

# Merging novel imaging technologies to understand muscle dynamics in monkey mouths

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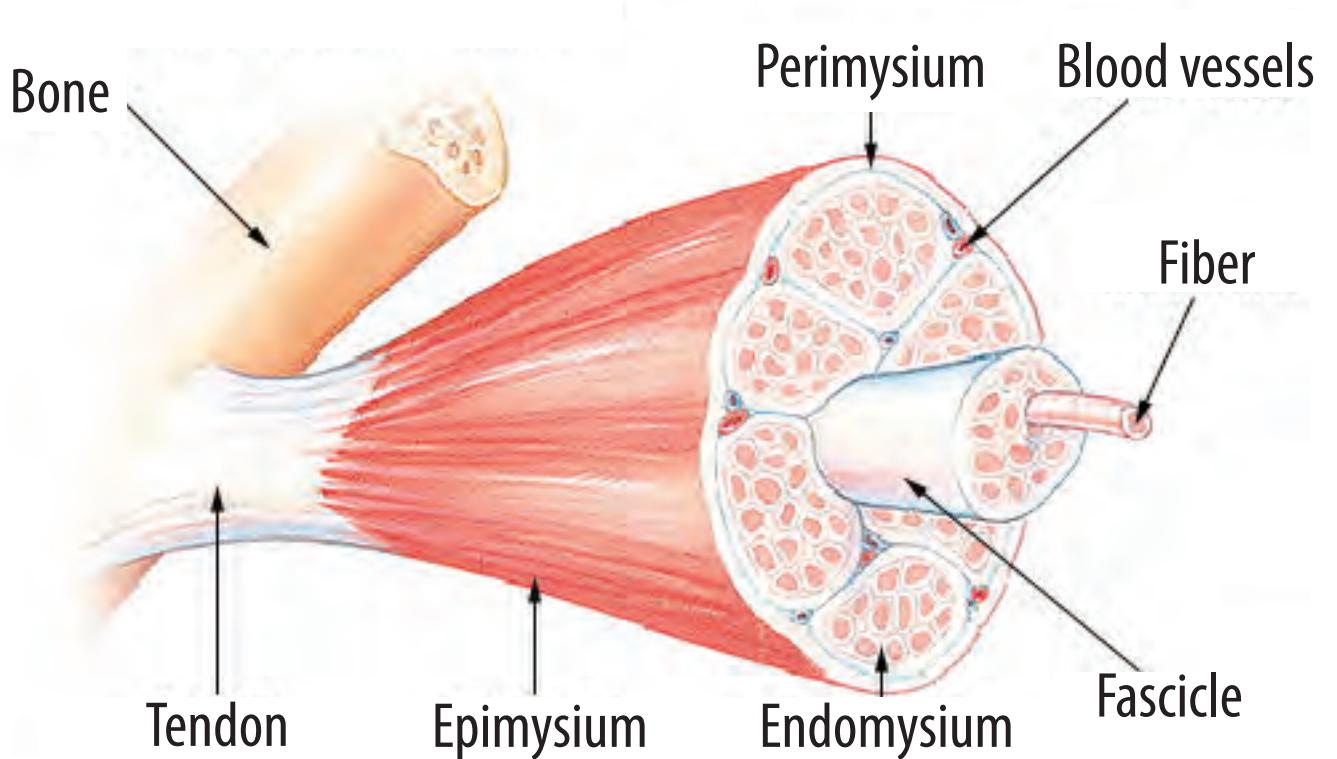
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## Research question

How do whole muscles behave during feeding?

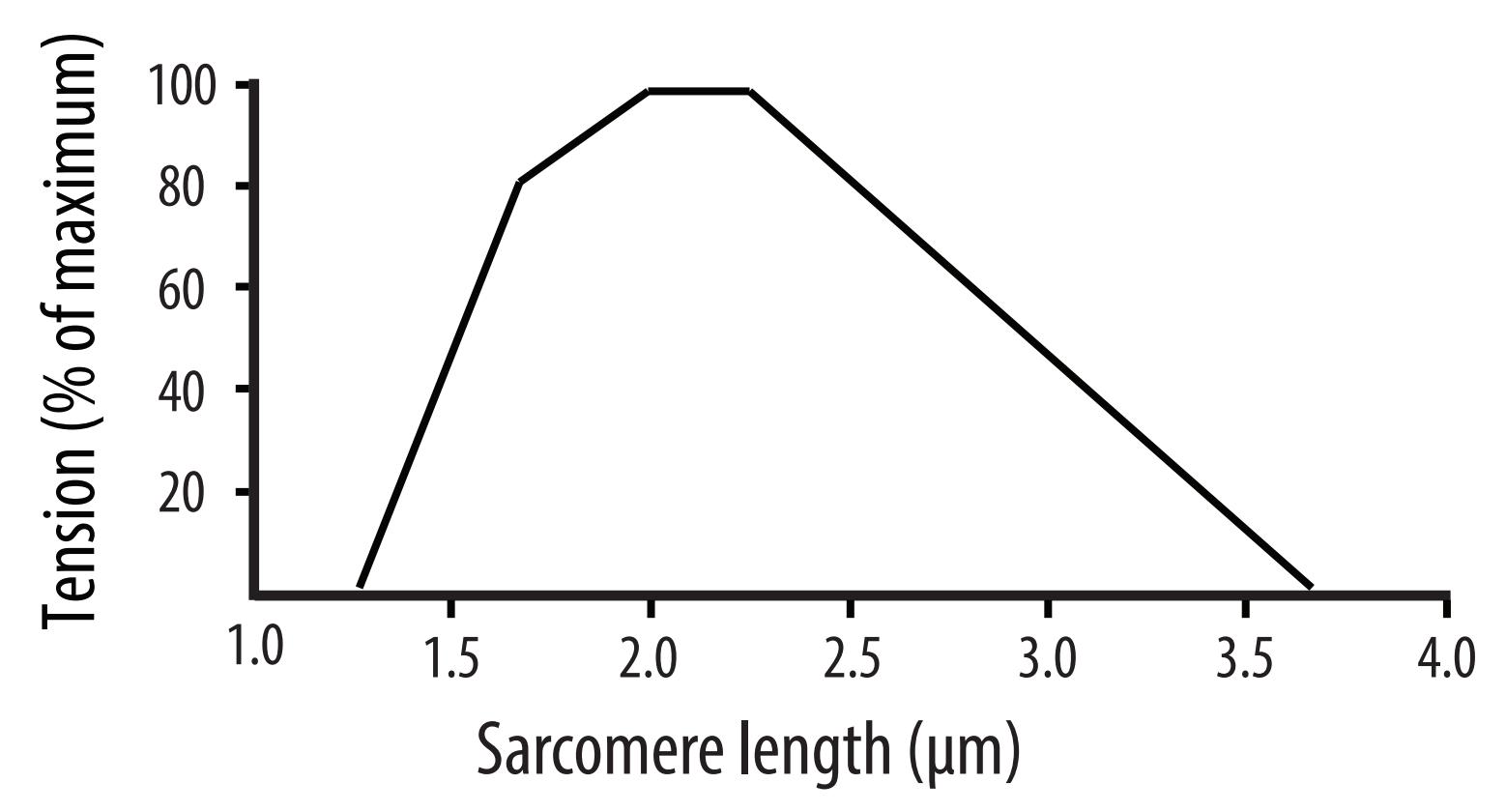
## Muscle 101

### Skeletal muscle anatomy



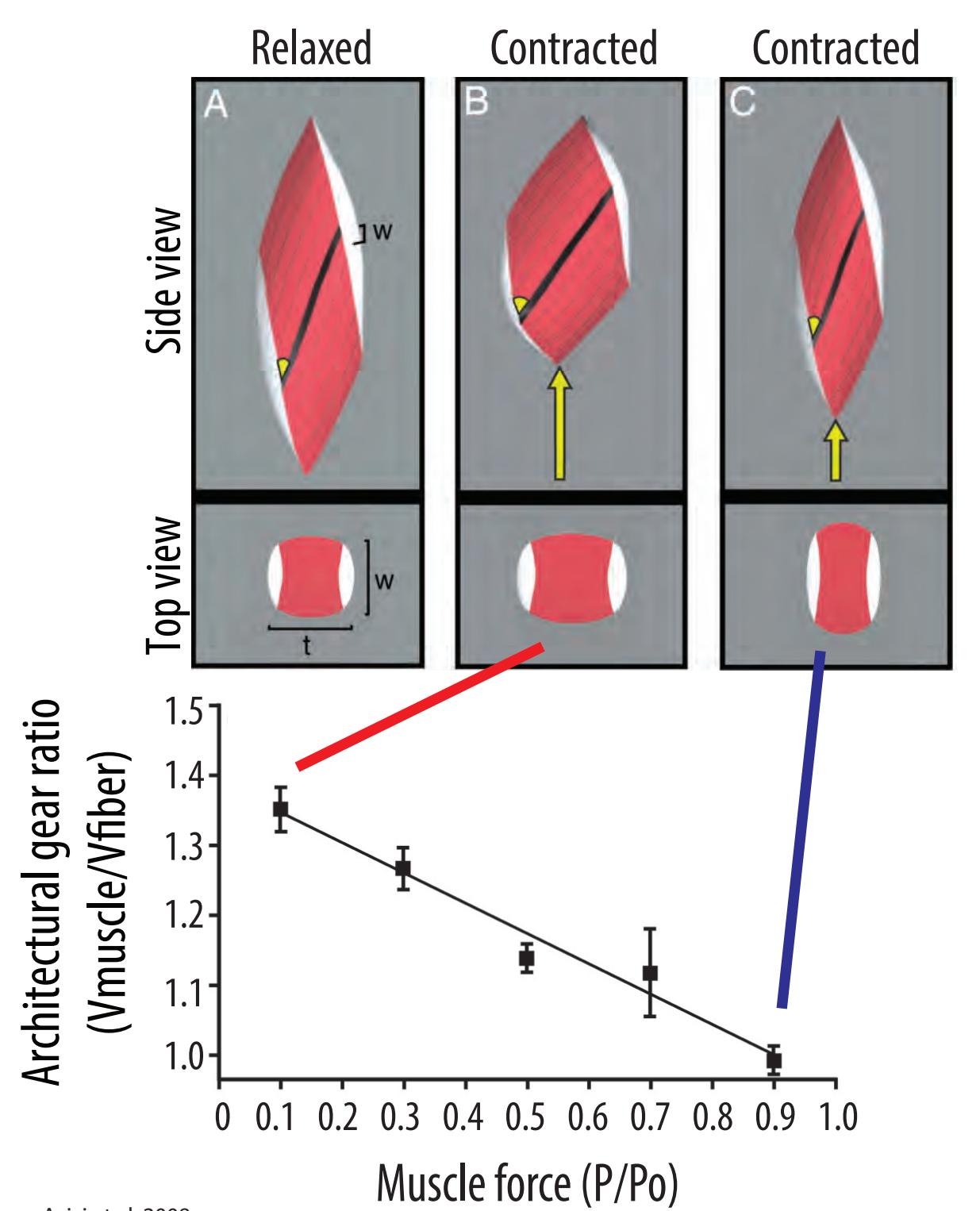
### Muscle force is length-dependant

Force is maximal at an intermediate length and declines as a muscle's fibers are either stretched or shortened.



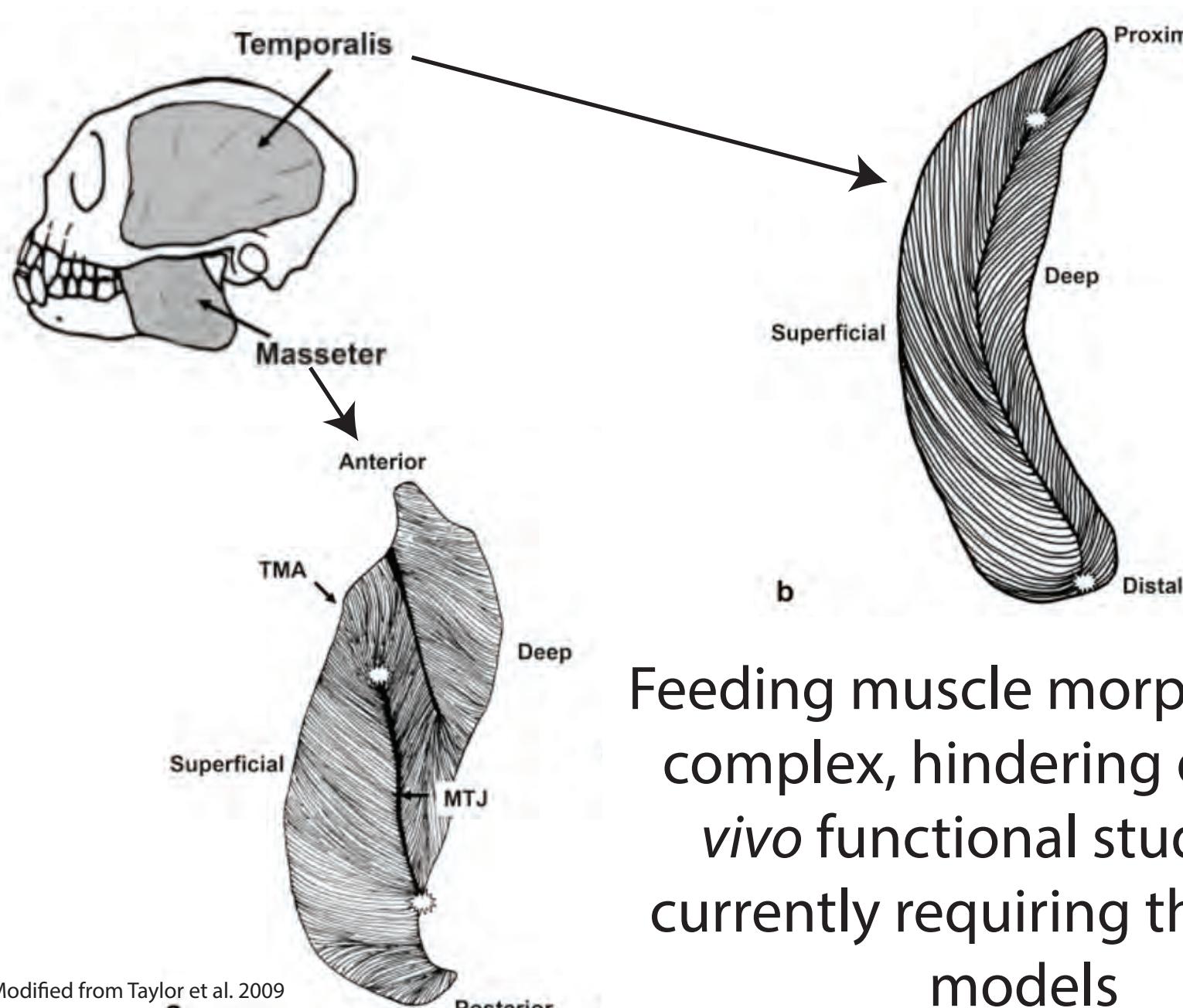
### Muscles change shape (bulge)

If muscle fibers rotate during contraction, the ratio of whole-muscle shortening to muscle fiber shortening is not constant



Therefore, the pattern of bulging effects muscle force output

## Feeding muscle architecture

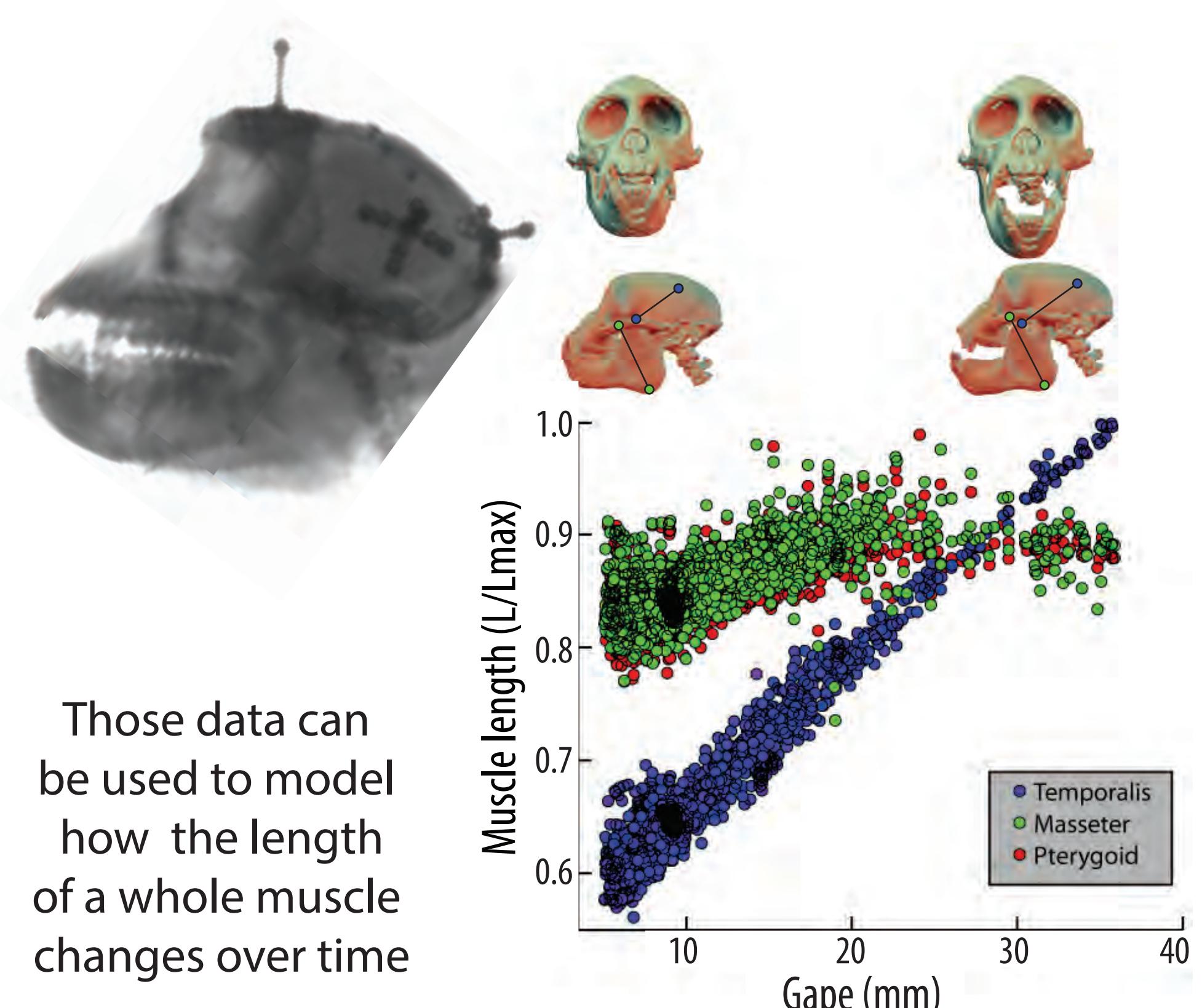


Feeding muscle morphology is complex, hindering direct *in vivo* functional study and currently requiring the use of models

## Whole muscle length models

### X-ray Reconstruction of Moving Morphology

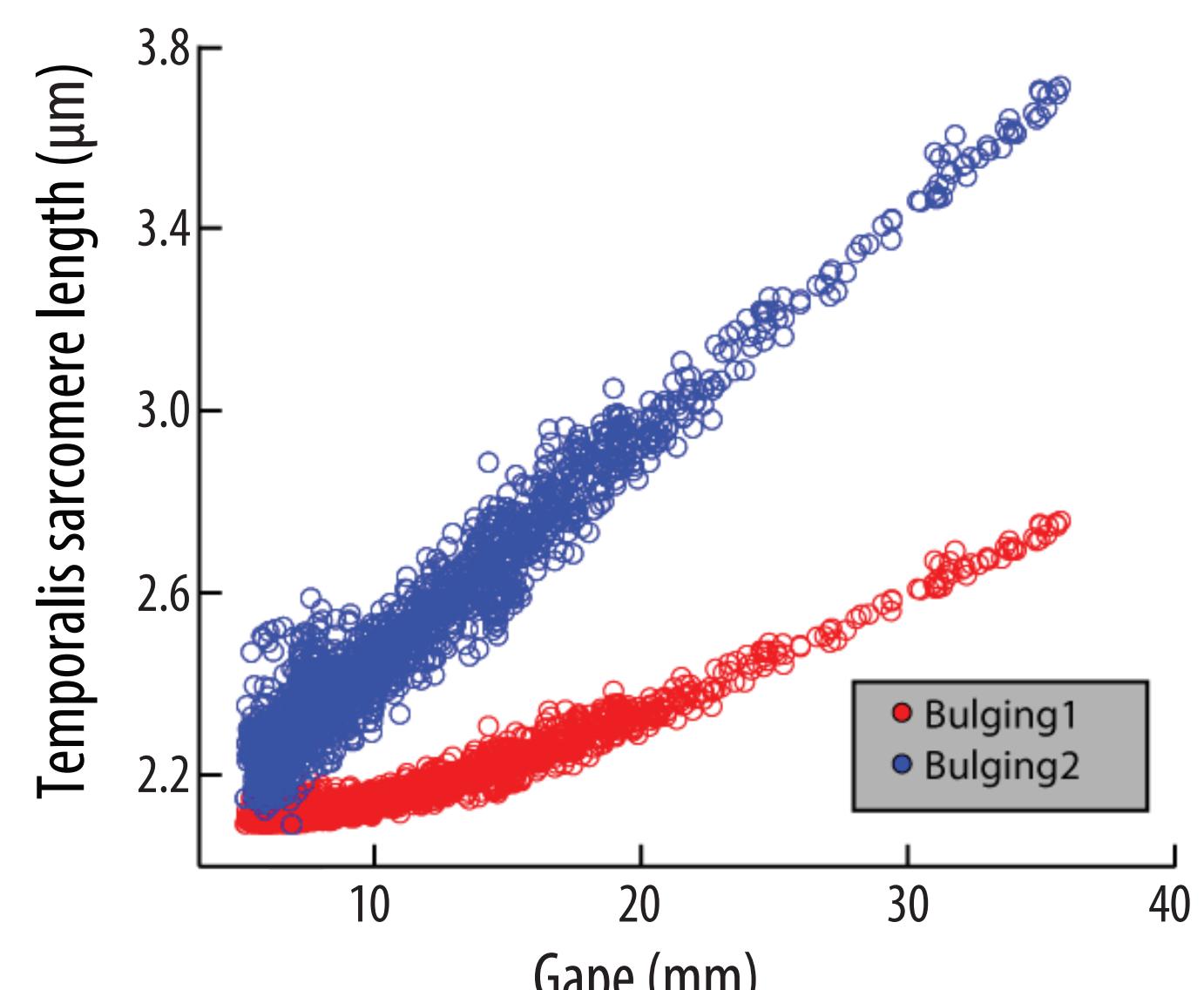
A new technology at UC that merges CT scans and x-ray videos to precisely measure how bones move *in vivo*



## Muscle fiber length models

### Extremes of bulging are not physically possible

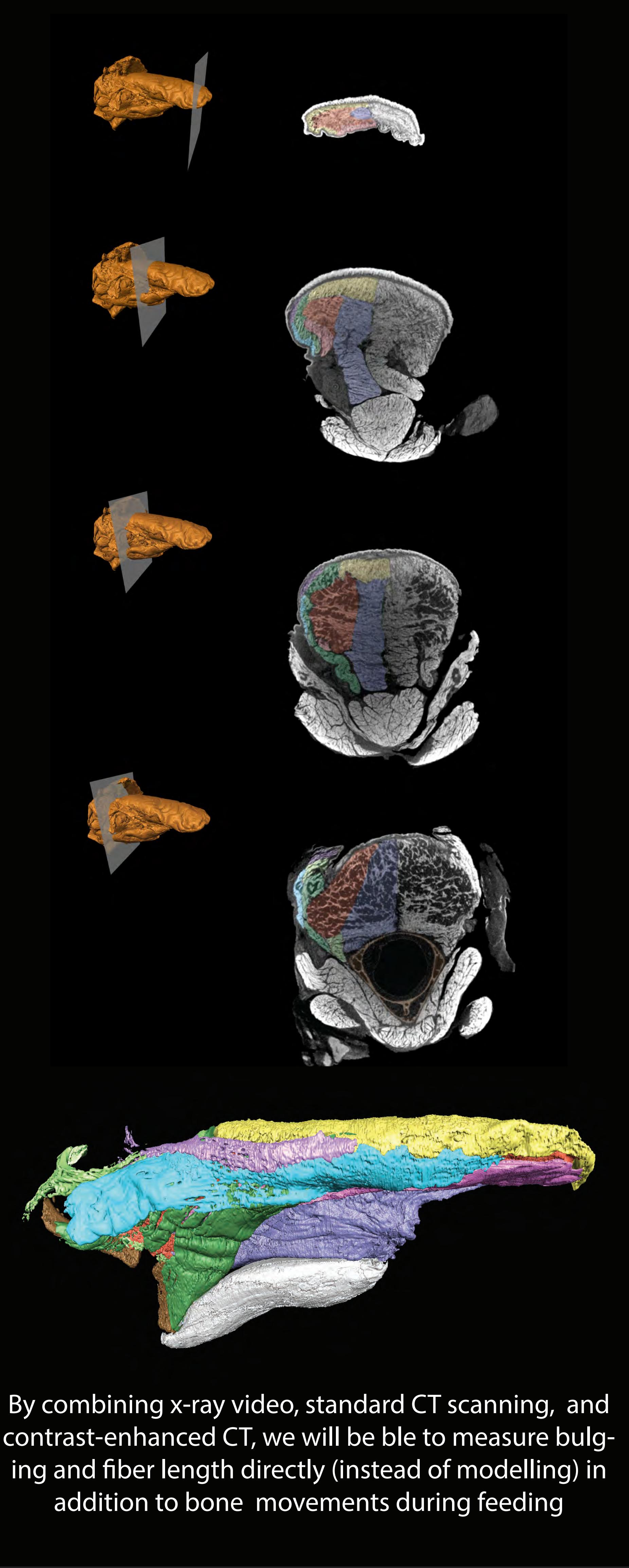
Stretching from 2.1 microns to 3.8 damages muscle



## Direct measurement through a novel combination

### Diffusible iodine-based contrast-enhanced CT

Permits high-resolution study of muscle architecture, even in structures as complex as the tongue. Compute nodes on Midway have been invaluable for analysis of these morphological datasets



By combining x-ray video, standard CT scanning, and contrast-enhanced CT, we will be able to measure bulging and fiber length directly (instead of modelling) in addition to bone movements during feeding

## How does RCC help with our data?

### Problems

### Solutions

#### Volume

Hours of high-resolution video from two high-speed x-ray cameras from each individual translate into terabytes of video data per individual, with several individuals on each of several studies.



The RCC has organized direct downloading of our video data from the computers that collect them automatically and securely stores data while maximizing accessibility

#### Management

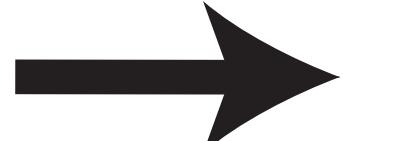
Several calibration files, muscle activity data, brain wave data and other datastreams are recorded in synchrony with the videos



The RCC is creating a custom-made client that will keep each trial's data organized and expedite entry of metadata for each trial

#### Logistics

Different facilities used for data acquisition and analysis, and data shared with collaborators at several institutions



Midway server allows access to data both on and off campus

#### Analysis

Historically, analytical tools require human input at almost every step, from extracting marker coordinates to calculating bone movements to registering marker locations within CT scans. Each step is hugely time-consuming



Our collaborating institutions have automated some analytical tools, but upload to their servers has been completely manual. The RCC is working with their programmers to automate and streamline our use of their tools.

## Acknowledgements

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## References

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