

EFFECT OF VASTI ACTIVATION ON MEDIAL AND LATERAL TIBIOFEMORAL JOINT

Image Redacted

Presented by Brad Meccia

Asymmetric loading of polyethylene leads to wear.

Videos Redacted

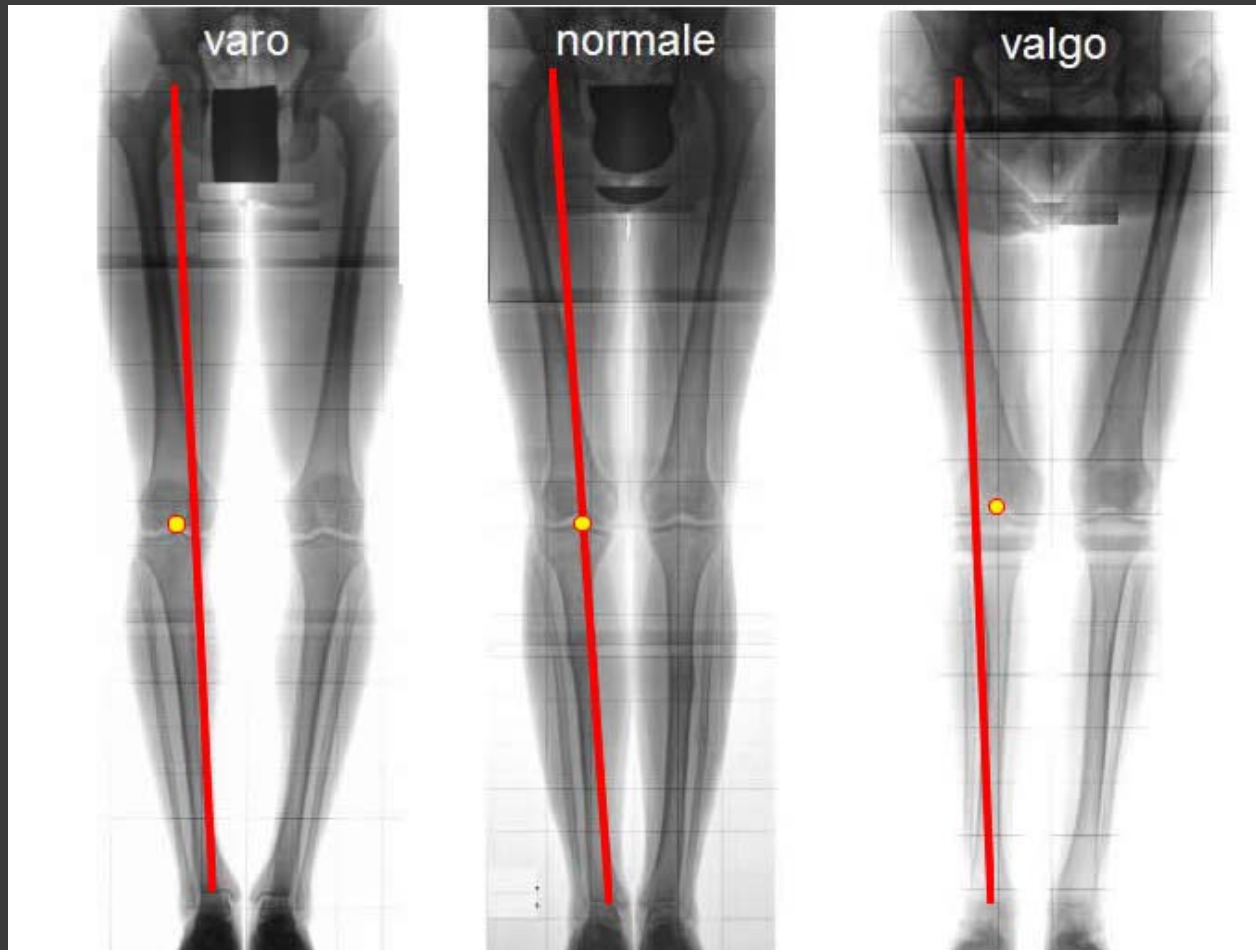
RP implants help with this problem by allowing the cam and post to stay flush

Videos Redacted

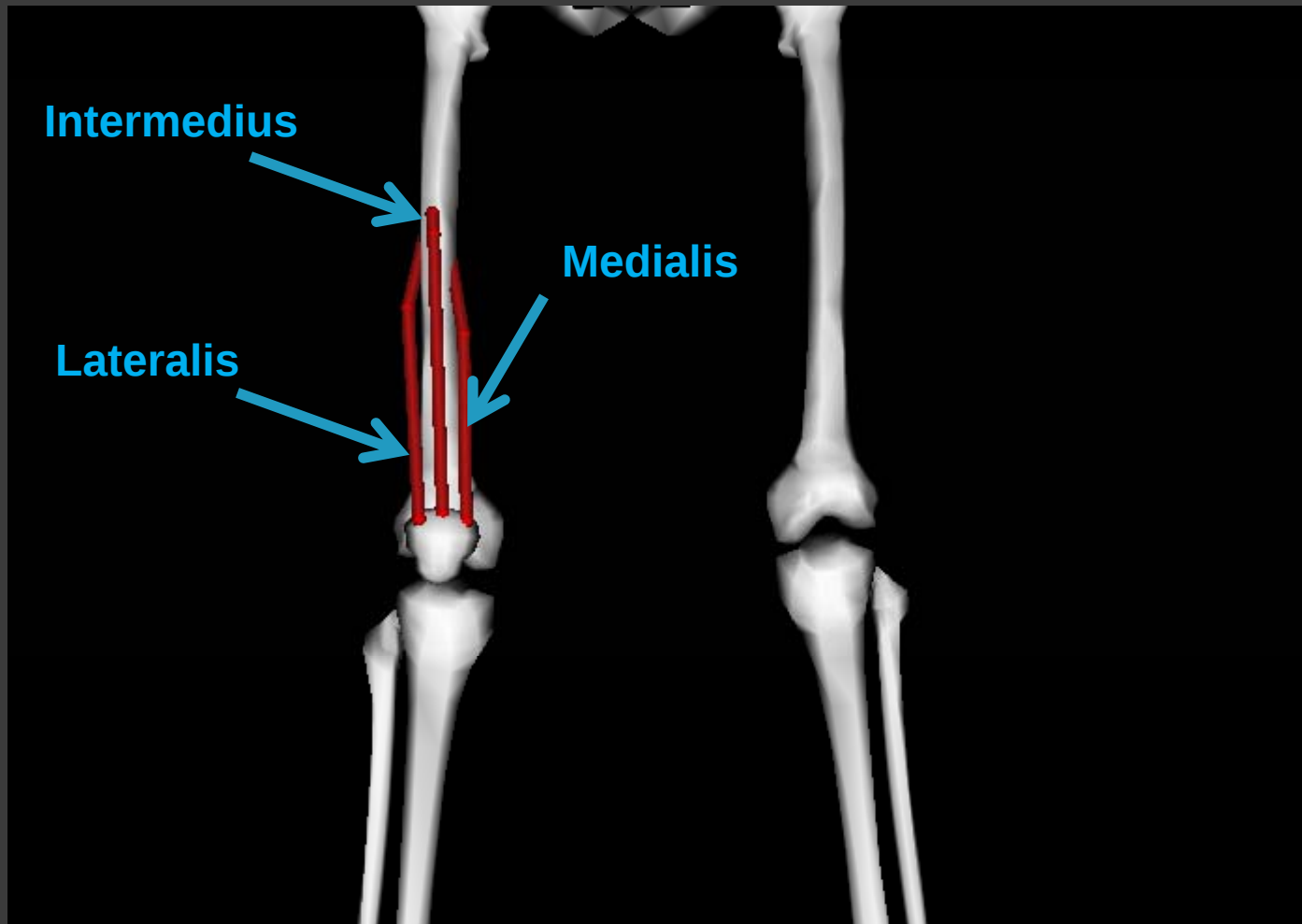
The rotation of the polyethylene is driven by the medial and lateral normal and shear forces.

Videos Redacted

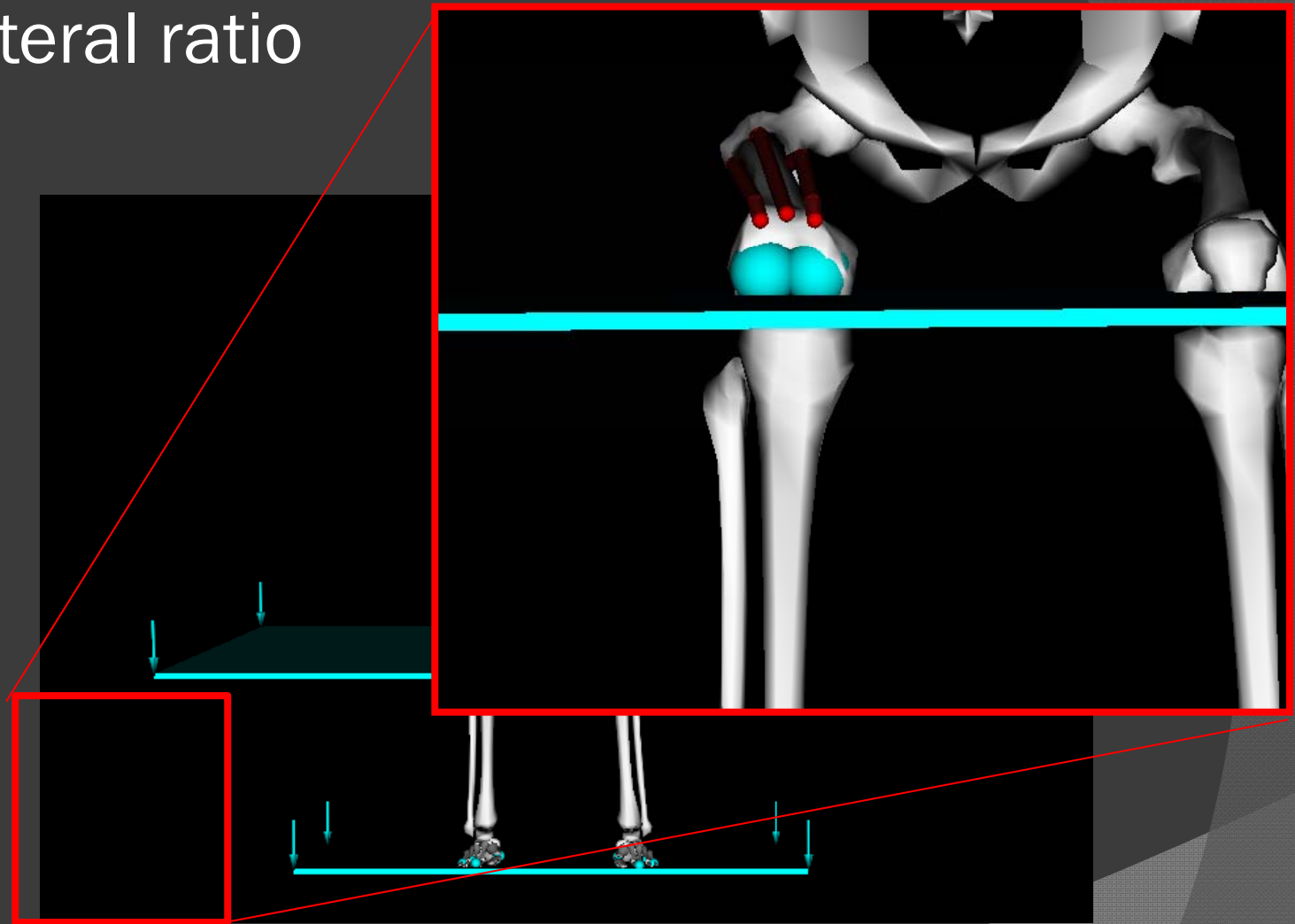
Traditionally, the mechanical axis used to control medial/lateral force ratio.



Hypothesized that vasti activation also influences medial/lateral ratio



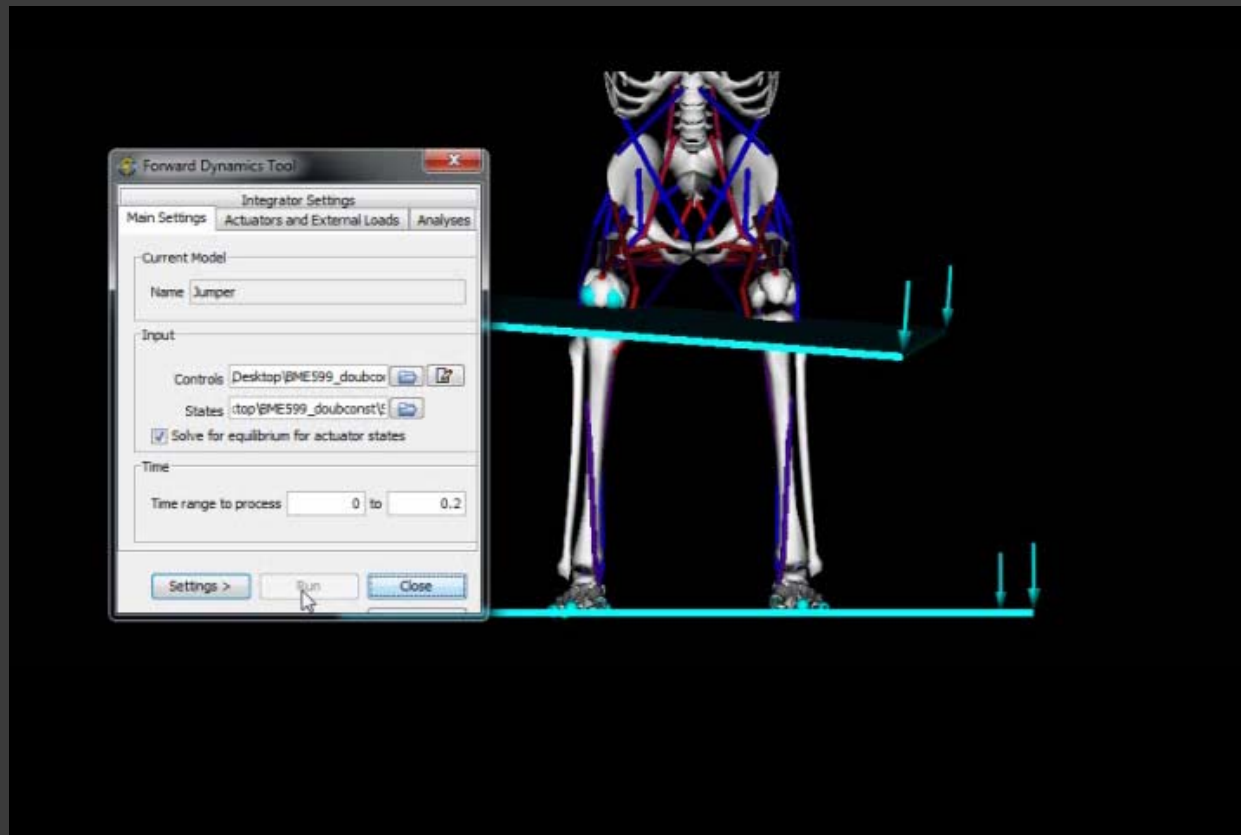
OPENSIM must be modified to find
medial/lateral ratio



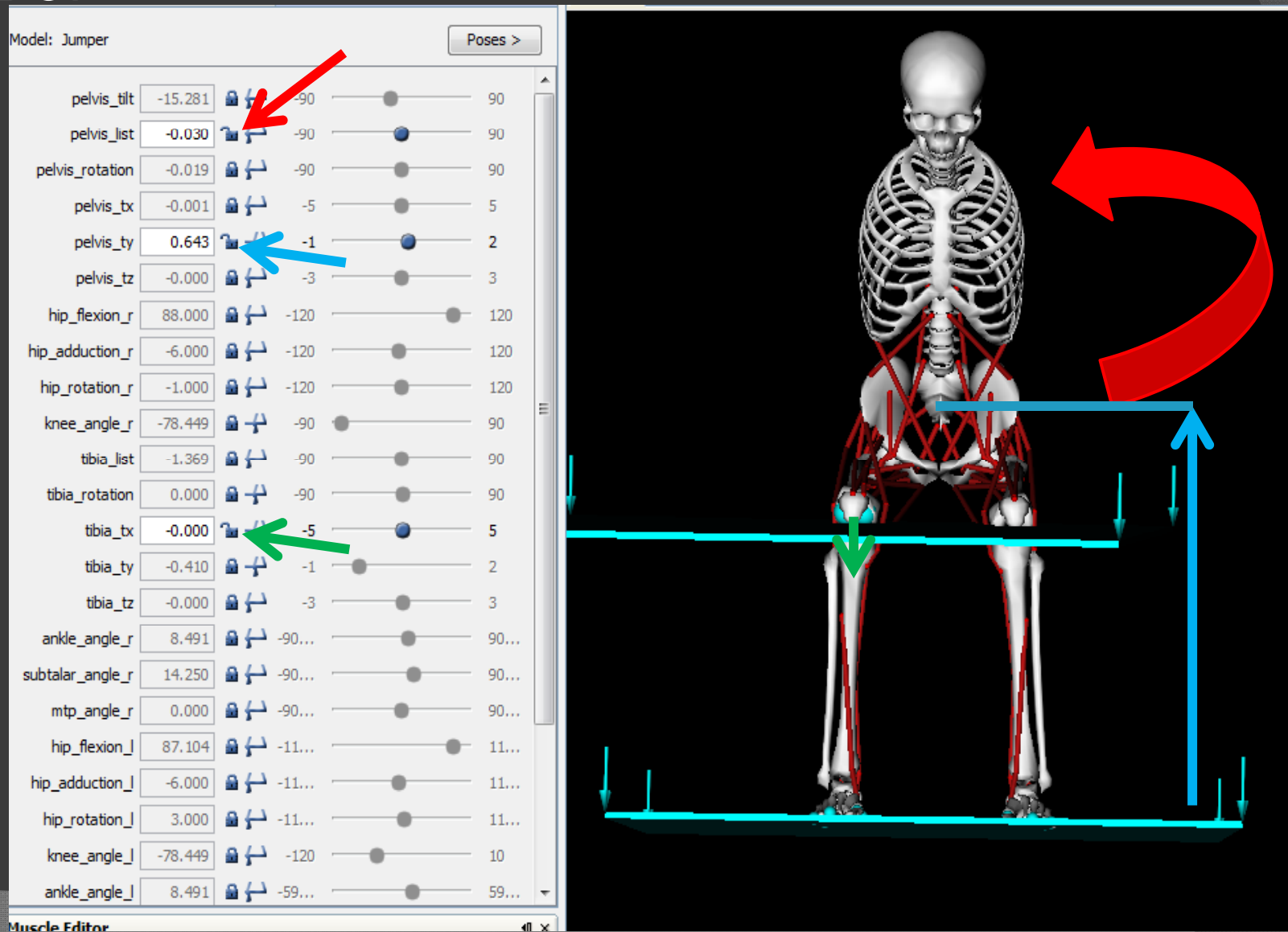
Implemented with two Hunt Crossley Forces in the XML code

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8549
8550 < HuntCrossleyForce name="knee_med">
8551   <isDisabled> false </isDisabled>
8552   < HuntCrossleyForce::ContactParametersSet name="">
8553     <objects>
8554       < HuntCrossleyForce::ContactParameters name="">
8555         <geometry> r_tib_plat r_fem_med </geometry>
8556         <stiffness> 100000000.000000000000000000000000 </stiffness>
8557         <dissipation> 0.500000000000000000000000000000 </dissipation>
8558         <static_friction> 0.900000000000000000000000000000 </static_friction>
8559         <dynamic_friction> 0.900000000000000000000000000000 </dynamic_friction>
8560         <viscous_friction> 0.599999999999999999999999999999 </viscous_friction>
8561       </ HuntCrossleyForce::ContactParameters>
8562     </objects>
8563   </groups>
8564 </ HuntCrossleyForce::ContactParametersSet>
8565   <transition_velocity> 0.100000000000000000000000000000 </transition_velocity>
8566 </ HuntCrossleyForce>
8567
8568 < HuntCrossleyForce name="knee_lat">
8569   <isDisabled> false </isDisabled>
8570   < HuntCrossleyForce::ContactParametersSet name="">
8571     <objects>
8572       < HuntCrossleyForce::ContactParameters name="">
8573         <geometry> r_tib_plat r_fem_lat </geometry>
8574         <stiffness> 100000000.000000000000000000000000 </stiffness>
8575         <dissipation> 0.500000000000000000000000000000 </dissipation>
8576         <static_friction> 0.900000000000000000000000000000 </static_friction>
8577         <dynamic_friction> 0.900000000000000000000000000000 </dynamic_friction>
8578         <viscous_friction> 0.599999999999999999999999999999 </viscous_friction>
8579       </ HuntCrossleyForce::ContactParameters>
8580     </objects>
8581   </groups>
8582 </ HuntCrossleyForce::ContactParametersSet>
8583   <transition_velocity> 0.100000000000000000000000000000 </transition_velocity>
8584 </ HuntCrossleyForce>
8585
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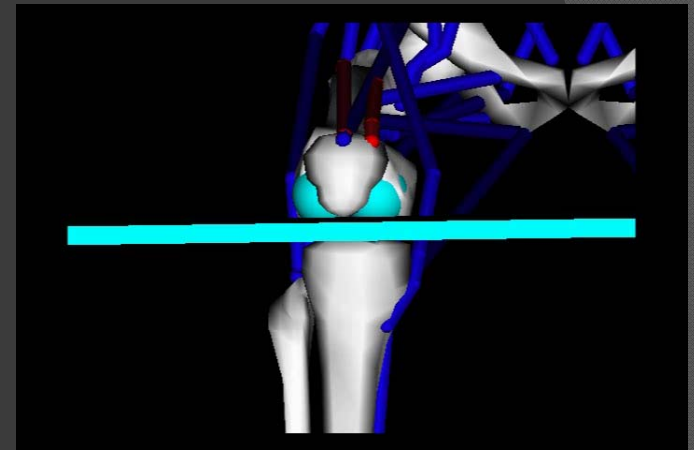
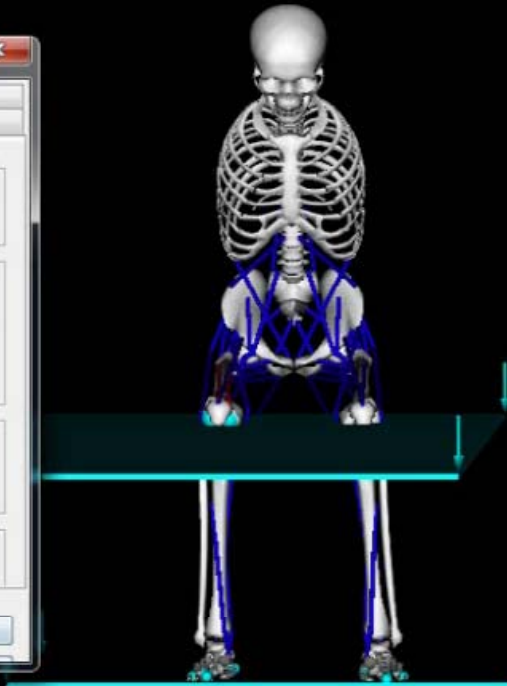
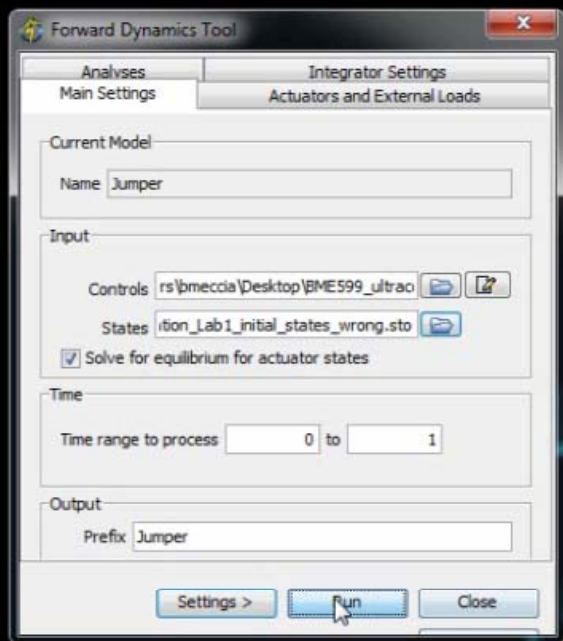
Contact bodies are extremely sensitive to initial positions



Develop a settler to detect initial positions with 3 DOF



Final settler position is used as model initial position



Inputting settled initial positions and including constrains completes the model

Model: Jumper

Poses >

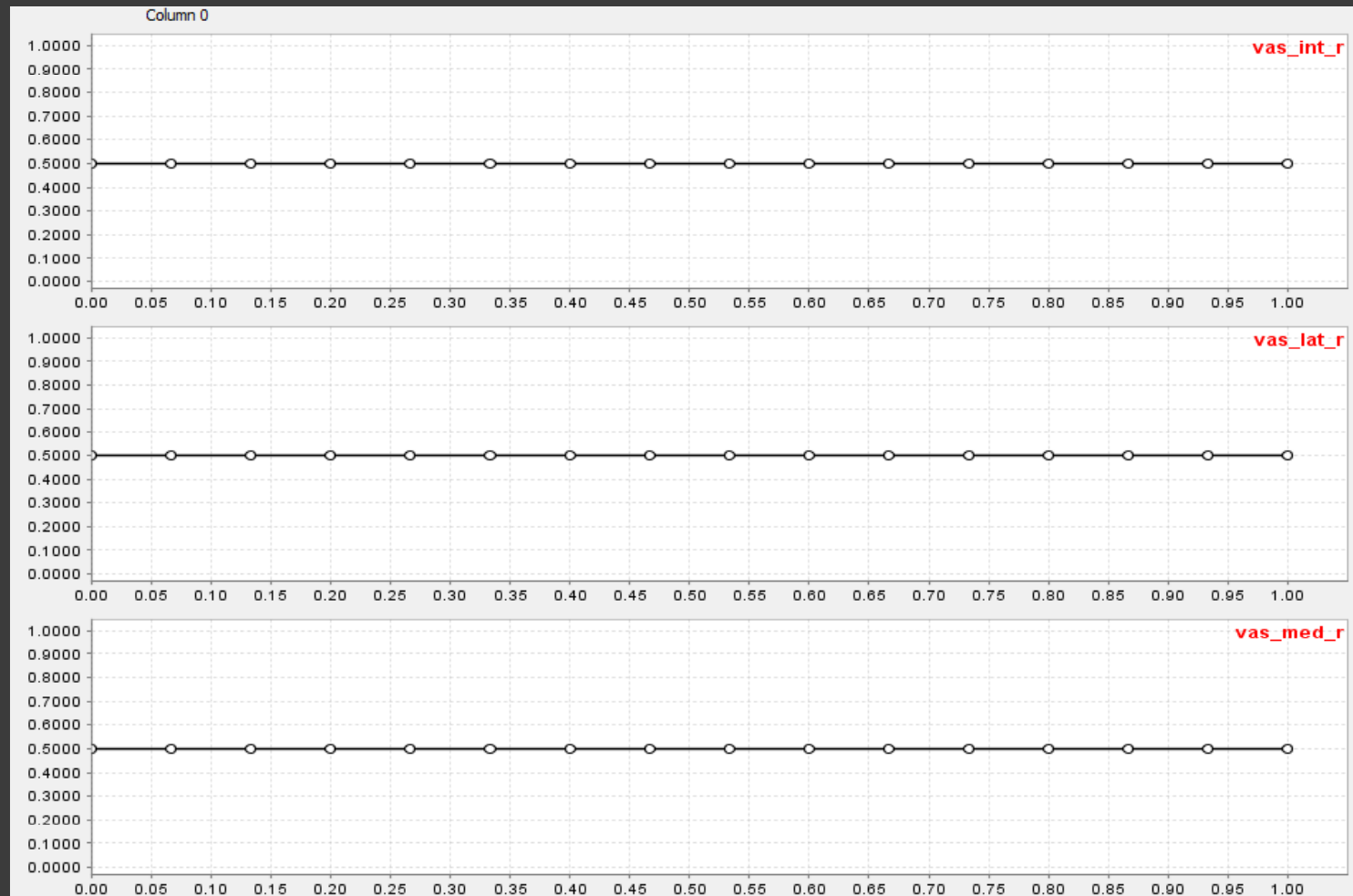
pelvis_tilt	-15.281		-90	90
pelvis_list	0.415		-90	90
pelvis_rotation	-0.019		-90	90
pelvis_tx	-0.001		-5	5
pelvis_ty	0.647		-1	2
pelvis_tz	-0.000		-3	3
hip_flexion_r	88.000		-120	120
hip_adduction_r	-6.000		-120	120
hip_rotation_r	-1.000		-120	120
knee_angle_r	-78.449		-90	90
tibia_list	-1.369		-90	90
tibia_rotation	0.000		-90	90
tibia_tx	0.003		-5	5
tibia_ty	-0.410		-1	2
tibia_tz	-0.000		-3	3
ankle_angle_r	8.491		-90...	90...
subtalar_angle_r	14.250		-90...	90...
mtp_angle_r	0.000		-90...	90...
hip_flexion_l	87.104		-11...	11...
hip_adduction_l	-6.000		-11...	11...
hip_rotation_l	3.000		-11...	11...
knee_angle_l	-78.449		-120	10
ankle_angle_l	8.491		-59...	59...

Muscle Editor

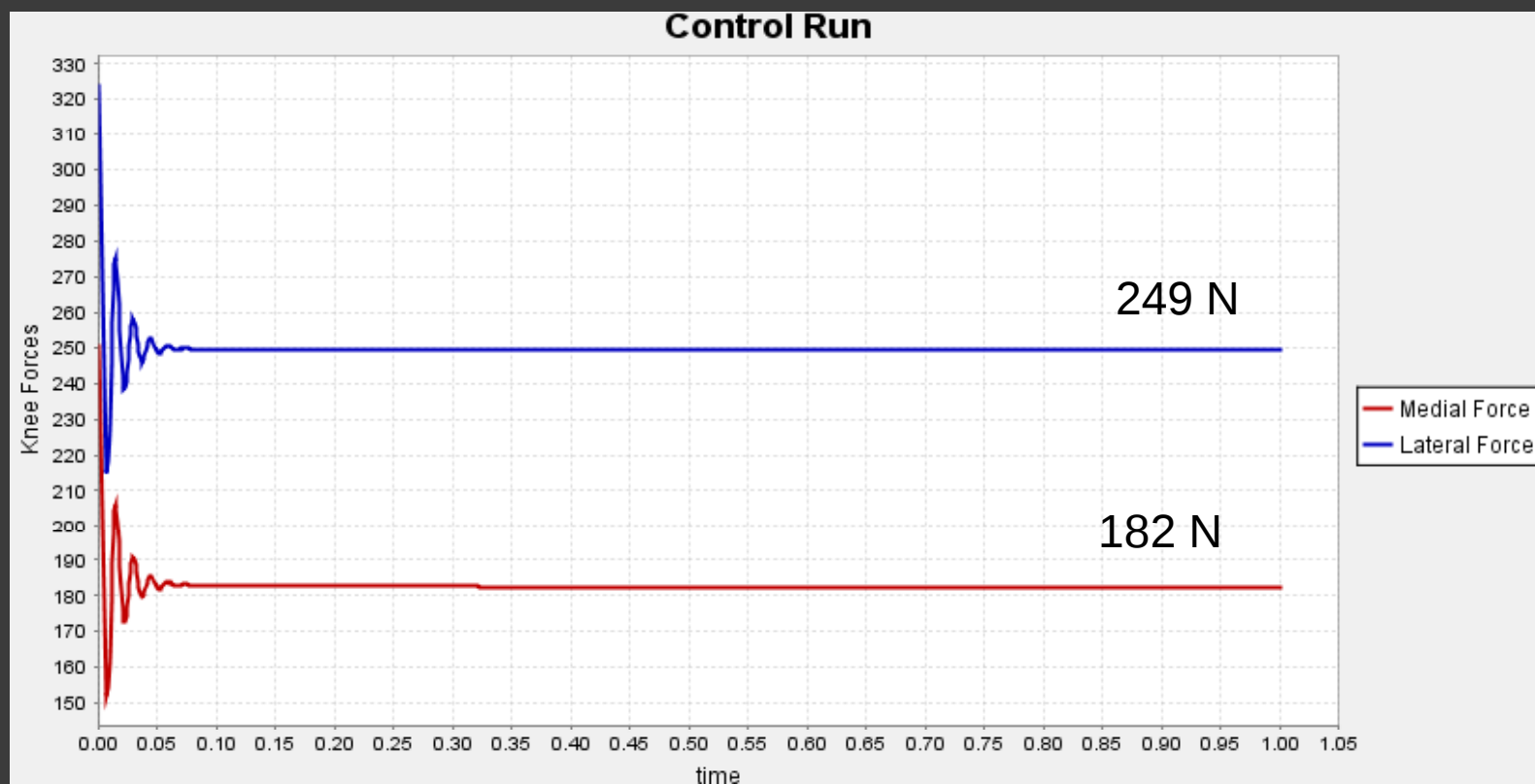
Model: Jumper

Messages

Forces were determined from the model in four scenarios: 1) Control 2) Max Lateralis 3) Max Intermedius 4) Max Medialis

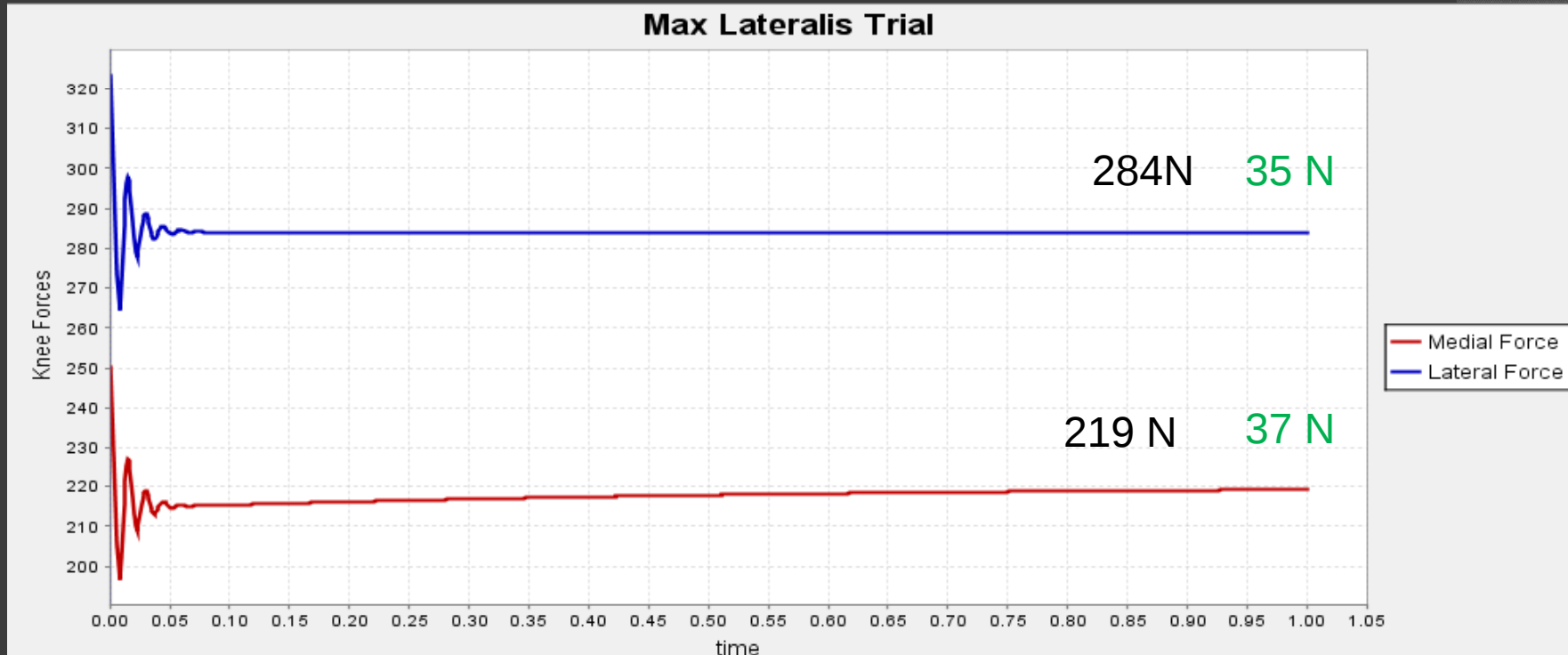


Higher lateral forces were seen with all muscles partially activated



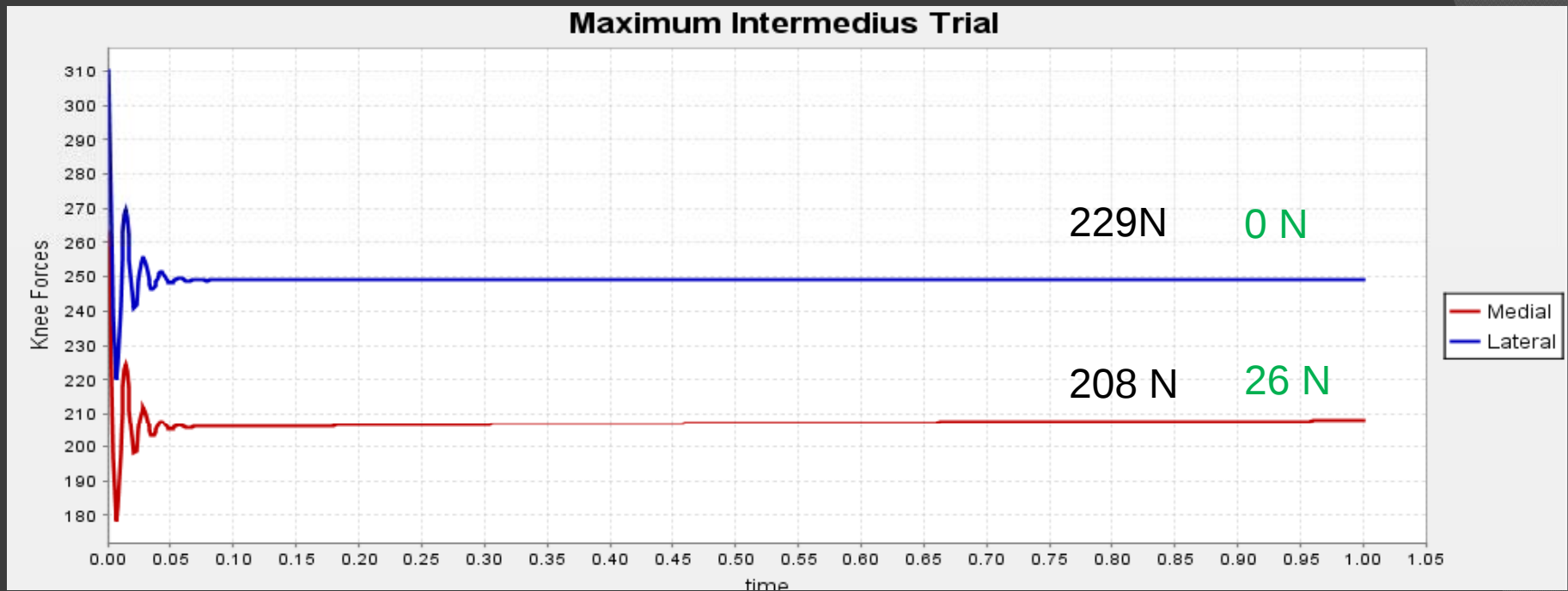
Scenario	Medial Force (N)	Lateral Force (N)	Medial Percentage
Control	182	249	42.2%
Lateralis			
Intermedius			
Medialis			

Activating the lateralis increased both contact forces evenly



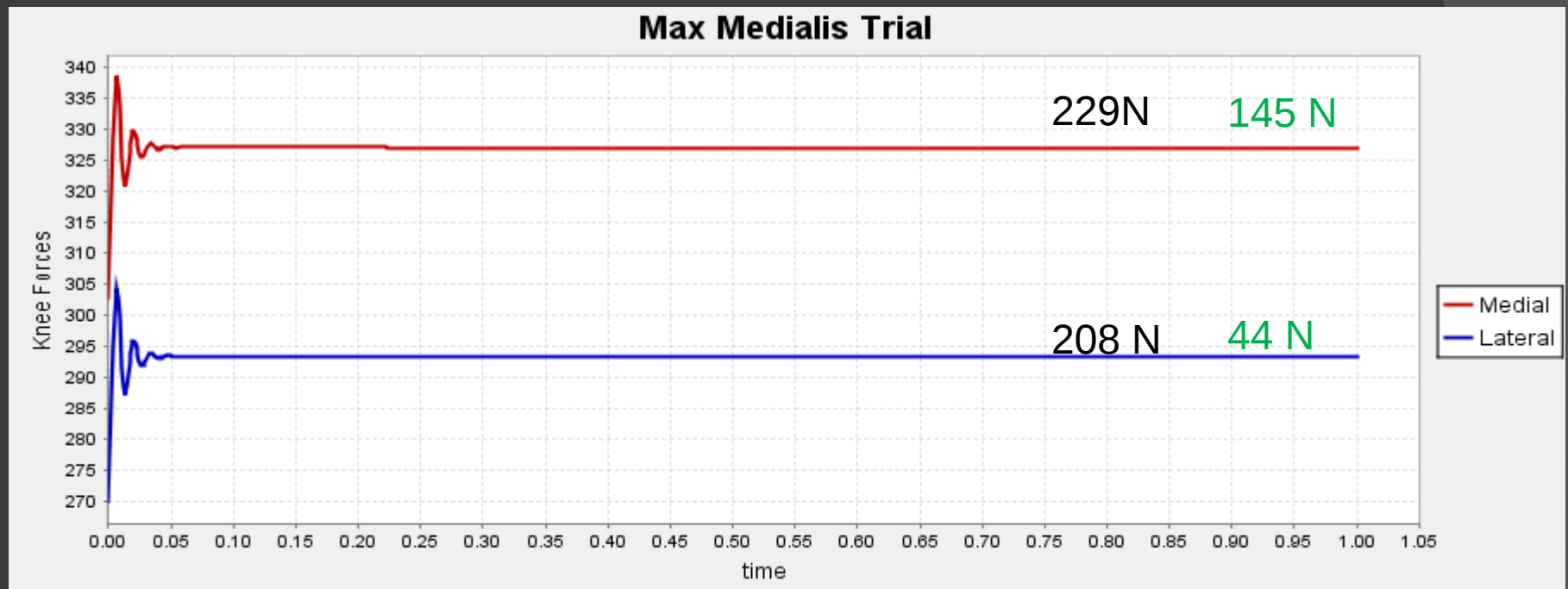
Scenario	Medial Force (N)	Lateral Force (N)	Medial Percentage
Control	182	249	42.2%
Lateralis	219	284	43.5%
Intermedius			
Medialis			

Intermedius activation increased only the medial force.



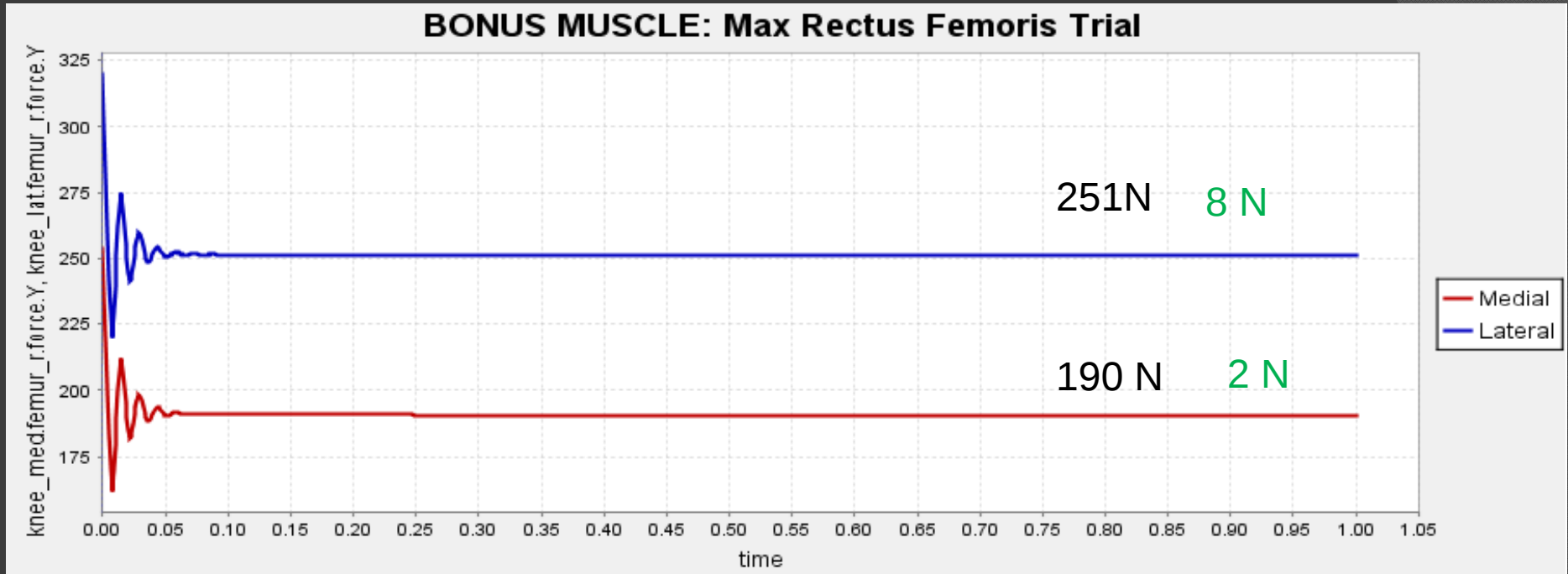
Scenario	Medial Force (N)	Lateral Force (N)	Medial Percentage
Control	182	249	42.2%
Lateralis	219	284	43.5%
Intermedius	208	249	45.5%
Medialis			

Medialis activation actually made the medial force higher than the lateral.



Scenario	Medial Force (N)	Lateral Force (N)	Medial Percentage
Control	182	249	42.2%
Lateralis	219	284	43.5%
Intermedius	208	249	45.5%
Medialis	327	293	52.7%

Bonus Muscle: Rectus Femoris had very little effect.

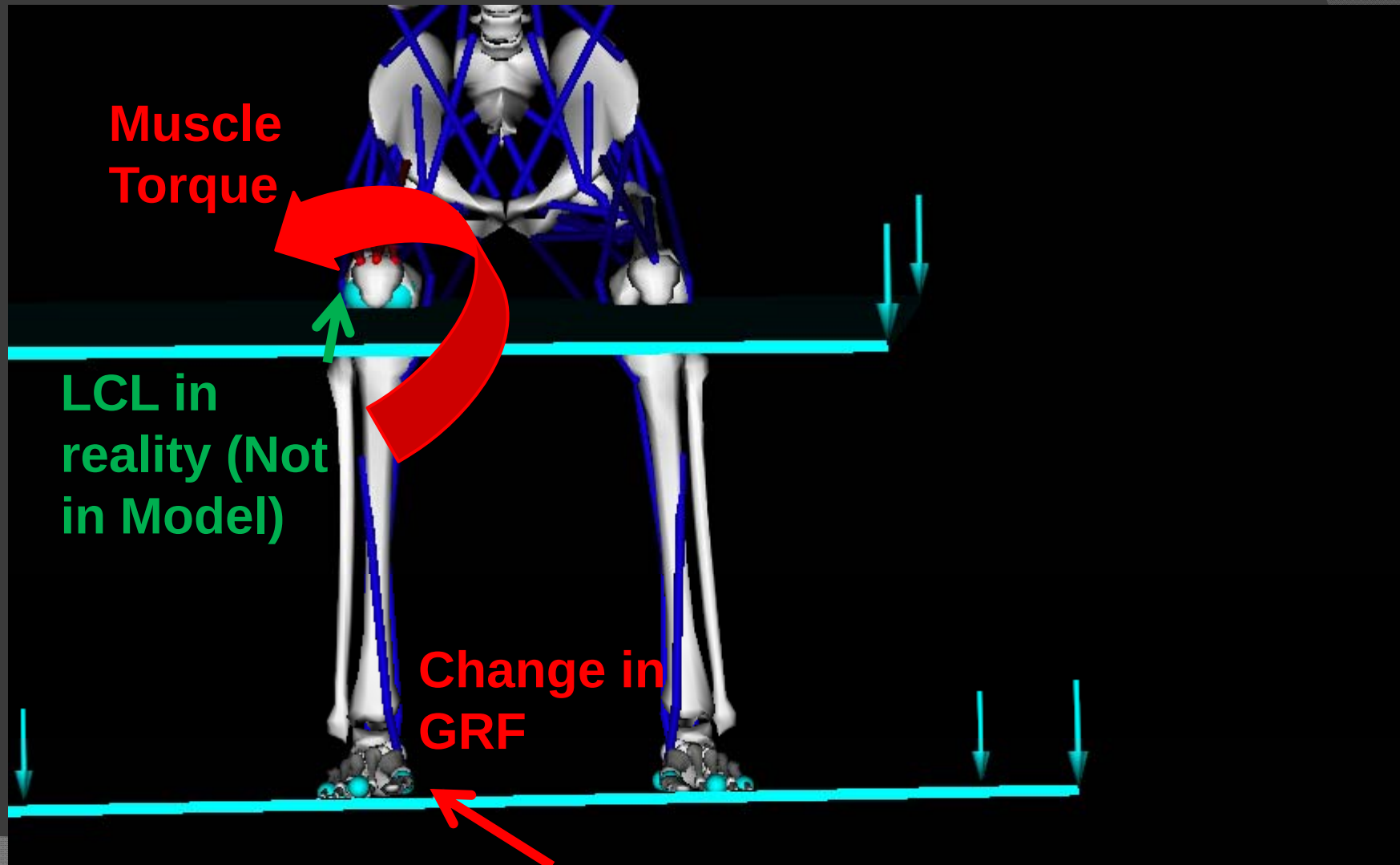


Scenario	Medial Force (N)	Lateral Force (N)	Medial Percentage
Control	182	249	42.2%
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Intermedius	208	249	45.5%
Medialis	327	293	52.7%
R. Femoris	190	251	43.1%

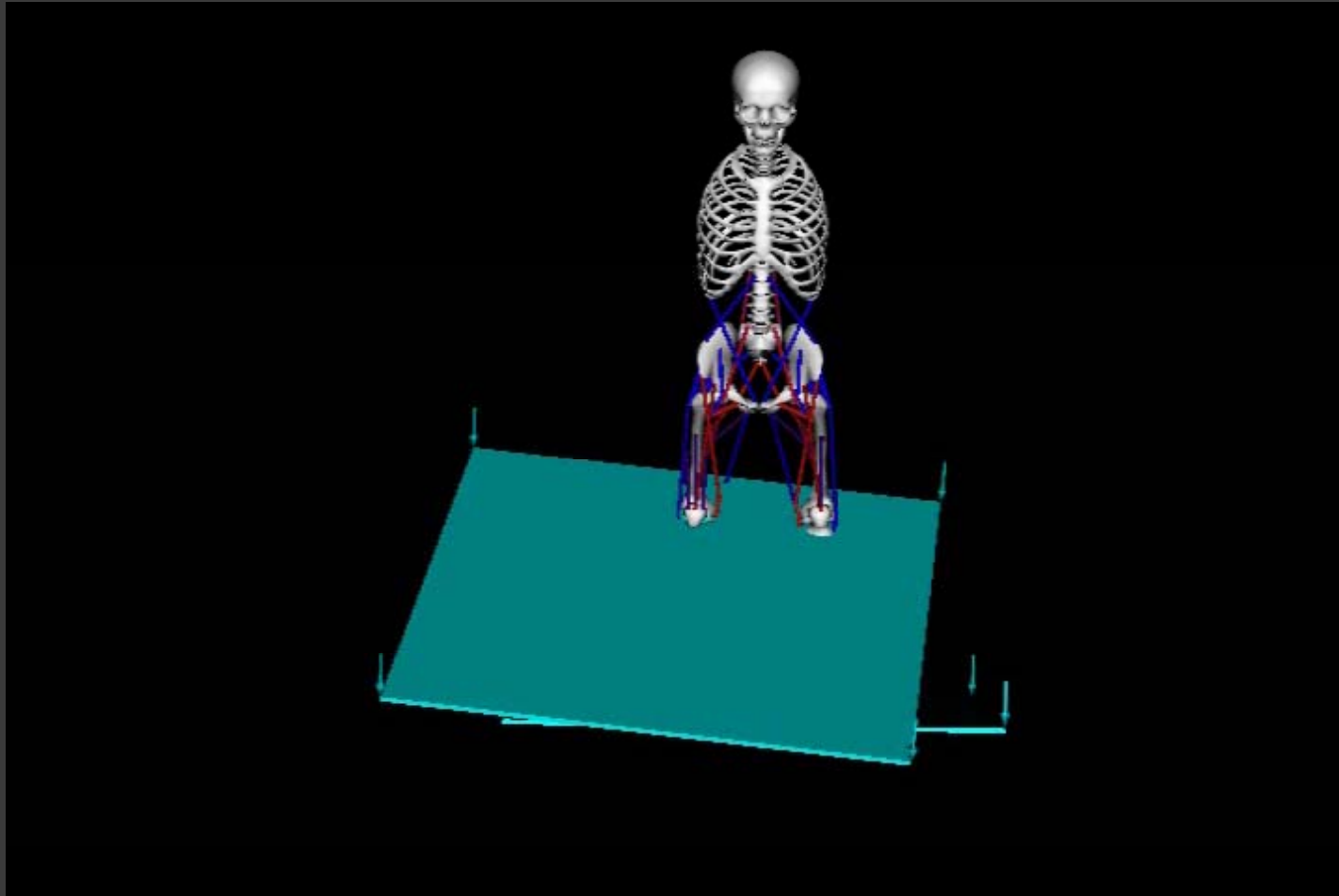
The medialis was the only muscle to have a substantial effect in total force or force ratio.

Scenario	Medial Change (N)	Lateral Change (N)	Medial Percentage Change
Control	NA	NA	NA
Lateralis	37	35	1.3%
Intermedius	26	0	3.3%
Medialis	145	44	10.5%
R. Femoris	8	2	0.9%

Ligaments should be added because currently the ground is acting like a ligament.



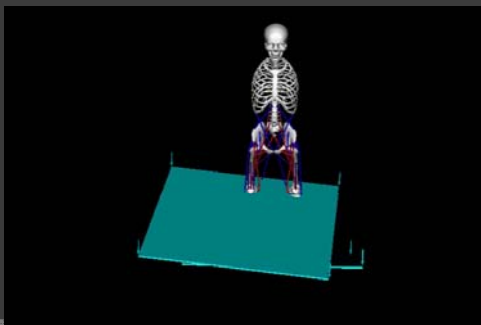
Can this model be expanded to dynamic activities?



Conclusions

Scenario	Medial Force (N)	Lateral Force (N)	Medial Percentage
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Medialis	327	293	52.7%
R. Femoris	190	251	43.1%

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Medialis	145	44	10.5%
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Thank you!

Questions?