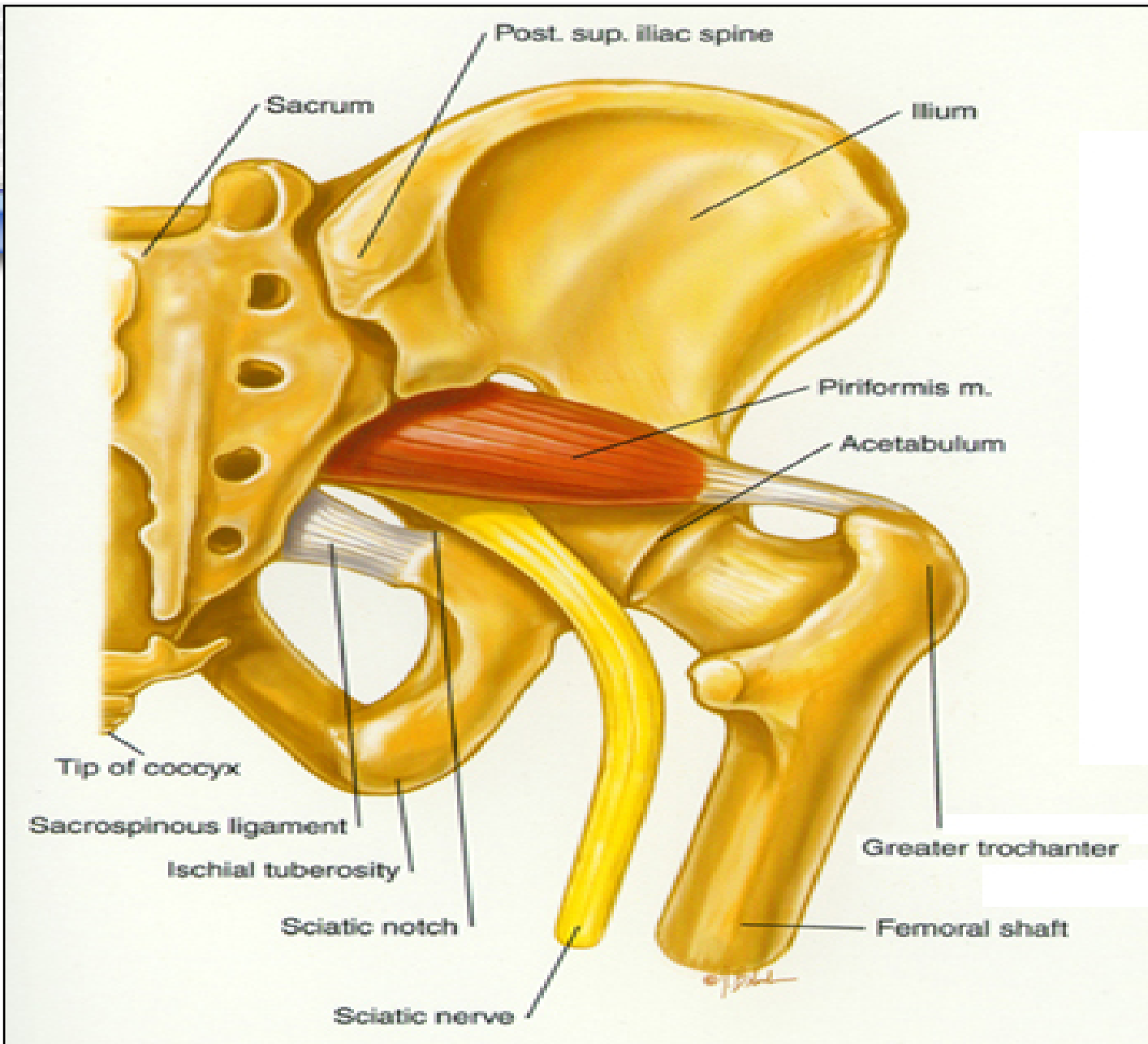


Piriformis Muscle: Anatomical Comparison of Effective Stretches Using Computed Tomography

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Introduction

- Piriformis Syndrome Pathology
 - ◆ Sciatic Nerve entrapment
 - ◆ Trigger/Tender Points
 - ◆ Tension from Pelvic Obliquity
- Hallmark for Conservative Management:
 - ◆ Stretching

Summary of Literature Review

- Limited research on optimal stretching
- Lack of consensus regarding stretch positions
- No research regarding the sequencing of stretch components
- Clinically, piriformis stretches are chosen based on clinical expertise rather than evidence-based practice

Previous Studies

- Pilot Study (2006)-used flouroscopy without adduction component
- Recommendations for present study
 - ◆ Computerized Tomography
 - ◆ Adduction Component of Stretch
 - ◆ Sequencing of Stretch Components
- Power Analysis in 2007 revealed that a minimum of 6 subjects are needed

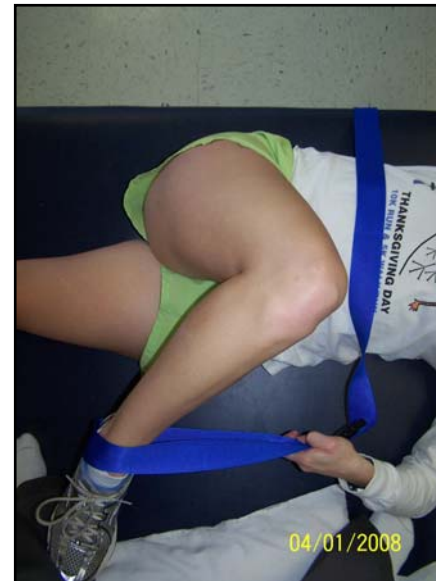
Purpose of Study

To measure the piriformis muscle and its relative change in length during various stretch positions using computerized tomography and biomodeling software.

2 Stretch Positions

- **“Stretch ADD”**
 - ◆ Hip flexion (90°)
 - ◆ Add (maximum)
 - ◆ ER (available)

- **“Stretch ER”**
 - ◆ Hip flexion (90°)
 - ◆ ER (maximum)
 - ◆ Add (available)



Hypothesis

- “Stretch ER” will yield a greater stretch than “Stretch ADD”
 - ◆ Based on subjective stretching
 - ◆ Based on observation of photos

Subjects

- Inclusion Criteria

- ◆ Female (3)
- ◆ 5'5" or less
- ◆ 20-30 y/o
- ◆ < 150 lbs.
- ◆ Ample flexibility to fit in CT machine

- Exclusion Criteria

- ◆ Smokers
- ◆ Radiation exposure in last year beyond a standard dental exam
- ◆ Known hip pathology
- ◆ Pregnant or planning to become pregnant within 6 mo.

Methods: Instrumentation

- General Electric LightSpeed Volume Computed Tomography
- 64 slice machine
- Two dimensional views



Methods: Procedure

- Three positions measured
 - ◆ Supine
 - ◆ “Stretch ADD”
 - ◆ “Stretch ER”
- Designated researcher performs goniometric measurements of hip flexion, add, ER
- Stretch positions held for the entire scan by the subjects with the aid of a strap

Methodology

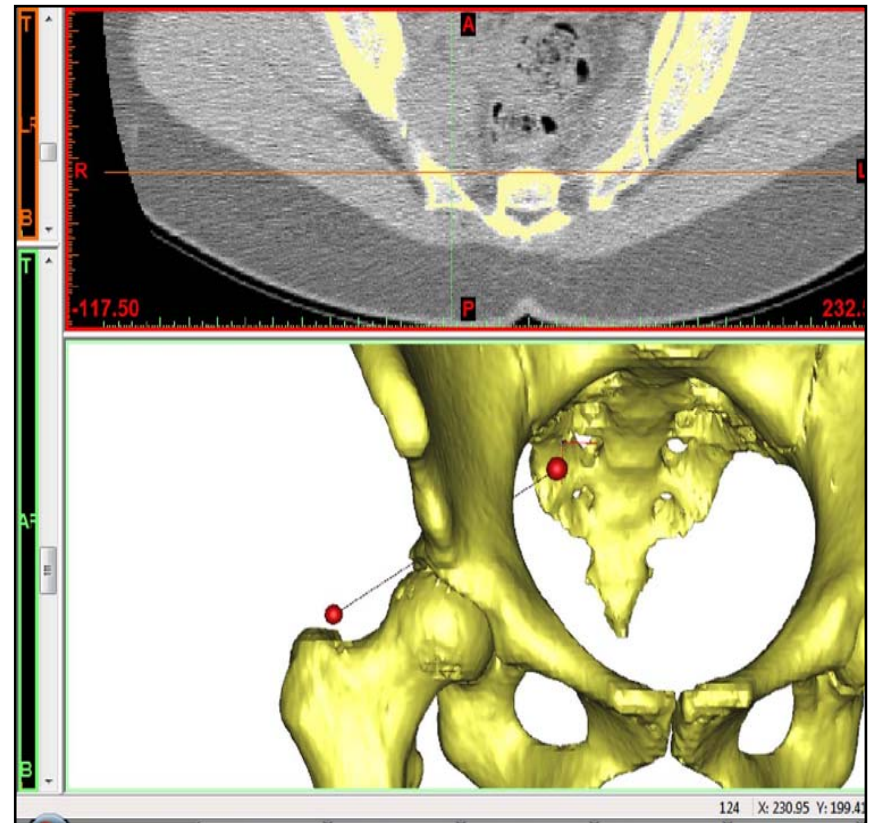


Methods: Measurement/Analysis

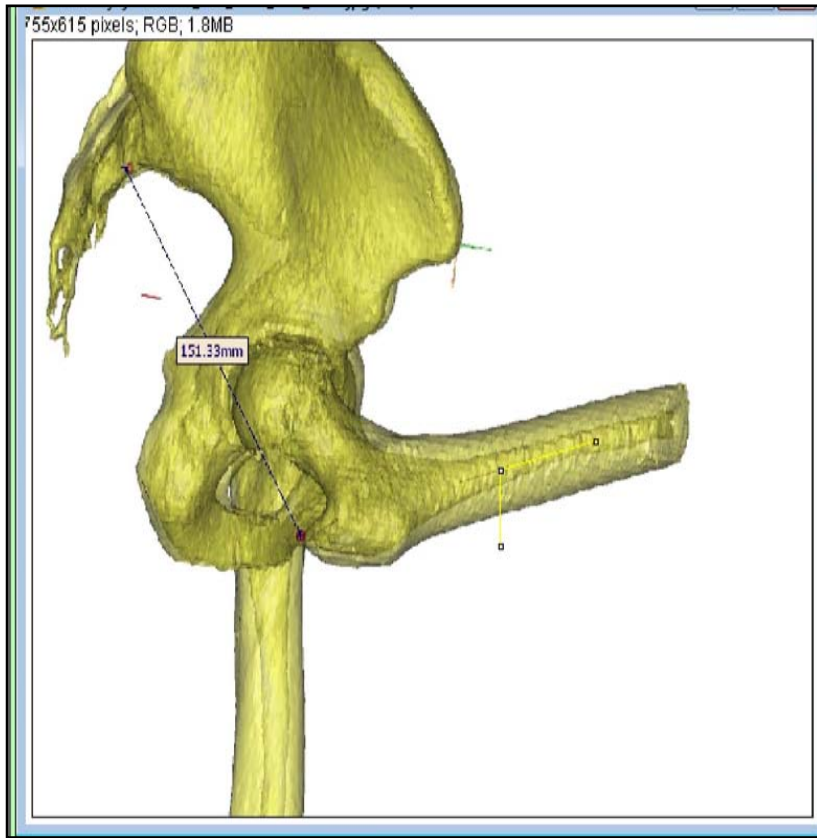
- CT scans-->Dicom images-->3-D images
- *Mimics*, biomodeling software program
- Analyzed by Dr. Marcellin-Little for musculoskeletal alignment
- The 3-D images can then be modified to study different joint positions
- Analysis: One-Way ANOVA corrected for repeated measures to compare different stretch positions.

Measurement of Piriformis

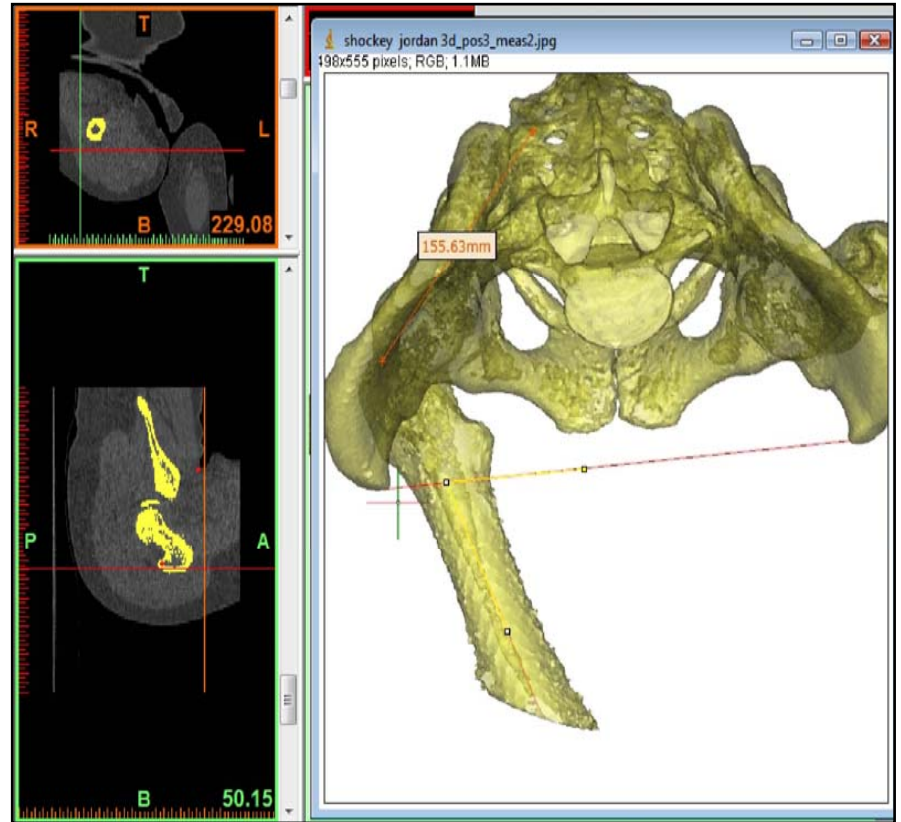
- Muscle length was calculated by *Mimics* using the distance between 2 spheres which represented the proximal and distal bony attachments of the piriformis
 - ◆ Proximal
 - ◆ Distal



MIMICS



“Stretch ER”



“Stretch ADD”

Goniometry

Subjects	“Stretch ER”	“Stretch ADD”
1	ER 65° ADD 37°	ADD 50° ER 35°
2	ER 67° ADD 35°	ADD 52° ER 33°
3	ER 68° ADD 36°	ADD 55° ER 50°
4	ER 73° ADD 43°	ADD 50° ER 40°
5	ER 68° ADD 40°	ADD 55° ER 42°
6	ER 65° ADD 32°	ADD 48° ER 35°

Length Measurements

*Hypothetical Data

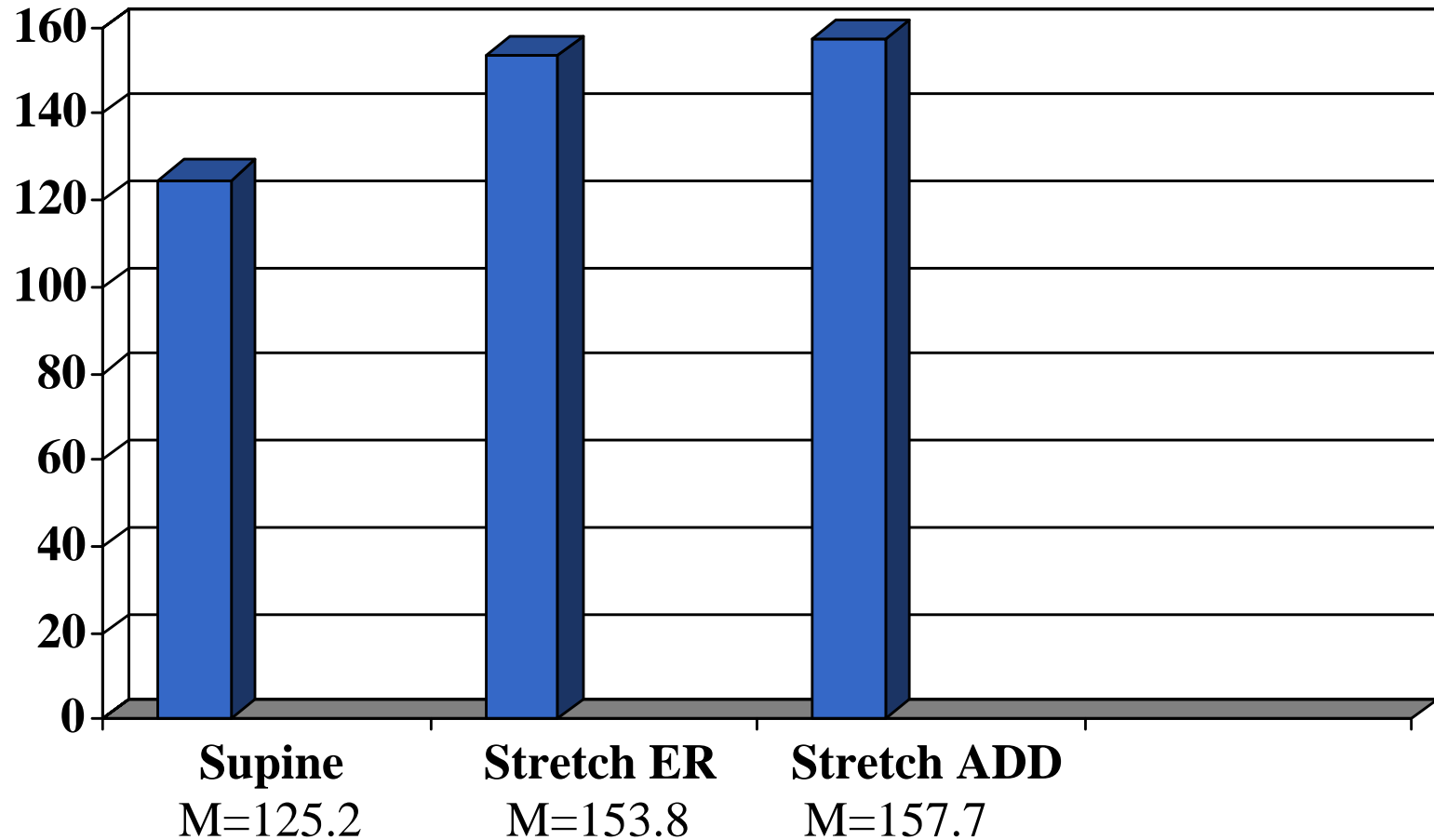
Subjects	Supine	“Stretch ER”	“Stretch ADD”
1	124 mm	151 mm 22% difference	156 mm 26% difference
2	126 mm	156 mm 24% difference	159 mm 26% difference
*3	125 mm	154 mm 23% difference	158 mm 26% difference
*4	126 mm	153 mm 21% difference	157 mm 25% difference
*5	123 mm	152 mm 24% difference	155 mm 26% difference
*6	127 mm	157 mm 24% difference	161 mm 27% difference

Statistical Results

*Hypothetical Data

- Supine to “Stretch ER” ($p < 0.01$)
- Supine to “Stretch ADD” ($p < 0.01$)
- Comparison of “Stretch ER” and “Stretch ADD” ($p = 0.014$)
 - ◆ Greater change in muscle length for “Stretch ADD”

Piriformis Length



Summary of Results

“Stretch ADD” >

“Stretch ER”



Study Critique

- Strengths

- ◆ Use of CT & Mimics to analyze piriformis lengths
- ◆ Same clinician performing measurements on subjects
- ◆ Practice session & 5-minute warm-up

- Limitations

- ◆ HYPOTHETICAL DATA
- ◆ Still awaiting results from 5 subjects
- ◆ Difficulty maintaining position during scan
- ◆ Homogeneous sample
- ◆ Healthy subjects

Conclusion

- The questions still remains. . .the research is not complete
- Both stretches resulted in lengthening of piriformis and are clinically applicable
- Once research is complete, study may provide evidence-based rationale for specific piriformis stretch

Future Studies

Using MIMICS biomodeling software, the existing data can be manipulated for different stretch positions



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Questions?