



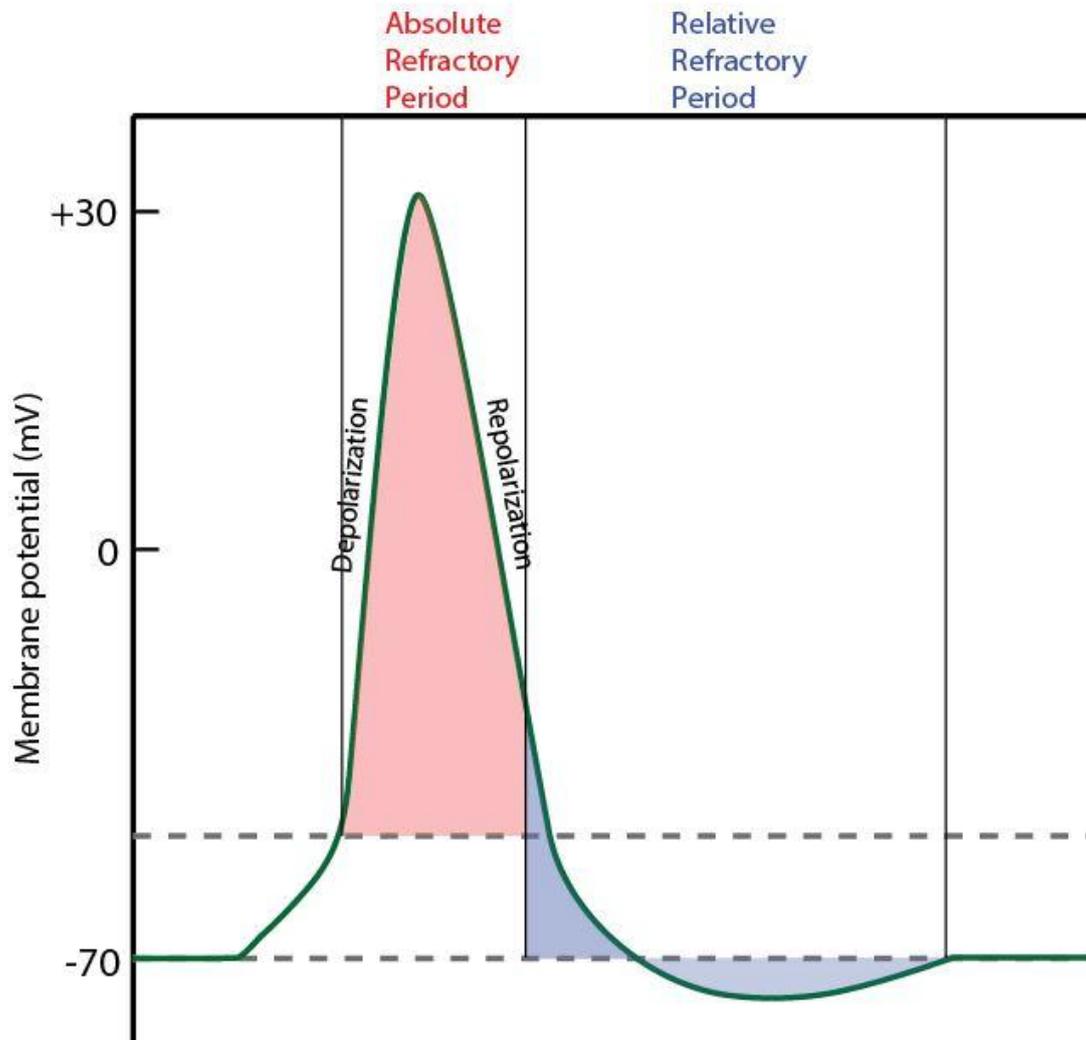
Properties of muscle

❖ Refractory period:

The refractory period is a period of time after a nerve or muscle cell fires during which the cell cannot respond to additional stimulation. In common sense, refractory period is the characteristic recovery time. It refers to the amount of time it takes for an excitable membrane to be ready to respond to a second stimulus once it returns to a resting state following an excitation. Refractory periods are caused by the inactivation gate of the Na^+ channel. Once inactivated, the Na^+ channel cannot respond to another stimulus until the gates are reset.

There are two types of refractory periods;

1. The **absolute refractory period**, which corresponds to depolarization and repolarization. The absolute refractory period is the interval of time during which a second action potential cannot be initiated, no matter how large a stimulus is repeatedly applied. This is because the sodium channels are inactivated and remain that way until hyperpolarisation occurs. In the cardiovascular mechanism, this refractory period is sometimes called effective refractory period (ERP).
2. The **relative refractory period**, which corresponds to hyperpolarization. The relative refractory period is the interval of time during which a second action potential can be initiated, but initiation will require a greater stimulus than before. This is because some of the sodium channels have been reactivated and have recovered but it is a difficult process due to the counter-acting potassium flow as some potassium ion channels are still open.



❖ Muscle Fatigue:

Muscle fatigue is a symptom that decreases the ability of muscles to generate force over time. It can be associated with a state of exhaustion, often following strenuous activity or exercise. When you experience fatigue, the force behind your muscles' movements decrease, causing you to feel weaker.

It can be a result of vigorous exercise but abnormal fatigue may be caused by barriers to or interference with the different stages of muscle contraction. Some health conditions can also prompt muscle fatigue, including muscle dystrophy.



Compiled and circulated by Dr. Parimal Dua, Assistant Professor,
Dept. of Physiology, Narajole Raj college

There are two main causes of muscle fatigue: the limitations of a nerve's ability to generate a sustained signal (**neural fatigue**); and the reduced ability of the muscle fiber to contract (**metabolic fatigue**).

Muscles require a supply of oxygen to function but are limited by energetic glycogen resources. In case the intensity of aerobic exercise increases, which requires a faster supply of oxygen than the transport system is able to provide, the exercising muscle tissue switches to the anaerobic extraction of energy. This leads to the overproduction of lactate and the development of metabolic acidosis. The lactate decreases mobilisation of fat reserves and leads to greater utilisation of glycogen as an energy source. The limiting factor is a critical decrease in glycogen reserves and subsequent hypoglycaemia, especially in CNS. The result is decreased glycolysis with reduced formation of ATP and CP. Acidosis worsens conditions for the formation and use of muscle potential, thus worsening the contractility of muscles. This leads to physiological muscle fatigue, which is sensed as a heaviness, weakness or pain or stiffness of the skeletal muscles. Fatigued and exhausted muscles tend to tremble and suffer from spasms. In muscle fatigue, the following insufficiencies occur: decrease in muscle strength, loss of speed and fine motorics (Nauza). In repetitive locomotor activities, when breaks are not sufficient for full recovery, acute pathological fatigue occurs (Máček, Vávra), which can end in blood circulation failure and death, or, in chronic pathological fatigue, it can lead to a reduction and atrophy of muscle fibres and their substitution by ligament tissue.

Several remedies are available to relieve muscle fatigue, including nutritional supplements or caffeine.



Compiled and circulated by Dr. Parimal Dua, Assistant Professor,
Dept. of Physiology, Narajole Raj college

♣ Causes of muscle fatigue:

Exercise and other physical activity are a common cause of muscle fatigue. Aging is also a common cause of muscle fatigue. But several health conditions can also produce muscle fatigue.

- Cancer
- Stroke
- Rhabdomyolysis
- Obesity
- Inflammatory diseases, such as arthritis
- Sepsis
- Burns
- HIV
- Chronic kidney failure
- Muscular dystrophy
- Addison's disease
- Anaerobic infections
- Anemia
- Anxiety
- Botulism
- Cerebral palsy
- Chemotherapy
- Chronic fatigue syndrome (CFS)
- Dehydration
- Depression
- Fibromyalgia
- Hepatitis C
- Hypothyroidism



Compiled and circulated by Dr. Parimal Dua, Assistant Professor,
Dept. of Physiology, Narajole Raj college

- Influenza (the flu)
- Lactic acid production
- Medications
- Mineral deficiency
- Myasthenia gravis
- Myositis (muscle inflammation)
- Poor muscle tone due to a medical condition
- Pregnancy
- Sleep deprivation
- Stroke
- Tuberculosis

♣ **Symptoms of muscle fatigue:**

Muscle fatigue can occur anywhere on the body. An initial sign of this condition is muscle weakness. Other symptoms associated with muscle fatigue include:

- Soreness
- Localized pain
- Shortness of breath
- Muscle twitching
- Trembling
- A weak grip
- Muscle cramps

If you begin having difficulty performing daily tasks or if your symptoms worsen, seek immediate medical attention. This could be an indication of a more serious health condition.