Skeletal Muscle

Identification

Student Name (or ID)	Started	Report
	2:09 PM Sep 14, 2012	4:49 PM Sep 14, 2012
	[redacted]	
	Computer: SBMS-204-021	

Case study

You are working as a physiotherapist at the Royal Brisbane & Women's Hospital. One of your patients has recently recovered from an operation which left them bedridden for 2 months; they have suffered chronic muscle atrophy during this time. A vital aspect of your role in the patient's recovery is to improve their coordination and muscle strength, and explain how this can be achieved to the patient.

Hypothesis 1

Decreasing stimulus strength will decrease the force generated by the gastrocnemius muscle

Prediction of results 1

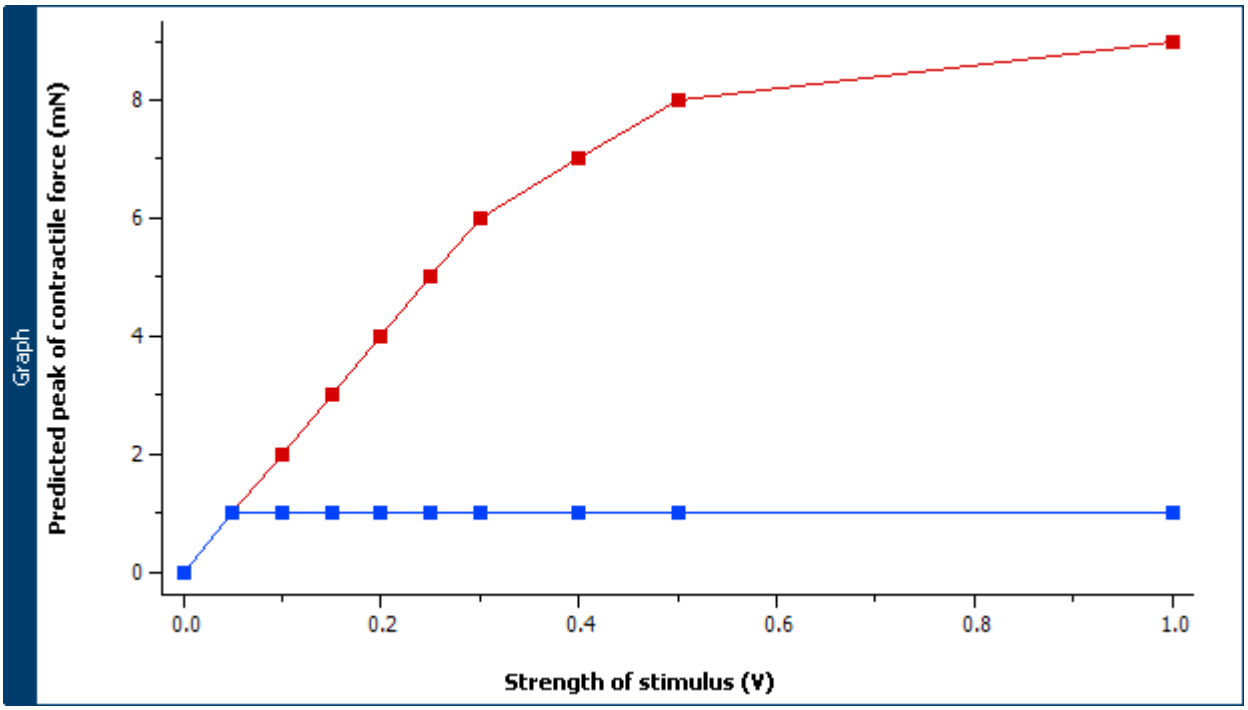

Figure 1: possible effects of stimulus strength applied to sciatic nerve on peak contractile force in B. marinus gastrocnemius muscle. Plots represent theoretical data if hypothesis is confirmed (red) and if the response is unaffected (blue).

Results 1

Table 2: peak contractile force of B. marinus gastrocnemius muscle (mN)				
Strength of Stimulus (V)	Replicate 1	Replicate 2	Replicate 3	Mean
0.00	0	0	0	0
0.05	154	149	143	148.6666 66666667
0.10	709	717	688	704.6666 66666667
0.15	737	749	732	739.3333 33333333
0.20	751	748	733	744
0.25	760	748	723	743.6666 66666667
0.30	780	748	726	751.3333 33333333
0.40	767	744	722	744.3333 33333333
0.50	786	754	698	746
1.00	1022	959	898	959.6666 66666667

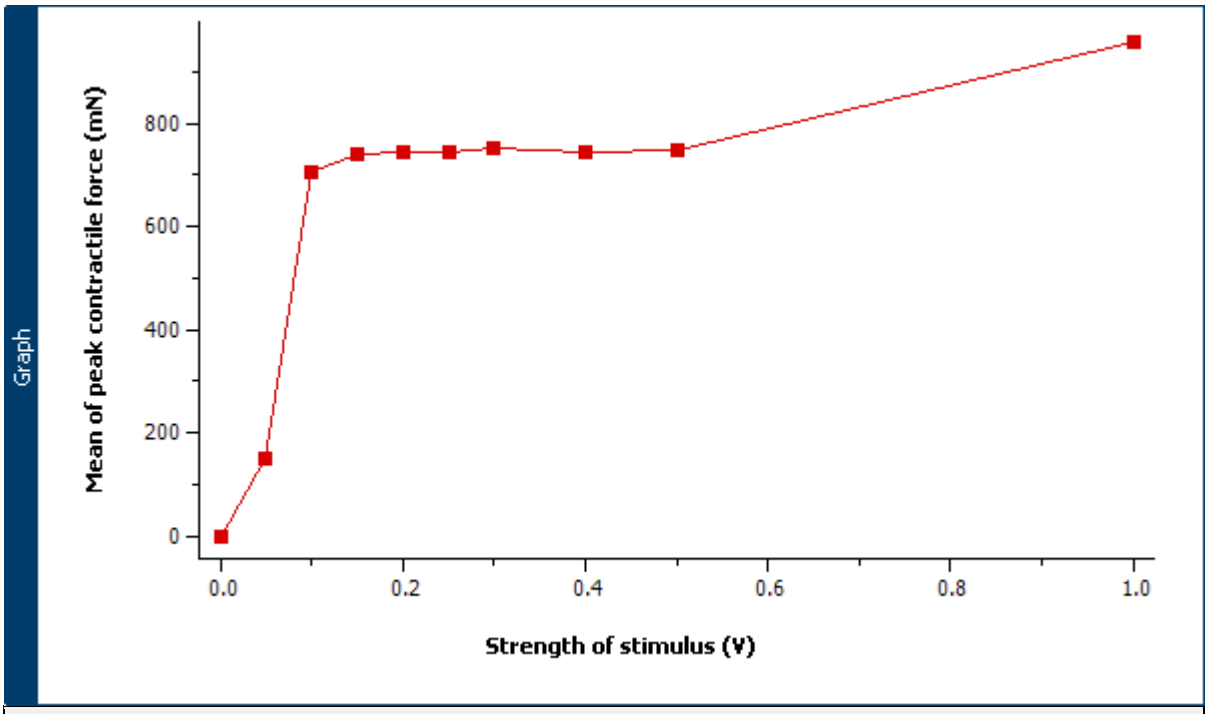

Figure 2.

Describes the increase in the mean of 3 replicates of peak contractile force (mN) for a B.marinus gastrocnemius muscle attached to a sciatic nerve, as the strength of the stimulus increases (V),keeping the passive force (200mN) constant.

Comparative analysis

Table 3.		
Comparative anaylsis for maximum single contractile force and the minimum stimulus required for the contraction between three groups.		
Group	Maximum contractile force generated (mN)	Minimum stimulus required for near maximum contraction (V)
Your own	1022	1
Alternate 1	1096	0.3
Alternate 2	959	0.5

Hypothesis 2

When the sciatic nerve attached to the skeletal muscles is stimulated, the contractile force would increase as the degree of stretch in the muscle (passive force) increases.

Materials and methods 2

The sciatic nerve of the B.marinus was placed in the nerve bath with the gastrocnemius muscle tied and initially pulled to a force of 200 mN. The contractile force was then recorded using PowerLab, with increasing passive forces (200mN, 300 mN, 400 mN, 500 mN…1100mN). This procedure was repeated twice to obtain a mean of 3 replicates for each reading.

Prediction of results 2

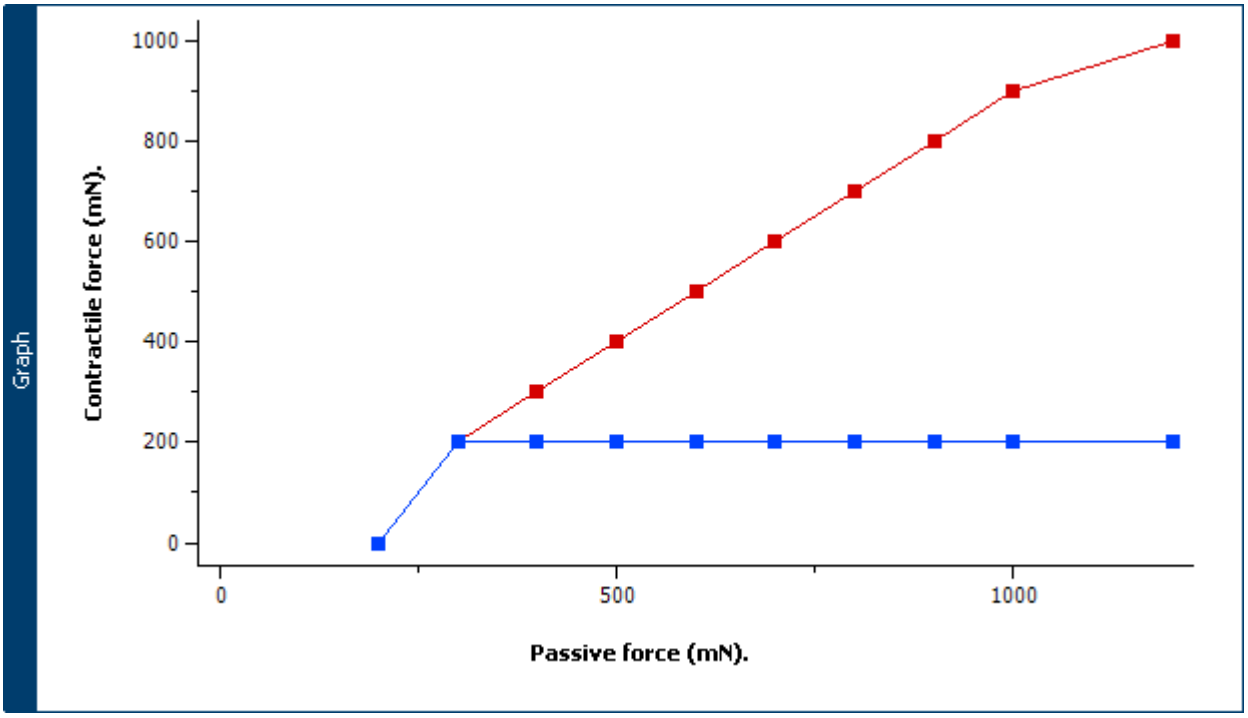

Figure 3.

Graph describing the predicted effects of contractile force (mN) depending the degree of stretch of the B.marinus gastrocnemius muscle attached to a sciatic nerve (passive force : mN). The red depicts hypothesis, and the blue depicts the response unaffected by the independent variable being passive force (mN).

Results 2

Write a paragraph of text in the box below, describing the important trends and relationships for all data presented from experiment 2:

Our hypothesis was proved incorrect. We observe the contractile force gradually declining with the increase in the passive force.

Table 5.

Independent Variable (units)	Replicate 1	Replicate 2	Replicate 3	Mean
200	565	597	605	589
300	573	577	563	571
400	538	531	519	529.3333333333333
500	501	479	469	483
600	450	430	423	434.3333333333333
700	390	385	374	383
800	348	343	331	340.66666666666667
900	309	304	290	301
1000	269	271	228	256
1100	227	238	197	220.66666666666667

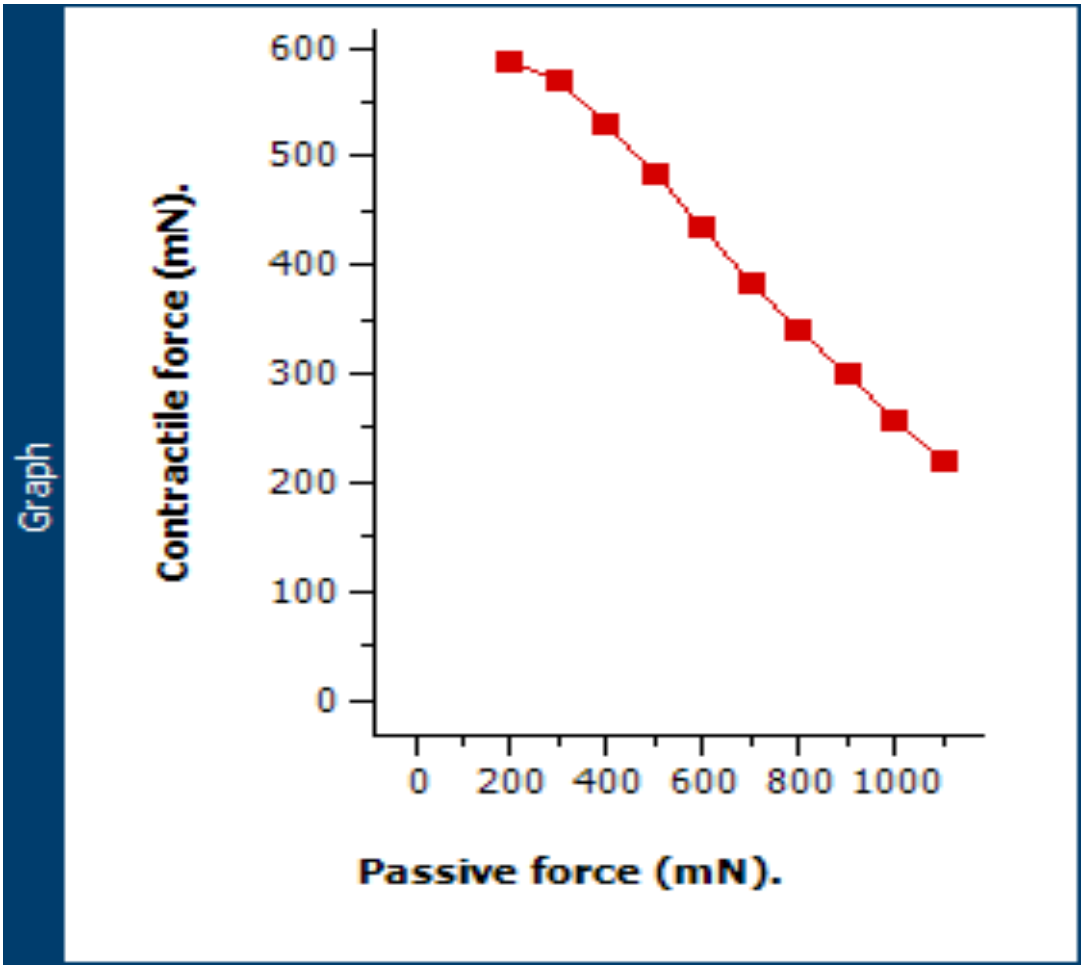

Figure 4.
Describes the decrease in the mean of 3 replicates of contractile force (mN) for B.marinus gastrocnemius muscle attached to a sciatic nerve, as the passive force (mN), being the independent variable, is increased.

Discussion

Remember to treat these questions like a short answer question in the final exam: be specific, clear, and concise.

1. Briefly describe (in complete sentences) whether the results of your first experiment confirm or disconfirm your hypothesis, and any errors in your data.

The results of the first experiment certainly confirm our hypothesis. With the decrease in stimulus there is an increased force. There was an unusual trend noticed in the first readings for the replicates, and this might be due to the infrequent frequency of the ringer poured.

2. Why do you think the peak contractile force changes with different stimulus strength?

During the occurrence of stimuli, force is exerted by the muscle which inducing action potentials towards the muscle fibers, causing them to contract. With the increase in stimuli there are more action potentials, with a higher number of motor units, thus resulting in further contraction.

3. What are the biological reasons for the differences between muscles in your comparative analysis?

Differences might have resulted due to different frequencies at which the ringer was poured, and also because some might have been due to the different thickness of the myelin sheath around the nerves (thicker it is, slower are the chances of the action potentials to pass).
Other attributes could be due to the age of the frog. Some might have thicker muscles as compared to others.

4. Briefly describe (in complete sentences) whether the results of your second experiment confirm or disconfirm your hypothesis, and any errors in your data.

The results of the second experiment disconfirm our hypothesis about the contractile force increasing with the passive force. The small unusual trend could be due the infrequent frequency of the ringer poured.

5. What biological processes do you think have caused the trends your results illustrate?

The basic biological mechanism involved is the activation of muscle fibers and release of motor units, to allow action potentials through connection muscles.

6. In the case study you are working on muscle atrophy, how do you think increasing muscle mass would affect the contractile force generated for a given stimulus?

Increasing muscle mass will not affect the contractile force. Contractile force for a given stimulus is affected by the frequency of action potentials. An action potential will give the same response no matter what size. (Tassinary, Cacioppo (2000).

7. The patient you are treating does not have a strong science background; explain to them (using complete sentences) how stimulation of skeletal muscle can result in different strength contractions using language which they can understand.

A motor unit consists of an alpha-motor neuron and the muscle fibers it innervates. Depending on the size of the motor unit, the alpha-motor neuron connects muscle fibers and sends a signal to trigger simultaneous contraction of all the fibers in that motor unit. This synchronized contraction allows the muscle to make coordinated movements. Therefore a smaller movement will have lesser contractions (Campbell *et al., 2011)*

References

List any references you have used in the panel below:

Tassinary, Cacioppo (2000). "The Skeletomotor system: surface electromyography"

Campbell Biology, 9th Edition, 2012, pg-1127-1134 (mentioned by Prof. Mike Bennett in module 3)