Validation of converted arm26 model

The converted MJC model has been tested under the three categories below and with the accuracy of:

- Step 1: XML Conversion Validation

Check multi-body forward kinematics (using endpoints), approximation of custom/coupling joints & conditional/moving path points

Mean error:0.0094 cm; std: 0.0046 cm

- Step 2: Muscle Kinematics Validation

Check muscle moment arms as indication how muscle wrap over joints

Mean error:0.075 cm; std: 0.1433 cm

- Step 3: Muscle Kinetic Validation

Check muscle force-length relationship as indication of how similar of them in generating forces

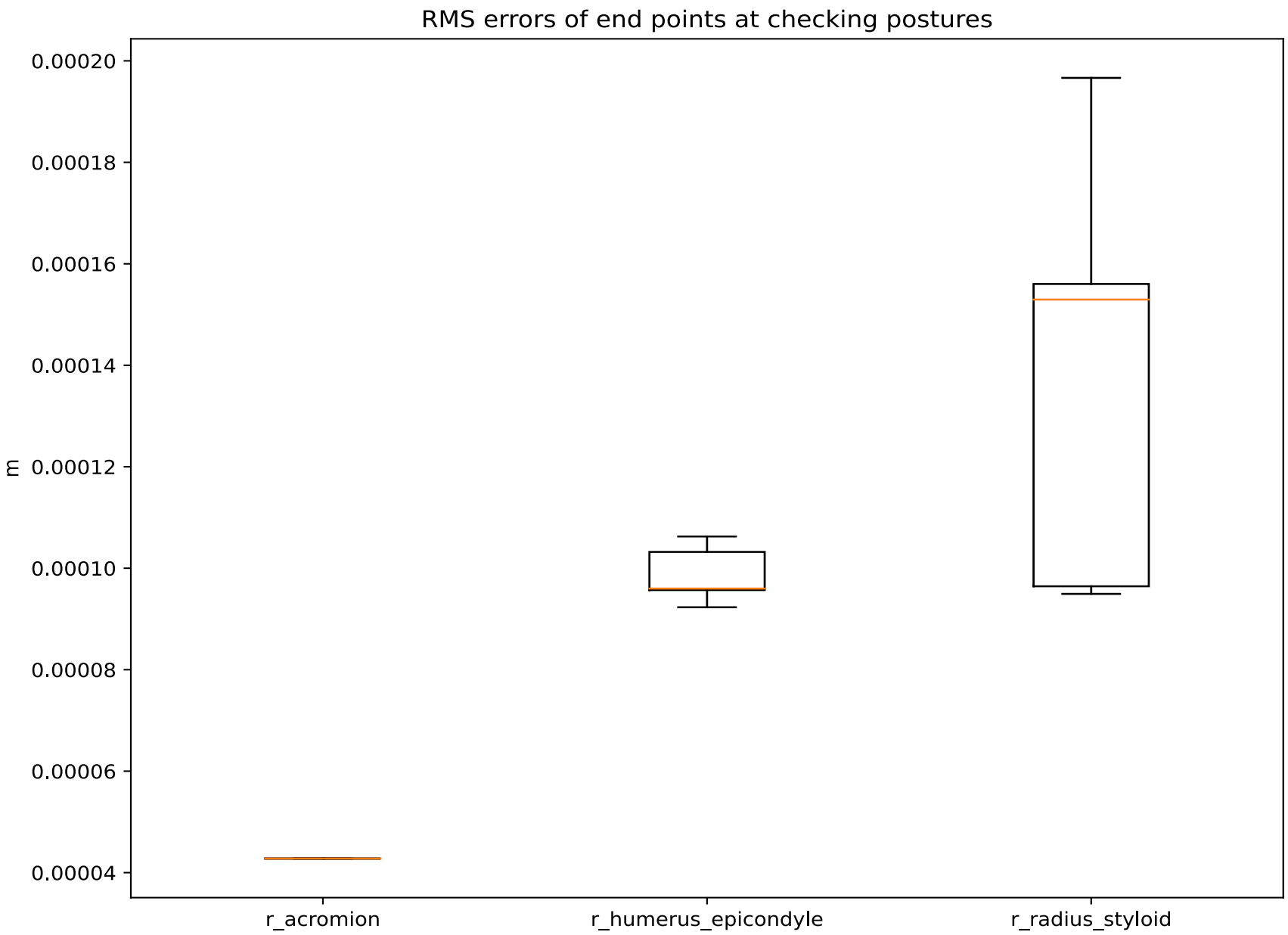
Mean error:0.531 Fmax; std: 0.0377 Fmax

Step 1: xml Conversion Validation

Randomly pose the model with 10 confgurations within the joint limits. In each posture, the endpoints(markers) global locations of Osim and Mjc models are extracted and compared. Box plot of their mean-std errros are plotted together. Individual endpoint differences of these 10 postures are also ploted in the VLT folder, but not included inside this report.

Besides the endpoint check, the approximation of customer joints, coupling joints, conditional/moving path points are plotted and attached. In these plots, blue dots/lines represent their setup in the OpenSim model. Yellow dots/lines represent the approximations in the MuJoCo model.

End points

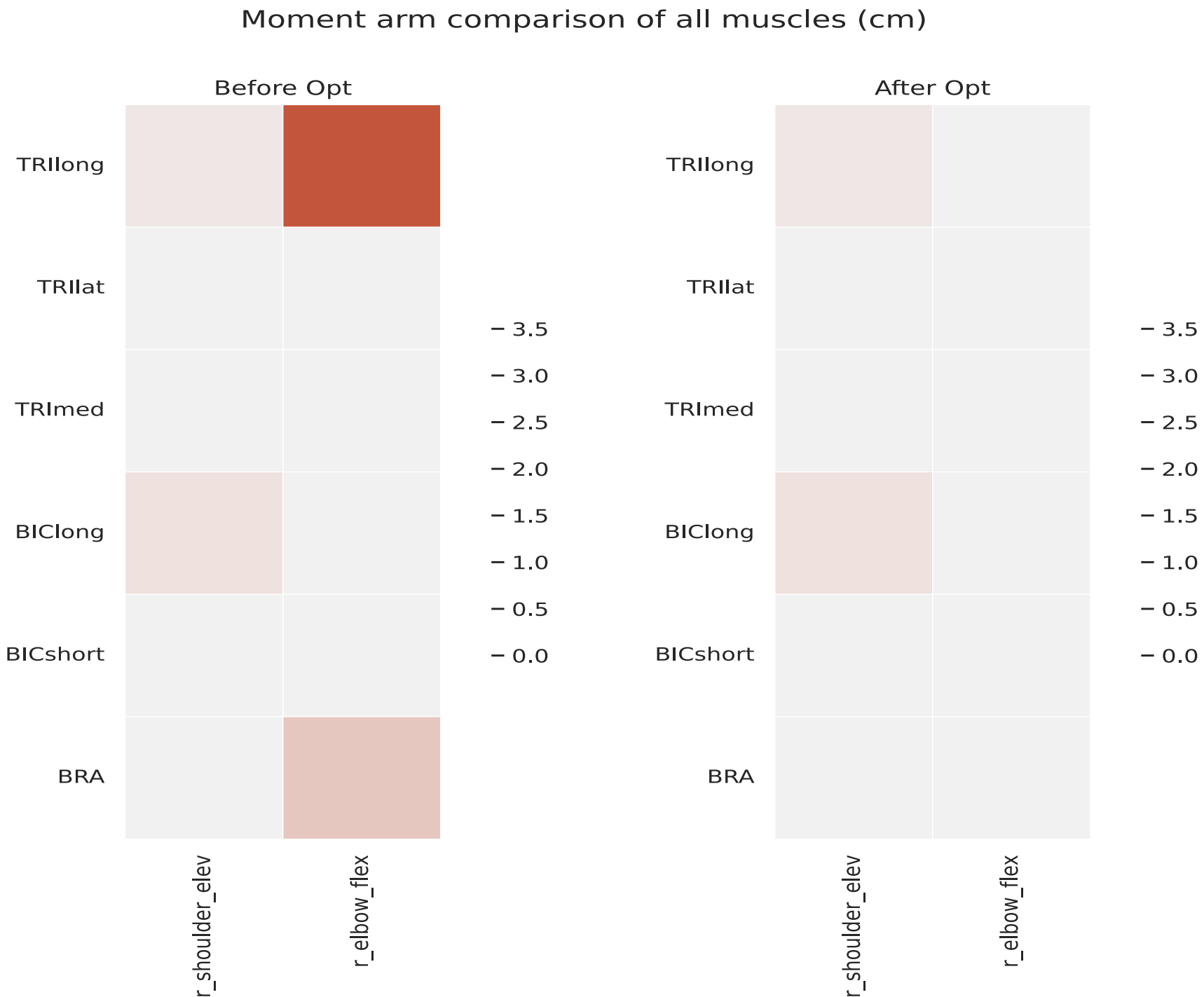

RMS errors of end points at checking postures
m
0.00020
0.00018
0.00016
0.00014
0.00012
0.00010
0.00008
0.00006
0.00004
r_acromion
r_humerus_epicondyle
r_radius_styloid

Step 2: Muscle Kinematics Validation

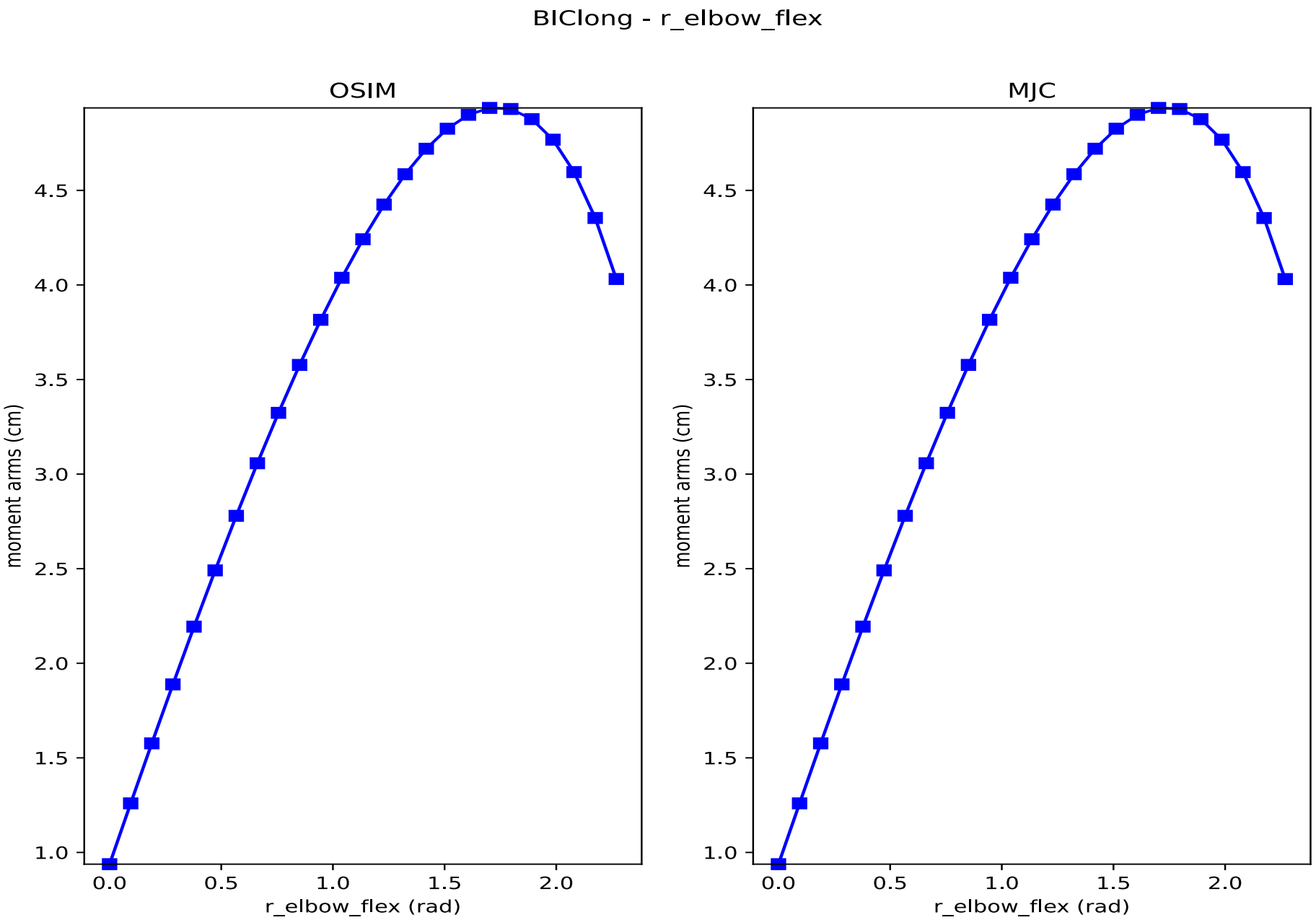
Moment arm of each muscle at each joint are compared between Osim and converted MJC model. A overall heatmap is included to indicate the overall moment arm errors before and after optimization. Then detail moment arm curves are plotted for comparison. For the muscles that wrap over multiple joints, moment arms with respect to one joint maybe affected by several other joints. In this case, several mesh points were check of these affecting joints, when plotting moment arms at one joint. This is why there are multiple lines (with different grey levels) plotted for one muscle on one joint.

How to interpret the plot:
Global title indicate the muscle and joints that affecting the moment arms in the plots. X axis indicate the joint that moment arms were extracted. Grey level of the lines indicate the mesh postures of other relevant joints (in the global tile, but not the x axis)

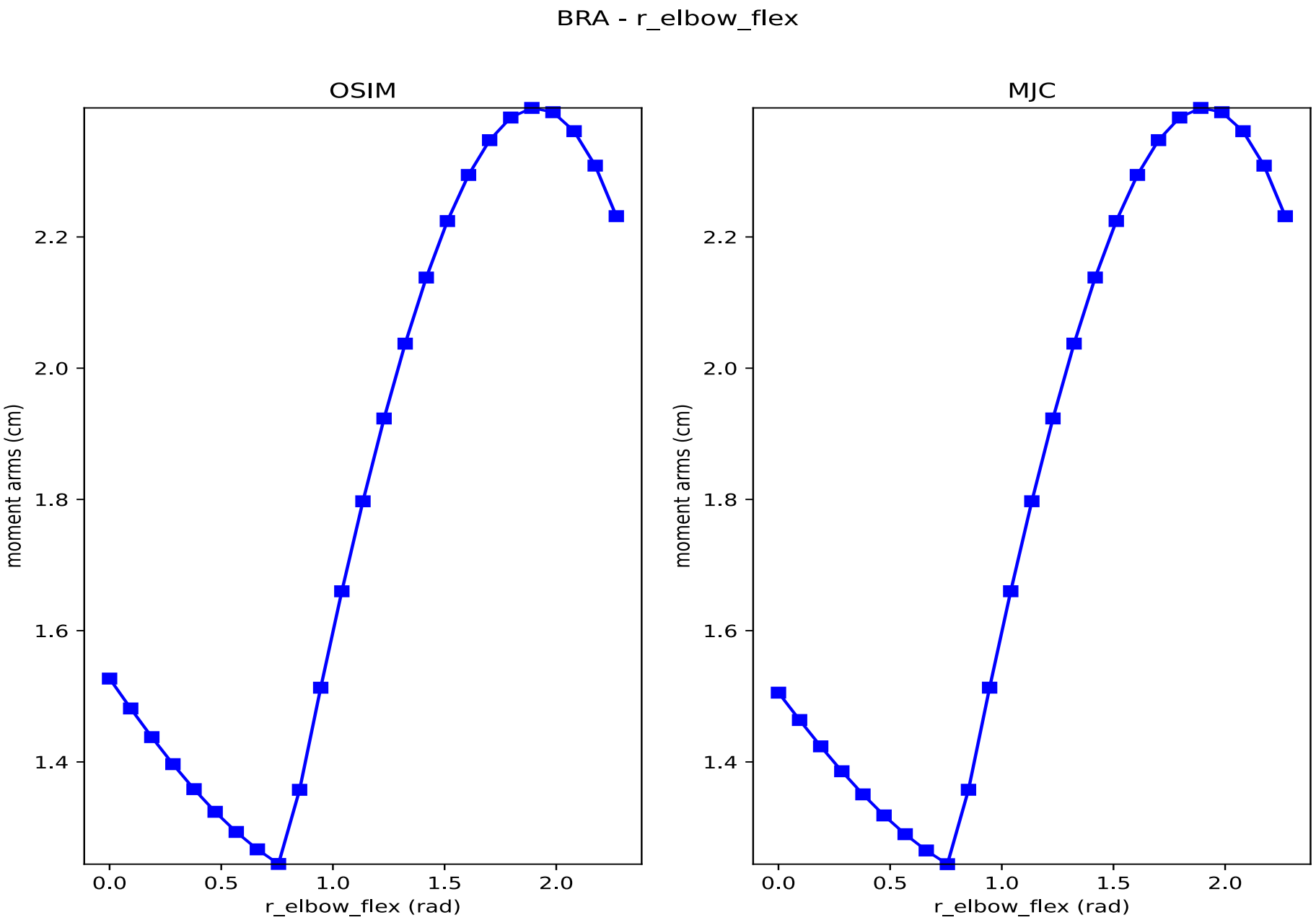
Overall comparison of muscle moment arms before/after optimization



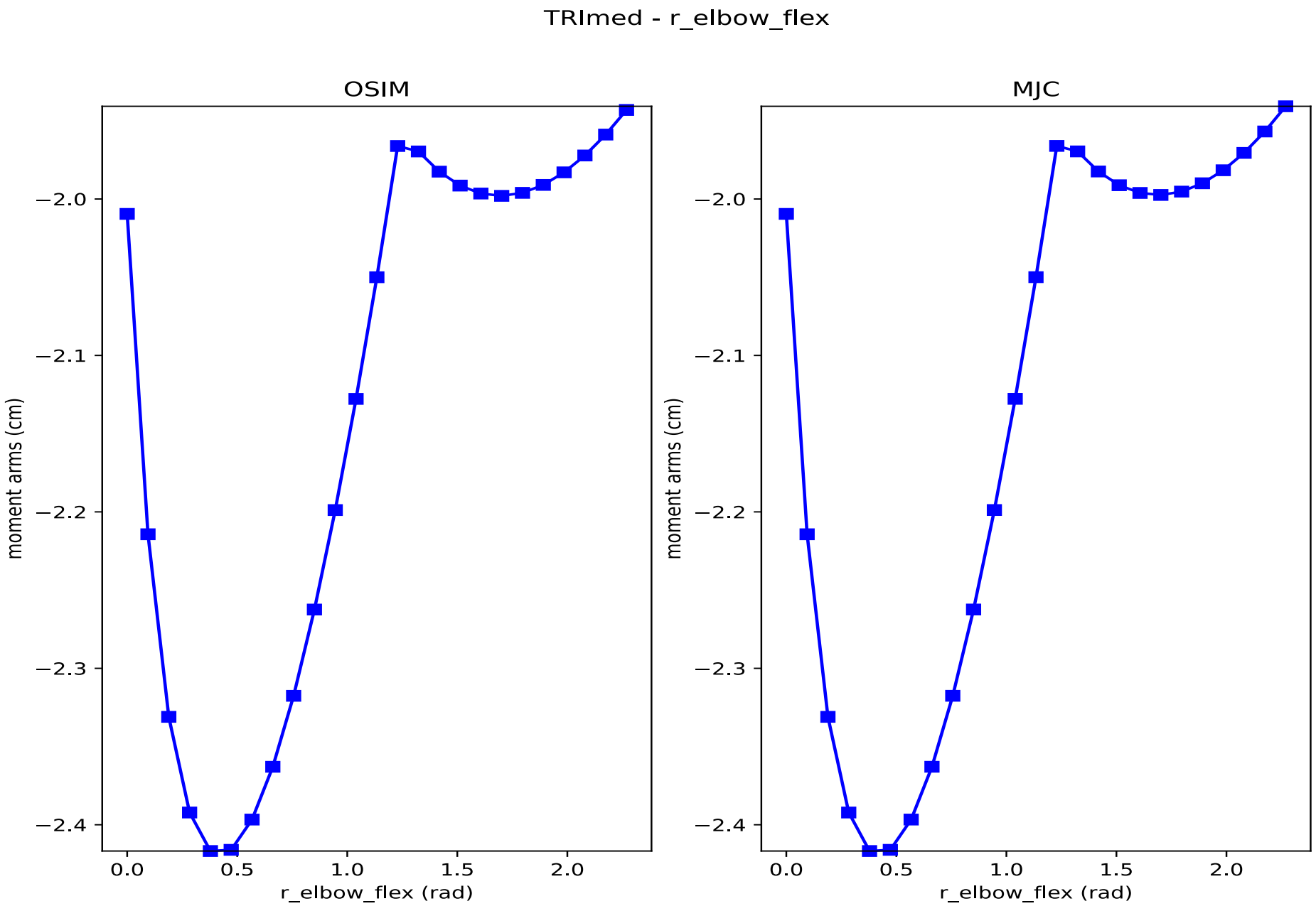
Muscle specific moment arm comparison with Osim model after optimization



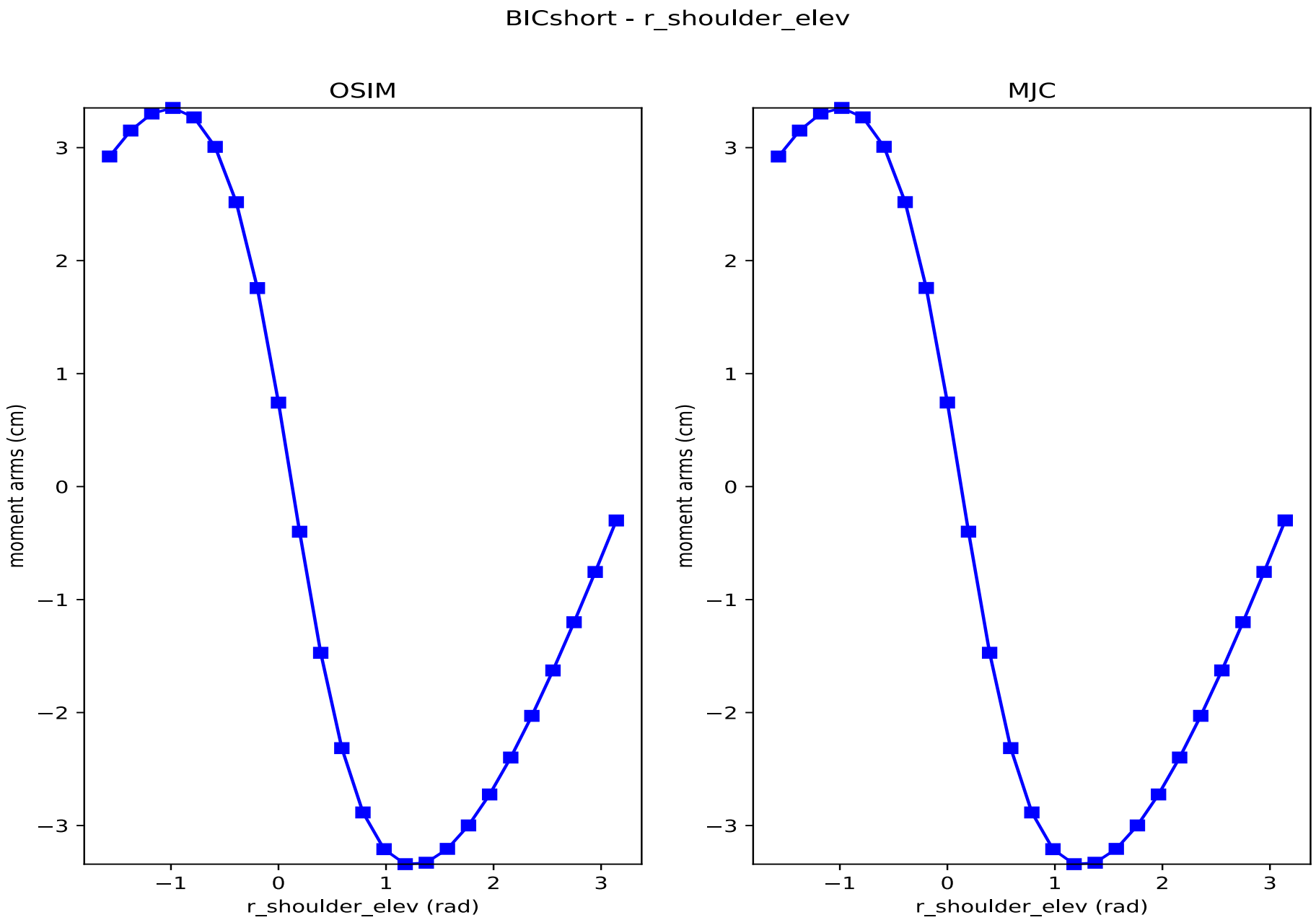
Muscle specific moment arm comparison with Osim model after optimization



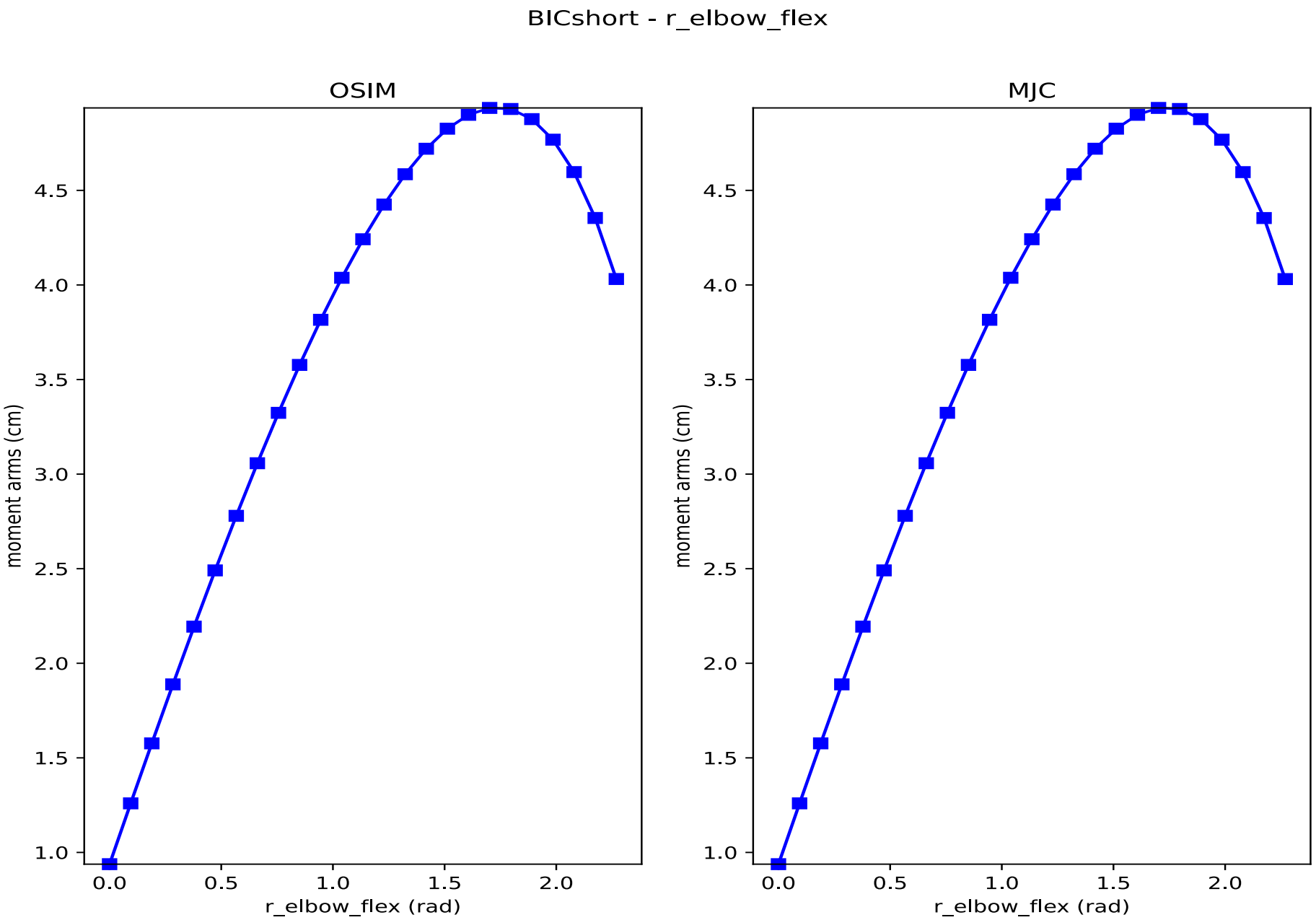
Muscle specific moment arm comparison with Osim model after optimization



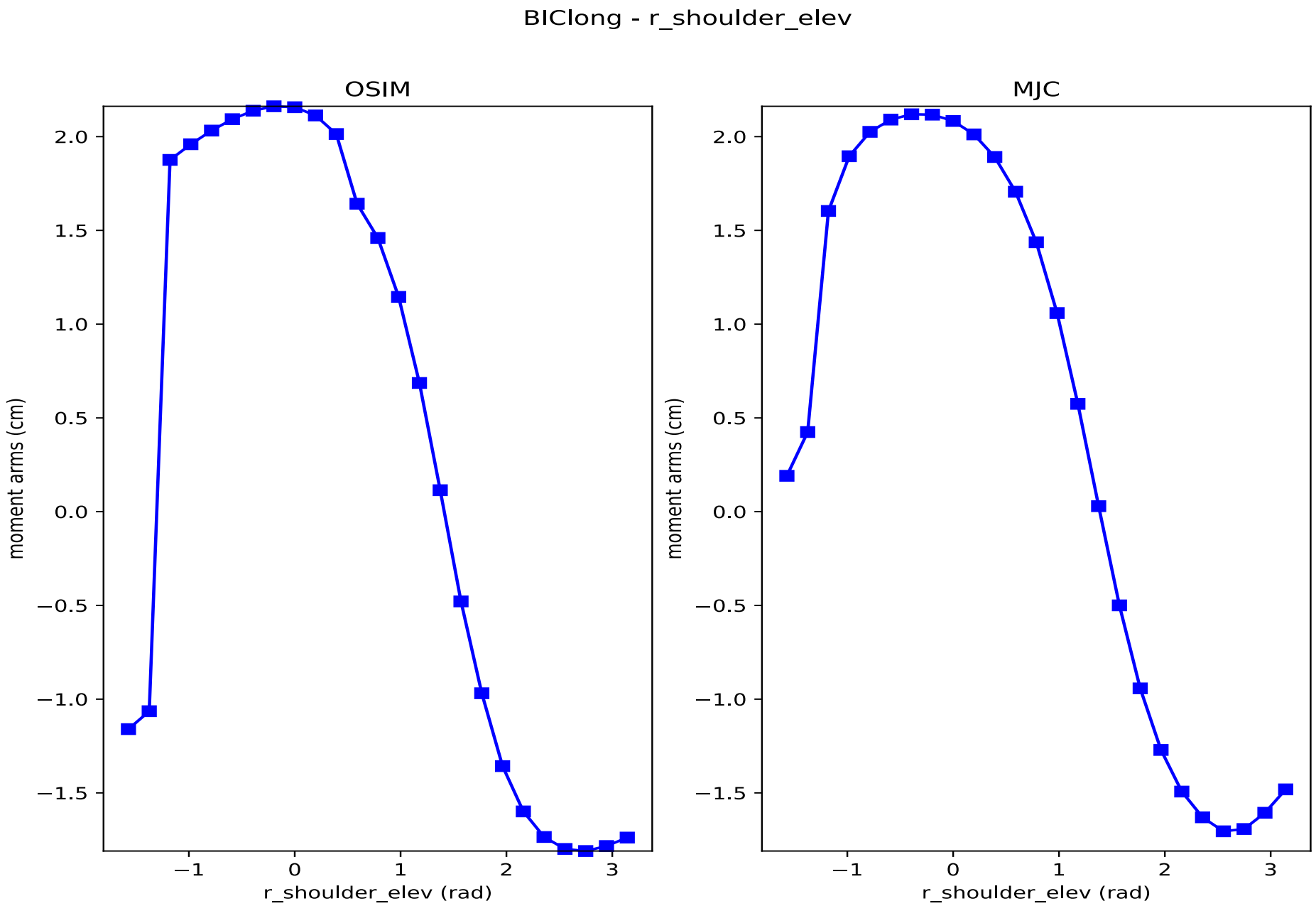
Muscle specific moment arm comparison with Osim model after optimization



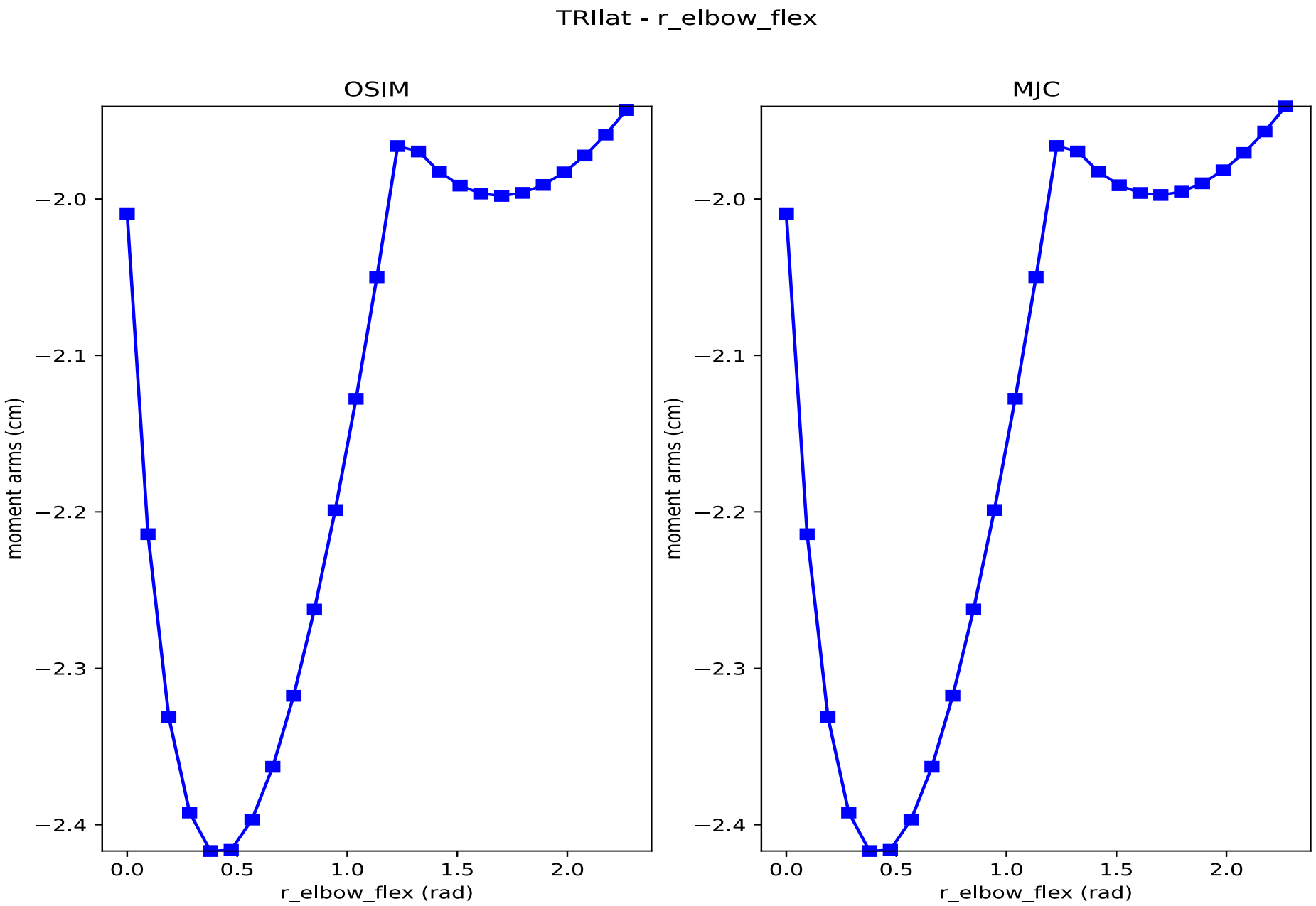
Muscle specific moment arm comparison with Osim model after optimization



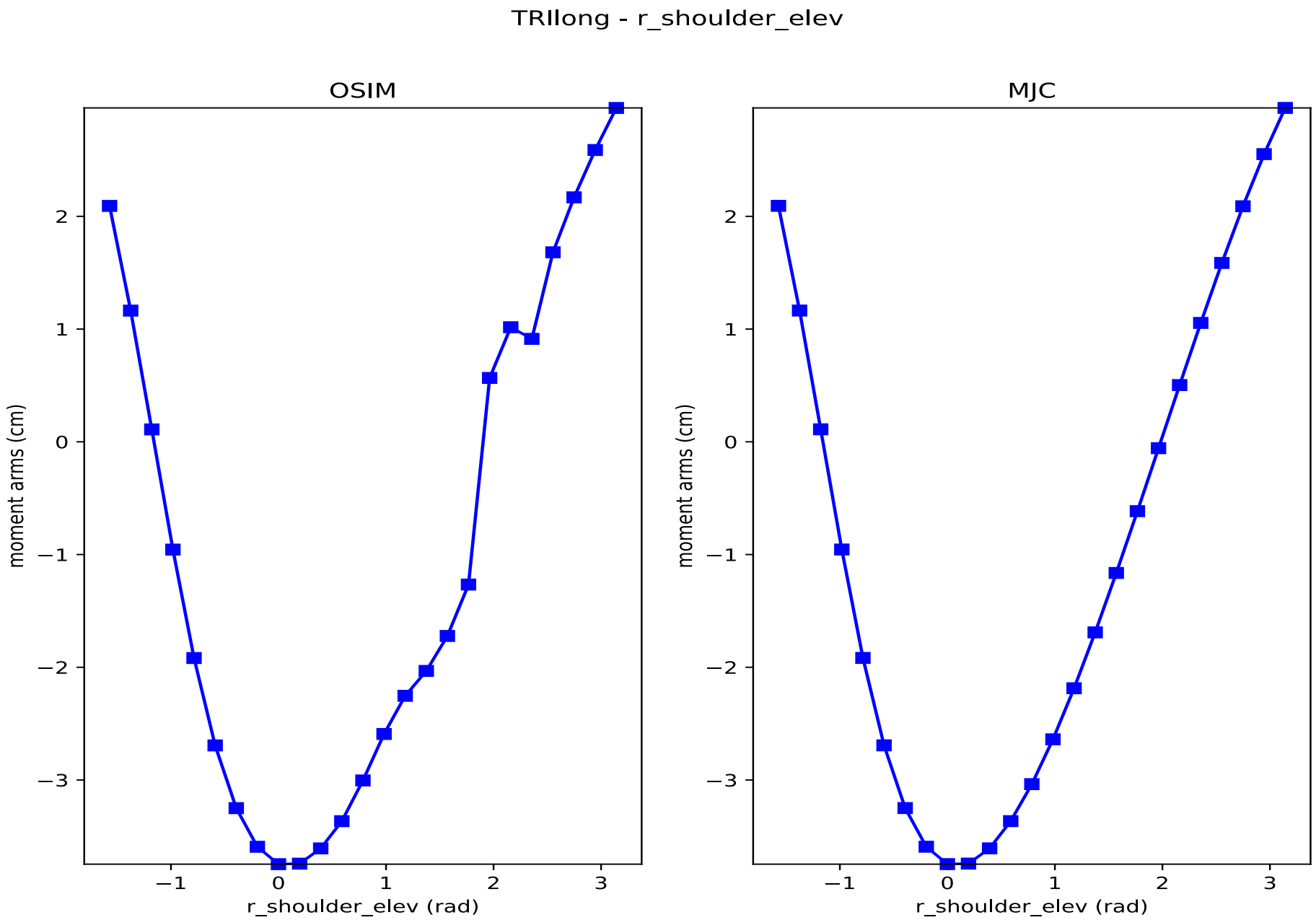
Muscle specific moment arm comparison with Osim model after optimization



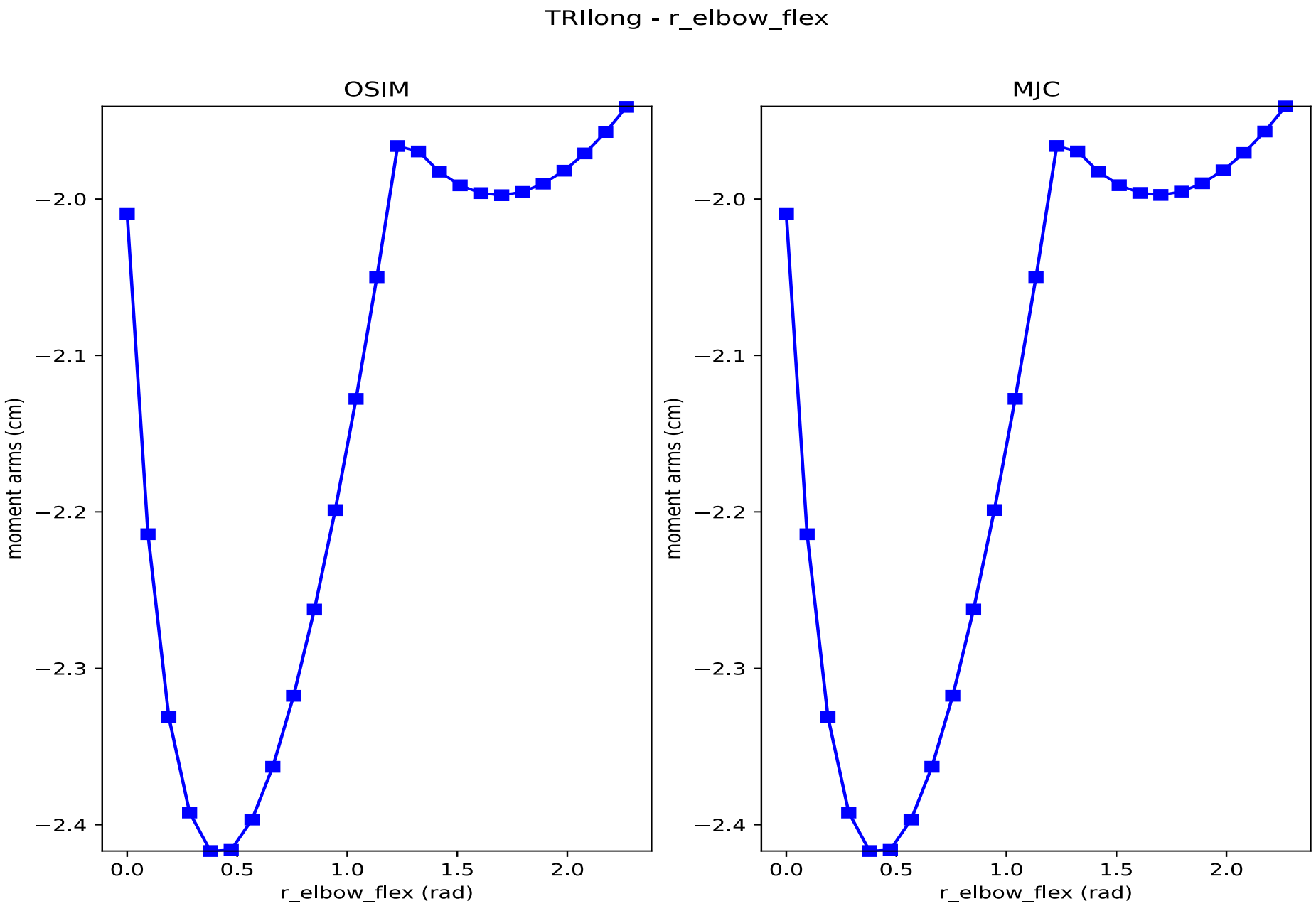
Muscle specific moment arm comparison with Osim model after optimization



Muscle specific moment arm comparison with Osim model after optimization



Muscle specific moment arm comparison with Osim model after optimization



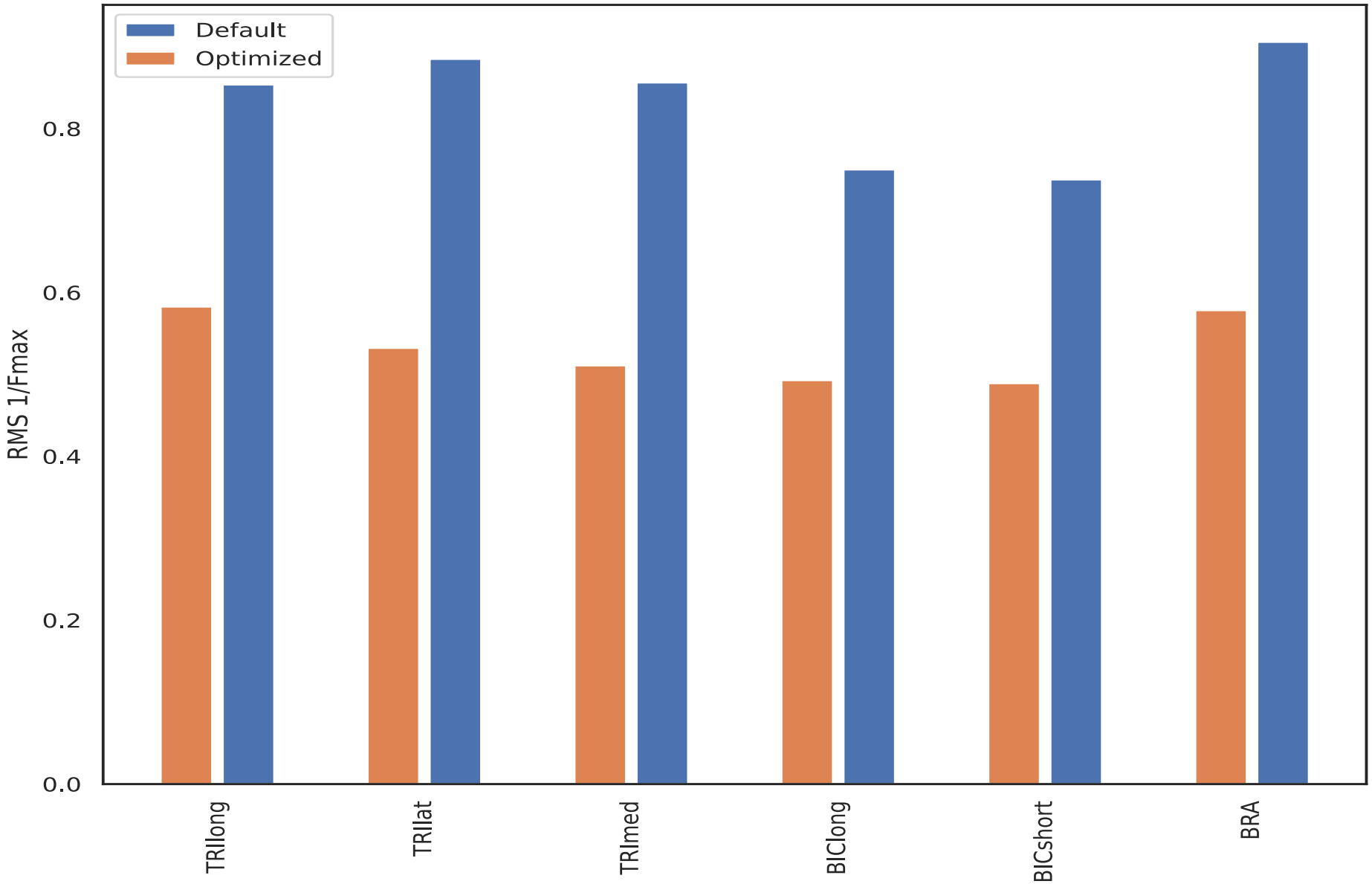
Step 3: Muscle Kinetic Validation

Muscle force-length property are compared between Osim and Mjc models. This force-length property only depends on muscle-fiber-tendon unit lengths. We made it isolated with the moment arm, so that the change in moment arms will not affect the muscle force properties. The muscle-fiber-tendon unit lengths were roughly even extracted (from shorest to longest) with all possible body postures. A bar plot of the froce errors of all muscle before and after optimization is included. Then the detail force-length curve comparsion plot of each muscle is included.

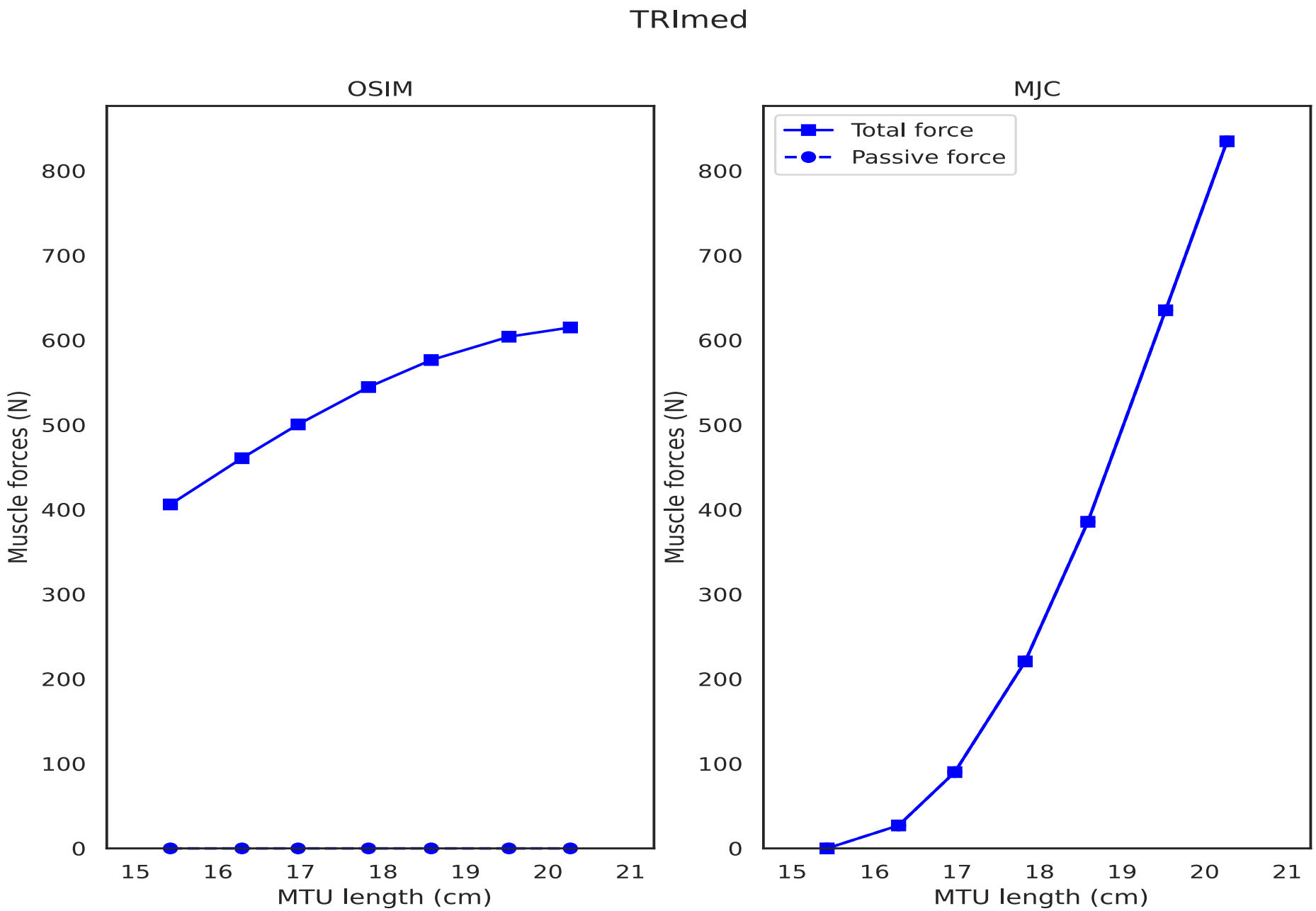
How to interpret the plot:

Global title indicate the muscle name. X axis indicate the muscle-fiber-tendon unit length. Y axis is the muscle force (unnormalized)

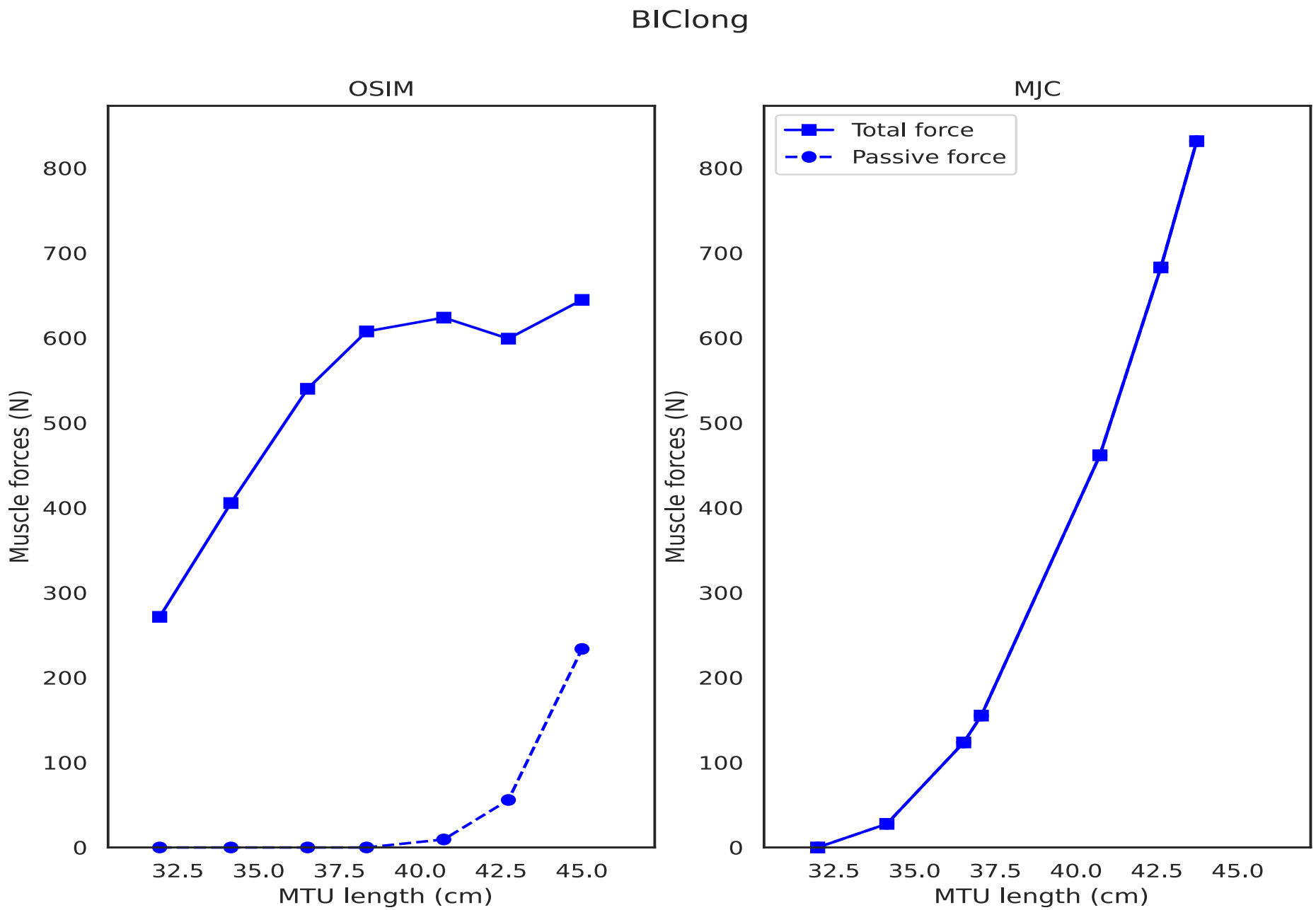
Overall comparison of muscle force-length relationship before/after optimization



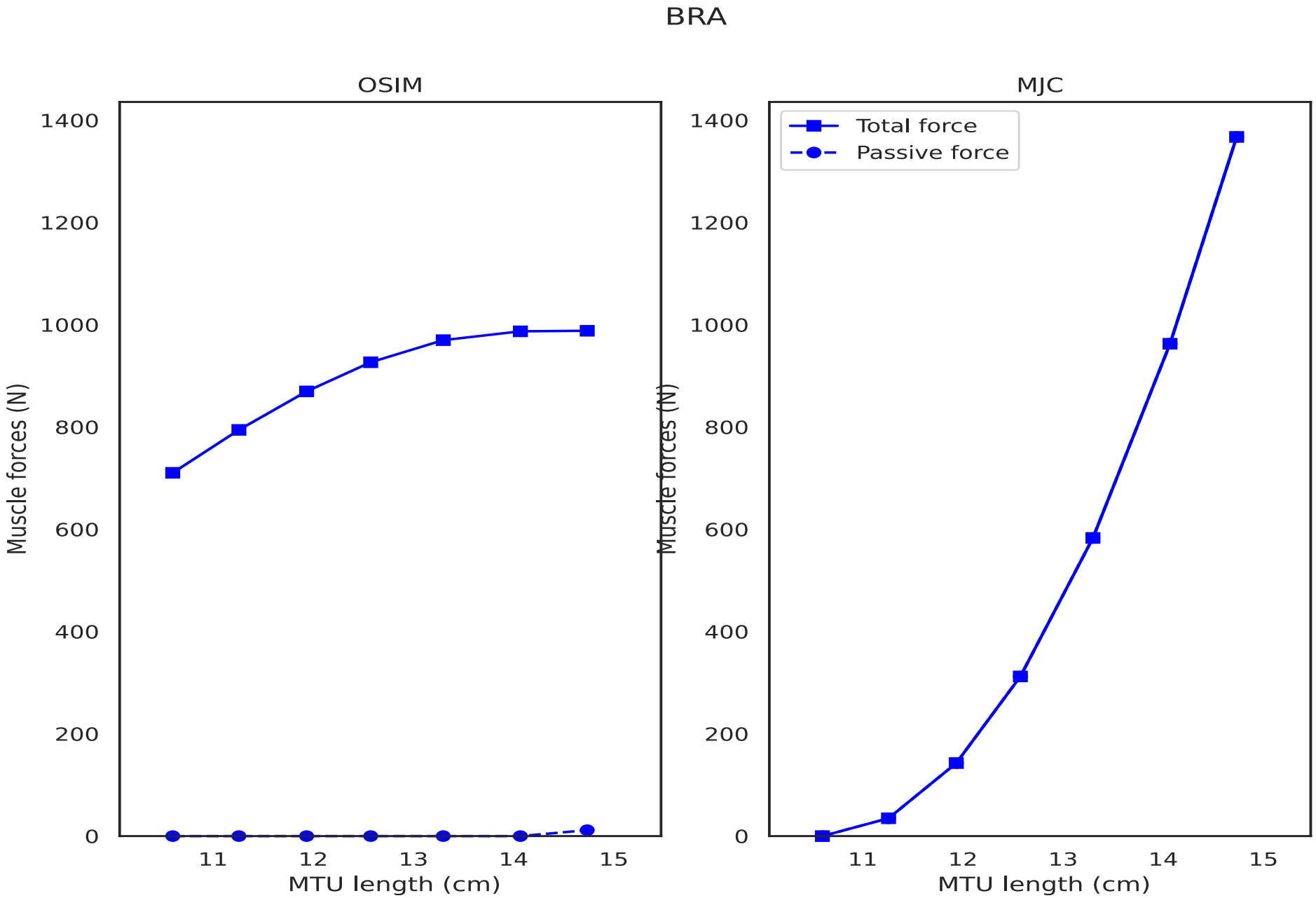
Muscle specific force comparison before/after optimization



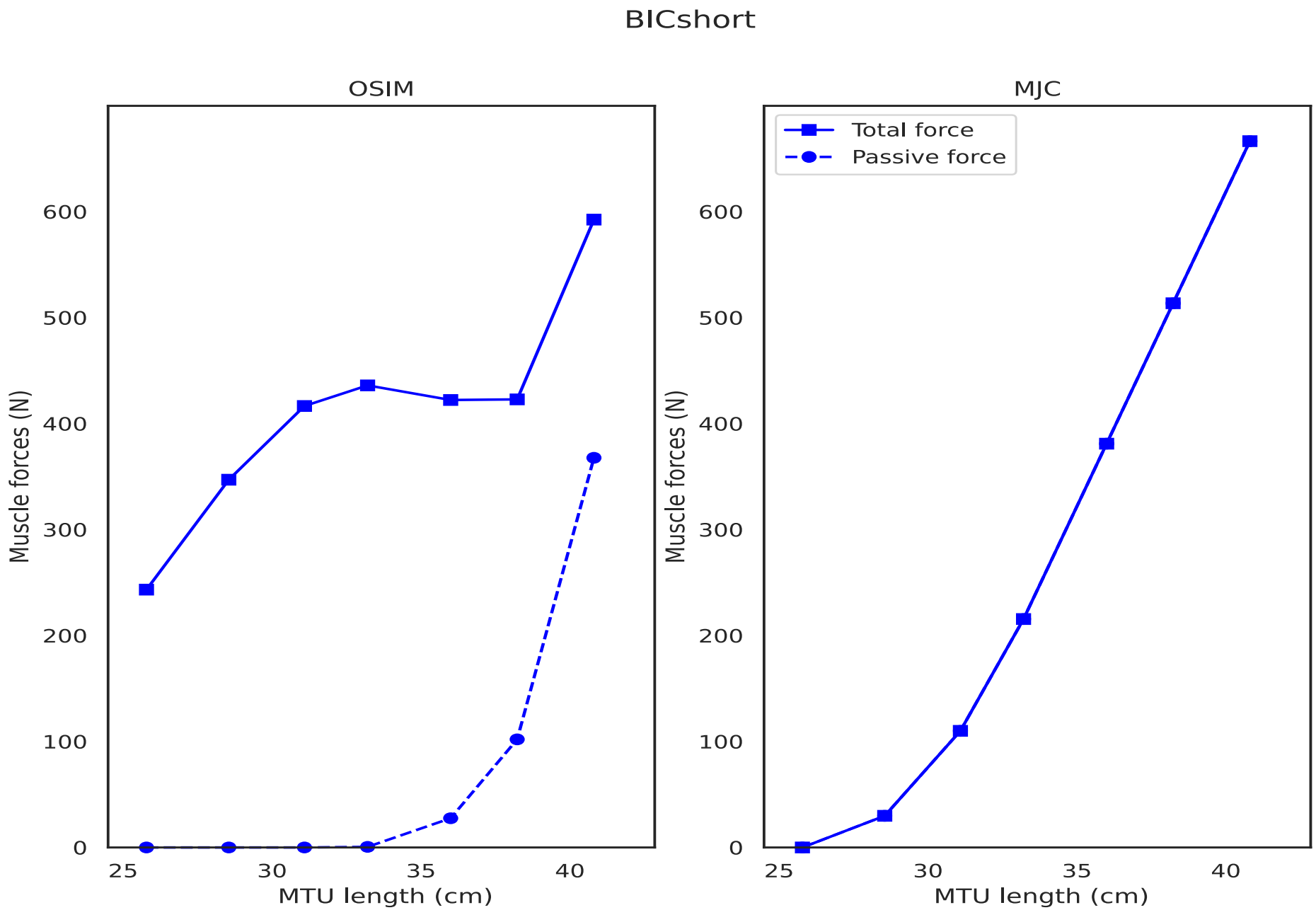
Muscle specific force comparison before/after optimization



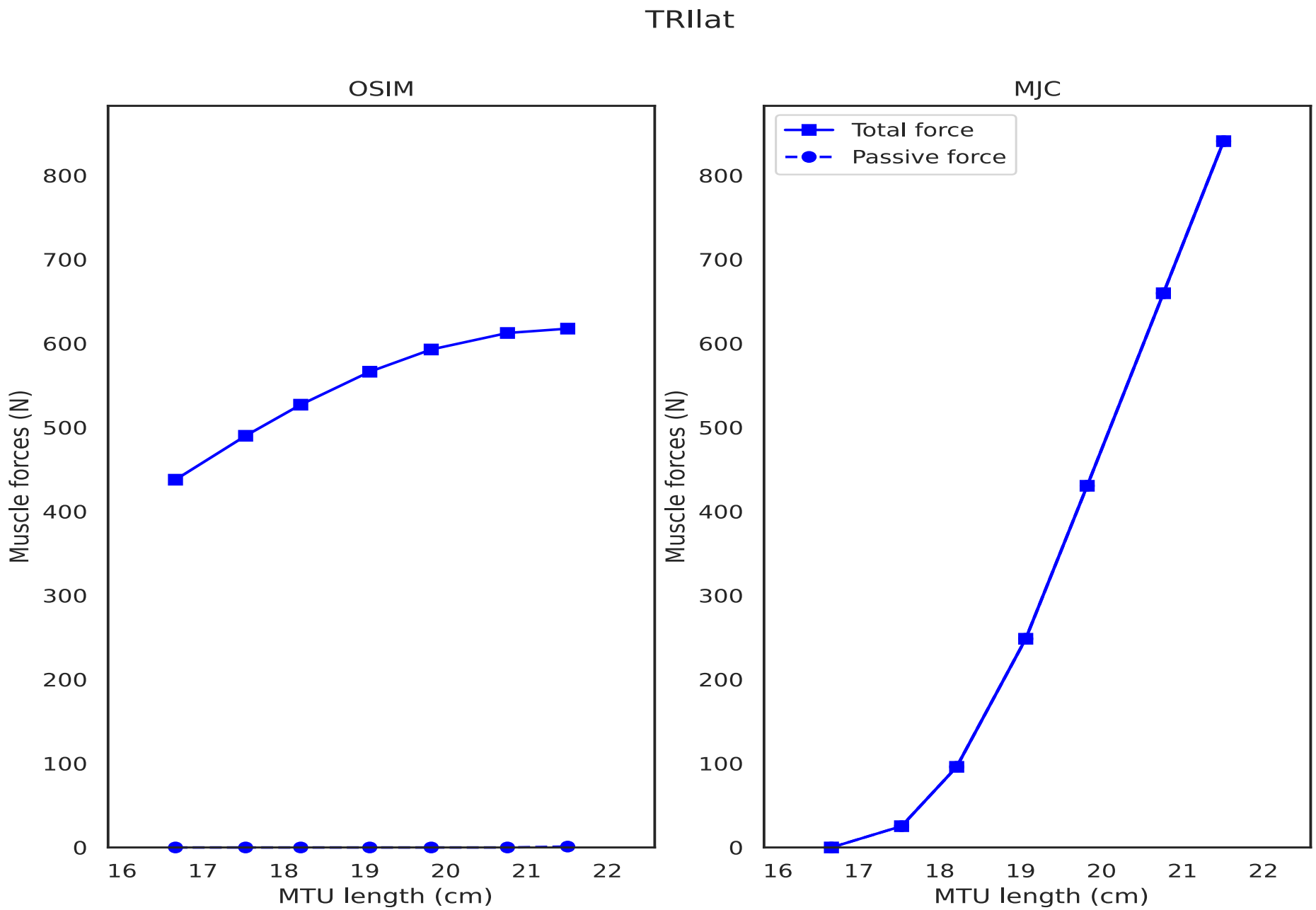
Muscle specific force comparison before/after optimization



Muscle specific force comparison before/after optimization



Muscle specific force comparison before/after optimization



Muscle specific force comparison before/after optimization