

Joint and implant biomechanics exercise

1. Two unidentified shoulder muscles spanning a 50th percentile male glenohumeral joint, Muscle 1 and Muscle 2, have had their abduction moment arms measured, resulting in the following table of glenohumeral joint abduction angle vs moment arm data. Both muscles are known to originate on the scapula and insert on the humerus.

<u>Joint angle (deg)</u>	<u>Moment arm of Muscle 1 (mm)</u>	<u>Moment arm of Muscle 2 (mm)</u>
0	5.7	-10.5
5	6.8	-10.7
10	7.9	-10.9
15	8.9	-11.0
20	10.0	-10.9
25	11.1	-10.9
30	12.1	-10.9
35	13.2	-11.0
40	14.0	-11.3
45	15.1	-11.8
50	16.1	-12.4
55	17.1	-12.4
60	17.9	-12.5
65	19.0	-12.8
70	20.4	-13.2
75	22.6	-13.9
80	24.7	-14.9
85	25.6	-16.4
90	27.0	-18.5

- a) Briefly explain the possible function of Muscle 1 and Muscle 2 at the shoulder
 - b) Suggest a likely candidate muscle for both Muscle 1 and Muscle 2. You may assume that Muscle 1 is superficial and Muscle 2 is deep.
 - c) Describe how Muscle 1 and Muscle 2 have the potential to work in concert to stabilise the glenohumeral joint.
2. Reverse total shoulder arthroplasty is performed on the subject's shoulder, resulting in medialisation of the glenohumeral joint centre by 25mm. Pre-operatively, the glenohumeral joint centre of rotation is located at the approximate centre of the head of the humerus.
 - a) Illustrate the change in moment arm of Muscle 1 after arthroplasty using a diagram, and state any assumptions about how you define the muscle line of action (muscle path) and the muscle moment arm. You may consider the arm to be abducted to 45°.
 - b) Muscle 1, when acting in isolation in the subject's pre-operative shoulder, is able to hold the entire arm at a maximum elevation of 45° of abduction. Estimate the additional weight that the patient will be able to hold in their hand at this arm position after reverse total shoulder arthroplasty is performed on the subject's shoulder. The elbow may be considered extended, joint translations and scapula motion neglected, and muscle force-length properties ignored. State any other assumptions made.