

1. Построение биомеханической модели совместной работы плечевого сустава и шейного отдела с помощью OpenSim.

2. Необходимы данные о положении набора маркеров при движении добровольца:

**Статическая поза** (несколько секунд)

**Для плечевого сустава** (согласно [плечевой модели](#) doi: 10.3389/fnbot.2019.00090 и [протоколу](#) doi:10.1016/j.jbiomech.2004.05.042 )

а. Сгибание, разгибание

б. Приведение, отведение

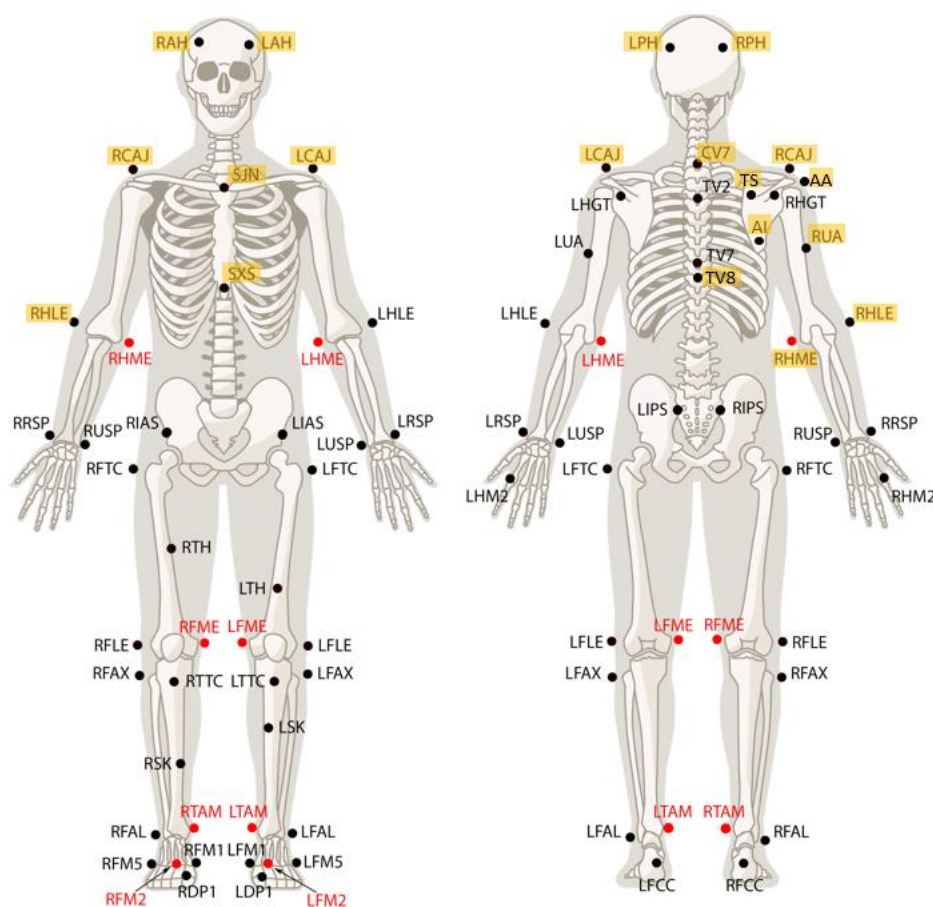
в. Пожимание плечами (shrugging)

**Для шейного отдела** (согласно [модели шеи](#) doi: 10.1371/journal.pone.0199912)

г. Наклоны головы вперед, назад, в стороны

д. Повороты головы относительно вертикальной оси

3. Предлагается следующее расположение маркеров (выделены желтым). Все они, за исключением четырех маркеров (TS, AI, TV8, AA, GH), взяты [согласно Optitrack](#)



### Head Markers

Labels	Related Segment	Anatomical Location	Placement Description
LAH	Head	Left Anterior Head	Place the markers on the left and right side of the fore head. The respective location is shown in the skeleton figure.
RAH	Head	Right Anterior Head	
LPH	Head	Left Posterior head	Place the markers on the left and right side of the head about 2 cm behind the ear. The respective location is shown in the skeleton figure.
RPH	Head	Right Posterior head	

### Torso Markers

Labels	Related Segment	Anatomical Location	Additional Description
SJN (IJ <sup>[1]</sup> )	Thorax	Sternum Jugular Notch	Top most section of the sternum. Place the marker on the center of the two clavicle bones.
SXS (PX <sup>[1]</sup> )	Thorax	Sternum Xiphoid Process	Lowest section of the sternum. Place the marker 1-2 cm above where bottom of the two rib cages conjoin.
CV7 (C7 <sup>[1]</sup> )	Thorax	Cervical Spine Vertebra 7	The 7th cervical spine vertebra is the largest vertebra located at the most inferior region of the neck. This section usually protrudes to the posterior side and can be palpated.
TV2 (T2 <sup>[1]</sup> )	Thorax	Thoracic Spine Vertebra 2	The second thoracic spine vertebra is located three spine levels below the C7 vertebra. Which is located approximately at same height with shoulder joint markers.
TV7 (T7 <sup>[1]</sup> )	Thorax	Thoracic Spine Vertebra 7	Usually located at the center of the thoracic spinal column.
LHGT	Upper Arm / Shoulder	Left Glenohumeral Joint	Place the marker on the posterior side of the shoulder axis. Ask the subject to posture in T-pose while placing the markers.
RHGT	Upper Arm /Shoulder	Right Glenohumeral Joint	

### Waist Markers

### Upper Extremity Markers

Labels	Related Segment	Anatomical Location	Placement Description
LCAJ (LA <sup>[1]</sup> )	Thorax	Left Clavicle-Acromion Joint	

RCAJ (RA <sup>1</sup> )	Thorax	Right Clavicle-Acromion Joint	Ask the subject to stretch both arms towards the side (T-pose), then palpate top of each shoulder for the protruding bone. The prominence is usually located at the end of the corresponding clavicle bone just before where the upper arm starts.
LHLE	Upper Arm	Left Humerus Lateral Epicondyle	Placed the markers on the lateral side of the elbow axis. Flex and extend the arm few times to find where elbow axis is located.
RHLE	Upper Arm	Right Humerus Lateral Epicondyle	
LHME*	Upper Arm	Left Humerus Medial Epicondyle	Place on the medial side of the elbow axis. Ask the subject to flex and extend the arm while placing the markers.
RHME*	Upper Arm	Right Humerus Medial Epicondyle	
LUA	Upper Arm	Left Upper Arm	Ask the subject to stand in T-pose while placing the marker. Palpate to find the groove between the triceps muscles where skin movements are relatively minimal.
RUA	Upper Arm	Right Upper Arm	

#### Дополнительные маркеры:

**AI:** Angulus Inferior (inferior angle), most caudal point of the scapula

**TS:** Trigonum Spinae Scapulae (root of the spine), the midpoint of the triangular surface on the medial border of the scapula in line with the scapular spine

**T8:** Processus Spinosus (spinal process) of the 8th thoracic vertebra

**AA:** Angulus Acromialis (acromial angle), most laterodorsal point of the scapula

**GH:** Glenohumeral rotation center (анализ с помощью Visual3D)

**Формат:** C3D

**Частота:** 100-120Hz