


Neuromuscular System

by Dr Grant Ralston

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Objectives

- Describe the anatomy of the neuromuscular system
- Describe anatomy of the muscular unit
- Understand force production
- Understand reflexes
- Describe neuromuscular training adaptations

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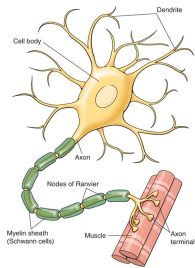
Nervous System

- Anatomical divisions
 - Central nervous system
 - Peripheral nervous system
- Functional divisions
 - Somatic (voluntary)
 - Autonomic (involuntary)



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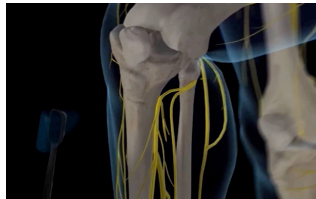
The Neuron



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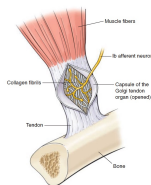
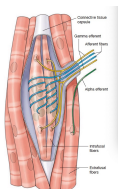
Reflexes

- Involuntary motor response to a stimulus
- Knee jerk reflex
- Withdrawal reflex




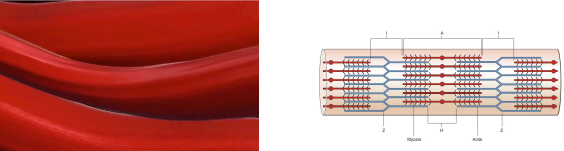
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Proprioception and Kinesthesia



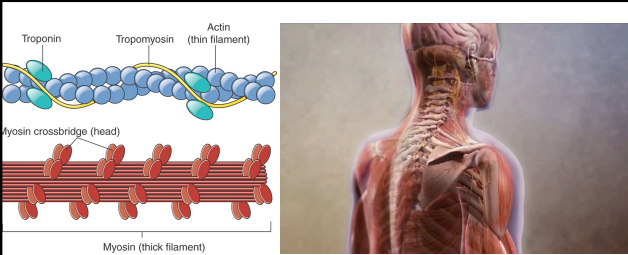
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Structure of the Myofibril and the Contractile Mechanism



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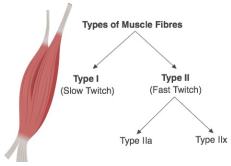
Sliding Filament Theory of Muscle Contraction



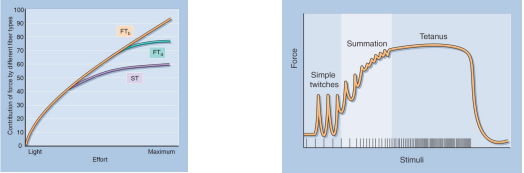
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Muscle Fiber Types

- The three primary fiber types in human skeletal muscle are slow-twitch oxidative (SO), fast-twitch oxidative glycolytic (FOG), and fast-twitch glycolytic (FG).
- These fiber types are also identified as:
 - Type I
 - Type IIA
 - Type IIX



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The first graph shows the 'Contribution of fiber types to total force' on the y-axis (0-100) against 'Stimulus' on the x-axis (Light, Effort, Maximum). It features three curves: FTx (fast-twitch) which rises most steeply, FTx+ST (mixed), and ST (slow-twitch) which rises most gradually. The second graph shows 'Force' on the y-axis and 'Stimulus' on the x-axis, illustrating 'Simple twitches' as small peaks, 'Summation' as overlapping peaks, and 'Tetanus' as a sustained high force level.

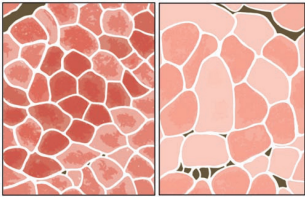
Graduation of Muscular Force

- Smaller MU are typically composed of ST fibers and have the lowest stimulus thresholds for contraction
- Increasingly forceful contractions, however, require the recruitment of larger MU containing fast-twitch fibers

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Muscular Fibre Adaptations

- Hypertrophy
- Atrophy
- Hyperplasia
- Sarcopenia

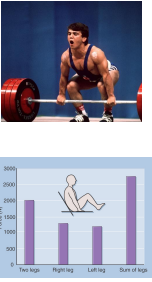


Two microscopic images of muscle fibers. The left image shows hypertrophied fibers, which are significantly larger and more densely packed. The right image shows atrophied fibers, which are much smaller and more widely spaced.

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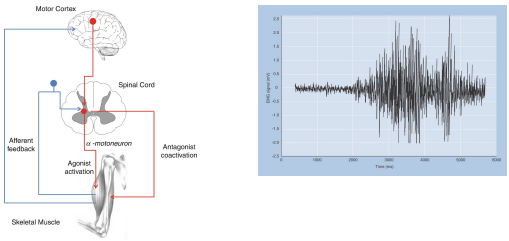
Bilateral/Unilateral Strength

- Unilateral cross-education
 - 60% increase in untrained limb
- Bilateral deficit
 - Inhibitory mechanism



The top image shows a person performing a squat. The bottom image is a bar chart with 'Force (N)' on the y-axis (0-3000) and four categories on the x-axis: 'Two legs', 'Right leg', 'Left leg', and 'Sum of legs'. The 'Two legs' bar is the highest (~2800N), followed by 'Sum of legs' (~2400N), 'Right leg' (~1200N), and 'Left leg' (~1100N).


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The diagram illustrates the neural control of skeletal muscles. It shows the Motor Cortex in the brain connected to the Spinal Cord. From the Spinal Cord, alpha-motoneurons descend to skeletal muscles. The diagram also shows afferent feedback from the muscles back to the Spinal Cord and Motor Cortex. Labels include: Motor Cortex, Spinal Cord, Afferent feedback, alpha-motoneuron, Agonist activation, Antagonist coactivation, and Skeletal Muscle. To the right of the diagram is an EMG waveform showing a burst of electrical activity over time, with a y-axis labeled 'EMG (mV)' ranging from -2.5 to 2.5 and an x-axis labeled 'Time (ms)' ranging from 0 to 5000.

EMG Evidence of Neural Adaptations

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A stylized, white, wireframe-like human figure is shown in a walking or dynamic pose. The figure is composed of thin lines representing the skeleton and major muscle groups.

Multiple Sclerosis

by Dr Grant Ralston

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The image shows various medical supplies including syringes, vials, and a stethoscope. In the foreground, there is a document with the title 'Multiple Sclerosis' and some illegible text below it.

Objectives

- Epidemiology and aetiology of multiple sclerosis
- Pathophysiology of multiple sclerosis
- The disease process

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Estimates for the prevalence of MS in men and women in the UK

People with MS in the UK

131,000 live with MS

That's 1 in every 500 people

130 new people are diagnosed every week

Age	Number of people with MS*		Number of people with MS (per 100,000 people)†,‡	
	Women	Men	Women	Men
Under 30	2,780	1,670	23	13
30-34	3,680	1,610	166	73
35-39	6,050	2,320	281	109
40-44	7,680	2,800	376	139
45-49	10,010	4,210	431	187
50-54	13,930	4,910	588	214
55-59	13,660	4,320	644	209
60-64	10,490	4,010	567	228
65-69	10,720	4,060	598	241
70-74	8,160	3,640	503	244
75+	8,490	2,620	272	115
Total	95,560	36,160	286	111
Total persons	131,720		199	

*Numbers rounded to nearest 10, †numbers rounded to 0 decimal places, ‡ based on an incidence rate calculated from average annual incidence 2012-2017. (MS Society, 2020)

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Epidemiology and Aetiology

An MRI image showing MS lesions in the brain (a) and spinal cord (b).

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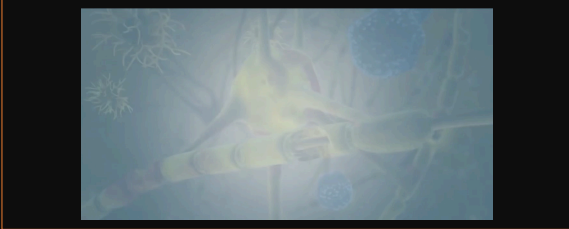
Healthy vs **Nerve affected by MS**

Labels: Schwann cells, Nerve fiber, Myelin sheath, Node of Ranvier, Exposed fiber, Demyelinated myelin.

Processes: Oligodendrocyte, Myelin sheath, degeneration in (autoimmune disease) Demyelination, Remyelination (regeneration by) (oligodendrocyte).

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Multiple Sclerosis (MS): Key Points



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Symptoms of MS



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Treatment of MS

• Key supplementary elements to the physical management, through exercise, for MS include the following:

- Diet
- Medication
- Catheterisation



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