SEEDING LARGE OPEN ACESS ANATOMICAL-FUNCTIONAL DATABASES

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INTRODUCTION

The advent of the Visible Human project and subsequent Korean and Chinese initiatives allowed the creation of a new generation of models containing realistic anatomical data. Also research initiatives in Europe (i.e. Living Human Digital Library) are trying to adress the lack of general availibility of anatomical and functional data for the biomechanics comunity. Nonetheless, so far very few large data sets have been made freely (and easily) available to the wider biomechanical comunity. Frequentely there are requests in the Biomech-L forum for some specific bone in a 3D CAD format to aid prosthetic design, musculoskeletal modelling or motion analysis. We try to adress this need by making freely available a large data set focused on the human upper limb and the shoulder in particular.

This data set consits of bones CT scanned and 3D reconstructed from five cadavers (from occiput to illiac crest level) with associated origins, path and insertions for all the shoulder girdle muscle Furthermore we provide 3D high resolution CAD models of (10 of each) sternums, clavicles, scapulas,humerus,radius and ulnas that ilustrate human anatomical variance and contain extra metadata (geometric least squares fittings,virtually palpated landmarks and coordinate systems based on ISB workgroups). Finally we make available a subset of the data from a arm motion analysis study during activities of daily living (7 diferent ADL's,scapular rythem, range of motion and joint centres/axis of rotation of 10 subjects)

This data set is to be made available at the International Shoulder Group (ISG) and BioMed Town (PhysiomeSpace) websites.[1,2]

METHODS

Five cadavers (male 89 years, female 65 years, male 72 years, male 76 years; female 94 years) were dissected and in all cadaver specimens the shoulder girdle muscles were sutured with copper wires of 0.7 mm thickness, 18 muscles in total for each side of the body (left and right) with an average of 5 wires per muscle
The arms of the specimens were positioned in adduction internal rotation and the elbow in approximately 90° flexion. The cervical spine was positioned in neutral position and both wrists were placed and strapped down on the lower abdomen then CT scanned (Philips Brilliance 16P) with parameters 140 KV, 0 mAs, slice increment 1 mm, pixel size 1x1mm.

The second part of the dataset was obtained from our dry bone collection, the bones were chosen based on the absence of wear. No age and gender information was available,these were CT scanned (Siemens/Volume Zoom) with parameters 120KV, 40.5mAs, slice increment 0.5mm, pixel size 0.5x0.5mm.

The Mimics software (Materialise NV, Heverlee, Belgium) was used in all 3D reconstructions from the 2D DICOM images using semiautomatic and manual segmentation, all reconstructions were checked by trained anatomists.

The third part of our data set is the motion data from 10 healthy subjects (mean age 24 years): We used an infrared camera system (ProReflex, Qualysis, Sweden) with 8 different cameras and 15 reflective markers. Measurements were performed at 60 Hz. Recommendations of the ISB and International shoulder group (ISG) on standard coordinate systems and bony landmarks were followed[3]. The measurements were performed after a static calibration of the arm, using 19 markers (all measurements were carried by at least 2 observers) these consisted of:
-Maximum range of motion of wrist joint (flexion extension, radial/ulnar deviation), forearm (pronation/supination), elbow (flexion/extension), glenohumeral joint (elevation in different planes and rotations). sternoclavicular joint (elevation/depression and protraction/retraction)
-Experimental determination of glenohumeral joint centre of rotation (done by performing small rotation of the humerus with elbow flexed 90 degrees and elevation below 30 degrees, to minimize scapular rotations)
-Seven activities of daily living (each repeated 10 times: Drinking from a cup, eating with a spoon, combing air, reaching opposite shoulder, answering cell phone call, simulated perennial task, moving 1kg book to a shelf above shoulder height.)
-Scapular rotations using a palpator and a series of static positions at 30 degrees intervals for elevation on frontal and scapular planes

RESULTS AND DISCUSSION

Five ribcages, 20 scapulas, 20 clavicles, 20 humerus, 20 ulnas, 20 radius, and 15 sternums were digitally reconstructed, the origin, path and insertion of 18 shoulder girdle muscle were extracted for 5 cadavers. The arm motion data of 10 subjects for 7 activities of daily living was acquired. It is hoped that by sharing this data we will motivate other groups to do the same and in conjunction with other initiatives (i.e. OpenSim) facilitate the development of shoulder/arm models and prosthetic design.

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REFERENCES

1. https://www.biomedtown.org/biomed_town/LHDL/
2. http://internationalshouldergroup.org/
3. G.Wu et al, ISB recommendation on definitions of joint coordinate systems of various joints for the reporting of human joint motion – Part II: shoulder, elbow ,wrist and hand, Journal of Biomechanics, 38 (2005), 981 – 992