

## Physiology of muscle dysfunction and manual techniques:

Notes accompanying lecture given 14<sup>th</sup> November 2012 for BS2070.

### Adaptation

Both muscular-skeletal dysfunction and its treatment can be understood by adaptation theory. Essentially this holds that the body responds to stresses and strains on it by changing its structure. For example a muscle used to the point of fatigue in work or exercise sustains some damage to its fibres known as micro-tears, in the process of these healing the fibres thicken and become stronger. This is an example of the body adapting according to the demands placed on it. This can be functional as in strength or flexibility training, and is considered dysfunctional if it leads to pain stiffness or loss of movement.

The causes of dysfunction in myofascial tissue (muscle and connective tissue including fascia, ligaments and tendon) can be divided into abuse, misuse and disuse.

Abuse refers to injury, for example a broken leg while healing will affect body use and often lead to tightening in the opposite side of the body.

Misuse refers to postural issues, that is the body used in a sub optimal manner, such as slouching at a desk eight hours a day, or doing a repetitive exercise with sub- optimal 'form'.

Disuse refers to problems and adaptations that come about due to weaknesses through lack of exercise.

In practice of course these spheres of influence overlap rather a lot, but it is a useful model for remembering the causes of muscular imbalance and dysfunction. (Chaitow & Delany, 2002)

### Pathological changes in myofascial tissues

**Cross fibres:** In the healing process, or as a response to not moving an area through its full range, cross-linking fibres of collagen can be laid down between muscle units, tethering them to each other leading to less flexible muscles and reduced movement. (Holey & Cook 2010)

**Fibrotic change:** This also happens as a response to injury or long term postural strain etc. Fasciae become thickened or an inflexible, usually palpable lump forms at the site of a prior minor injury. In the case of fibrotic change the connective tissue fibres are often arranged in the same orientation as is normal. (Juhan 2003)(Lederman 1997)

**Adhesions:** In adhesions the orientation of the fibres is often multi directional. This is because movement while the healing process occurs helps break down cross-linking, but in injuries processes frequently inhibit movement. This often leaves the tissue with a palpable lump and is one of the events that people refer to as a 'knot'. (Cash 1996)

**Spasm:** This is a physiological reflex mechanism which causes a muscle, or some fibres within a muscle to contract outside conscious control. (Lederman 1997)

Strains and tears: As a result of over exertion, sudden forces and a muscle either not strong or not pliable enough some fibres of the muscle can tear or rupture. This is an acute situation where direct manual therapy is not advised. First aid should be applied (Rest Ice Compression, Elevation) and any manual therapy should be applied to adjacent tissues or other structures affected, or that are likely to become affected by postural adaptation to the injury. (Cash 1996)

Trigger points:

A Trigger point is a part of muscle tissue held in contracture. That is, it is a chemical and mechanical situation not mediated by the nervous system, although the factors involved in their evolution are usually habitual and postural, and some of the associated symptoms are due to sympathetic nervous system response. They can be seen as an adaptive mechanism by which the body attempts to remain functional. Trigger point formation is thought to arise from tissue being held in a tonic state for a long time. Without relaxing, the blood flow to the area is reduced and therefore nutrition to the cells is impeded and waste products are not removed. (Simons et al. 1999)

As the waste products from muscle contraction build up a situation develops where  $Ca^{2+}$  ions reach a concentration which holds the muscle in a contracted state permanently on a cellular level. These cells are ischaemic. This means that to treat them we need to restore blood circulation to the area in order to treat them. Received wisdom also states that to prevent their recurrence it is essential to restore the tissue to its 'normal' resting length, and in order to maintain that length in the long term a change in body use/ posture is necessary (Chaitow & Delany 2002).

The key characteristics of trigger points are:

- Exquisite tenderness on pressure
- Found in a taut band of muscle tissue
- A muscle twitch response can be elicited with palpation
- Upon pressure a referred sensation/ pain is experienced: This could be a pain distant from the point or radiating from the point.
  - If this pain is familiar to the patient = Active trigger point
  - If this pain is unfamiliar to the patient = Latent trigger point
- The skin above a trigger point becomes less elastic
- The skin above a trigger point becomes sticky (Hypersecretion of sweat glands)

(Chaitow & Delany 2002)

The referral zones of trigger points often correspond to acupuncture channel, just as their locations often correspond to channel points- comparisons have found an 80% correlation between Travell and Simons Trigger point map and the traditional Chinese acupoint locations (McCarthy 2003). An earlier study had also found an 82% correlation between 361 classical acupuncture points and perforation points in the superficial fascia where a bundle of peripheral nerve, venule and arteriole (Heine 1995).

## Physiological effects of manipulation

### Fluid dynamics:

compression and release of the tissues has effects on their fluid dynamic. Effectively a manual pumping displaces lymph, blood and interstitial fluid, which then returns into the area. Working in the direction of venous/ lymphatic return is thought to facilitate circulation generally

### Reflex effects:

The many sensory organs in the skin and muscle tissues can be affected by touch. There are reflex effects from the skin which can give a sense of relaxation, calming in a general way and specifically losing tone in tight muscles. These also appear to have an effect on pain perception for a limited time after the massage, long term effects are disputed. An interesting finding has been that the free (without specialised mechanoreceptors) nerve endings which transmit most pain (nociception) also relay information about movement and can't do both. As such it is possible that part the effect of manual therapies is to engage the free nerve endings in responding to tissue movement rather than pain.

### Connective tissue effects:

Recent research has shown that connective tissue can adapt and remodel very rapidly and it is now hypothesised that many of massages' perceived effects come from adaptations to the fascial structures due to stimulation of specialised mechanoreceptors located in the connective tissue (Schleip 2003a.). Moreover that stimulation of these receptors can change the viscosity and therefore mobility of connective tissue (Schleip 2003b.) and that fascia can also actively contract and influence biomechanics (Schleip 2007).

## Types of dysfunction treated by different manual (Swedish massage/ Tui Na) techniques.

In this section the information is based on analysis of scientific research and material presented at the 1st international congress on fascia research, Boston MA, 4th-5<sup>th</sup> October 2007, the 2<sup>nd</sup> international congress on fascia research, Amsterdam, 27th-29<sup>th</sup> October 2009, and the Robert Schleip workshops 'fascinating fascia' delivered in February 2009. As such the information is not 'proven' but is a reasonable application of current understanding to the field of manual therapy.

Problems involving fluid dynamics, including trigger points, chronically stiff tissue etc can be addressed by utilising pumping like actions. So on superficial tissues useful techniques include:

Effleurage

'stroking'

Tui fa (pushing)

Gun fa (rolling)

Rou fa (kneading) or Mo fa (circular kneading)- with less pressure

At the deeper and more focused levels of tissues more appropriate techniques include:

Friction

Deep transverse frictions

An fa (pressing) and Di An fa (finger pressing)

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Ya fa (suppressing)  
Rou fa and Mo fa with stronger pressure  
Che fa (squeezing)

All massage techniques will have reflex effects at some level as they involve contact, in general:

Inhibitory- relaxing:	Stimulatory:
Slower, gentler techniques	Faster, vigorous techniques
Tui fa	Percussive techniques; tapotement, Ji fa (chopping) Pai fa (patting/ knocking) etc
Effleurage	Zhen fa
Petrissage	Tan Bo fa (plucking)
Ma fa (wiping)	Yi Zhen Chan Tui Fa (1 finger meditating)
An fa, Ya fa, Dian fa	Dou fa (shaking)
Rou fa	Cuo fa (rub-rolling)
Na fa (grasping)	

Vibratory and percussive techniques probably stimulate the pacini corpuscles, which are densely concentrated in the joint capsules, and seem to have a regulatory effect on tissue tone. Many of the stimulatory techniques above will fall into this category:

Dou fa, Zhen fa, Cuo fa etc.

Connective tissue remodelling techniques are those which place strong pressure along fibres to align or remove cross-linking, transverse to reduce tone or break down adhesions, or with shearing multidirectional forces. These strong directional forces encourage adaptations from the tissue which should be aimed at increasing functional ability and range of movement. Techniques include:

Petrissage	An fa
Frictions	Dian fa
Deep transverse friction	Na fa
Myofascial release	Deep Rou/ Mo fa

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