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Everything You Need To Know About TENS Machines

TENS machines are a wonderful **electronic pain relieving device**, that when used correctly, can reduce your pain and can even help increase muscle strength if you use an EMS capable unit.

While you are welcome to print this eBook, it is best viewed on your computer with internet access.

Hyperlinks are activated within this eBook to directly link you to the information you via the index below or hyperlinks within the eBook.

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TENS Machines

TENS is an easy to use and drug free method of electronic pain relief.

What is TENS?

TENS is an abbreviation of Transcutaneous Electrical Nerve Stimulation. Transcutaneous means "across the skin". The rest are reasonably obvious: electricity that stimulates the nerves. In simple terms, a TENS unit stimulates your nerves via an electrical current through your skin.

Modified electrical pulses are then passed from the TENS unit, via the lead wires and electrodes, to the nerves which lie underneath the skin surface.

The TENS unit is usually a small battery operated box which produces pain relieving electrical pulses. Either 2 (single channel) or 4 (dual channel) self-adhesive electrodes are applied to the skin and attached to the TENS unit with lead wires.

What are the Advantages of Using a TENS Machine?

TENS does not involve the use of drugs. For patients who find it helpful, TENS can significantly reduce or eliminate drug use for pain relief and thus reduce the potential side effects associated with medications and drugs. Some patients also like TENS because they are in control and can adjust the length and intensity of treatment.

How Long Does it Take for TENS to Work?

Your TENS machine will provide both a release of opioids and an effective "pain gating" effect.
The "gating" effect should be evident within a few seconds of application.
The opioid release (and extended pain relief) may not become apparent until after 30 minutes of application. Applications for more than two hours will give maximum opioids results.

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Which Nerve Fibres Does TENS Effect?

In order for you to understand how pain is relieved by your TENS machine, you'll need a basic understanding into what causes you to feel pain in the first place.

TENS stimulates A beta fibres, the *fastest* and *largest* fibres. This means that the "pleasant" messages provided by your TENS machine bombard the brain and eliminate the much slower "painful" messages that travel via much slower and smaller C fibres. The end result is that you will feel less or no pain.

It's that simple! TENS tricks your brain to relieve your pain.

What Conditions Does TENS Help?

Your TENS machine is a research-proven, effective, electronic pain relief solution.

- Arthritis
- Back Pain
- Bursitis
- Childbirth (Labour Pain)
- Bruising
- Headaches
- Ligament Injuries
- Muscular Strains
- Neck Pain
- Period Pains
- Phantom Limb Pain (Post-Amputation)
- Post-Operative Pain
- Sciatica
- Sports Injury
- Tendonitis
- Tennis Elbow

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What Causes You to Feel Pain?

There are Two Types of Pain:

- **Somatic pain** arising from the stimulation of receptors in the skin, muscle joints and tendons and visceral pain arising from the stimulation of receptors in the skin, muscle joints and tendons and
- **Visceral pain** arising from the stimulation of receptors in the viscera. (Tortora and Anagnistakas, 1984)

How Does Your Brain Feel Pain?

In general, pain receptors are classified according to their location (Carey, 1985). Receptors that respond to injury or noxious stimuli are termed nociceptors and are sensitive to thermal (heat), electrical, mechanical, chemical and painful stimuli. Each nociceptor is connected to a nerve that transmits an electrical impulse along its length towards the spinal cord and then, ultimately your brain. It is your brain that informs you whether or not you are experiencing pain. (Hoskins and Welchew 1985).

Pain Messages Travel Slower than Other Nerve Stimulation

Nerves can also be categorized according to their diameter (width) and whether or not a myelin sheath is present.
Fordham (1986) suggested that three types of nerves are concerned with the transmission of pain.

- **A beta fibres**, which have a large diameter and are myelinated.
- **A delta fibres**, which have a small diameter and also have myelinated sheaths.
- **C fibres**, which have small diameters and are non-myelinated (slowing their conduction rate) and are generally involved with the transmission of dull, aching sensations (Carey 1985).

Nerves with a large diameter conduct impulses faster than those with a small diameter (Hoskins and Welchew 1985). The presence of a myelin sheath also speeds up the nerve conduction rate.

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How Does TENS Relieve Pain?

There are two main methods that a TENS machine uses to provide you with pain relief.

- Pain Gating
- Endorphin Release

Pain Gating

A TENS machine produces millions of tiny electrical impulses, which enter your body via electrodes placed on the skin near or over the painful region. These fast electrical impulses override the slower pain impulses and travel quickly along your nerves to your spinal cord and up to your brain.

Your brain is immediately bombarded by millions of pleasant electrical impulses. Your pain signals continue to be sent to your brain but travel along much slower (smaller diameter) nerve fibres. Since your brain can only interpret a limited amount of information, the pain signals are easily outnumbered by the pleasant high-speed TENS stimulation.

This is known as the Gate Control Theory**.**

The Gate Control Theory was initially proposed in 1965 by Melzack and Wall based on the fact that small diameter nerve fibres carry pain stimuli through a 'gate mechanism' but larger diameter nerve fibres going through the same gate can inhibit the transmission of the smaller nerves carrying the pain signal.

Chemicals released (endorphins) as a response to the pain stimuli also influence whether the gate is open or closed for the brain to receive the pain signal. This led to the theory that the pain signals can be interfered with by stimulating the periphery of the pain site or the appropriate signal-carrying nerves at the spinal cord.

It is generally recognised that the 'Pain Gate' can be shut by stimulating nerves responsible for carrying the touch signal (mechanoreceptors) which enables the relief of pain through massage techniques, rubbing, and also the application of tens machines, wheat bags and ice packs.

Example

Pain 'Gating' is very simply described by using the example of when you "bump your elbow", and then rub it to ease the pain. When your elbow is bumped, pain messages travel to your brain. Here the messages are interpreted as "Pain". Rubbing this same elbow vigorously will stimulate an abundance of new "non-painful" messages to travel to the brain.

Luckily, your brain can only interpret a limited amount of information. If the "rubbing" sensations outnumber the painful "bump" sensations, the brain will interpret the sensations as being from the pain-free rubbing source rather than the painful bump. In other words, the rubbing sensations have 'bombarded the gate', so painful messages cannot get through.

We all know from personal experience, the faster we rub our bumped elbow, the better the results. Your TENS works in just the same way ... it's just rubs you via an electrical stimulation instead. Plus, it doesn't get as tired!

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When using TENS to 'close the gate' we use Continuous (or Conventional) Tens Mode. Continuous TENS mode produces a gentle and pleasant 'tingling' under and between the electrodes. The 'tingle' sensation helps to block the pain by closing the 'pain gate' and slowing down the painful nerve signals - this produces analgesia (numbness) in the painful area that can last for a few hours.

Endorphin Release

The Pain Gate can also be shut by stimulating the release of endogenous opioids (endorphins, enkephalins, and dynorphins), which are pain-relieving chemicals naturally released by the body in response to pain stimuli. Opioids are a naturally occurring hormone in the body. They are released in response to an injury or physical stress to reduce your pain and promote a feeling of wellbeing. Much like Morphine, and related medications, your opioids have a similar chemical structure, which explains their strong painkilling effects.
Acupuncture and TENS machines stimulate the release of endogenous opioids. The opioids then inhibit the transmission of pain signals in the substantia gelatinosa part of the spinal cord - what is often referred to as the spinal root part of the nerve.
When using TENS to help activate opioids release we use a Burst Tens Mode. Burst mode produces a rhythmic pulse which should be strong enough to produce a 'twitch' in the muscles underneath the electrodes. This muscle 'twitch' helps to release the opioids and also helps the pain 'switches' in the brain to be activated through muscular and reflex activity.
Example
A great example of endorphin release is the natural 'high' that runners and other athletes experience after 30 minutes of sustained exercise. Much like exercise, the endorphin release stimulated by the TENS may take up to 30 minutes or more to take a noticeable effect. The "feel good" effect may last several hours before endorphin levels in the body need to be increased again.

Does TENS Work for Chronic Pain?

Chronic pain is pain that has been present for at least three months. The main problem with chronic pain is that your body establishes habitual response patterns.
TENS is effective at relieving chronic pain by breaking the habit of feeling pain.
To break the habit of pain, we suggest that you apply TENS regularly over many weeks for long-term sufferers. In this way, you are teaching your body the habits of being pain-free!

Does TENS Work for Phantom Pain?

Amputee's who experience phantom pain are a prime example of chronic pain. In our experience, TENS machine have been very successful in the relief of long-term phantom pain sufferers.
"I am an amputee who has suffered phantom pain since the war. Why didn't someone tell me about TENS forty years ago? It's absolutely fantastic!" E Monaghan, Redcliffe
In short, they work. Give TENS a try yourself.

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EMS Machines

What is EMS and how does it help with Muscle Weakness?

Research has shown that electronic muscle stimulation (EMS) can help to strengthen weak muscles. The main reason lies in the fact that at any time you maximally contract a muscle, at best, only 30% of all your muscle fibres are in a state of contraction. The remaining 70% are dormant and awaiting recruitment when the contracting fibres fatigue.

With EMS you can electrically stimulate these resting muscle fibres and thereby improve their strength quicker.

Another reason that EMS works is by an improvement in the recruitment of nerve conduction rates. Explained simply, it takes a few weeks for your brain to learn how to quickly send a message to your muscles via the quickest nerve pathways. The more frequent the muscle is recruited the better your body becomes at finding the quickest way to recruit that muscle.

It is similar to moving house; it takes you a few weeks to find the quickest way to drive to work via new roads. But, once you've found the quickest way, you'll keep using that same way almost subconsciously.

Your nerves are just the same, they take time to learn the quickest way to send the message and then keep using it. EMS can help you speed up this learning process.

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TENS and EMS Machines: How to Select

Please click here to use our online interactive TENS and EMS Machine Selection Guide.

Which TENS / EMS Machine has the Features You Want?

This page contains technical information related to the electronics that operate within TENS or EMS units.
The easiest method of selecting the TENS or EMS that would suit your needs, please use the Interactive Section Guide: TENS and EMS Machine Selection Guide

TENS & EMS Machine Features

ENS / EMS Units	Single or Dual Channel	Controls	Output Modes	Machine Power	Pulse Width (µS)	Pulse Rate (Hz)	Warranty	Cut-off Timer
NT Rehab	D	D	C B M E R	VH	50 - 450	2 - 200	2yr	up to 12hr
NT Sports XL	Q	D	C B M E	VH	50 - 450	2 - 100	2yr	1-90min
NT Sports	D	D	C B M E	VH	50 - 450	2 - 100	2yr	1-90min
NT TENS	D	D	C B M	VH	50 - 300	2 - 200	2yr	up to 12hr
SportsMed	S	A	C M E	VH	250	4 - 100	2yr	
Digi10's	D	D	C B M	H	30 - 260	1 -150	1yr	15/30/60min
ProTens	D	A	C B M	H	30 - 260	2 - 150	1yr	15/30/60min
PainEze Plus	S	B	M	M	200	10 - 35	3mth	

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Feature Coding: What it all means?

Single, Dual or Quad Channels

- **S - Single Channel Units** have one set of controls that affect the current that passes down one lead and ultimately into 2 electrodes. A single channel unit is most effective when only one area is being treated at any one time. eg back pain
- **D- Dual Channel Units** have two sets of controls that affect the current that passes down both leads independently and ultimately into 4 electrodes. A dual channel unit is the best choice if you are wishing to treat two regions of pain simultaneously. eg back & leg pain, neck & arm pain, arthritic pain or sciatica. A dual channel unit can also be used as a single channel unit if only a small region requires treatment.
- **Q- Quad Output/ Dual Channel** Units have two sets of controls that affect the current that passes down both leads independently and ultimately into 8 electrodes. A quad output/dual channel unit is the best choices if you are wishing to treat activate large groups of muscles simultaneously. eg abdominals, quadriceps. A dual channel unit can also be used as a single channel unit if only a small region requires treatment.

Settings Adjustment Mechanism

- **Digital:** Fully adjustable in digital format. If you can operate a microwave, you can easily operate this unit.
- **Analogue:** Simply twist the knob to fine tune your units power output.
- **Button:** Press the green button to step up the power. Press the orange button to lower it.

Modes

- **C = Constant Stimulation** at the frequency and pulse width setting. Most commonly used or acute pain relief via a gating effect.
- **B = Burst Mode**. The unit will send through a burst of pain relieving power. Useful in chronic pain relief.
- **M = Modulation.** The frequency varies between different settings to help reduce nerve adaptation. This is useful for acute and chronic pain relief.
- **E = Electrical Muscle Stimulation** (EMS). EMS can be used to retrain or strength muscles via an electrical current.
- **R = Remote Switch** to assist in the timing on EMS-assisted contractions.

Machine Power

- **VH = Very High** Power for individuals with a very high pain threshold.
- **H = High** Power for individuals with a high pain threshold.
- **M = Moderately** High for individuals who are sensitive to modest stimulation.

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Pulse Width
These are the ON periods of the current. Generally speaking, pain relief will occur with low to mid time periods. Muscle stimulation requires a longer pulse width to successfully reproduce a muscle contraction.

Pulse Rate (Frequency)
Pulse rate is simply the number of pulses per second. Pain relief can occur at various frequencies. Acute pain is usually most effective between 80 and 120 Hz. Chronic pain can also benefit from lower settings 2 to 10Hz that stimulates an endorphin release. A setting between 35 and 50Hz is commonly used to stimulate muscles for strengthening or even relaxation.

Warranty
A manufacturer warranty is available on your tens unit. Limitations, terms and conditions may apply and are manufacturer dependent.

Cut-Off Timer
Some units have an ability to be set to shut down after a set period of time. Other units need to be manually turned off.

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TENS & EMS Electrodes

What are the Best TENS / EMS Electrodes?

The Highest Quality TENS Electrodes

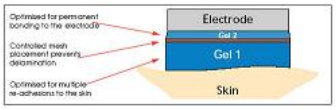
PALS wanted to offer the best electrode in the world so they created Multi-StickT, a reliable, long lasting gel that adheres when and where it should time after time... after time.
All PALS electrodes are made from Multi-StickT, the adhesive gel which lasts up to 10 times longer than the standard electrode gel.

- No other electrode has Multi-StickT Gel.
- Can be repositioned multiple times without diminished effectiveness.
- Offers optimal adherence to skin and conductive material alike.
- Comfortable, non-irritating and easy to peel.
- Resists drying, binding and contamination from skin oil and debris.
- Provides maximum durability, longevity and performance.

PALS® Platinum

Special features:

- Designed for all types of applications
- Unique knitted stainless steel fabric and gel construction
- Ensures an even distribution while reducing current at edging
- Minimise edge curl
- Designed to withstand rigors of lower back TENS application
- Adheres to patient skin when minor moisture is present



Skin Irritation:

If skin irritation occurs, try reducing the amount of electrical stimulation and moving the electrodes slightly. Ensure that your skin is not broken or that your self-adhesive electrode has not deteriorated. Please replace with a new electrode if this has occurred.

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Electrode Sizes & Shapes Available Online

Please click the link below for more online information.

Premium Quality Electrodes:

- PALS Platinum Electrodes - Rectangle (5cm x 9cm)
- PALS Platinum Electrodes - Rectangle (7.5cm x 10cm)
- PALS Platinum Electrodes - Square (5cm)
- PALS Platinum Electrodes - Round (5cm)

Budget Electrodes:

- Valutrodes

Special Use Electrodes:

- PALS Platinum Blue Low-Allergy Electrodes (4cm x 9cm)
- PALS Platinum Blue Low-Allergy Electrodes (5cm)
- Butterfly Spinal Electrode

TENS Replacement Leads & Batteries

- EziStim Battery Pack
- EziStim Cable Pack
- Replacement Leads

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TENS and EMS Machines: How to Use Most Effectively

While most of the better TENS machines have built in protocols, it’s useful to know what will work best for you and why.

What are the TENS Treatment Protocols?

Conventional TENS or Normal Mode

This mode enables the user to select any rate between 2 Hz - 200 Hz and a pulse width between 50 µS - 300 µS. This is the most frequently used of the three modes. The most common selection is 80 Hz with a 200 µS pulse width.

Burst Mode

This mode is comparable to the low rate TENS technique except that each low rate pulse is substituted for by a short BURST of 9 pulses (200 µS) at 150 Hz. It is a combination of conventional and low rate TENS. The burst mode is often referred to as "Acupuncture-like TENS".

Modulation Mode

This mode is designed to help prevent nerve accommodation that some patient's experience. It is achieved by continuously cycling the pulse width and rate.

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What TENS Machine Settings are the Most Effective?

What TENS Settings Should You Try First?

- **Program 1** is aimed at **acute pain** relief. Try this first.
- **Program 2** is aimed at **muscle relaxation** (massaging effect)
- **Program 3** is aimed at **chronic pain** (that does not respond to Program 1 or 2)

Note: Try the different programmes to find the one that "you" feel is the most effective. There is no right or wrong settings. It's what works best for you.

How to Customise Your TENS

Most mid-priced TENS units can be easily programmed to provide you with effective pain relief. Cheaper models (eg PainEze Plus) are only programmed for one setting. You will not be able to alter these settings, only the power you feel. The good news is that the settings used are usually an effective way to provide you with pain relief.

You may need to remove the battery cover to adjust the settings. Please follow your manual for instructions.

Setting the Mode

Most TENS machine have an ability to set the modality of pulse delivery.

Program 1: Constant Stimulation at the frequency and pulse width setting. This program is most commonly used or acute pain relief via a gating effect.

Program 2: Modulation. The frequency varies between different settings to help reduce nerve adaptation. This is useful for acute and chronic pain relief.

Program 3: Burst Mode. The unit will send through a burst of pain relieving power. This program is useful in chronic pain relief.

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Setting the Pulse Rate (Frequency)

Pulse Rate is the number of electrical pulses you will feel in one second. Frequency is measured in Hertz (Hz). Pain relief can occur at various frequencies. Acute pain is usually most effective between 80 and 120 Hz. Chronic pain can also benefit from lower settings 2 to 10Hz that stimulates an endorphin release. A setting between 35 and 50Hz is commonly used to stimulate muscles for strengthening or even relaxation.

We recommend the following settings (choose one):

Program 1: 80 to 100Hz
Program 2: 60 to 100Hz
Program 3: 2 to 10Hz

Setting the Pulse Width

These are the ON periods of the current. Generally speaking, pain relief will occur with low to mid time periods. Muscle stimulation requires a longer pulse width to successfully reproduce a muscle contraction.

You can alter the time that each pulse lingers before resetting. The time period is extremely small. It's measured in microseconds uS (1000th's of a second). While you may not notice the difference, your nerves can.

We recommend the following settings (choose one):

Program 1, 2 or 3: 175 to 200uS

You can strengthen the power of your machine by increasing the pulse width.

What Time Duration Should You Use a TENS Machine?

We recommend the following settings (choose one):

Program 1: 20 to 60min
Program 2: 20 to 60min
Program 3: 20 to 30min

How Often Should You Use Your TENS Machine?

TENS is non-addictive. This means you can safely use your TENS as often as you like without fear of nasty side-effects.

A successful approach can be to use your TENS machine as a replacement for analgesic drug-therapy. Rather than reaching for a tablet, reach for your TENS instead.

TENS can provide relief for many hours. If you know that your pain will last for about 4 hours, try using

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your machine around the 3 1/2 or 4 hour mark to pre-empt the onset of your pain.

What Precautions Do You Need to Take with TENS Use?

- It is not advisable to drive a vehicle or operate dangerous machinery whilst receiving TENS stimulation.
- Skin irritation from the treatment itself does not occur. However, certain skin types do react to the glue on the electrodes and, therefore, users should use hypoallergenic brands.
- Electrical stimulation should not be used on the front of the neck. Care must be used when treating to avoid the immediate vicinity of the richly innervated carotid sinus. This can be dangerous.
- People who wear pacemakers should ask their doctors about whether TENS is safe for them. TENS can interfere with the operation of some types of pacemakers. It is inadvisable to use TENS if demand type pacemaker is fitted.
- It is not clear whether TENS is safe for pregnant women. You are advised to not use a tens machine in the first 3 months of pregnancy and after that, only after consulting with your obstetrician. A TENS machine can be used during labour to ease the pain associated with childbirth.
- TENS should not be used for undiagnosed pain.
- A TENS unit should not be immersed in liquid substances.

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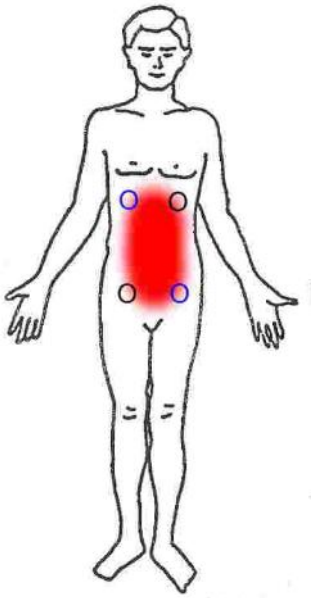
TENS Electrode Placements – The Best Locations

Simple Rules:

- Where possible place electrodes across your painful region. You should try to leave 5cm between electrodes.
- Avoid hairy areas, open wounds and scarred skin areas.
- Dual channel units use a second set of electrodes. It is beneficial to position these electrodes between your brain and the pain.
- Spinal Pain: Place either side of your spine.
- Leg Pain: Place either side of your lower back.
- Arm Pain: Place either side of your neck.

Abdominal Strengthening



Achilles Tendonitis

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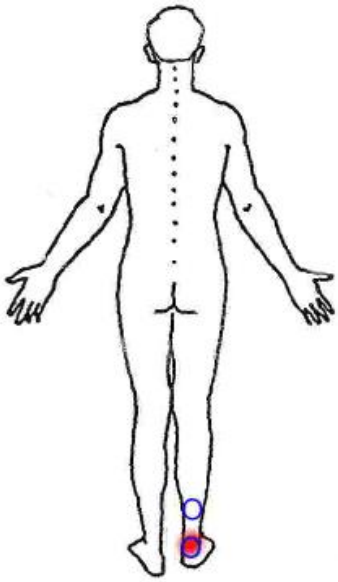
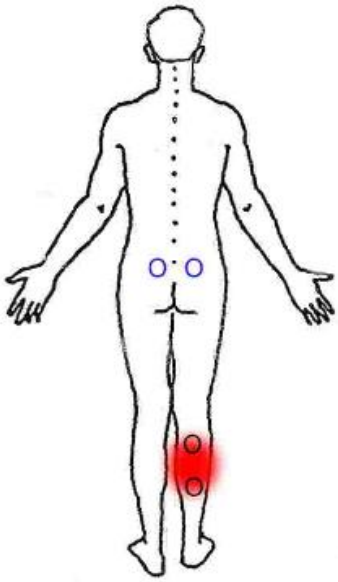


Calf Pain



Shin Pain

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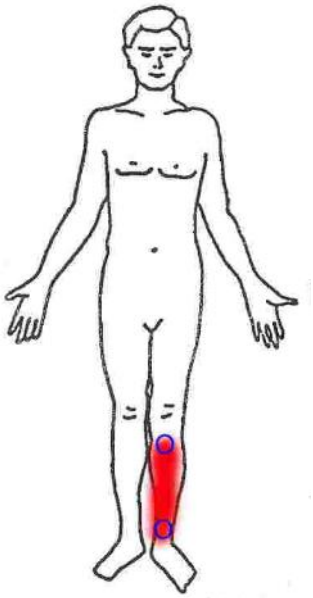
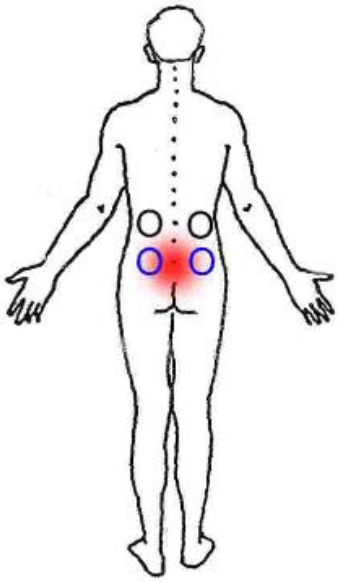


Lower Back Pain



Sciatica

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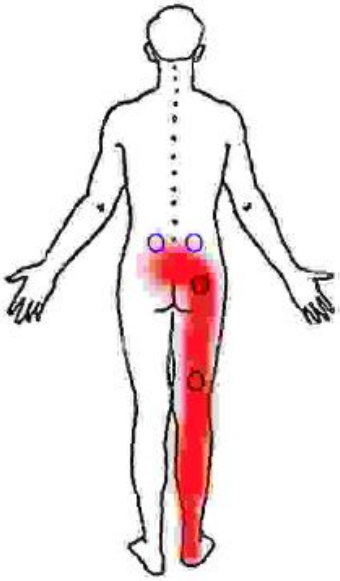
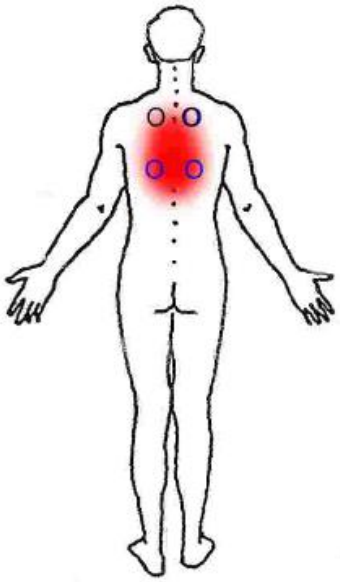


Upper Back



Elbow

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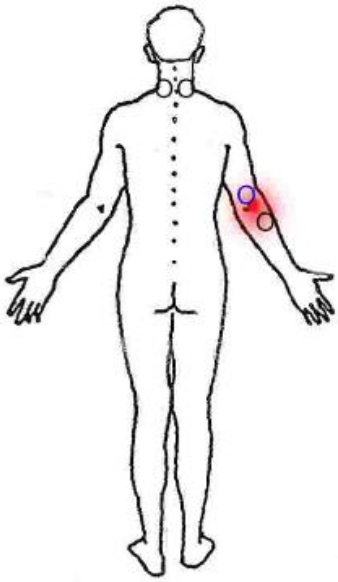
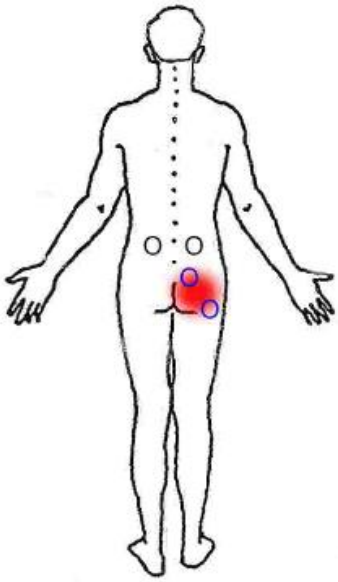


Hip and Buttock



Knee

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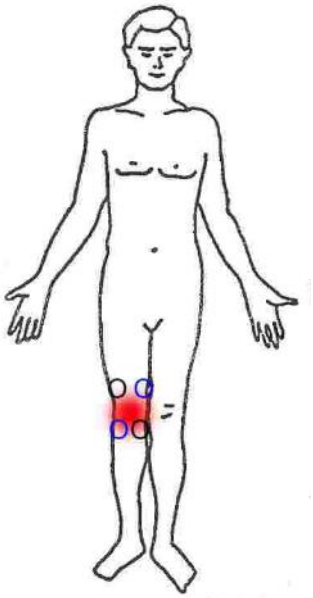
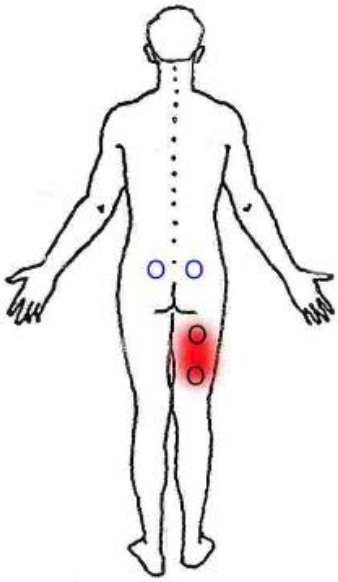


Hamstring



Thigh (Quadriceps)

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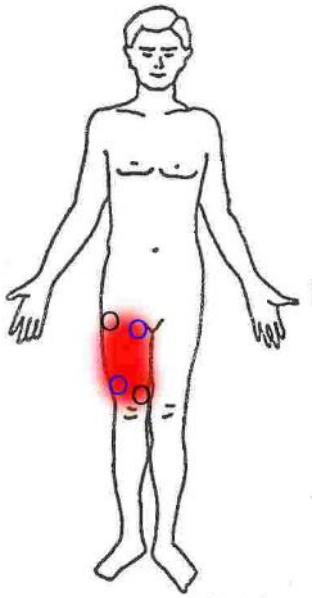
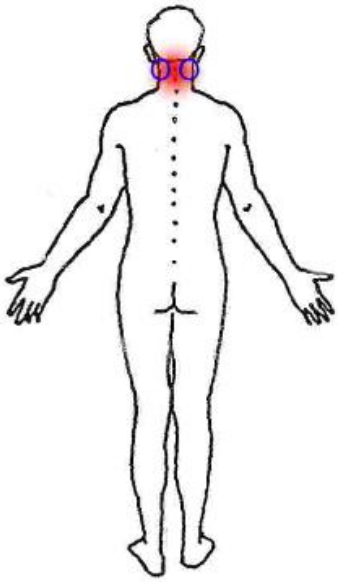
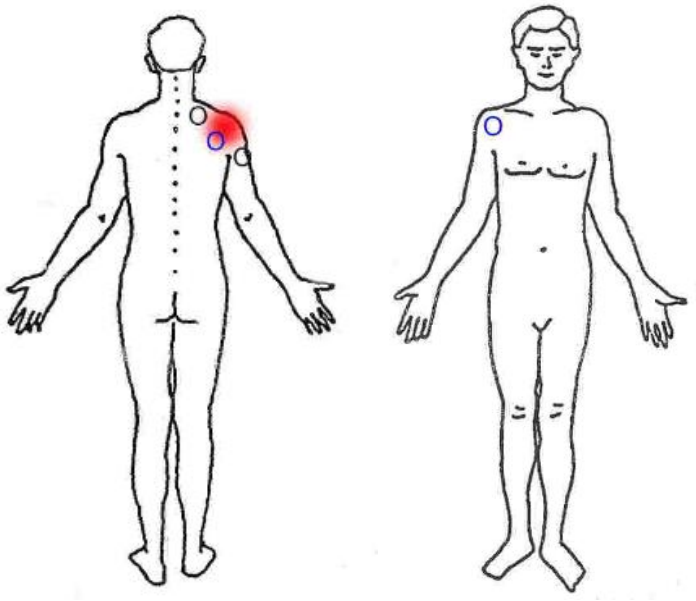


Neck, Headaches or Migraines



Shoulder

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