

**“CMPWG-II”**

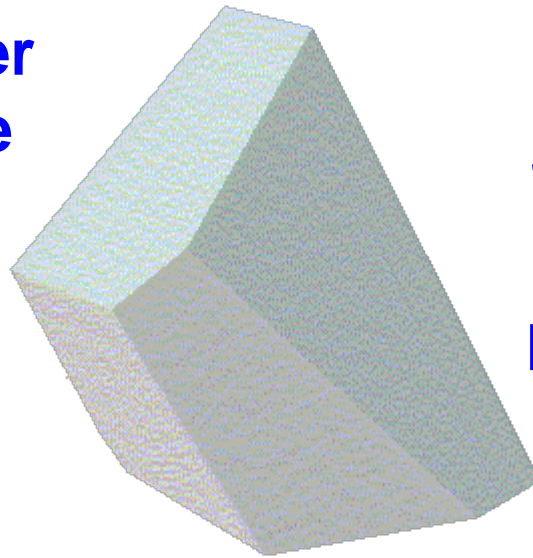
Computational Medical Physics Working Group Workshop II

*Sep 30 – Oct 3, 2007*

*University of Florida (UF) Hilton Hotel and Conference Center  
Gainesville, Florida USA*

# Implementation Of Salivary Glands In The Bodybuilder Anthropomorphic Phantoms

**Kenneth A. Van Riper**  
**White Rock Science**



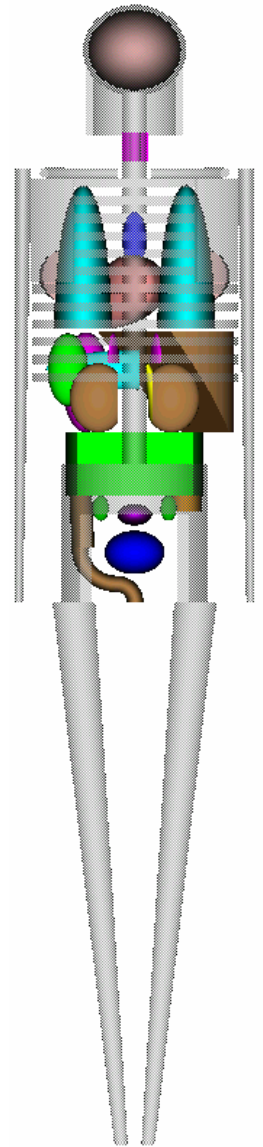
**James Roberts &  
Josephine Clorley**

**Radiation  
Protection Service**

**Velindre Cancer  
Centre, Cardiff**

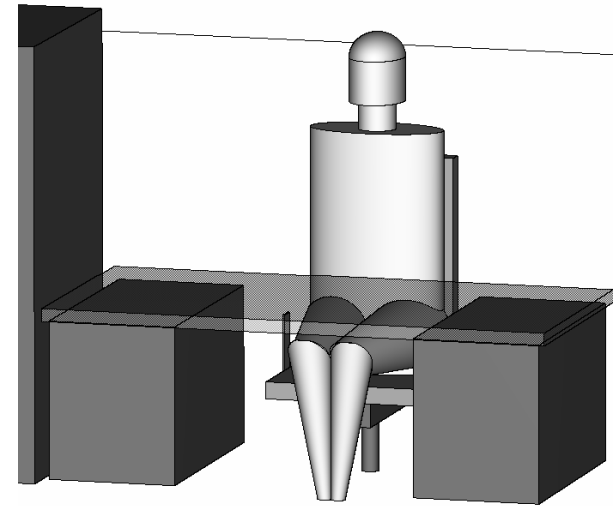
# BodyBuilder Program

- Generates MIRD geometry in MCNP format
- Any age: newborn to adult
  - Interpolation between MIRD models
  - 0, 1, 5, 10, 15, 21 years
- User choice of Organs to include
- Options
  - Single Left + Right Cell or Separate L, R Cells
  - Wall + Contents or Solid (stomach, ...)
- New (2004) postures added to models
  - Legs Up
  - Sitting

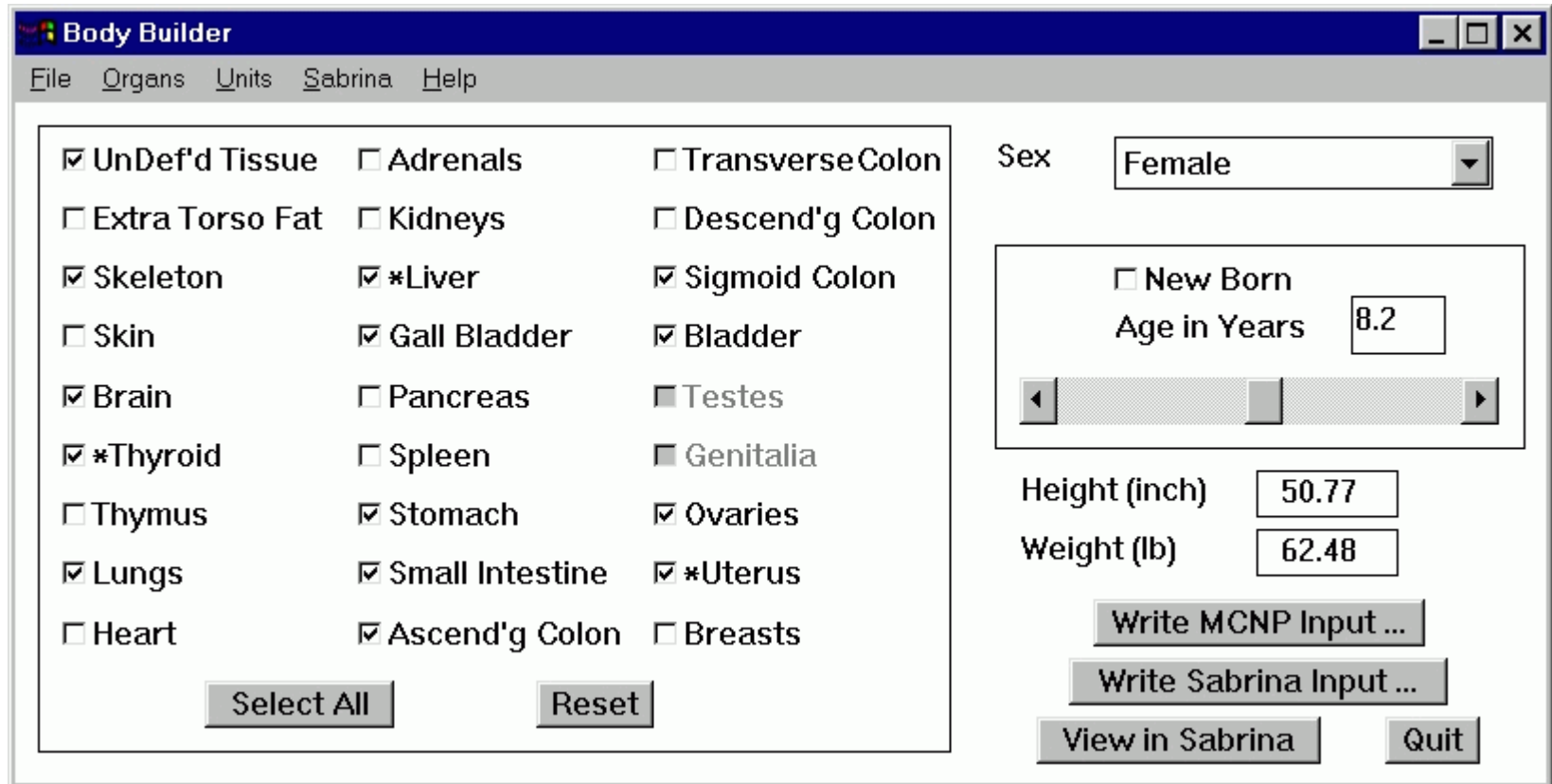


# BodyBuilder Output

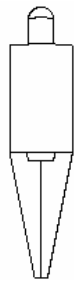
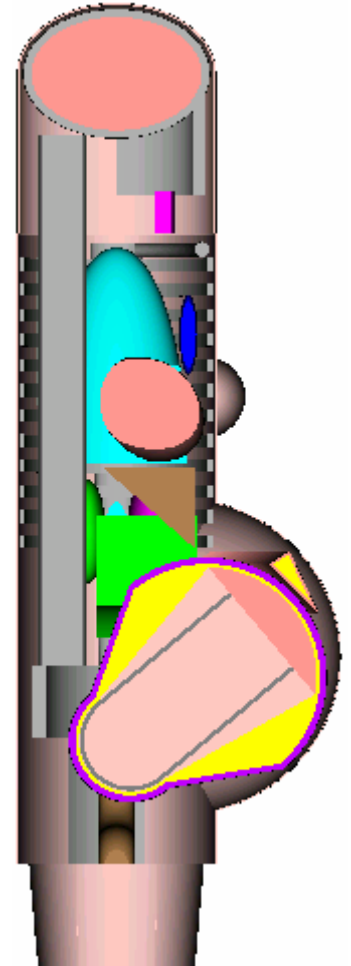
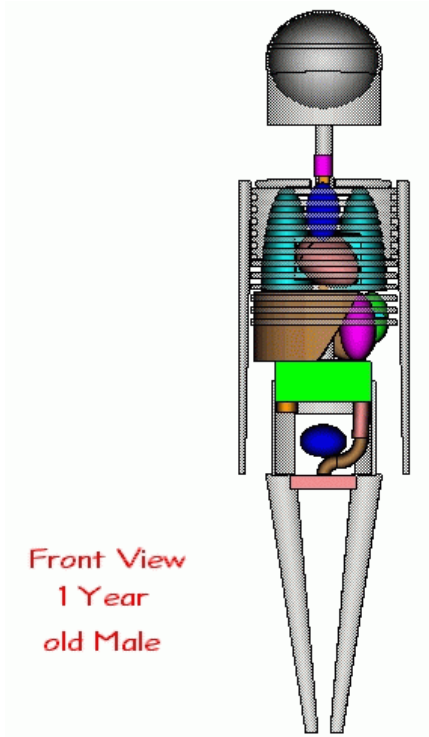
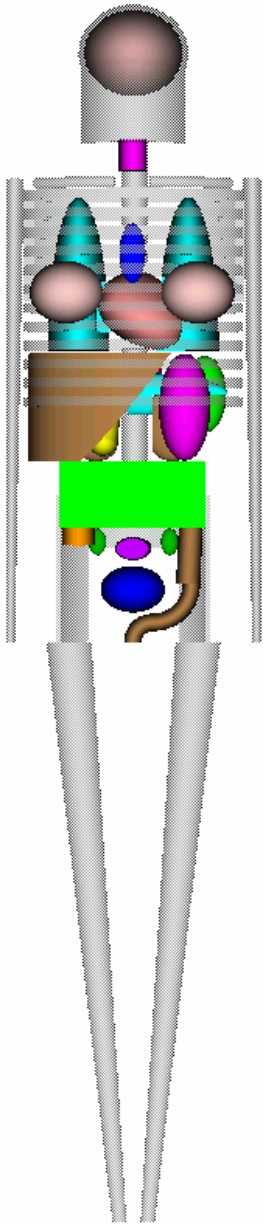
- Portions of MCNP input file
  - Geometry
  - Materials
  - Cell Tallies
- User adds source, external geometry
- Expanded file with visualization commands for Moritz or Sabrina
  - BodyBuilder starts and passes model to Moritz or Sabrina



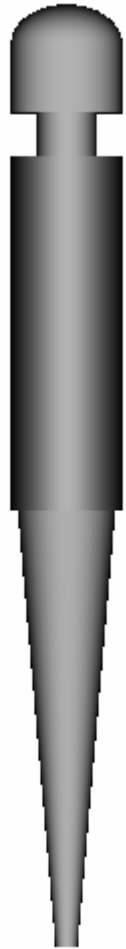
# BodyBuilder User Interface



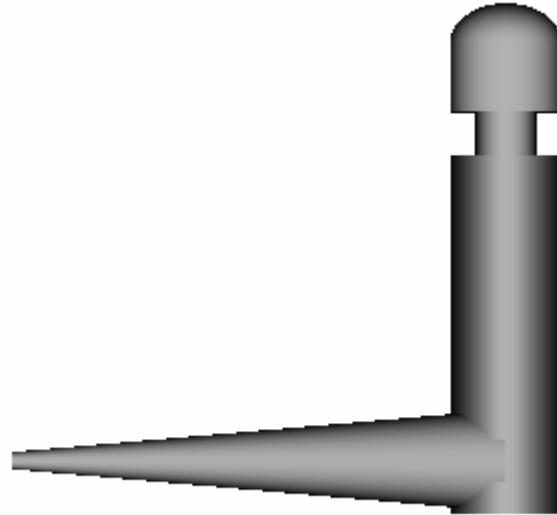
# Some BodyBuilder Models



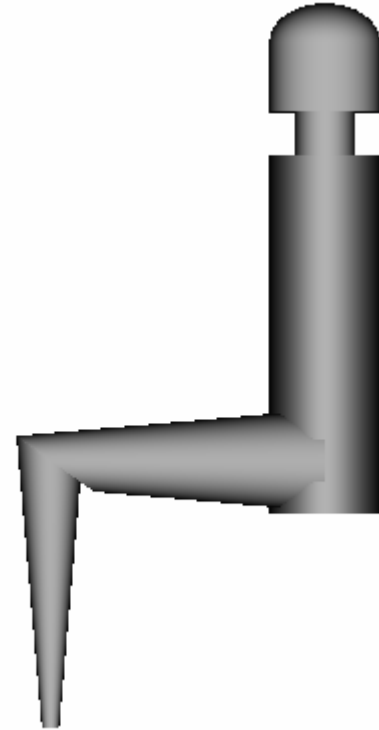
# Postures



Standing



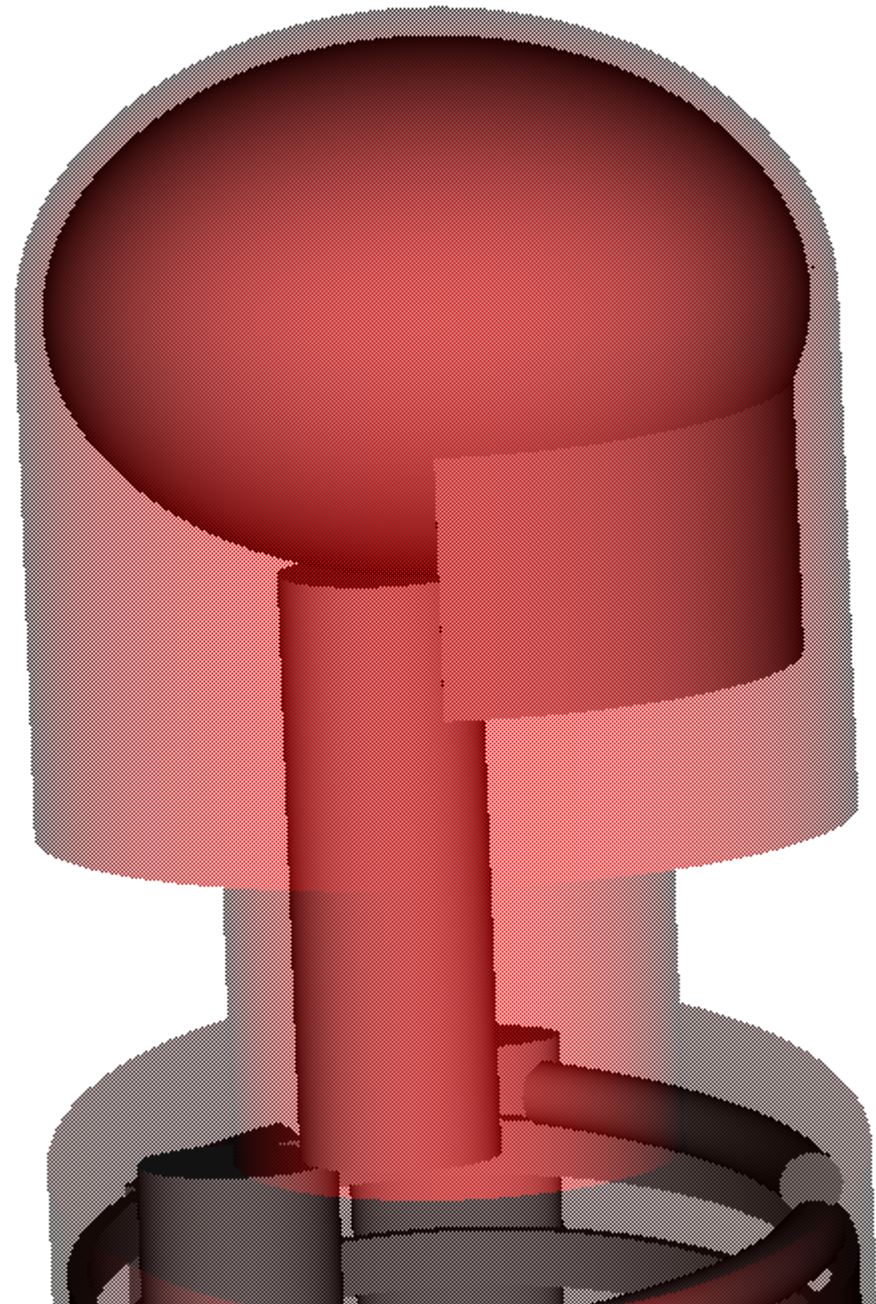
Legs Up



Sitting

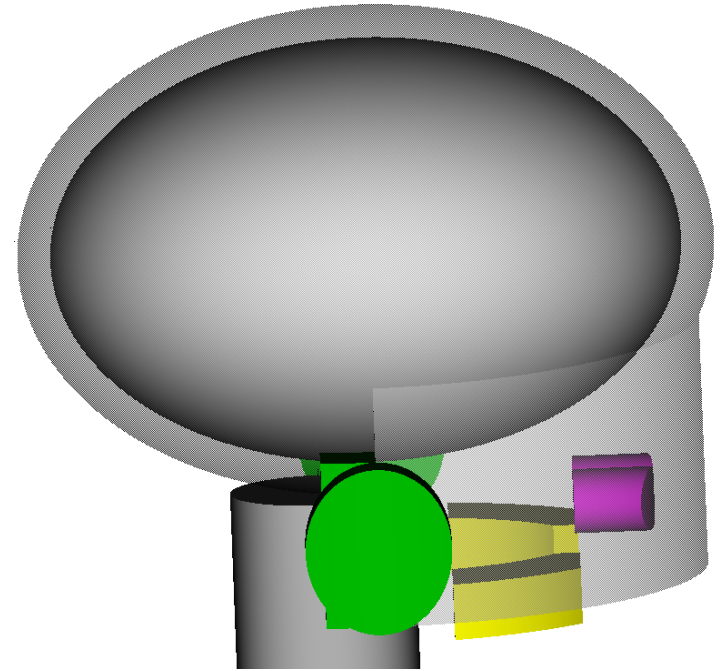
# The Head

- Components
  - Cranium & Brain
  - Face / Jawbone
  - Spine
  - Skin
  - Undifferentiated tissue
- No Salivary Glands



# Salivary Glands

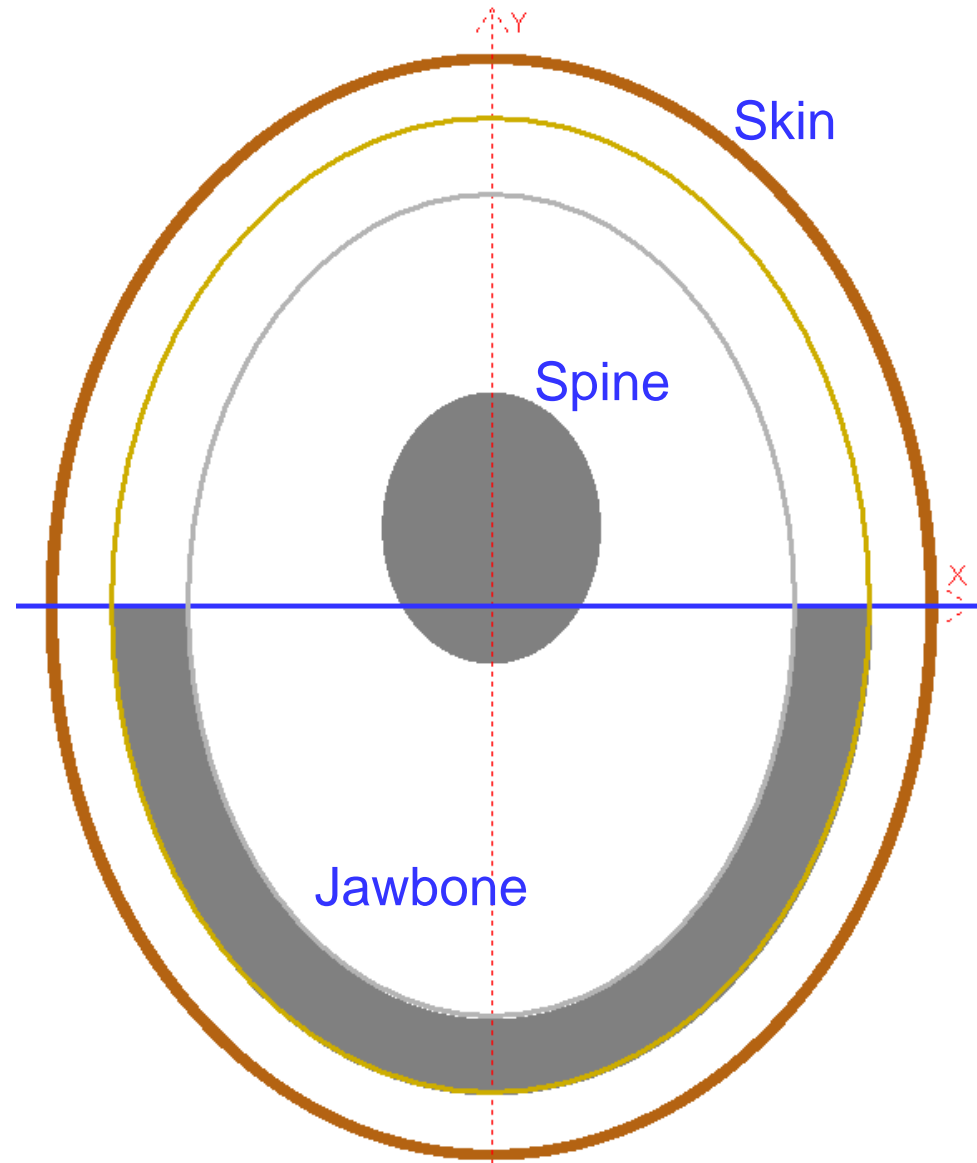
- Added models for
  - Parotid
  - Submandibular
  - Sublingual
- Each 1 (left + right) or 2 (l, r) distinct cells
- Started with descriptions from Moore & Dalley anatomy text
  - Augmented by CT images, diagrams
  - Refined during implementation





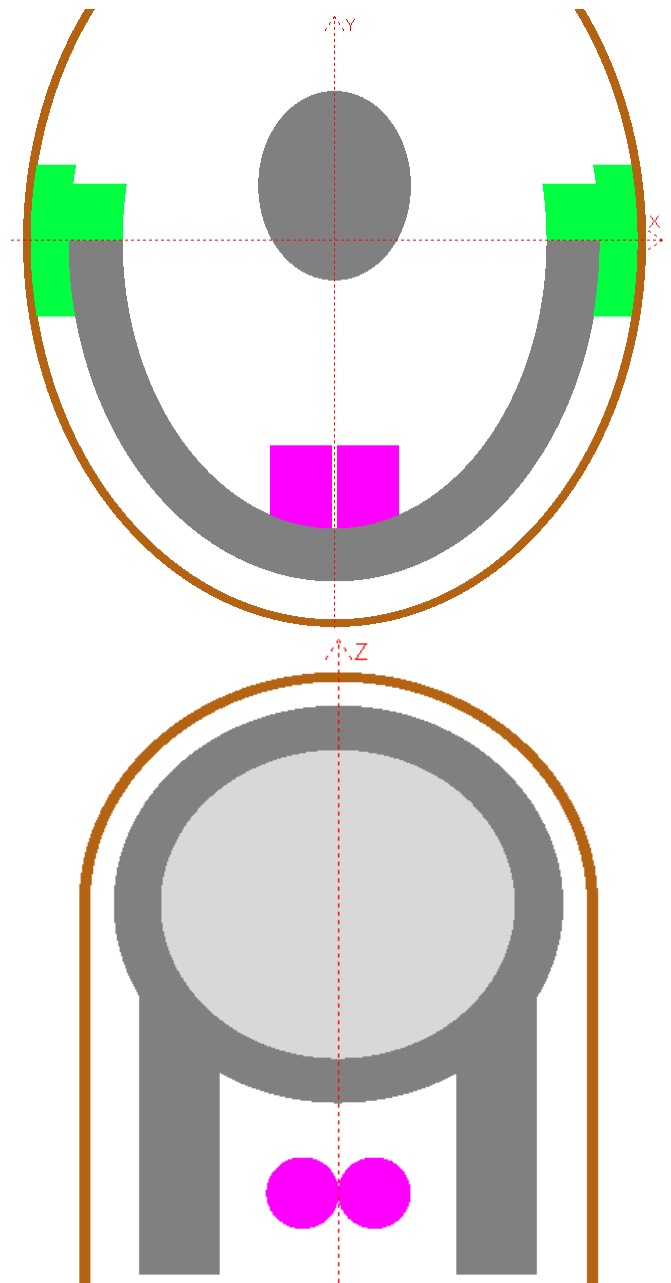
# Head Surfaces

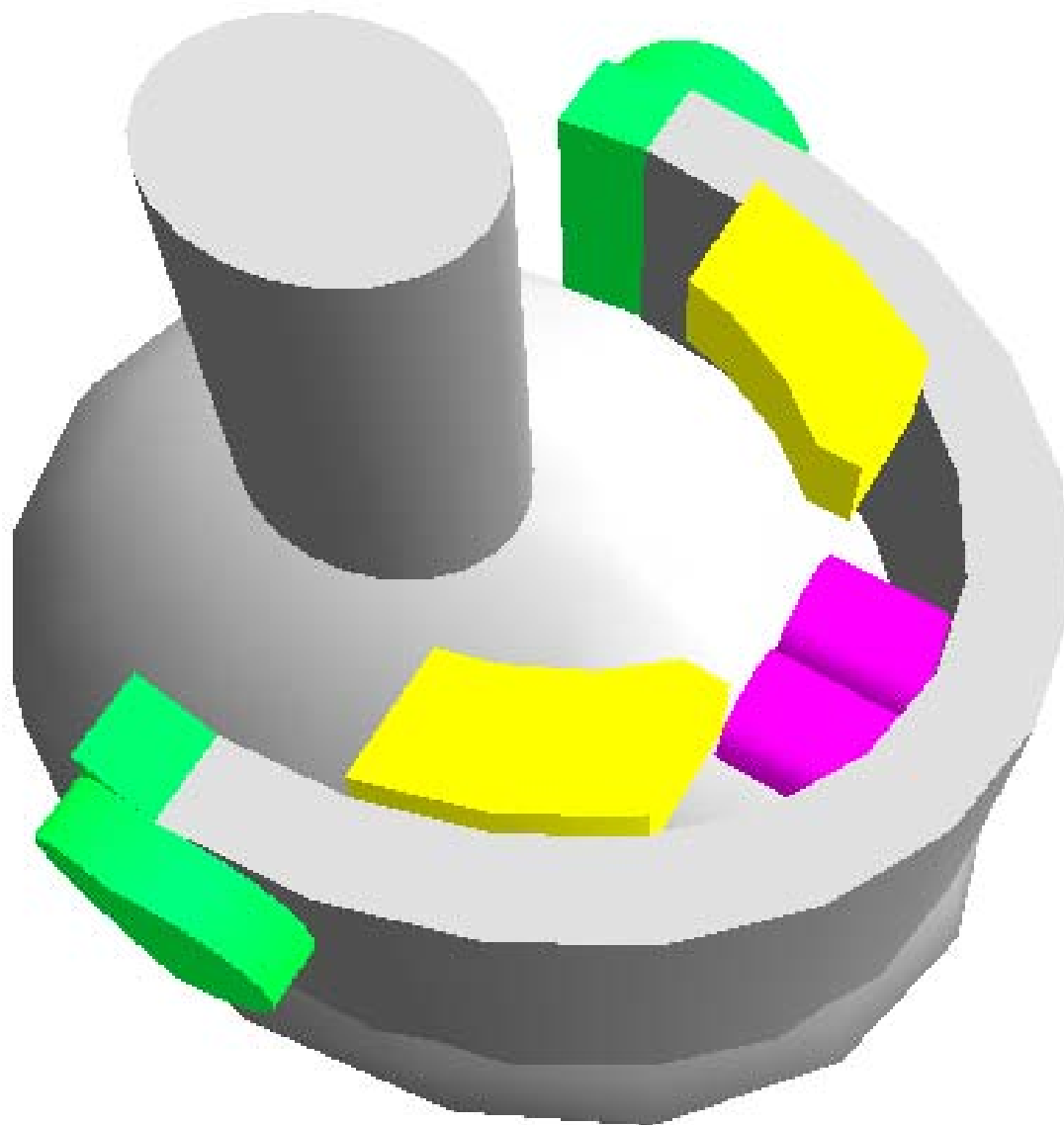
- Elliptical Cylinders bound components in lower head
- Coordinates
  - X lateral
  - Y towards rear
  - Z vertical



# Sublingual Glands

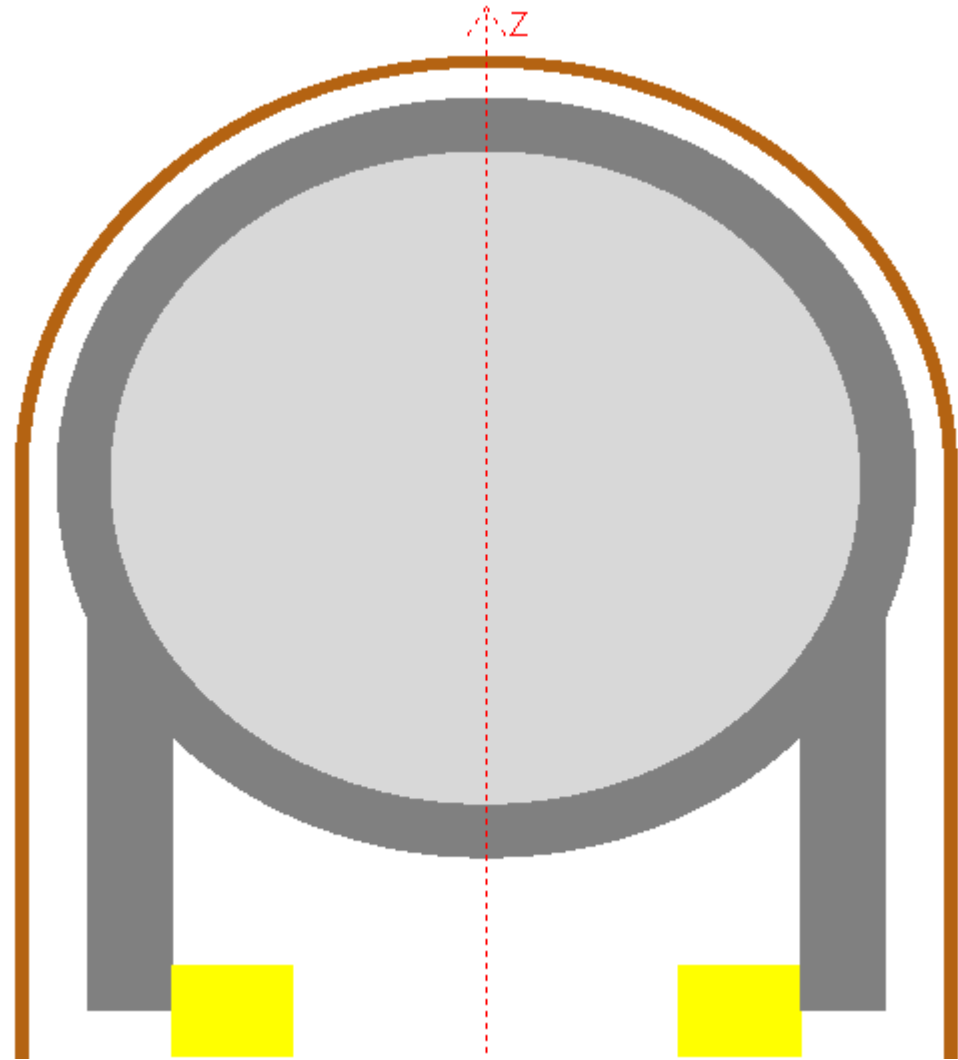
- 2 Y Cylinders tangent at  $X = 0$
- Center  $Z =$  top of spine
- Cylinders cut off by
  - Inner jawbone
  - Plane 2 cm in (for adult)





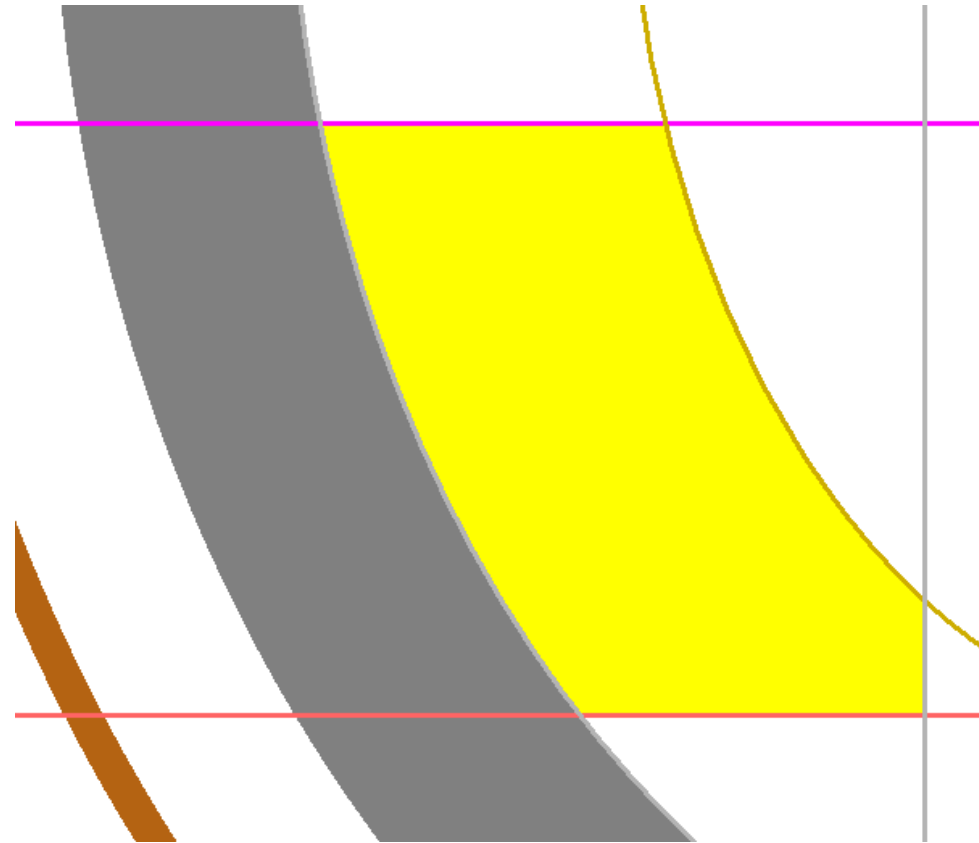
# Submandibular Glands

- Vertical Extent
  - Centered on lower edge of jawbone
  - Approximately 2 cm thick (adult value)

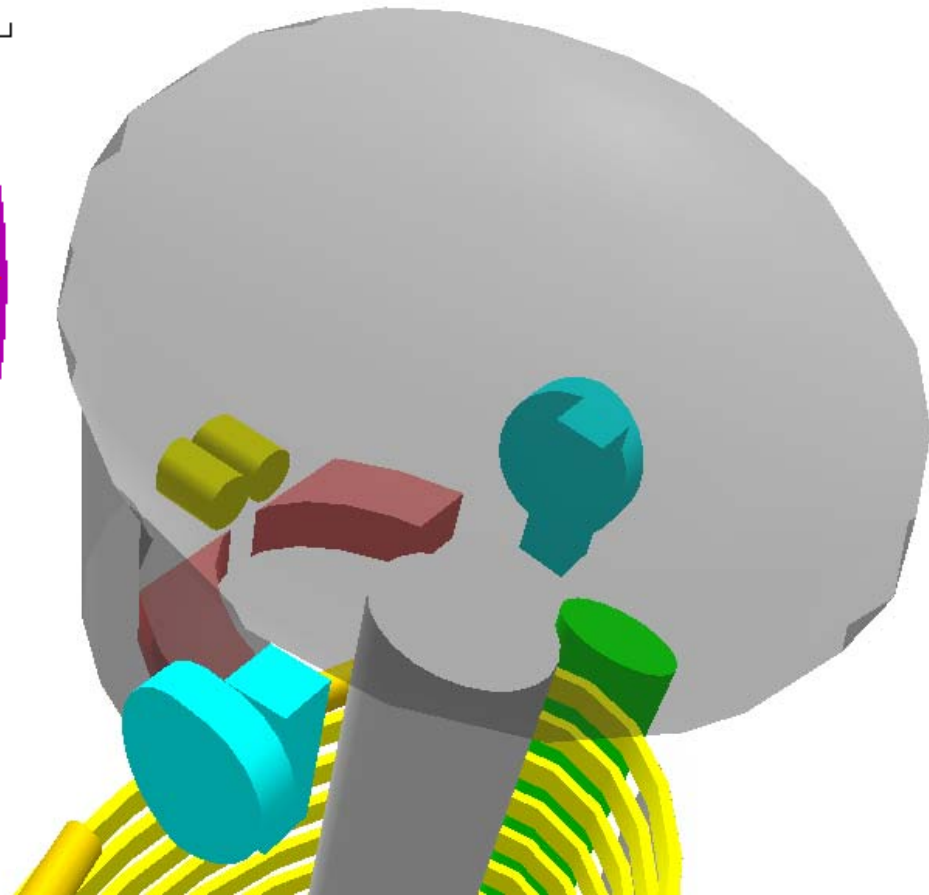
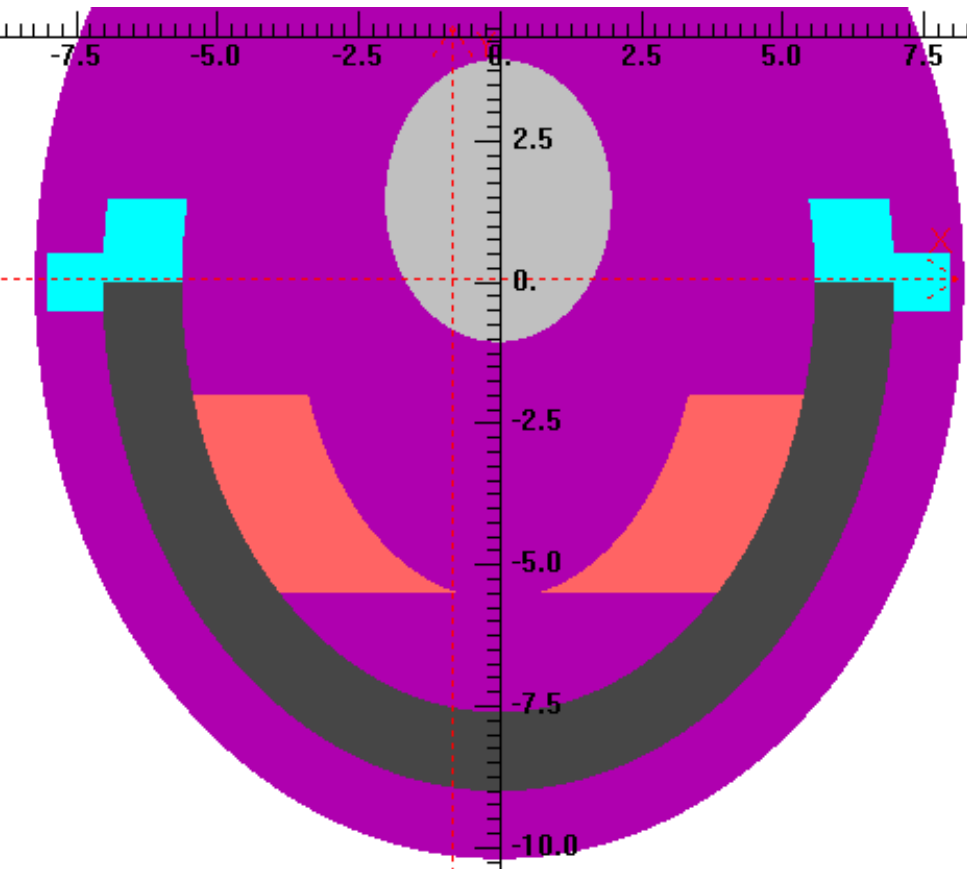


# Submandibular Glands

- Bounded by
  - Inner jawbone
  - Ellip. Cyl. w/ radii  
= inner jaw – 2 cm
  - $Y = -2$  cm
  - $Y = -5.5$  cm
  - $X = \pm 1.8$  cm



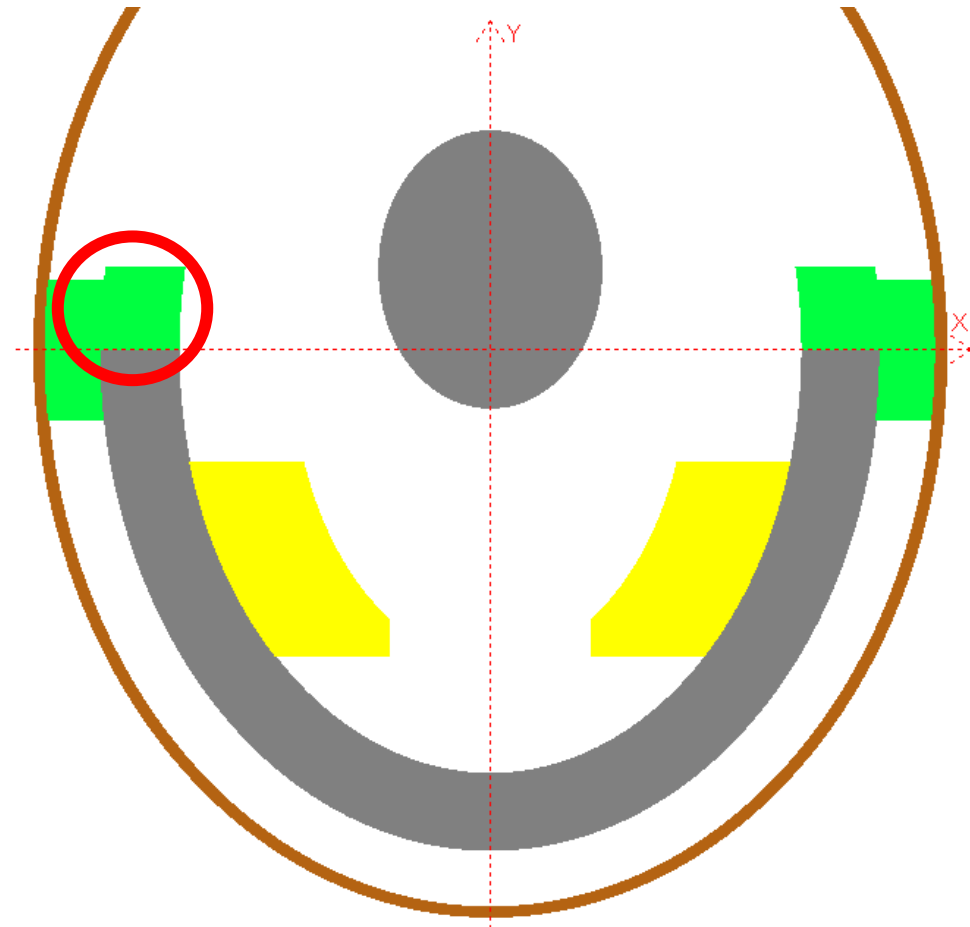
# Submandibular without X Plane





# Inner Parotid Glands

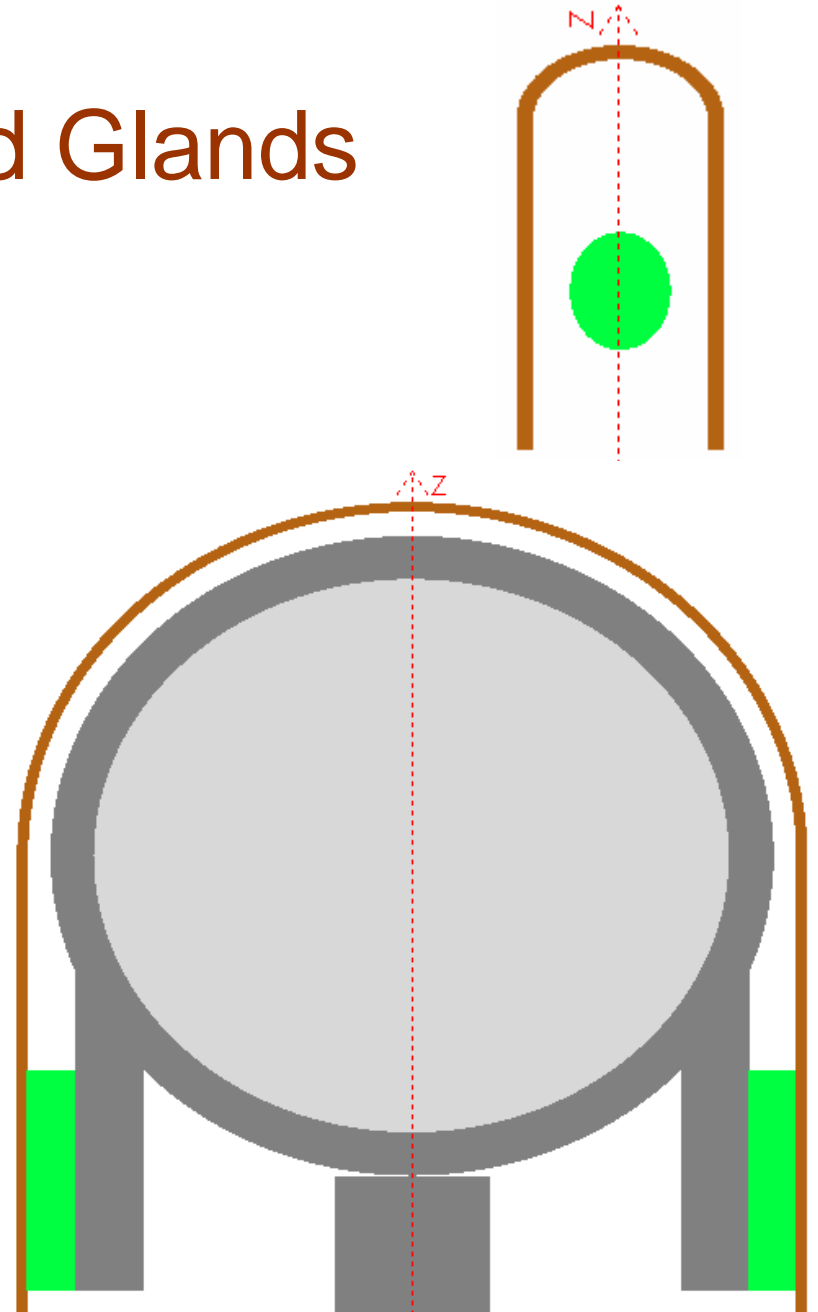
- Partoid: Inner & Outer parts (same cell)
- Inner boundaries
  - Jawbone cylinders
  - Jawbone rear ( $Y = 0$ )
  - $Y = 1.5$  cm
  - Bottom = Jawbone bottom
  - Height 4 cm (adult)

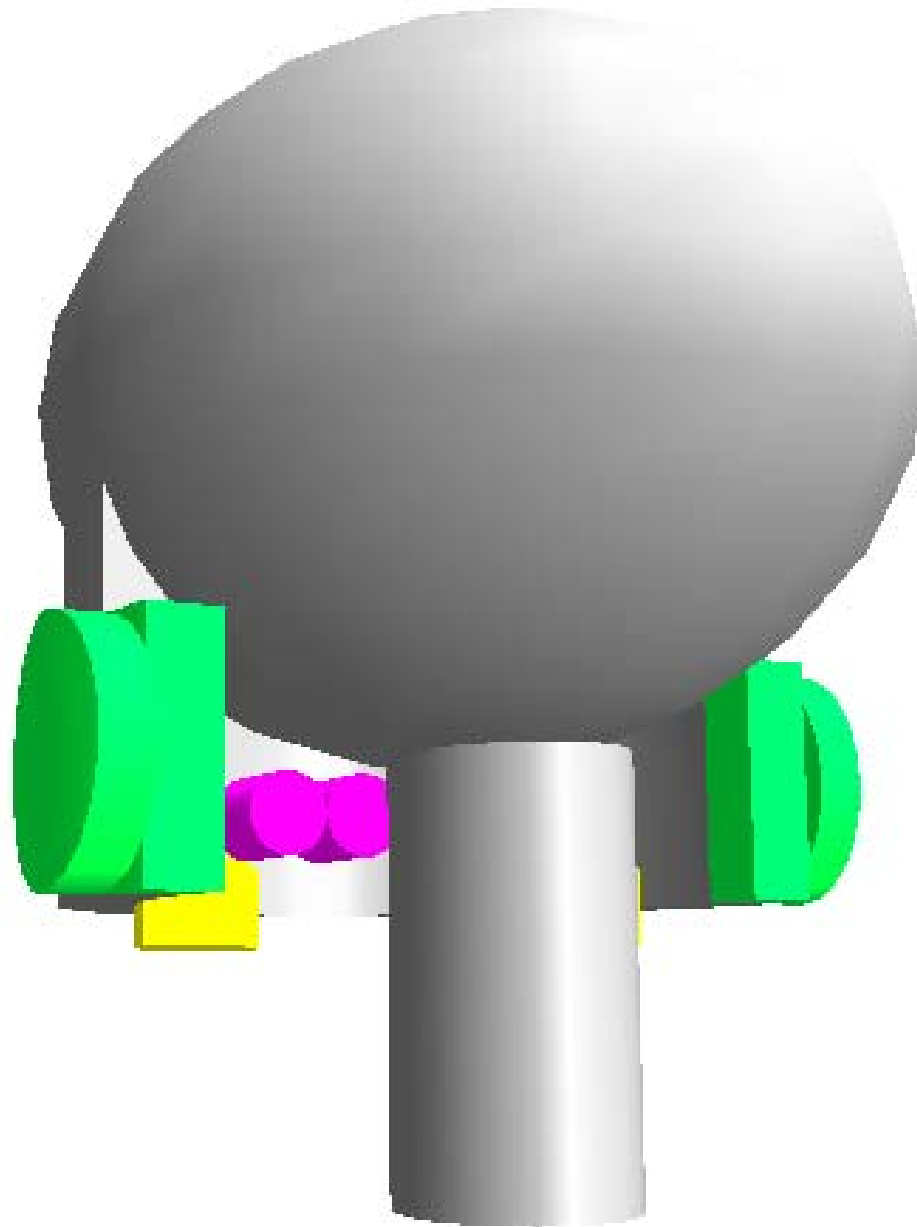


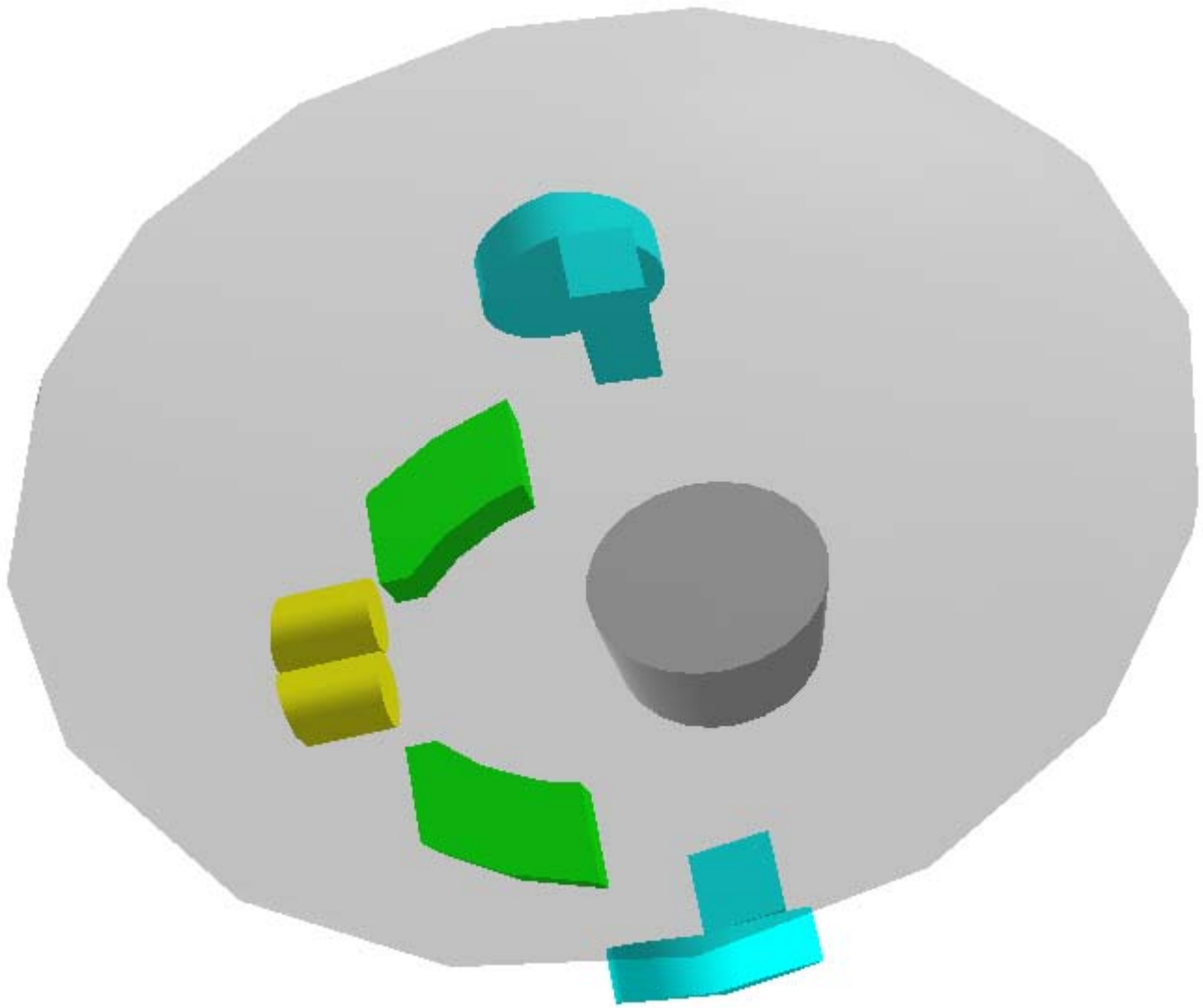


# Outer Parotid Glands

- Bounded by
  - Outer jawbone
  - Inner skin
  - X Elliptical cylinder
    - $r_z = 2.3$  cm
    - $r_y = 2$  cm
    - $Z_{\text{center}} = \text{Jaw bottom} + 2$  cm
    - $Y_{\text{center}} = \text{Jaw rear}$





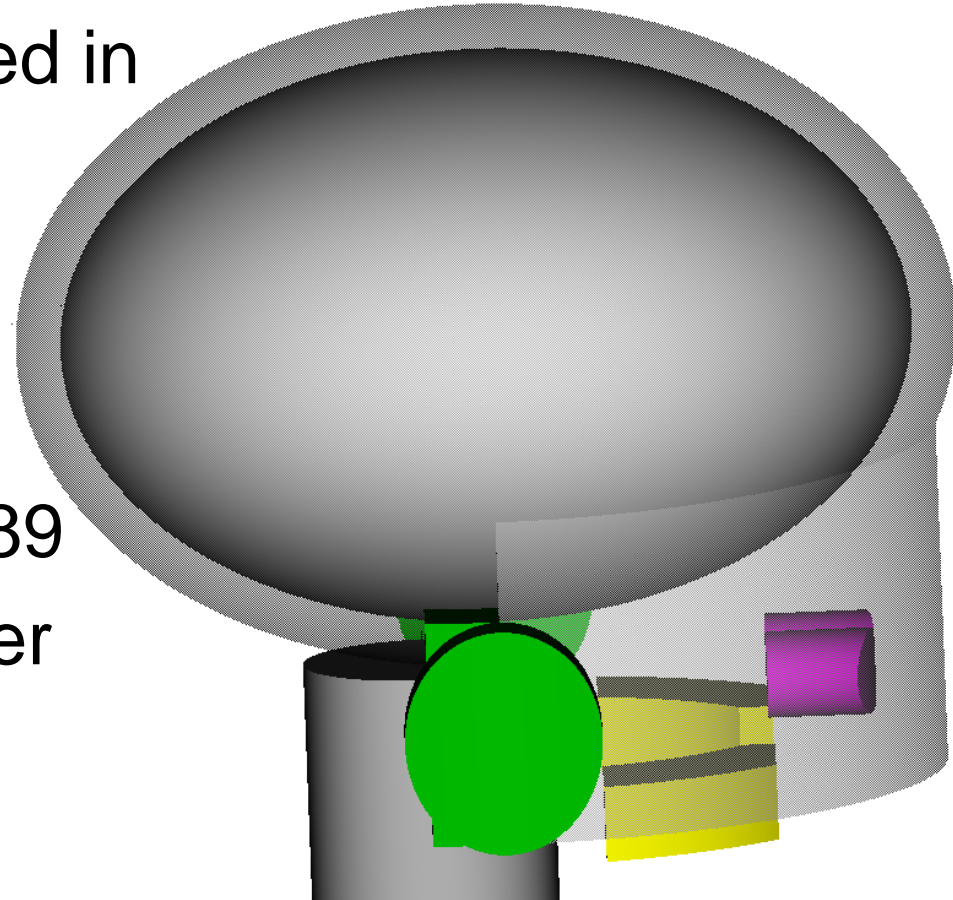


# Gland Volumes

- Volumes calculated with Moritz
- Adult dimensions adjusted to = ICRP 89
- 0, 1, 5, 10, & 15 year old
  - (BodyBuilder interpolates between ages)
  - Dimensions  $\times R_{\text{current}}/R_{\text{adult}}$ 
    - $R$  = Inner jawbone  $r_x$
  - Volumes calculated each age & adjusted to match ICRP 89

# Summary

- Salivary glands modeled in BodyBuilder
  - Parotid
  - Submandibular
  - Sublingual
- Volumes match ICRP 89
- Standard in BodyBuilder from version 1.31
- Ready for ...



# The Users



