

Computational Modeling of Forearm Rotation in Primates

Viet Nam Tran¹, Wee Kheng Leow¹, Dennis Chew², Andy Khye Soon Yew³, Joyce Suang Bee Koh³, Tet Sen Howe³

¹ National University of Singapore, Singapore, Singapore

² Duke-NUS Medical School, Singapore, Singapore

³ Singapore General Hospital, Singapore, Singapore

Name of Presenting Author

Tran Viet Nam

Category

Oral presentation

Institution

National University of Singapore

Introduction / Objective

The forearm is involved in a wide range of movements and activities for humans and other primates. It involves complex motion at several joints and is susceptible to injuries that can require surgical treatments. To facilitate understanding of forearm motion at each joint, computational modeling of forearm rotation is applied on human and other primate subjects.

Materials & Methods

Three cadaveric subjects, specifically a human, a chimpanzee and a howler monkey, are studied in this work. For each subject, 3D bone models of a forearm are obtained from a CT scan. For simplicity, forearm rotation is modeled by rotating the radius about a fixed axis while the ulna is kept stationary. The axis is defined by two rotation centers that are obtained by fitting circles to landmarks placed on bone surfaces according to joint anatomy.

Results / Discussion

For the human subject, the results show that the PRUJ gap is approximately the same during forearm rotation. This is because the proximal radial head is approximately circular. However, the DRUJ gap changes during forearm rotation, since the distal ulnar head is not circular. Similarly, for the chimpanzee, the results show that the PRUJ gap is approximately the same during forearm rotation, while the DRUJ gap changes. This is expected because chimpanzee anatomy resembles human anatomy. However, for the howler monkey, the results show that both the PRUJ gap and the DRUJ gap change during forearm rotation. This is because its proximal radial head and distal ulnar head are not circular and deviate significantly from human anatomy.

Conclusion

Rotating the radius about a fixed axis gives a reasonable approximation of forearm rotation in humans. This simple approach is also applicable in primates with similar anatomy to humans. It is less effective in primates that deviate significantly from human anatomy.