to latitude and longitude. Selecting U is important if you are making a curve that will run around the head instead of end-to-end.)



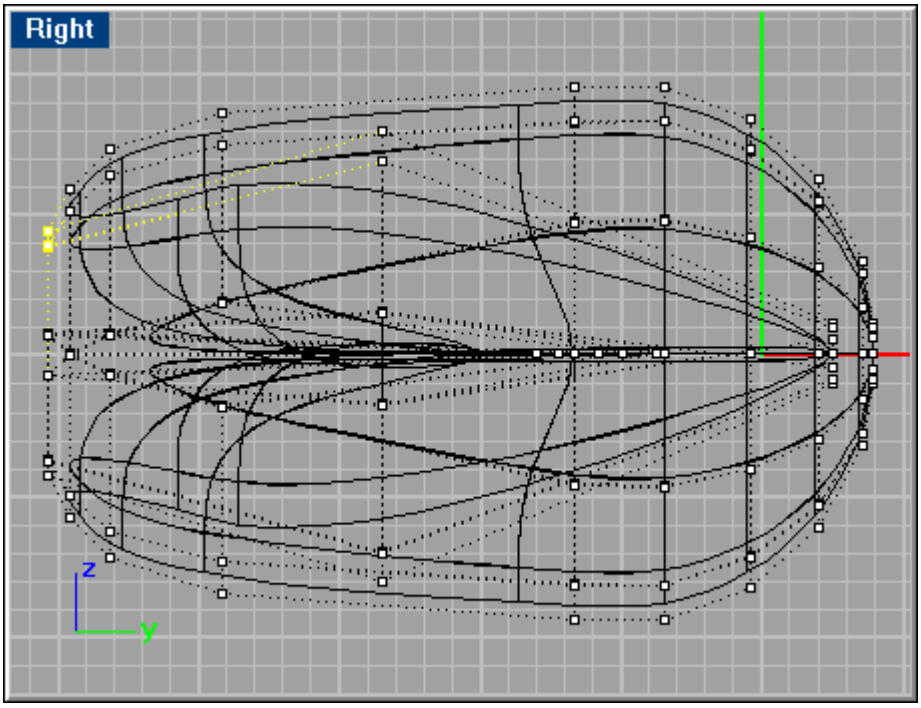
Select the CV’s that were created and in the Right viewport use ‘Scale1D’ command. For ‘Origin point’, place the marker in the center of the head, and then place the ‘First reference point’ as shown below.



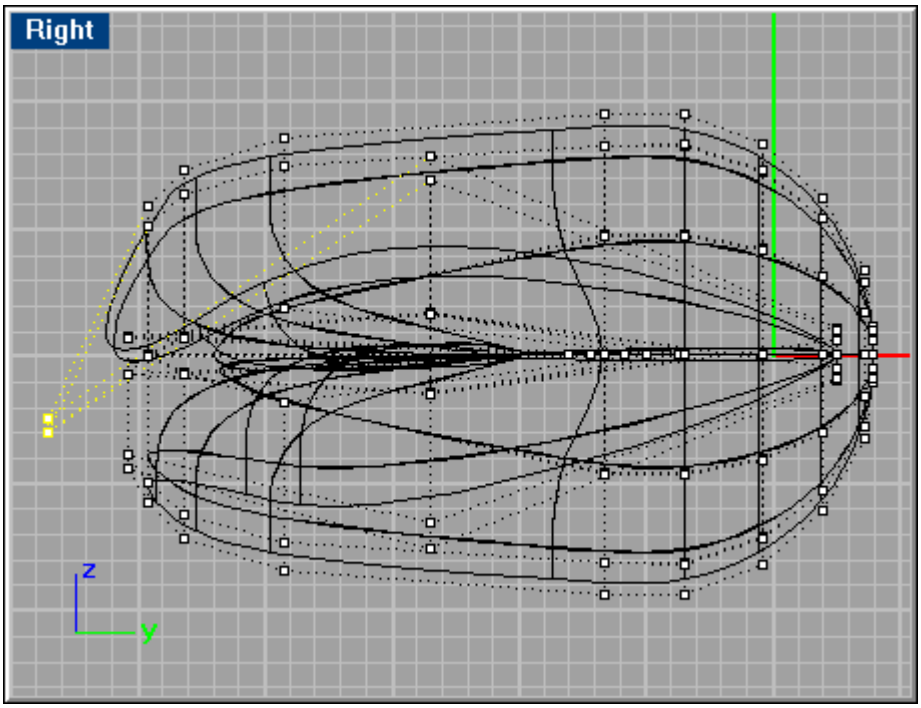
Move the marker up (hold Shift for a straight line) until the space in the mouth has been scaled taller, as shown below.



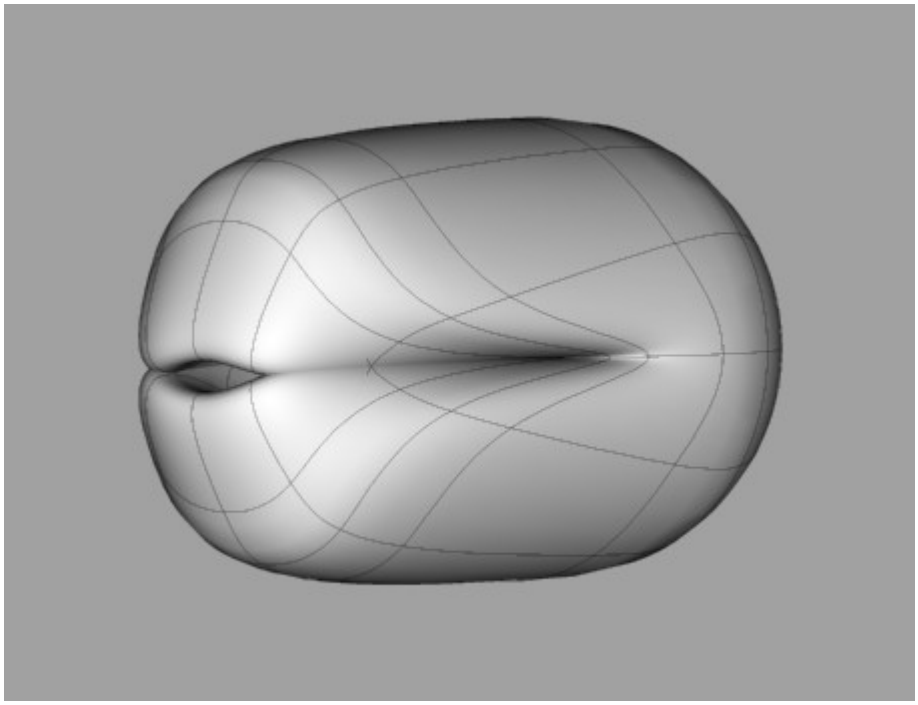
In order to close the opening in the front of the mouth, select the CV's shown below and pull them downwards (use 'DynamicShadingPerspective' to help better view your work).



In the Right viewport, move the CVs to the left to achieve a more rounded end of the mouth.



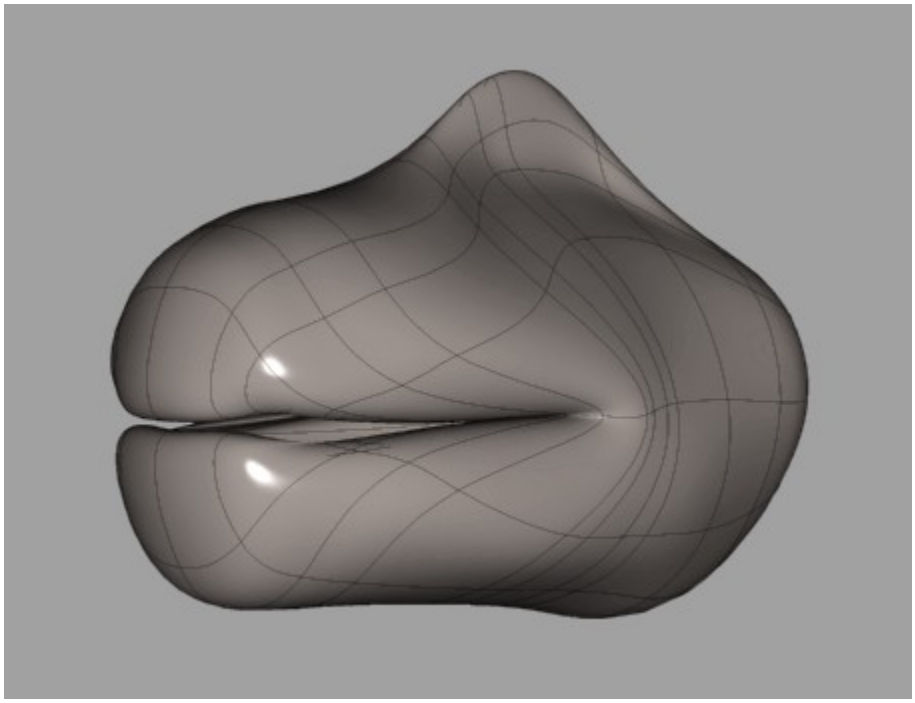
Do the same with the equivalent CV's in the lower jaw, so you get the results something like this:



OPTIONAL: You may wish to edit the shape of the head by inserting more isoparms and dragging them to add extra detail, such as a ridge along the top of the head. How many, or how few, small details you add is really up to you. In modeling creatures that will be animated or rendered in other software, you may be able to add more detail later via texture mapping, bump mapping, or displacement mapping, so that you render realistic creatures while sticking with relatively simple geometry. Simpler geometry is usually easier to edit or animate than surfaces with large numbers of isoparms.

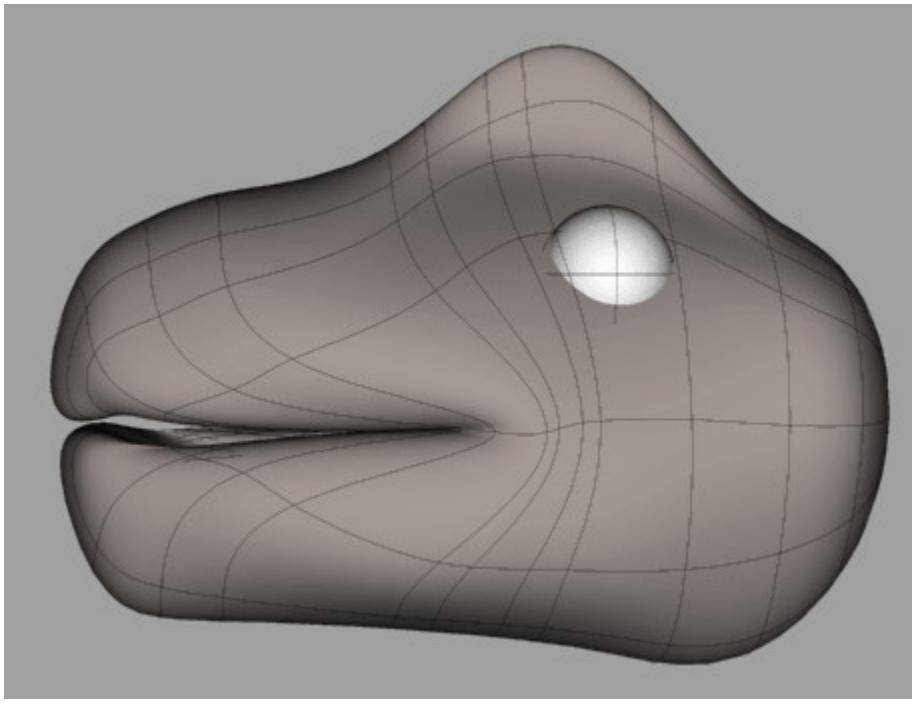
Use 'DynamicShadingPerspective' when editing CV's. Insert isoparms in areas where you can't get enough detail you want with the current number of isoparms. It is up to you how you want your head to look, so move CVs and insert isoparms as you see fit to customize and improve the modeling of the head. If you want to add a ridge along the top of the head, you will probably want to insert at least 2 or 3 isoparms near the back of the head, and then show points and drag them upwards.

The sample file 'brachio4.3dm' from the CD-ROM shows a head modified after this step.

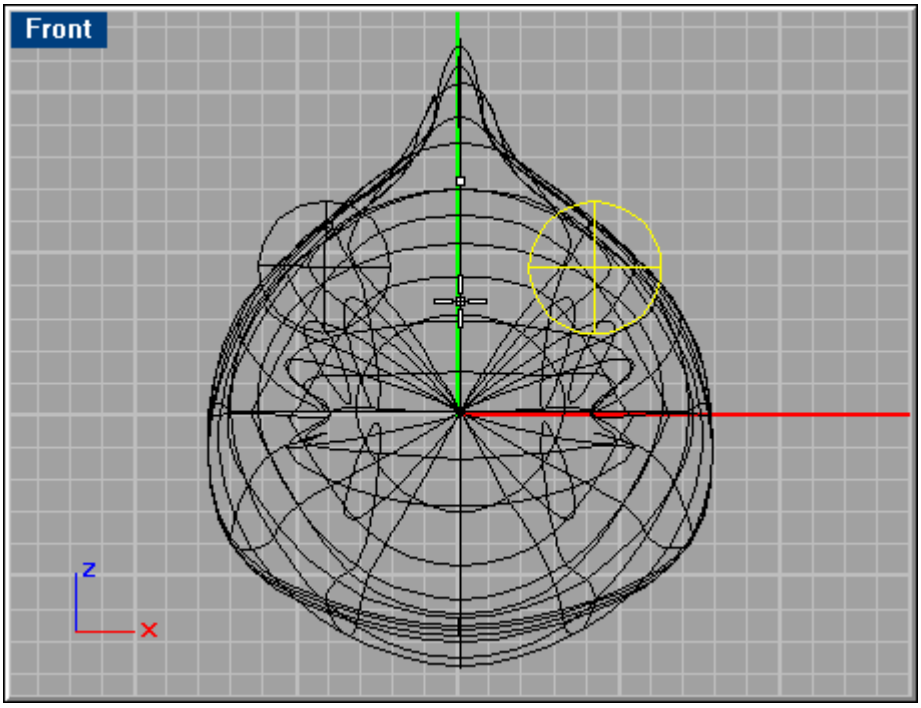


After some CV manipulation, scaling and inserting isoparms in the proper areas the head is starting to take shape.

Create a sphere for the eyeball, and place it as shown below.

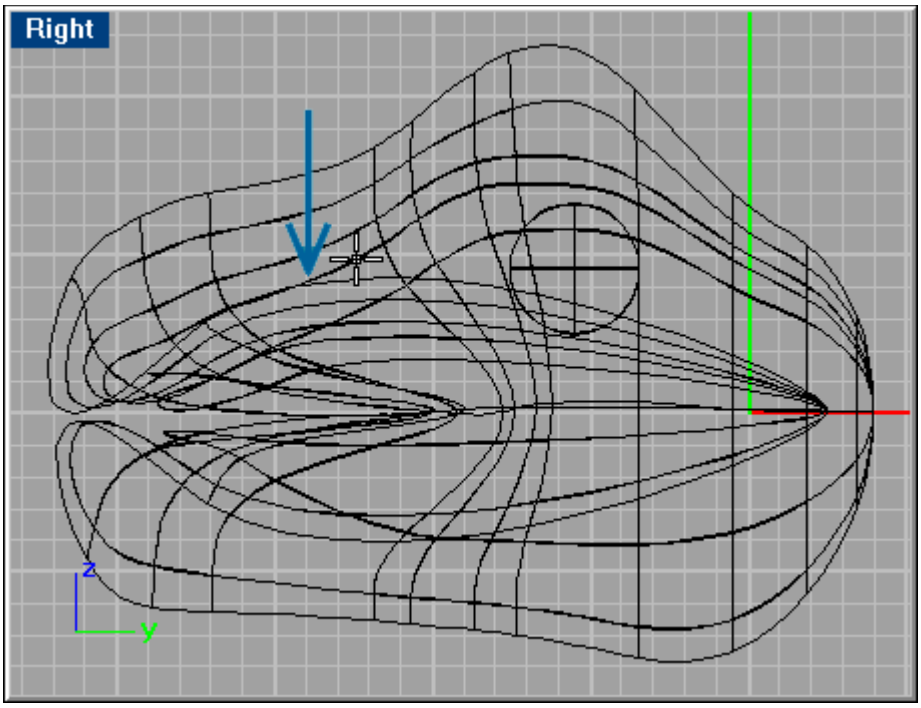


In the Front viewport set Object Snap to 'Near' and use the 'Mirror' command to have an eye on the opposite side of the head.



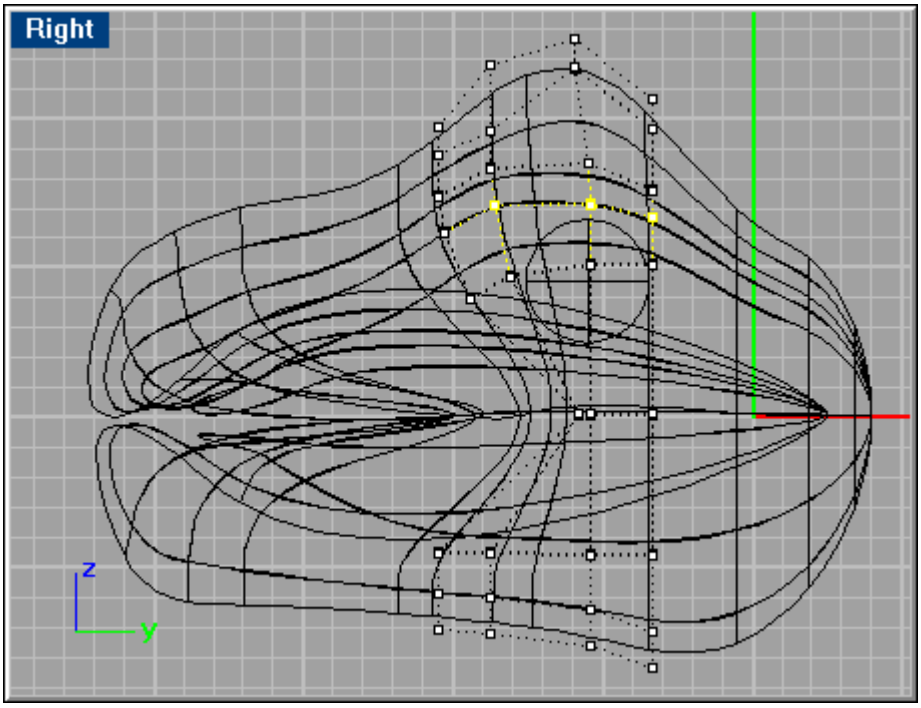
It is necessary to position the eyes before doing the eyebrows, because the position of the eyeballs will be used as reference for the eyebrow position.

The area around the eyes needs more detail. Insert an isoparm as shown below, don't forget to make it symmetrical.

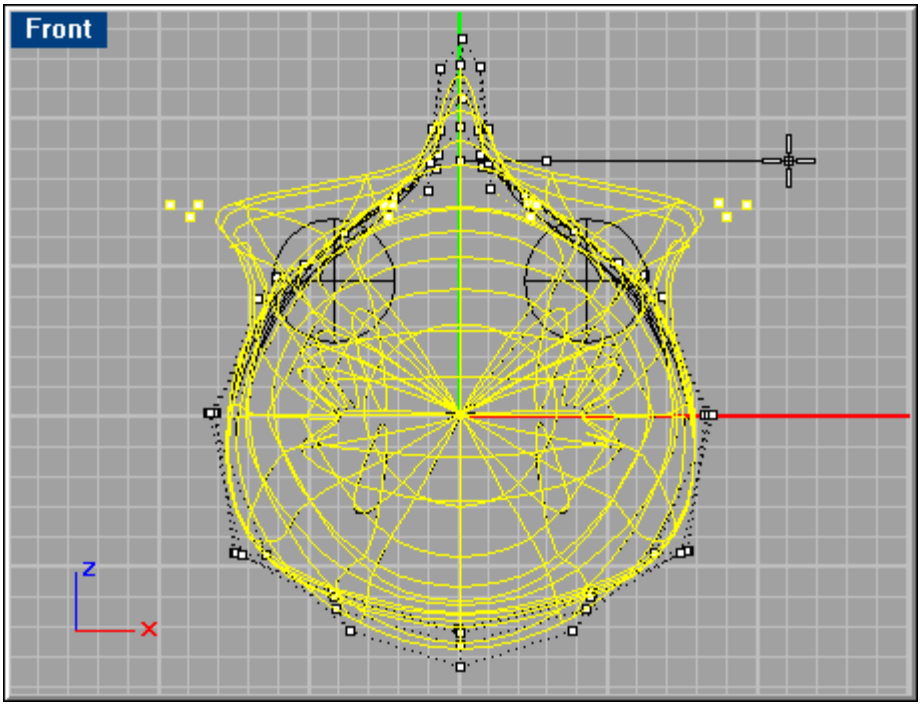


NOTE: To insert symmetrical isoparms in a closed surface requires that the seam be located along the plane of symmetry. You can use the ShowEdges command to visually highlight the seam to make sure it is in the right spot.

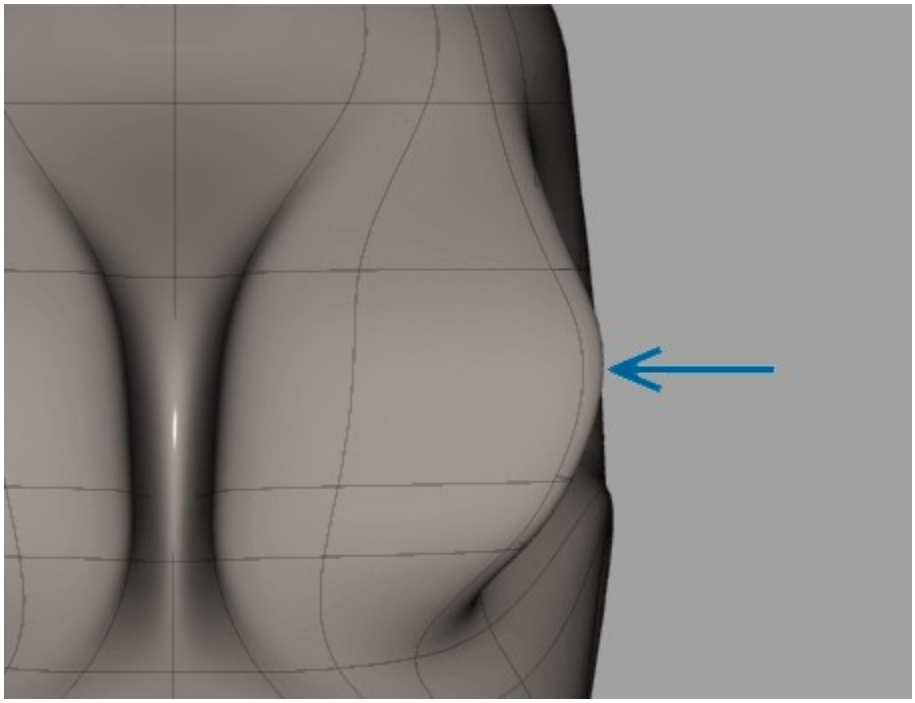
Select the CV's shown here:



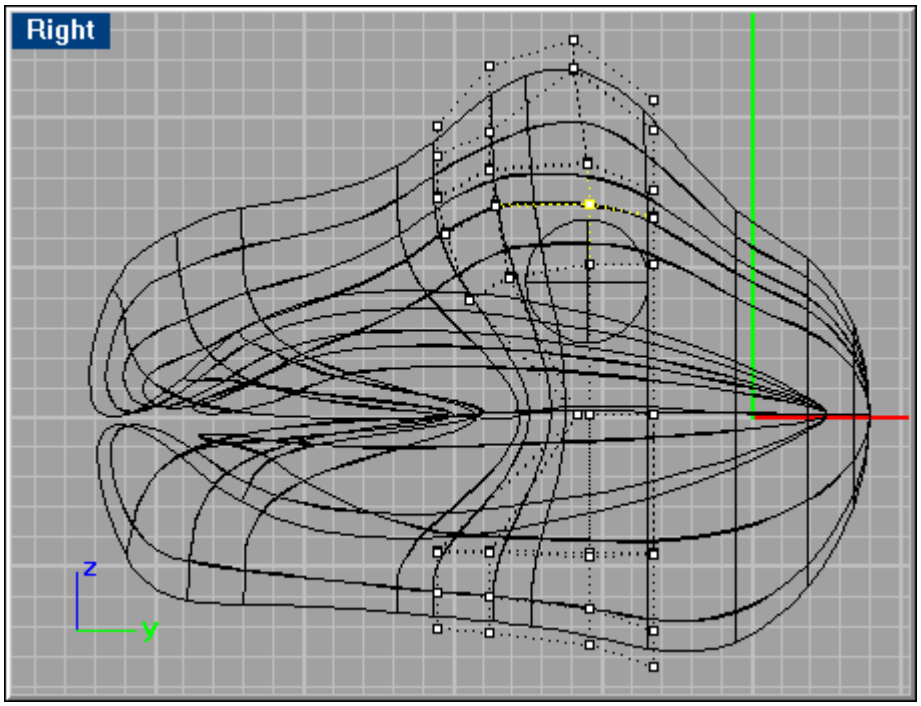
In the Front viewport, use the command ’Scale1D’ and stretch the CV's from the center of the head and outwards until the eyes no longer can be seen.



The surface that was stretched out needs a bit more tweaking. In the Top viewport, stretch the CV’s so the middle pair of CV’s are the most stretched.

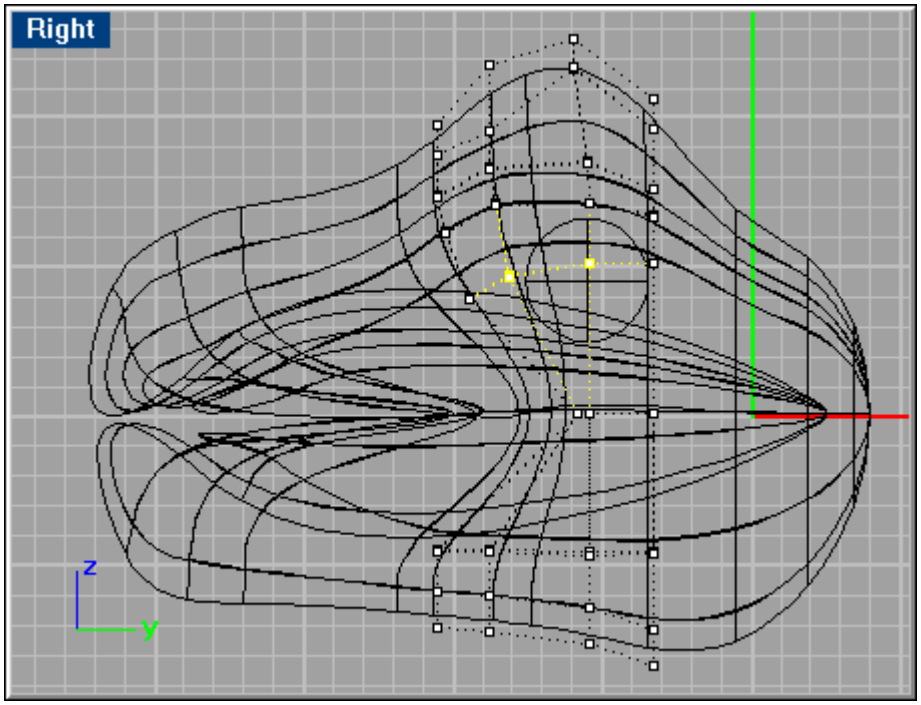


Select the CV's shown here:

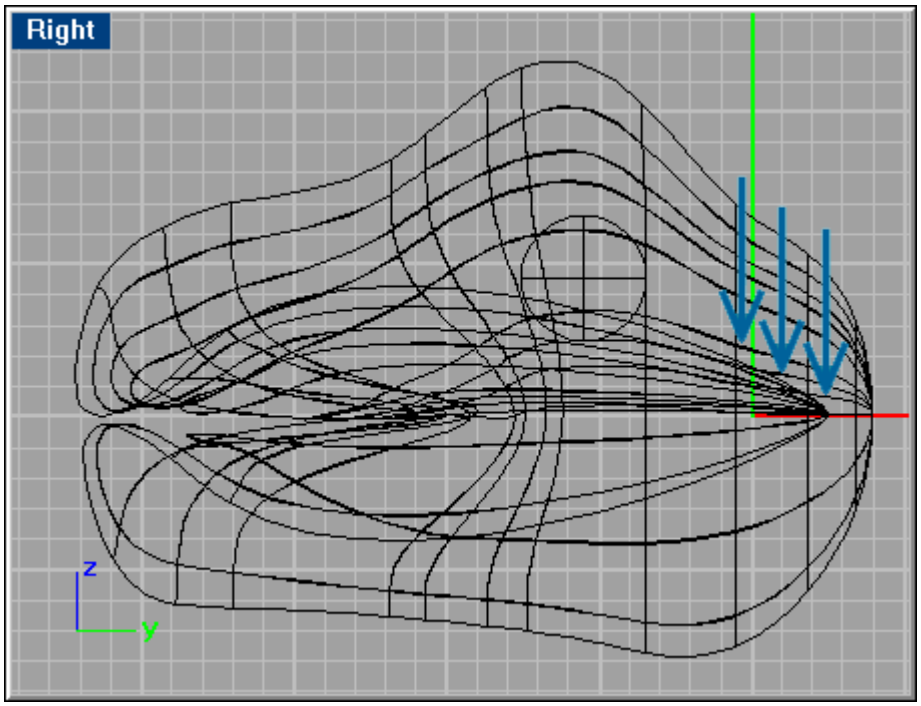


Move these points up a bit to get a more rounded shape from the side view as well.

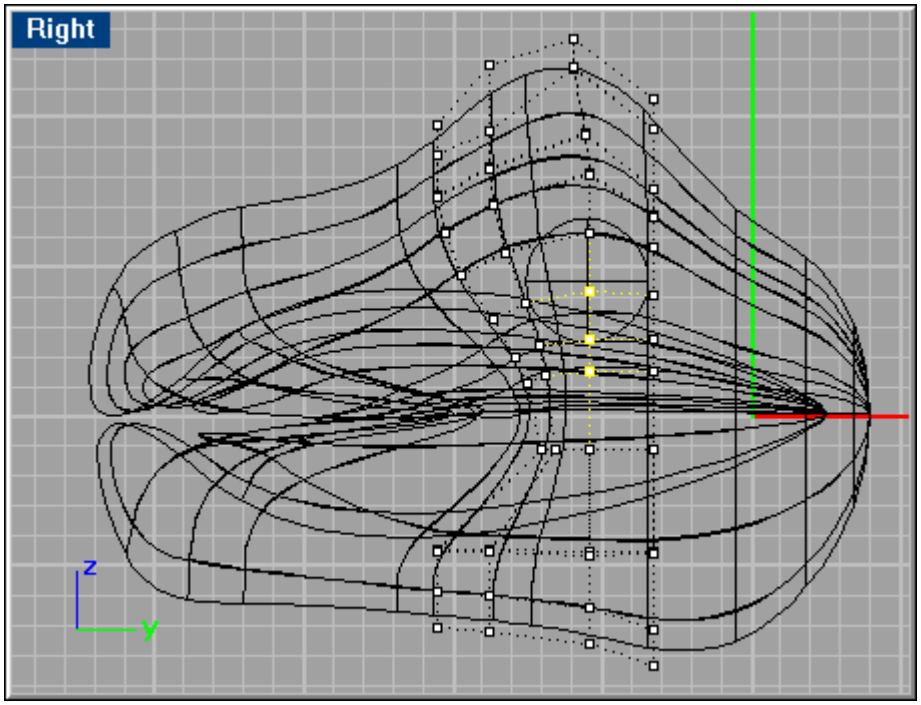
Select the CV's shown below, and stretch them but inwards this time. With 'DynamicShadingPerspective' you can see how much you need to stretch until the eyes become visible.



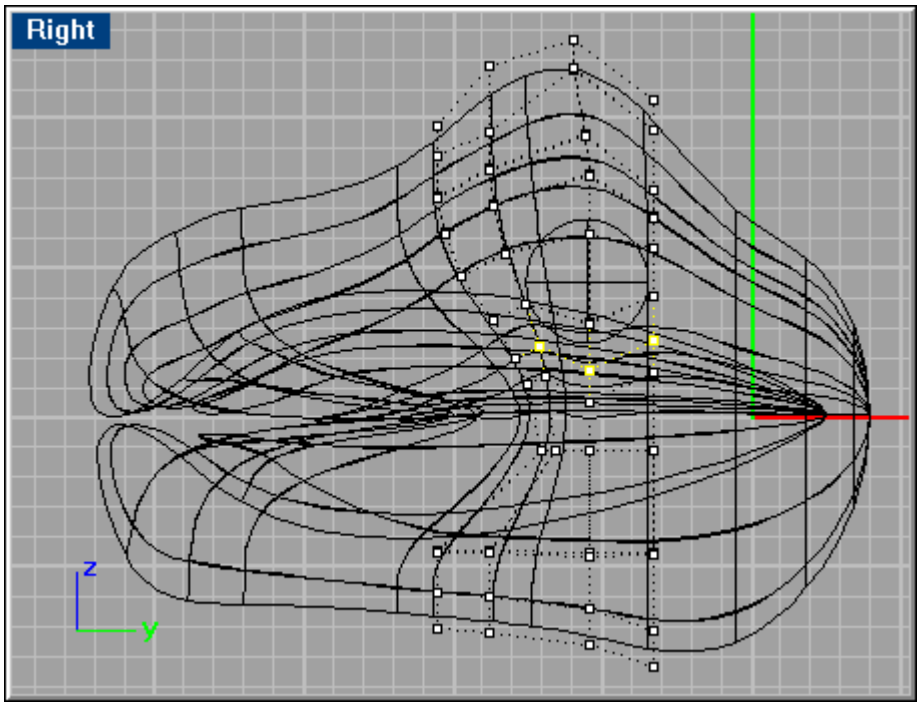
The areas just below the eyes needs more detail to look more convincing. Insert 3 isoparms:



Select the CV's as shown below and move them down, so the isoparms follow the lower part of the eyes.



Select the middle of these 3 CV's, and the ones next to it on each side:

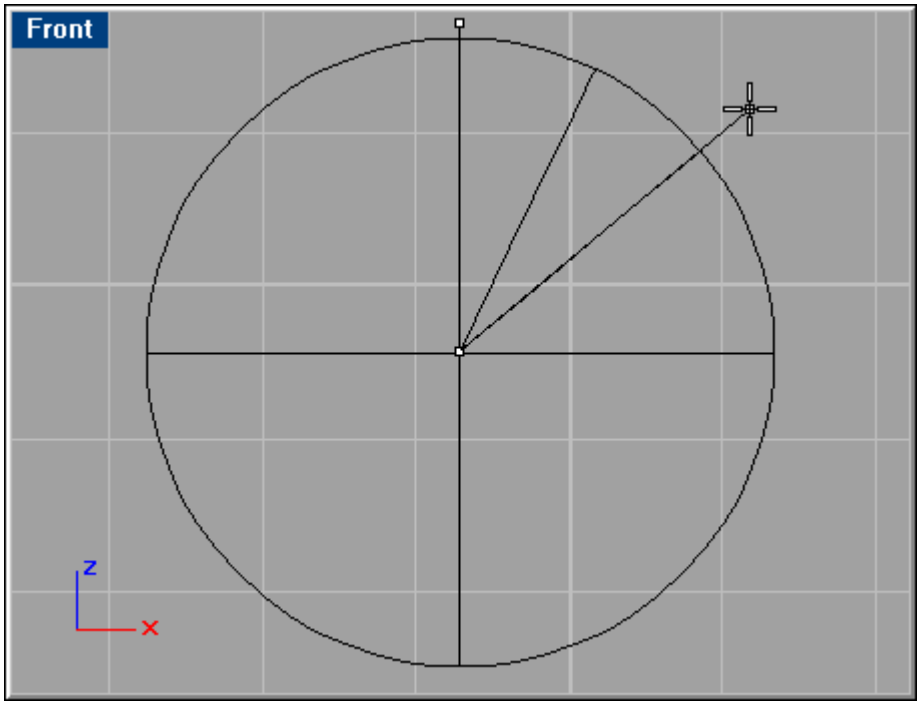


Stretch these outwards, about half the way the upper eyebrows reach. Then tweak with each pair (one on each side) of these CV's to get a smooth and decent look. If there is some area that seems hard to get smoother, choose the affected CV's and with the 'Smooth' command (smooth factor 0.1 recommended), smooth that area out. (Reference file 'brachio5.3dm).

There are different approaches in making eyelids. For this tutorial they will be modeled as separate parts, because the head geometry doesn't get as dense as if you would make it out of the head surface. It will also be easier to animate.

Hide everything but the right eye: select the right eye as seen from Front viewport, use "invert" to select everything but the eye, and then use the "Hide" command.

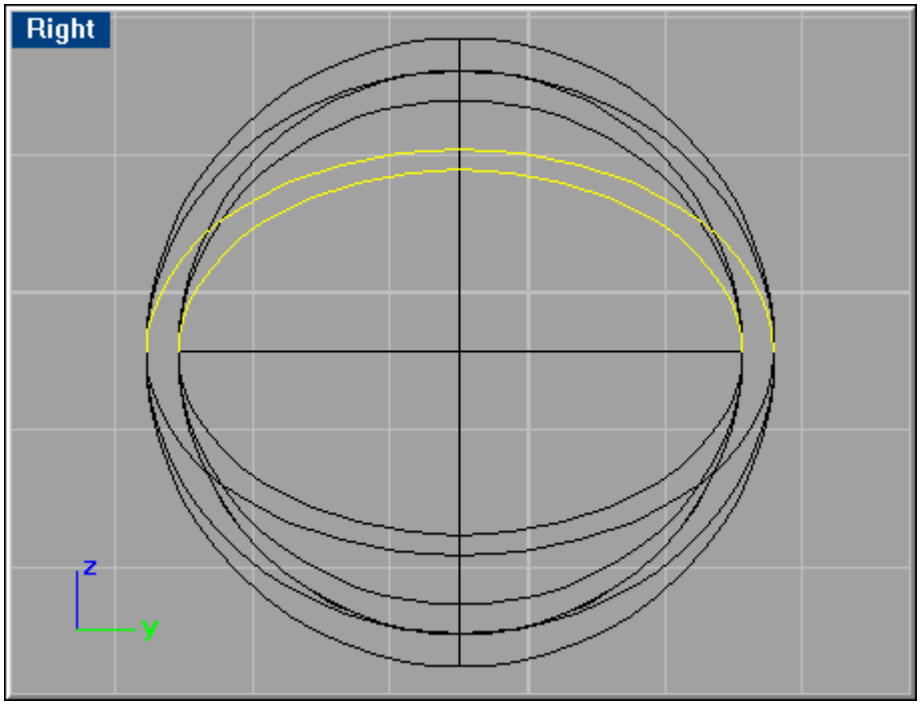
With the 'DupEdge' command, select the top edge of the sphere to extract a copy of it. In the Front viewport, use 'Rotate' command with Copy option (press C and Enter during process) and make sure you have the Object Snap 'End' on when you select the 'Center of rotation'. Rotate and copy the curve twice as shown here:



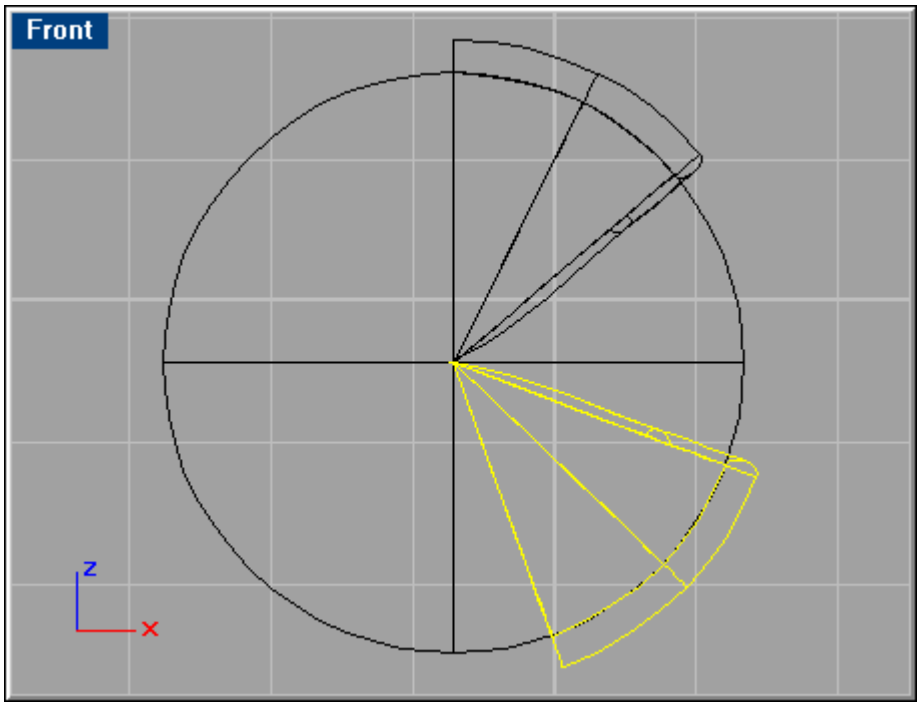
Select the 3 curves, and with the 'Loft' command (with default parameters) skin them together to a surface. Move the curves into the 'Original curves' layer.

Set Object Snap to 'Center', and use the command 'Scale'. Hit C for copy, and scale the surface just somewhat larger than the original surface, to give the eyelid some thickness. Mirror the eyelid 180 degrees with Copy option, so you have a lower eyelid as well.

With the command 'BlendSrf', select the edges as shown below.

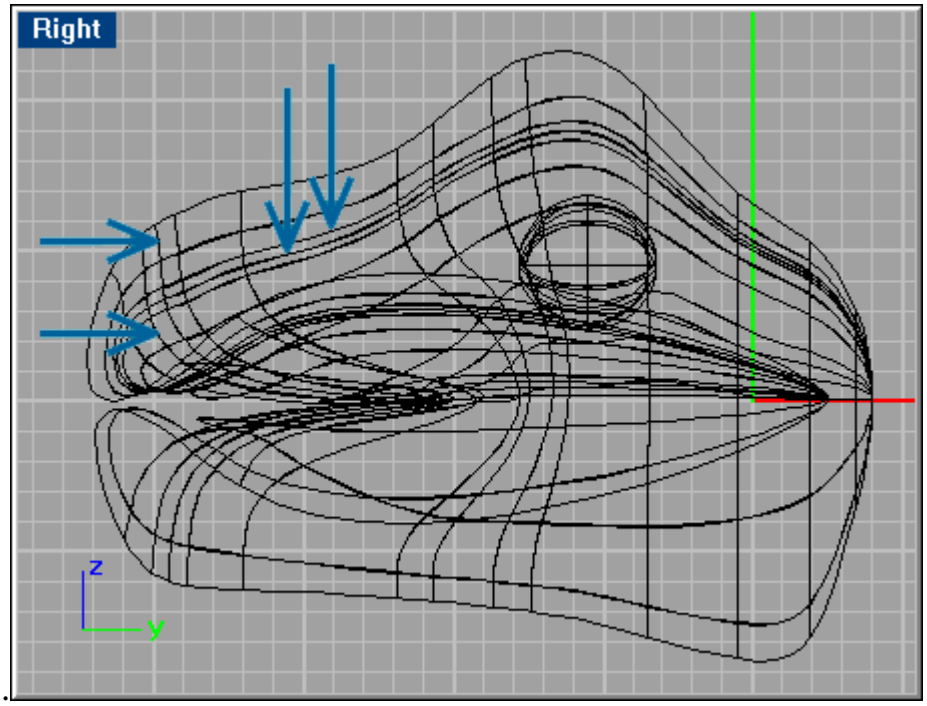


Then join these 3 upper eyelid surfaces with 'Join' command. Do the same for the lower eyelid. Rotate the lower eyelid:

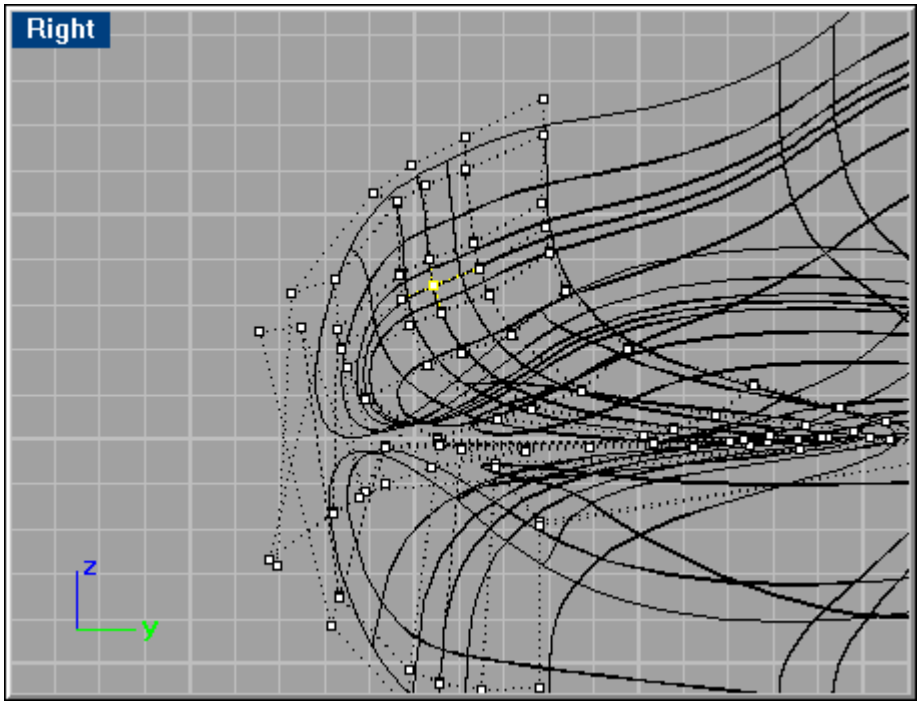


Make all hidden objects visible with 'Show' command. Select the eyelids surfaces, mirror those to the other eye, (use the center of the head as 'Start of mirror plane' with the 'Near' Object Snap) and the head is almost finished.

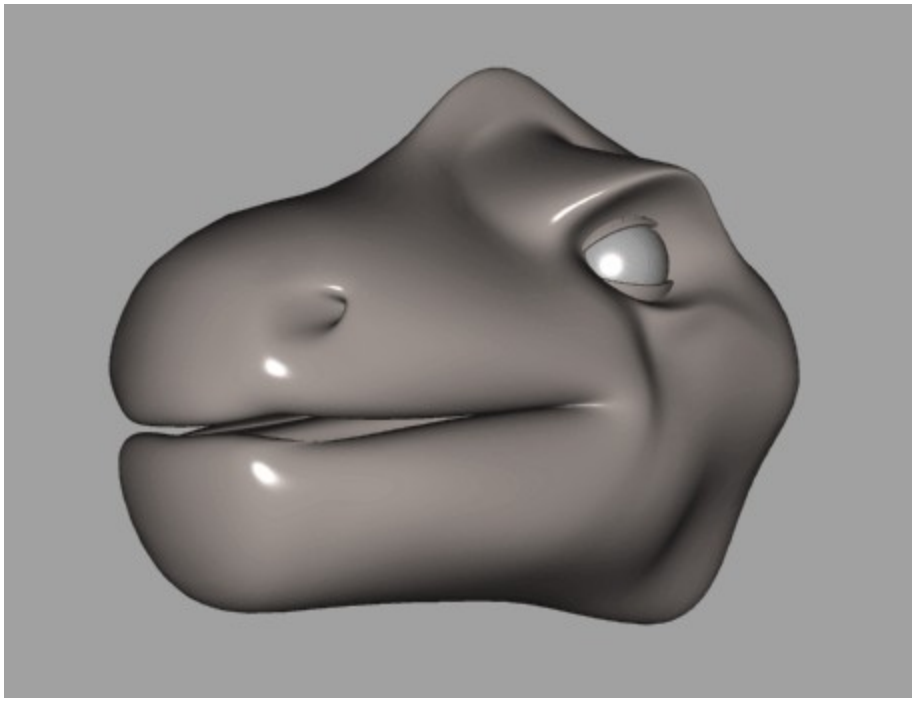
To model the nostrils, insert 4 isoparms as shown below (make sure 'Symmetrical=Yes' when inserting the two in the V direction).



Pull the CV's shown below inwards until you get convincing nostrils.

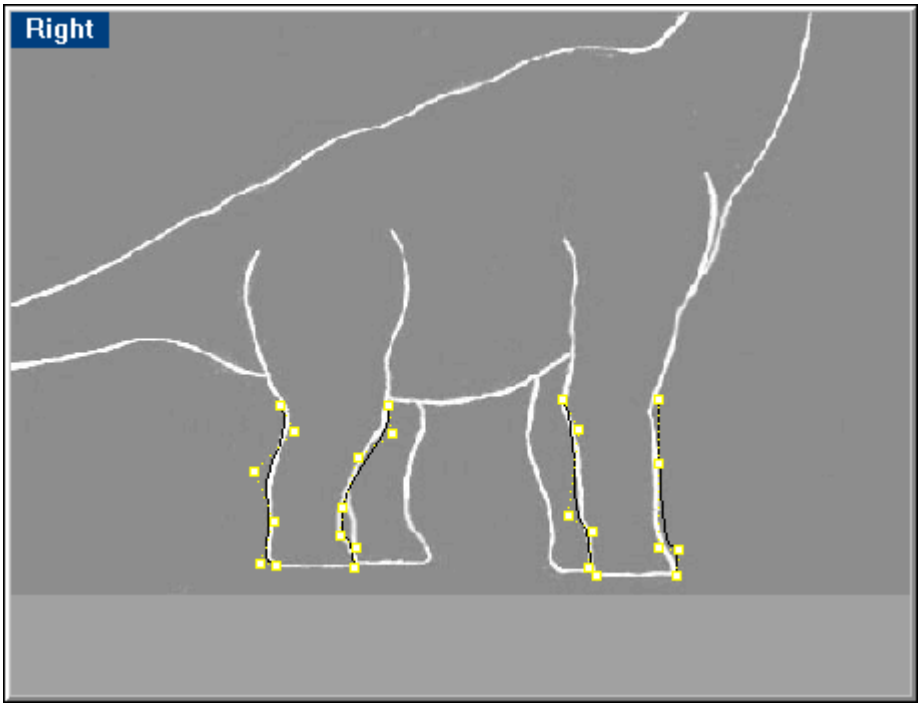


The final result of the head after this step your scene should be similar to the sample file 'brachio6.3dm' from the dino directory of the CD-ROM.



Make a new layer called 'Head surface,' put everything visible in the scene into that layer, and set it to 'Off'. In the Right viewport, use 'ShowBackgroundBitmap' to display the background.

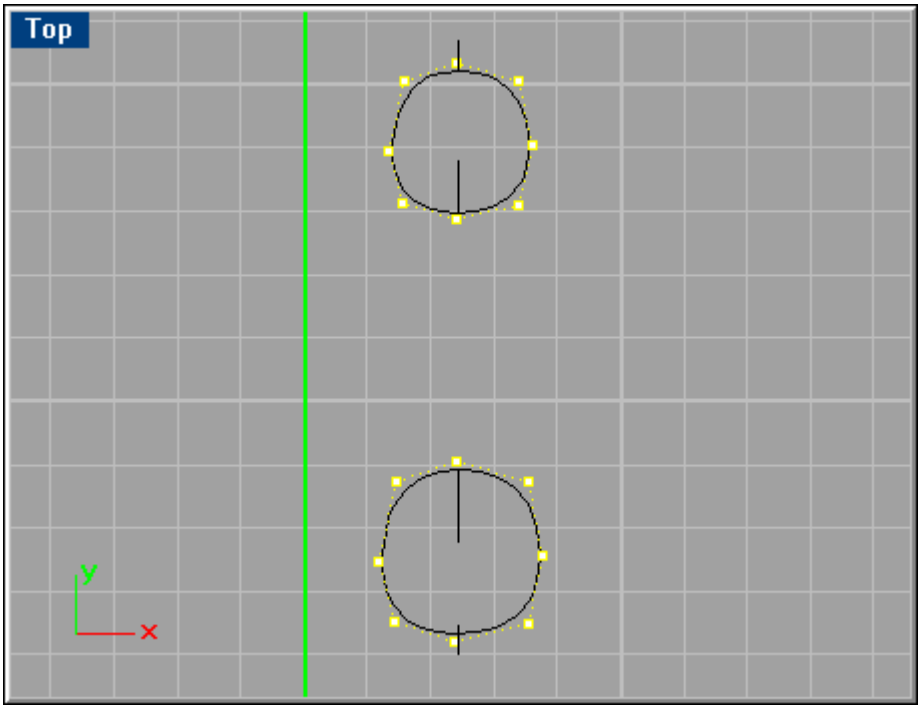
Start outlining the legs with two curves, one on each side:



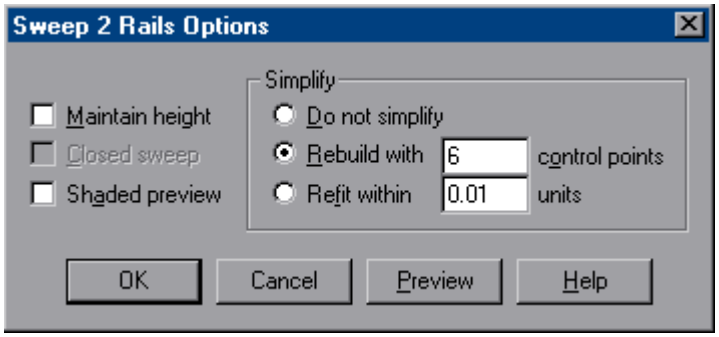
The upper part of the legs will be blended surfaces, therefore there is no need to outline those areas. As always, try to make the curves as detailed as possible, but with a small number of CV's.

The legs will later on be capped, so the bottoms of the feet need to be planar. To achieve this, set Object Snap to 'Point', select the lowest CV on either curve, snap it to the other curve's lowest CV, then move it back to it's place while holding Shift so it moves perfectly straight in the same horizontal height.

In the Top viewport, draw a closed curve for each leg as shown below. Make sure they lie on top of the curves from a side view. (Your current scene should be similar to the sample file 'brachio7.3dm' from the CD-ROM)



Select all curves on the back leg, and use the 'Sweep2' command. Use the settings shown here:



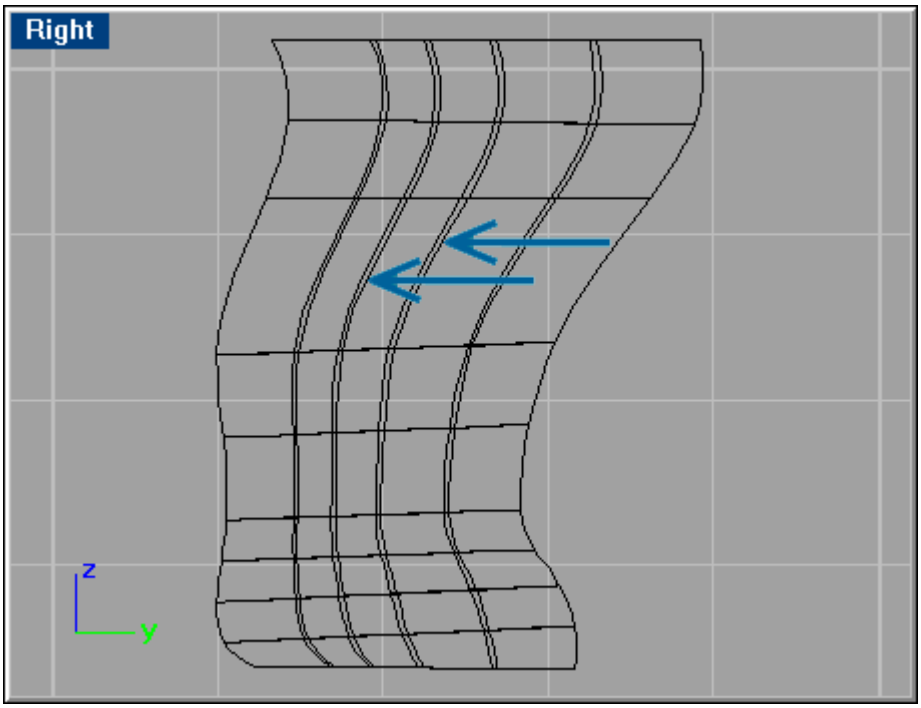
Do the same for the front leg.

Select all curves (’SelCrv’ command), and use 'change layer' to move them into the ’Original curves’ layer.

OPTIONAL: You may wish to edit the legs with CV manipulation.

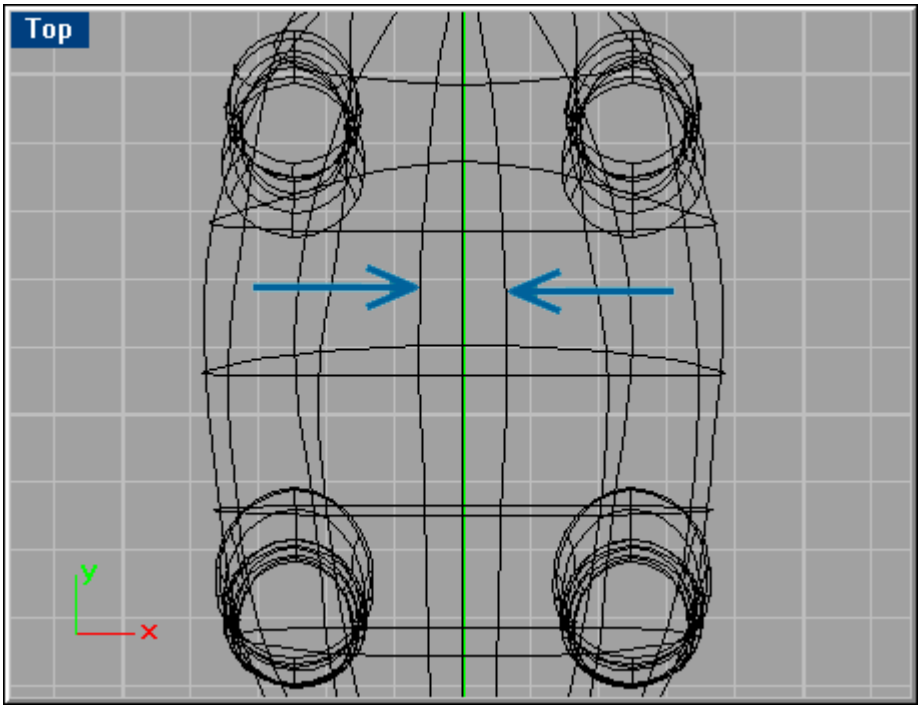
The back leg is pretty thin at the foot and thick at the top, so it may be a good idea to make the top a bit thicker, by selecting the upper half rows of CV’s, and scaling them (Scale1D) inwards in the Front viewport. Give the front leg a bit more lean, and if needed, move around with the CV’s in any areas where it is necessary.

Insert isoparms as shown below (Direction=U, Symmetrical=Yes) and start stretching CV’s inwards and outwards in those new rows to make the splint muscle. Use the same technique for the front leg.



Now you will put all surfaces together. In the ’Edit Layers’ panel, set the ’Body surface’ layer to On.

Move the legs just a bit farther out from the body. Select the body surface, use the Object Snap ’Near’, and mirror it to the opposite side.

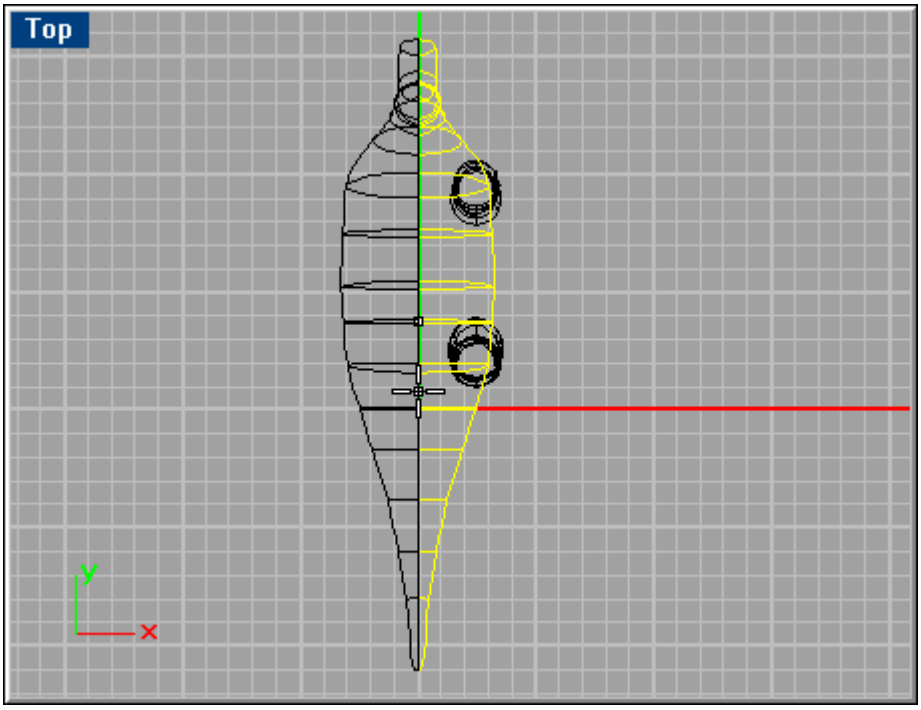


Select both body surfaces and use the 'MergeSrf' command. Then use 'RebuildSrf' (point count of 20 in U direction and 10 in V direction) to rebuild the surface to remove any potential creases.

Now there could be some areas that you might need to tweak, since you can now see how the whole surface looks. For example, the tail could be too elliptical.

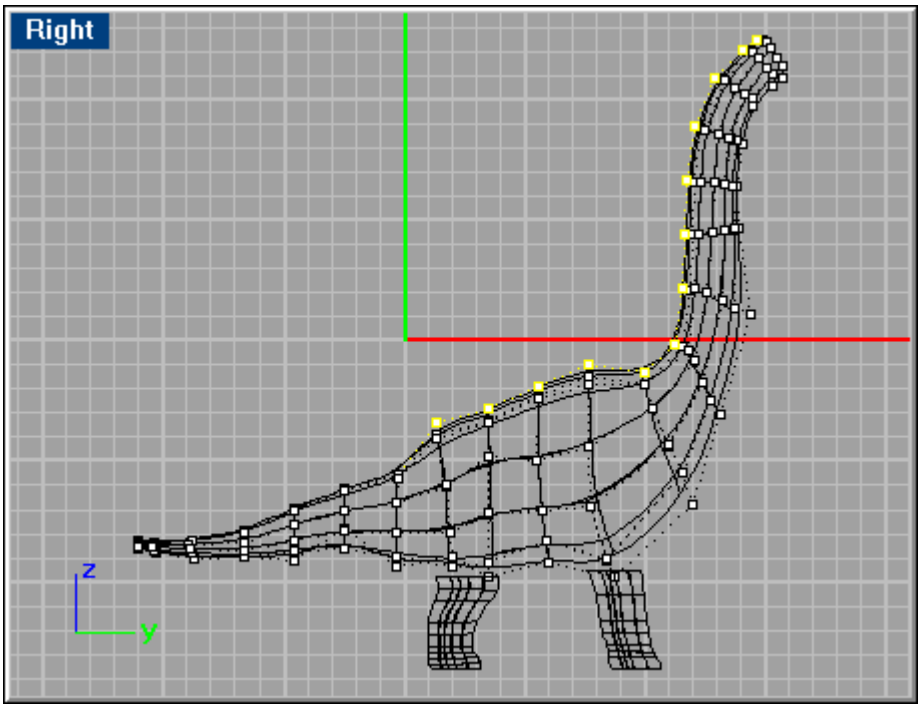
In the Front viewport, stretch some CV's to achieve a more circular look. The stomach area needs to be rounder and wider. CV's in that area should be stretched outwards. If there are other areas that need to be fine tuned, make the changes now.

In order to make the spine appear, insert isoparms as shown here:



Move the center CV row up a bit to get the peak. Select the CV's running up the back of the neck,

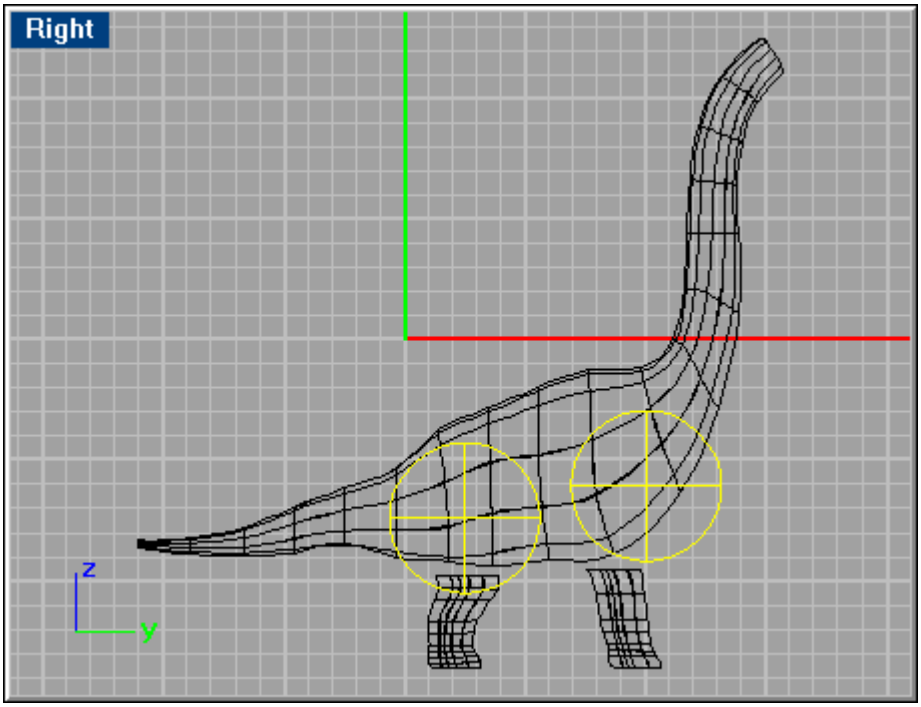
and drag them out also, to make the peak extend up the neck as well. This figure shows the CV's after being moved:



You might need to smooth some CV's out with the 'Smooth' command. (At this state your scene should be similar to the sample file 'brachio8.3dm' from the CD-ROM.)

To seamlessly attach the legs to the body, you need to blend them. Blending is a hard task ,and requires some tweaking to get the result that you want. The tweak can be as simple as moving one of the objects a bit in order to make the blended surface look better.

Make two spheres with the size and position shown here:

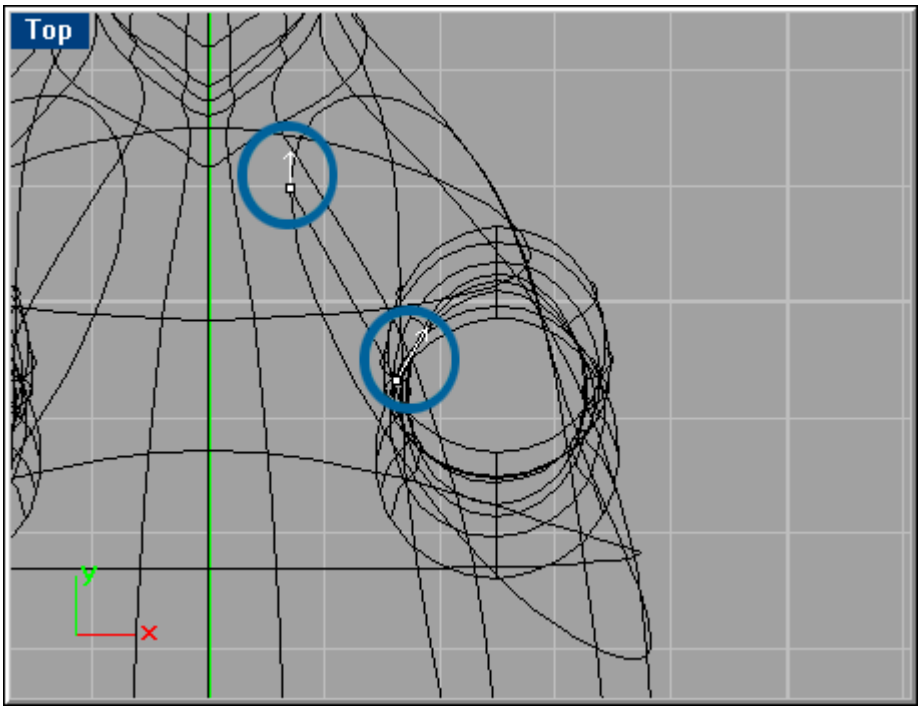


They should be about half a unit from the center of the body (seen from Top or Front viewport).

Then mirror these to the other side of the body (use Object Snap 'Near' here as well). To split the body with the spheres with the command 'Split', select the body surface first, and then the spheres.

Move the spheres to a new layer named 'Spheres,' turn this layer off, and delete the surfaces that were split from the body surface.

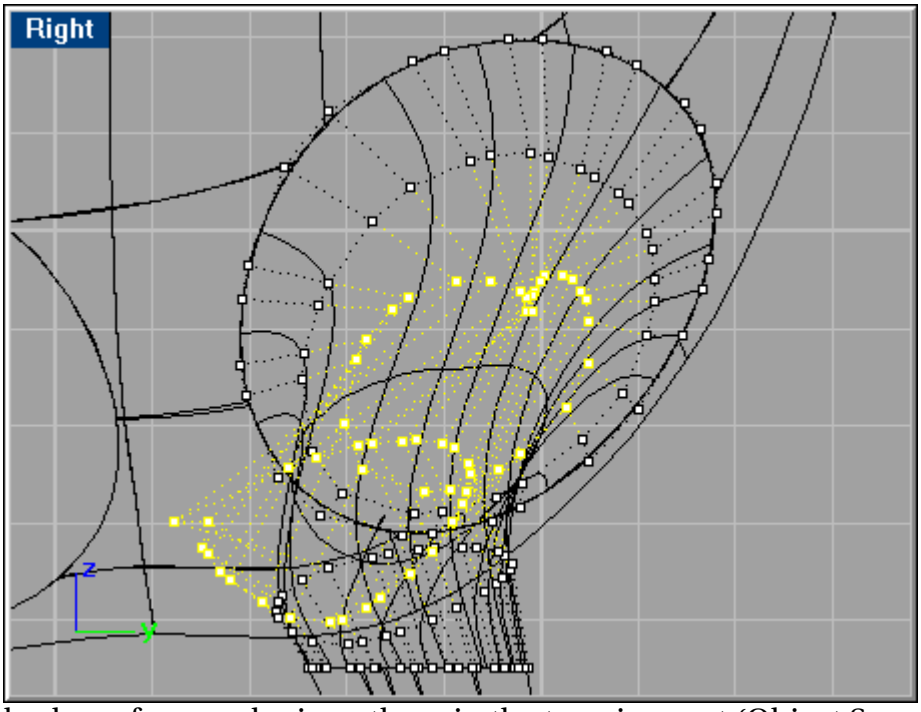
Now, use the 'BlendSrf' command, and for the first 'Edge to blend', select right back leg's opening, and for the 2nd, select the back legs top edge. Hit A for automatic. Sometimes automatic doesn't work, then you have to move the arrows manually. Make sure the arrows point at the same direction, and that the arrows are either as far out as possible from the body surface, or as close to center. Otherwise the blend gets twisted. This figure shows how it could look for a successive blending:



Do the same for the front leg.

(Your scene should now be similar to the sample file 'brachio9.3dm' from the CD-ROM).

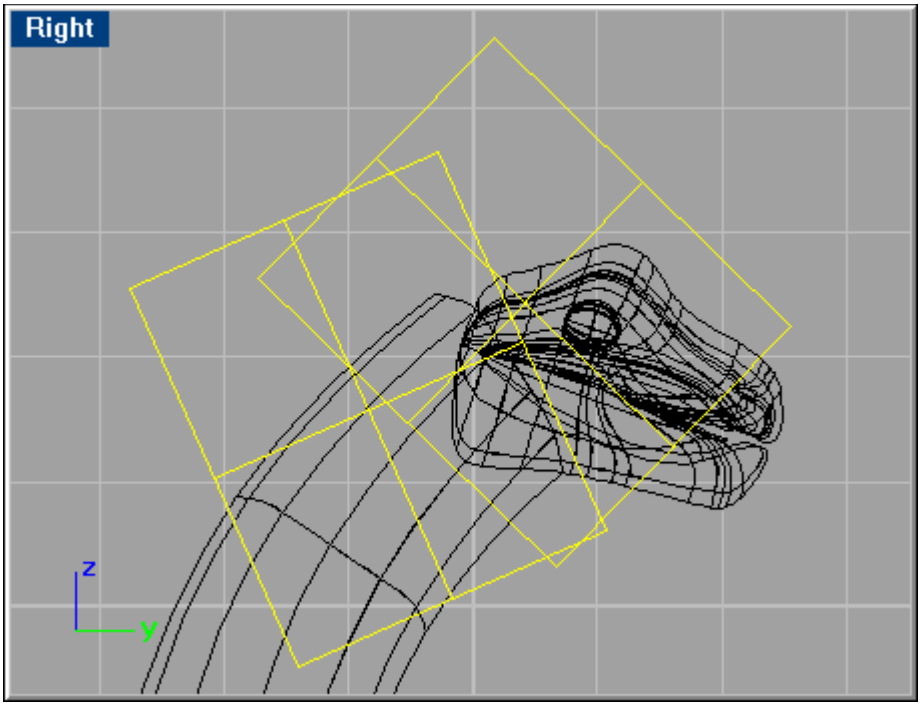
IMPROVING YOUR RESULTS: If you aren't happy with the results of your blend, here is a trick to use: select the two rows of CVs in the middle of the blend surface (as shown below), and use the 'Smooth' command with default settings. Repeat this two more times and the blended surface looks more even, without creases. Usually you shouldn't tweak with the CV's of blended surfaces, or the objects that got blended. But this technique is quite useful, and the seamlessness is maintained as long as you smooth no more than three times.



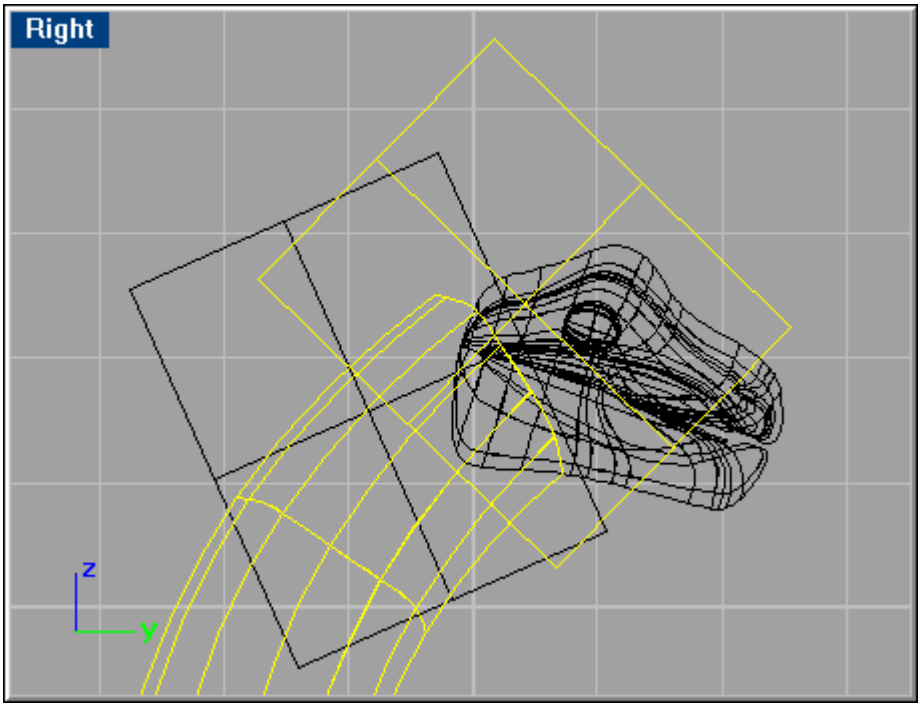
Select all but the body surface, and mirror these in the top viewport (Object Snap 'Near' as usual) to give the Brachiosaurus two more legs.

Turn on the 'Head surface' layer. With the 'Rotate' command, rotate all of the head 180 degrees in the Top viewport, move it to it's position and scale it ('Scale' command) to the proper size.

Make two boxes ('Box' command) that cross the neck and are rotated and positioned as shown here:



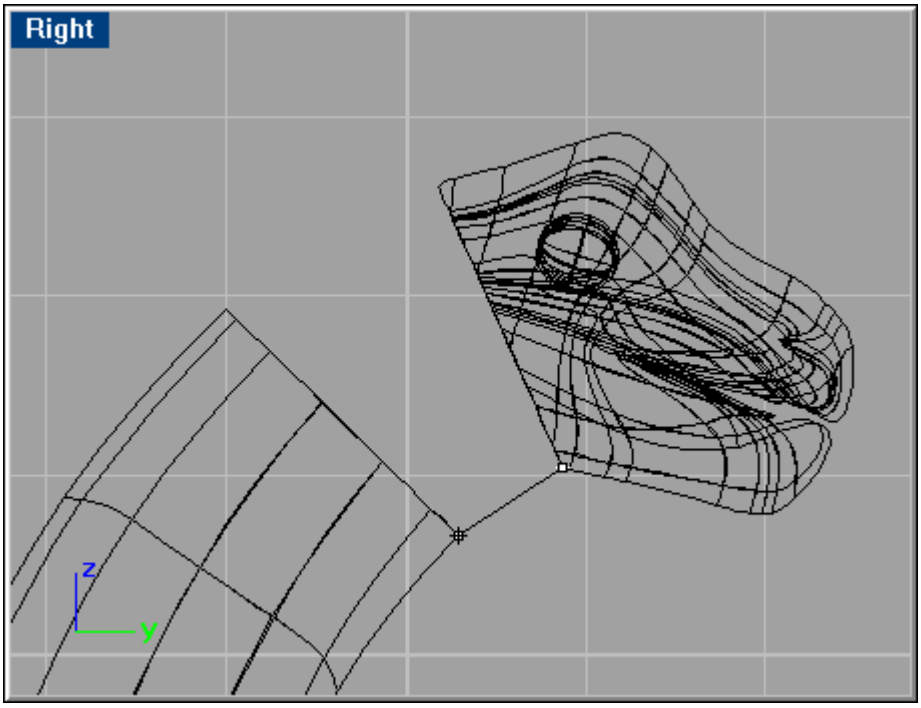
Use the 'Split' command to split the body surface and choose the box shown below as cutting object.



NOTE: There are other approaches possible to this task that would produce the same results, but could be more convenient. One alternative would be to use the 'CutPlane' command to create cutting planes. CutPlane will work on any kind of surfaces, whether they have been joined or not. If the objects involved are simple surfaces (not polysurfaces), then an even simpler solution is possible: you can just draw some lines, and use the lines as cutting objects to cut the surfaces (when working from a plan view.)

Do the same for the head but with the other box as the cutting object. Hide the boxes and delete the small cut parts that are no longer needed.

Blend the neck edge to the head edge. Use Automatic and Smooth the two middle rows of CV's three times.



Use the 'Cap' command to cap all the holes at the bottom of the Brachio's feet so they no longer look hollow. Explode them and delete the top cap of the legs.

Finally use the 'Join' command and join all the surfaces together except for the eyes and eyelids. The sample file 'Brachio10.3dm' shows the final result.

Now that you have completed your dinosaur model, you might want to take it into another program for animation, rendering, or compositing with a photographed environment. The notes below describe how author Daniel Ljunggren brought the dinosaur into 3D Studio MAX to produce his final rendering.

If you want to export your dinosaur model into another 3D package as polygons, select all of the dinosaur and use the command 'Mesh'. In the 'Create Polygon Mesh from NURBS object' panel, go into 'Detailed Controls', and uncheck 'Refine', and in the 'Max edge length', set it to 0.5. Then the result is evenly meshed polygons for use with animation and close-ups. If no close-ups of the head will be rendered make the 'Max edge length' a value of 1 – 1.5 for lower polygon count.

The figure above shows a final rendering in 3D Studio Max. The Brachiosaurus had four different textures applied: three bump maps and one diffuse map. Two of the bump maps were manually painted wrinkles, and the third was a tileable photo of an animal's skin (mixed together with the 'Mix' material). The largest bump map was 2000x1700, in order to look good in close-ups. The diffuse (aka "color") map was painted, about 850x700 in size. Maps were applied as Planar mapping, which turned out well for this purpose.

There are three lights in the scene: one target spot light casting shadows, working as the main light source, and two omni lights (as fill lights) that light up different areas of the dinosaur without shadowcasting. They were carefully placed in order to make the bump look natural.