Chapter Eight

8

Differential diagnosis of fibromyalgia

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Since the 1990 publication of the American College of Rheumatology criteria for the classification of fibromyalgia (ACR criteria), fibromyalgia (FMS) has become a well-recognized clinical entity (Wolfe et al 1990). The World Health Organization has included the diagnosis of FMS in its *International Statistical Classification of Diseases and Related Health Problems* (World Health Organization 2007), while the US Food and Drug Administration has recognized FMS by approving pregabalin and duloxetine for its indication (Food and Drug Administration 2007). Several studies offer support for the administration of pregabalin and duloxetine to patients with FMS (Arnold et al 2008, Crofford et al 2005, 2008, Mease et al 2008, Pae et al 2009, Russell et al 2008); however, neither drug demonstrated acceptable efficacy for the majority of patients (Lawson 2008).

According to the ACR criteria, a diagnosis of FMS should be made when an individual presents with widespread pain lasting longer than 3 months and tests positive for the tender point count. Several associated conditions have been described and multiple aetiological hypotheses have been developed. Even though the ACR criteria were widely used in clinical practice, they have several significant limitations, which may explain why fewer health care providers use them in clinical practice compared to a decade ago (Clauw 2008). At the time of the development of the criteria, FMS was considered a discrete disease, which could be captured with the somewhat simplistic tender point count, even though the number of positive tender points was based on a totally arbitrary decision-making process. The tender point count remains a non-specific concept and does not differentiate FMS from other chronic widespread pain diagnoses featuring many of the same symptoms (Dommerholt 2002). Physicians who still consider the ACR criteria as the gold standard when making the diagnosis of FMS, or physicians who consider a diagnosis of FMS an endpoint rather than an opportunity to explore what may be causing the widespread pain and associated symptoms, may disregard the established medical differential diagnostic process and ignore the current thinking about FMS. This

chapter will highlight several other pain syndromes that should be considered in the differential diagnosis of FMS with special attention to the diagnosis of myofascial pain.

The ACR criteria

The ACR criteria were deliberately referred to as 'classification' criteria to distinguish them from 'diagnostic' criteria. The term 'classification' was used to represent the minimal standard for entry of subjects into research and epidemiological studies; however, the ACR criteria suggested that the criteria would be useful for clinical diagnosis as well (Wolfe et al 1990). A consensus document developed during the 1992 Second World Congress on Myofascial Pain and Fibromyalgia in Copenhagen supported using the ACR criteria as diagnostic criteria, even in the absence of the required number of tender points (Jacobsen et al 1993, Wolf et al 1993). According to the Copenhagen declaration, strict adherence to the tender point count was indicated in research protocols. However, when the ACR criteria were used as diagnostic criteria, the diagnosis of FMS could be made with less than 11 tender points, a sentiment repeatedly expressed in several other publications (Bennett 1999, Jacobsen et al 1993, Wolfe et al 1995). Following the publication of the ACR criteria and the Copenhagen declaration, physicians and other health care providers worldwide started applying the classification criteria diagnostically in their clinical practices. Compared to other medical specialists, rheumatologists most frequently made the diagnosis (White et al 2000a).

Because the ACR criteria include only two parameters, namely widespread tenderness and duration of symptoms, there are potential pitfalls clinicians should be aware of when considering the diagnosis of FMS. First, the ACR criteria associate a single non-specific clinical feature, such as tenderness, with an entire pain syndrome and fail to distinguish between cause and effect (Cohen & Quintner 1993). Although several studies have confirmed the validity and inter- and intra-observer reliability of the tender point count, there is no evidence that this validates the tool to characterize a specific syndrome (Okifuji et al 1997, Tunks et al 1988, 1995). Technically, patients with widespread burns may meet the ACR criteria for FMS; however, it is inconceivable that a physician would diagnose FMS in the presence of obvious signs of burn scars (Wolfe 1993). A recent study showed that anatomical regions of tenderness are indeed non-specific for describing patients with diffuse pain (Katz et al 2006). A Norwegian study of over 3000 subjects showed that localized musculoskeletal pain is relatively rare and that musculoskeletal pain usually coexists with pain in other body regions, which suggests that using a tender point count to establish the widespread nature of a particular pain problem may lead to many false positives (Kamaleri et al 2008a, 2008b). It has been established that a high number of tender points may depict a more general measure of distress, more somatic symptoms, more severe fatigue and low levels of self-care, but the use of the tender point count and its arbitrary 11-point cut-off remain highly subjective (Croft 2000, Jacobs et al 1996, McBeth et al 1999, Smythe 1986, Wolfe 2000).

Second, there is a substantial risk of circular reasoning. After patients have been diagnosed with FMS using the tender point count, they may still wonder why they have pain. Invariably, the clinician will answer something like: 'You have pain, because you have FMS.' This circular reasoning basically implies that patients have pain, because they have pain. By not distinguishing between cause and effect, circular reasoning is inevitable (Cohen & Quintner 1998).

Third, tenderness assessed by the tender point count does not distinguish a particular clinical entity, but may be an indication of allodynia, hyperalgesia, peripheral and central sensitization (Croft et al 1996, Graven-Nielsen et al 1999, Henriksson 2002). The current thinking considers that FMS is a diffuse disorder of central pain processing with widespread body pain (Clauw 2008). However, central sensitization is not specific to FMS and is commonly seen with other chronic pain syndromes, including myofascial pain, spinal cord injuries, burn injuries, post-herpetic neuralgia, phantom limb pain, trigeminal neuralgia, back and neck pain, endometriosis, whiplash-associated disorders, temporomandibular pain, headache, etc. (Bajaj et al 2003, Coderre et al 1993, Curatolo et al 2004, 2006, Eich et al 2000, Eide & Rabben 1998, Eide et al 1994, 1996, Fernández de las Peñas et al 2007a, Johansen et al 1999, Kavanagh et al 1991, Mense & Hoheisel 1999, Okifuji et al 1999a, O'Neill et al 2007, Sessle et al 1999, Yunus 2007a).

There is much evidence that most chronic pain states feature a combination of central and peripheral mechanisms (Cousins 2007, Curatolo et al 2006).

Neuroimaging studies of patients with various chronic pain syndromes have shown similar alterations in functional brain activity, independent of the specific diagnosis, that may contribute to allodynia, hypersensitivity, tenderness and other abnormal pain experiences (Bradley et al 2000, Bushnell et al 2002, Grachev et al 2000, Niddam et al 2007, 2008).

Although the word fibromyalgia suggests that FMS is a musculoskeletal syndrome limited to fibrous and muscular tissues, FMS is now defined as a medical condition, characterized and defined by the hallmark of chronic widespread non-articular musculoskeletal pain (Chakrabarty & Zoorob 2007). There is some evidence that people with FMS are more pressure sensitive than others with chronic widespread musculoskeletal pain (Cöster et al 2008), but in a given individual all tissues are usually equally tender (Vecchiet et al 1994). There is no evidence of any peripheral FMS-specific aberrations (Dommerholt 2000, Henriksson et al 1993, Mengshoel 1998, Nørregaard et al 1994, Schrøder et al 1993, Simms 1994, 1996, Yunus et al 1989). FMS is a diffuse central nervous system disorder with pain and dysfunctional sensory processing (Clauw 2007). Yet, patients with FMS are not a homogeneous group and it is unlikely that all non-pain symptoms such as disturbed sleep, fatigue, cold intolerance, dry eyes and dizziness can fully be explained by the sensitization model (Jones et al 2007). Yunus has argued that FMS is part of a spectrum of overlapping central sensitivity syndromes (Yunus 2007b, 2008).

Last, in cases where a treatable medical diagnosis can be identified, it is questionable if and how patients benefit from an additional diagnosis of FMS. The ACR criteria suggest that the diagnosis of FMS is 'a diagnosis by inclusion', which should be made irrespective of other diagnoses (Wolfe et al 1990). Patients were advised to avoid physicians who believe that FMS is a diagnosis by exclusion (Russell 2001). Yet, there is an inherent risk in making the diagnosis of FMS by inclusion, especially when the majority of symptoms in a particular individual can be traced back to other medical conditions that feature similar symptoms, including widespread pain, sleeplessness and fatigue (Dommerholt 2002). Schneider & Brady (2001) refer to this category of patients as 'pseudo FMS' patients, or patients who were misdiagnosed with FMS.

Clauw maintains that one of the characteristics of FMS is that no physical reason for the pain can be identified, which in his view may lead to a belief by health care providers that patients may be malingering and thus delay the diagnosis and treatment (Clauw 2008). However, there are many medical conditions that may feature widespread pain and not all health care providers will rule out all other differential diagnoses, making it questionable whether there really is no other physical reason for pain. Myofascial trigger points are just one of many conditions that can cause widespread pain and few health care providers are skilled in identifying trigger points. Patients with multiple trigger points may thus get a diagnosis of FMS, while the treatment of their trigger points likely would resolve or lessen their widespread pain (Dommerholt et al 2006a, Gerwin 2005). When a diagnosis of FMS is made by inclusion, other diagnoses may not get identified, which potentially could result in withholding appropriate treatment options from the patient. For example, any time a cardiologist prescribes or increases the dose of a cholesterol-lowering medication, the patient may develop widespread myalgia as a side-effect of the medication. All cholesterol-lowering medications in the so-called 'statin' family have widespread myalgia as a potential side-effect (Silva et al 2006, Sirvent et al 2008). The patient may not realize that the cholesterol-lowering drug may be responsible for the relatively sudden onset of widespread muscle pain and may consult a general practitioner, rheumatologist or physiatrist, instead of the cardiologist who prescribed the medication. The patient may be diagnosed with FMS if the physician is not familiar with the potential side-effects of cholesterol-lowering medications or if the physician follows the principle of a diagnosis by inclusion. It is safe to assume that the symptoms that are now ascribed to FMS will continue as long as the patient continues to take the cholesterol-lowering medication.

After much debate during the past decade, it is now abundantly clear that there is nothing special about the number of tender points. Rheumatologists have finally suggested that the ACR criteria should not be used as diagnostic criteria for clinical use (Ablin et al 2008).

Differential diagnoses

Among the diagnoses that may feature widespread pain and a positive FMS tender point count are hypothyroidism, disturbed sleep, growth hormone

Table 8.1 Differential diagnosis of fibromyalgia syndrome

Fibromyalgia
Hypothyroidism
Adult growth hormone deficiency
Metabolic insufficiencies
Myofascial pain syndrome
Myalgias secondary to medication use
Parasitic infestations
Myoadenylate deaminase deficiency
Rheumatic diseases
Psychological diagnoses
Hypermobility syndrome
Whiplash syndrome
Widespread burns

deficiency, metabolic insufficiencies, myofascial pain, myalgias secondary to medication use, parasitic infestations, myoadenylate deaminase deficiency, rheumatic and infectious diseases, psychological diagnoses, hypermobility syndrome and whiplash syndrome (Table 8.1). There is evidence that the mere diagnosis of FMS may contribute to feelings of hopelessness, depression, anger, anxiety and illness behaviour, which is one important reason why clinicians should be cautious with giving patients the diagnosis of FMS (Hadler 1996, Hellström et al 1999).

In spite of the notion that, according to the ACR criteria, a diagnosis of FMS should be made irrespective of other diagnoses, a more logical approach would dictate following the accepted medical differential diagnostic process and exclude other potential causes of widespread pain, fatigue, sleep problems and psychosocial distress. A brief review of some common causes of widespread pain and associated symptoms pertinent for the differential diagnosis follows.

Hypothyroidism

Hypothyroidism is suspected clinically when there is a complaint of coldness, dry skin or dry hair, constipation and fatigue. Several authors have suggested that FMS may be associated with hypothyroidism (Garrison & Breeding 2003, Lowe 1996). Hypothyroidism is commonly associated with widespread pain and in one study occurred in 10% of chronic myofascial pain subjects with widespread myofascial trigger points (Gerwin 1995). The thyroid-stimulating hormone (TSH) level may only be in the upper range of normal, but as shown by TRH stimulation tests, may still be abnormal for a given individual (Gerwin 2005). Patients with hypothyroidism are commonly managed with medications such as levothyroxine (Singh et al 2000, Woeber 2000). However, not all tissues are equally able to convert thyroxine to triiodothyronine, the active form of thyroid hormone. The addition of triiodothyronine to thyroxine has been shown to result in an improved sense of well-being, an improvement in cognitive function and mood, and an increase in serum levels of sex-hormone-binding globulins, a sensitive marker of thyroid hormone function (Bunevicius & Prange 2000, Bunevicius et al 1999). For more information about thyroid dysfunction, see Chapter 10 of this book, where John Lowe has provided a comprehensive review of his metabolic approach to patients with chronic widespread pain.

Since the clinical features of FMS and hypothyroidism are so similar, there is no real advantage to diagnosing patients with FMS as well, once hypothyroidism has been established.

Disturbed sleep

One of the commonly described symptoms of FMS is sleep disturbance, even though impaired sleep patterns were not part of the ACR criteria. Interestingly, disturbed sleep is an independent predictor of chronic widespread pain, as are poor health, low energy and emotional distress (Schochat & Raspe 2003). Patients diagnosed with FMS presented with significantly higher levels of dysfunctional beliefs and attitudes about sleep and perceived stress than healthy controls (Theadom & Cropley 2008). It is often thought that persons with FMS have a disturbed sleep pattern with a characteristic alpha-delta anomaly, which is also known as the alpha EEG. However, not all studies support this notion. The alpha-delta sleep anomaly was found in only one-third of persons diagnosed with FMS (Carette et al 1995).

A recent sleep study demonstrated that subjects with FMS were not different in most polysomnographic measures when compared to healthy

controls (Burns et al 2008). The only difference was that FMS patients had shorter stage 2 sleep periods, which confirmed an earlier study by Landis et al (2004). One study identified three varieties of alpha EEG sleep in subjects diagnosed with FMS, including phasic alpha sleep (50% of patients vs. 7% of healthy controls), tonic alpha sleep (20% of patients vs. 9% of controls) and low alpha sleep (30% of patients vs. 84% of controls) (Rizzi et al 2004). Alpha EEG sleep occurs not only in slow wave sleep, but is also observed in stage 2 sleep (Moldofsky 2008). Patients with phasic alpha sleep more likely had poor sleep efficiency, increased post-sleep tenderness and subjective pain (Rizzi et al 2004). Morning stiffness and diffuse pain are also common in FMS patients with phasic alpha sleep (Moldofsky 2008).

Many clinicians assume that insomnia is a consequence of pain; patients assume that they are awakened by nocturnal pain. Yet, in one study the type and degree of insomnia were equal in persons with chronic pain as in persons with primary insomnia, suggesting that nocturnal pain may not be causally related at all to a lack of delta sleep and severe fragmentation of sleep (Schneider-Helmert et al 2001). Many of the secondary symptoms of FMS, including cognitive dysfunction, fatigue and poor attention span, can be explained by insomnia, but are not specific either (Schneider-Helmert et al 2001).

Sleep disturbances or insomnia are commonly observed not only in persons diagnosed with FMS, but also in healthy subjects, in persons diagnosed with AIDS, osteoarthritis, rheumatoid arthritis, myofascial pain, depression, restless leg syndrome, obstructive sleep apnoea, irritable bowel syndrome and temporomandibular joint disorders (Hirsch et al 1994, Korszun 2000, Kubicki et al 1989, Moldofsky 2008, Moldofsky et al 1987, Schneider-Helmert et al 2001, Scudds et al 1989, Von Korff & Simon 1996).

Side-effects of medications

In patients with initial complaints of widespread pain a few weeks after they increased the dose or started taking any of the 'statin' drugs, the cholesterol-lowering medications could be responsible for the pain complaint (Silva et al 2006, Sirvent et al 2008). It is now hypothesized that the statin-induced myotoxicity is the result of multiple factors. Statin drugs appear to impair the mitochondria, resulting in a mitochondrial calcium leak and an altered regulation of the sarcoplasmic reticulum (Sirvent et al 2008). Statin drugs also block the production of farnesyl pyrophosphate, which is an intermediate in the synthesis of ubiquinone or coenzyme Q10 (CoQ10). CoQ10 is important in mitochondrial energy production. Although some have hypothesized that statin-induced CoQ10 deficiencies would be involved in the pathogenesis of statin myopathy, recent studies did not confirm the role of CoQ10 in causing myopathies (Marcoff & Thompson 2007, Young et al 2007). Irrespective of the underlying mechanism, these patients can be successfully treated by reducing the dosage of the medication or by switching to another cholesterol-lowering drug.

Alnwick reported a case of a 42-year-old female with a diagnosis of FMS, who was found to have serotonin syndrome as a result of taking citalopram (Alnwick 2008). Citalopram is a serotonin reuptake inhibitor, which may have triggered excessive stimulation of serotonergic receptors (Chan et al 1998, McDaniel 2001, Mason et al 2000). Poduri & Gibson (1995) reported a case of medication-induced lupus that was mistaken for FMS. When patients present with widespread pain after having started new medications, or after altering the dosage of current medications, a diagnosis of FMS is often not indicated. Rather, these patients should be diagnosed with side-effects of medication use.

Parasitic disease

Parasitic infestations, such as amoebiasis, fascioliasis and giardia, can cause or contribute to widespread pain. According to the World Health Organization, fascioliasis is perhaps the least known parasitic disease in this category, even though it is endemic worldwide (http://www.who.int/neglected_diseases/diseases/fascioliasis/en). Fascioliasis is a common infectious disease of domestic herbivores, such as cattle, sheep and goats, due to liver flukes (Mas-Coma 2005, Mas-Coma et al 2005, Saba et al 2004). Occasionally, humans can become a host, especially in areas where sheep and cattle are raised and where humans consume raw watercress or other aquatic vegetables, such as kjosco and water caltrop (Laird & Boray 1992, Sapunar et al 1992). De Gorgolas and colleagues reported that the most common symptoms of fascioliasis are fever (83%), abdominal pain (100%), weight loss (83%), and

generalized myalgia and joint pain (67%) (de Gorgolas et al 1992). Most parasitic infestations can be treated effectively with medications, such as triclabendazole or praziquantel, eliminating the symptoms perhaps attributed to FMS (de Gorgolas et al 1992, Jamaiah & Shekhar 1999, Mannstadt et al 2000, Qureshi et al 1997, Richter et al 1999). Similarly, chronic candida yeast infections are common contributing factors to widespread pain. Particularly in women who have been given courses of antibiotic therapy for recurrent urinary tract infections, suspected sinusitis, complaints of earache or sore throat, candida yeast infections are common (Gerwin 2005, Gerwin & Dommerholt 2002, Teachey 2004).

Myoadenylate deaminase deficiency

Myoadenylate deaminase deficiency is a syndrome of muscle enzyme deficiency that in few cases may cause widespread pain for which there are no permanent solutions. Marin & Connick published a case report of a patient who for years was treated unsuccessfully for FMS until she finally was diagnosed with myoadenylate deaminase deficiency (Marin & Connick 1997). Patients with pain resulting from myoadenylate deaminase deficiency are best managed with common pain management strategies.

Metabolic insufficiencies

In her work with pain patients, Dr Janet Travell was one of the first physicians to suggest that metabolic insufficiencies and deficiencies, including those for vitamin B_{12}, folic acid and ferritin, may cause or contribute to complaints of localized and widespread pain (Simons et al 1999). A deficiency is a value outside the normal range and is easily recognized; an insufficiency is within the normal range, but may be suboptimal, and often receives little attention. Yet, insufficiencies may cause serious problems for individual patients (Simons et al 1999). Although there are few scientific studies to support Travell's claims, clinicians familiar with her work recommend paying close attention to metabolic insufficiencies or deficiencies when patients experience only temporary improvement following physical therapy intervention (Gerwin 2005, Gerwin & Gevirtz 1995).

Vitamin D deficiency is commonly observed with chronic, non-specific musculoskeletal pain (Plotnikoff & Quigley 2003). Nearly 90% of 150 subjects with musculoskeletal pain had vitamin D levels less than 20 ng/ml and 28% had less than 8 ng/ml, where levels above 30 ng/ml are considered optimal (Plotnikoff & Quigley 2003). Vitamin D deficiency in adults is defined as serum 25(OH)D levels below 20 ng/ml and vitamin D insufficiency as 25(OH)D below 30 ng/ml (Vieth et al 2007). Vitamin D deficiencies are endemic in northern Europe and America (Gordon et al 2004, Huh & Gordon 2008, MacFarlane et al 2004), and are associated with muscle weakness, myofibrillar protein degradation, reduced muscle mass, osteoporosis and decreased functional ability (Bischoff et al 1999, 2000, 2001, Dukas et al 2005, Holick 2006, Wassner et al 1983). Although there are no randomized controlled studies examining the correlation between vitamin D deficiencies or insufficiencies and myofascial pain, empirical observations in a community pain management centre suggest that vitamin D insufficiencies are very common among individuals with myofascial pain (Gerwin 2005). In the hierarchy of evidence-based medicine, clinical evidence is a valid parameter and should be included in the review of evidence (Moore et al 1995, Pencheon 2005, Sackett et al 1996).

The assumption that vitamin D deficiencies would cause or contribute to disease processes has recently been challenged (Marshall 2008). Marshall suggests that low values of vitamin D may not be the cause, but the result of the disease process. Current biology studies support the notion that vitamin D may not even be a true vitamin, as vitamin D metabolites play an active role in the gene transcription of hundreds, if not thousands, of genes. According to Marshall, the idea that exogenous modulation of a metabolism could provide a simple clinical solution is not only naïve, but could also pose significant risks (Marshall 2008).

Vitamin B_{12} and folic acid are closely related and function not only in erythropoieses, but also in central and peripheral nerve formation. Serum levels of vitamin B_{12} below 350 pg/ml may be clinically significant and associated with a metabolic insufficiency manifested by elevated serum or urine methylmalonic acid or homocysteine (Pruthi & Tefferi 1994). Laboratories commonly indicate that the normal range for vitamin B_{12} levels is between 200 and 1200 pg/ml. Gerwin found that 16% of patients with chronic myofascial pain were either

deficient in vitamin B_{12} or had insufficient levels of vitamin B_{12}. Ten percent of those patients had low serum folate levels (Gerwin 1995, 2005).

Ferritin represents the tissue-bound non-essential iron stores in the body that supply the essential iron for oxygen transport and iron-dependent enzymes. Serum levels of 15–20 ng/ml indicate that storage sites for iron, such as muscle, liver and bone marrow, are depleted of ferritin. Many female patients with a chronic sense of coldness and chronic myofascial pain have insufficient or deficient ferritin and iron levels, either from excessive menstrual iron loss or from chronic intake of non-steroidal anti-inflammatory drugs. Iron insufficiencies in chronic myofascial pain suggest that iron-requiring enzymatic reactions like the cytochrome oxidase and NAD(H) dehydrogenase reactions may be limited, possibly resulting in a local energy crisis when muscles are exposed to excessive mechanical stress (Gerwin 2005, Gerwin & Dommerholt 2002). Serum ferritin levels below 30 ng/ml need to be corrected through iron supplementation (Gerwin 2005).

By correcting the insufficiencies and deficiencies, patients commonly experience either total elimination of their pain complaints or they are now able to respond to medical and physical therapy interventions (Simons et al 1999).

Rheumatologic and infectious diseases

Several rheumatologic and infectious diseases, including seronegative rheumatoid arthritis, ankylosing spondylitis, Sjögren's disease, polymyositis, Lyme disease, polymyalgia rheumatica and systemic lupus erythematosus, feature widespread pain and can easily be mistaken for FMS (Aloush et al 2007, Bliddal & Danneskiold-Samsoe 2007, Bonafede et al 1995, Marques 2008, Middleton et al 1994, Poduri & Gibson 1995, Reilly 1999, Reilly & Littlejohn 1992). Most rheumatic diseases are treated with medications and education, combined with physical therapy and occupational therapy interventions (Bertin 2000, Clark 2000, Ramos-Remus et al 2000, Stucki & Kroeling 2000).

Infectious diseases have been implicated in the aetiology of FMS, including Lyme disease and hepatitis C (Ablin et al 2006, 2008). Lyme disease in the United States is caused by the spirochete *Borrelia burgdorferi sensu strictu*. In Europe and Asia, three species of *Borrelia* are responsible for most human infections, including *B. burgdorferi sensu strictu*, *B. afzelli* and *B. garini*, collectively referred to as *B. burgdorferi sensu lato* (Baranton et al 1992, Tilly et al 2008). In the northeastern and midwestern United States, the *Ixodes scapularis* tick or Eastern black-legged tick is the primary transmitter of the disease, while in the western part of the country the *Ixodes pacificus* or Western black-legged tick is most common. In Europe and Asia, the *Ixodes ricinus* or European sheep tick and the *Ixodes persulcatus* or taiga tick are the primary transmitters respectively (Burgdorfer et al 1985, Marie-Angele et al 2006, Nahimana et al 2004, Piesman & Gern 2004, Postic et al 1997, Smetanova et al 2007, Uspensky et al 2006, Vorobyeva et al 2002).

Persons infected with Lyme disease can present with a wide variety of symptoms, including headaches, diffuse myalgia and arthralgia, and neuropathy, among others (Ablin et al 2006, Ogrinc et al 2008). Fortunately, only about 25–33% of patients suspected of being infected are usually found to have Lyme disease (Marques 2008, Ogrinc et al 2008). Most patients are treated successfully with antibiotics, but a small number of patients do not recover and develop chronic Lyme disease, which is a controversial term used to describe different patient populations with varying symptoms and levels of dysfunction (Marques 2008). Some of these patients are so-called slow responders, who may have symptoms for weeks or months. Others may have irreversible damage, while approximately 10–20% of patients have persistent or intermittent subjective symptoms, including fatigue, stiffness, paraesthesia, myalgias, arthralgias, synovitis, disturbed sleep, irritability, cognitive dysfunction, poor concentration and depression (Ablin & Buskila 2008, Ablin et al 2008, Marques 2008, Ogrinc et al 2008, Sigal 1990).

Proponents of the FMS diagnosis suggest that many of these patients should be diagnosed with FMS to avoid unnecessary antibiotic therapy (Ablin et al 2006). Others would recommend a diagnosis of chronic fatigue syndrome, chronic Lyme disease or post Lyme disease syndrome (Marques 2008). Concerns that patients with these symptoms may suffer from persistent infections of *B. burgdorferi* have not been confirmed, realizing that *B. burgdorferi* cultures have very low sensitivity in most body fluids (Auwaerter 2007, Halperin 2008, Marques 2008). More research is needed to explore whether Lyme disease may indeed trigger FMS. Overlapping

symptoms do not necessarily justify the conclusion that Lyme disease and FMS must be related. Again, is the diagnosis of FMS justified when the clinical history suggests an infectious disease like Lyme disease? Similar arguments have been developed about other infectious diseases and FMS.

Two Israeli studies found that 16% of persons diagnosed with hepatitis C met the ACR criteria for FMS (Buskila et al 1997a, 1998). Ablin and colleagues suggested that both hepatitis C and FMS have aberrant cytokine profiles in common, which may be involved in the symptoms of disturbed sleep and chronic fatigue (Ablin et al 2006). A more recent Spanish study did not confirm any relation between hepatitis C and FMS (Narvaez et al 2005). It seems again premature to conclude that hepatitis C may result in the development of FMS. It may be preferable to recognize that certain infectious diseases feature symptoms of diffuse widespread pain, cognitive dysfunction and depression.

Growth hormone deficiency

Growth hormone is an amino acid polypeptide hormone synthesized and secreted by the anterior pituitary. Its primary function is to promote linear growth. Growth hormone stimulates the release of somatomedin C in the liver, which is required for the maintenance of normal muscle homeostasis (Neeck & Crofford 2000). Approximately 70% of the growth hormone production occurs during stage 3 and 4 non-rapid eye movement sleep (Van Cauter & Plat 1996). Acute stress and exercise stimulate the secretion of growth hormone, but chronic stress, depression, traumatic brain injury and chronic illness blunt its release (Casanueva 1992, Casanueva et al 1984, Sachar 1976, Vigas et al 1977).

Growth hormone deficiency is a distinct clinical entity (Nilsson et al 2007). In the United States approximately 6000 new cases occur annually. Some 70 000 adults are estimated to have growth hormone deficiency. The disease can be caused by pituitary tumours, adenoma, head trauma and certain infectious diseases, such as HIV/AIDS. The symptoms of growth hormone deficiency are variable and not all patients have symptoms. Some of the more common symptoms of growth hormone deficiency include fatigue, muscle weakness, stiffness, joint pain, a reduced ability to exercise, reduced cardiovascular function, depression, social isolation, osteoporosis and a weakened immune system (Nilsson et al 2007). Several of these symptoms have been described for FMS.

Growth hormone deficiencies have been established in some subsets of patients with FMS (Bennett 1998, Bennett et al 1992, Griep et al 1994, Leal-Cerro et al 1999). Bennett found growth hormone deficiencies in approximately 30% of patients with FMS (Bennett 2002a, Bennett et al 1998). Landis et al (2001) observed decreased nocturnal levels of growth hormone in women with FMS compared to normal controls. When compared to healthy subjects, FMS patients exhibited a reduced growth hormone response to exercise, which was thought to be the result of increased levels of somatostatin (Paiva et al 2002). Somatostatin is a growth hormone inhibiting hormone that is secreted under the influence of corticotropin-releasing hormone and thyroid hormones (Sapolsky 1992). Other researchers did not find any significant growth hormone deficiencies (Dinser et al 2000, Nørregaard et al 1995).

The question remains whether the symptoms of these patients are solely due to growth hormone deficiency or due to FMS. If the symptoms are part of the symptomatology of growth hormone deficiency, would there be any benefit to adding a diagnosis of FMS? Guidelines have been developed for the management of growth hormone deficiency syndrome (Nilsson et al 2007). When patients are diagnosed with FMS instead of growth hormone deficiency, they may not receive the most appropriate treatment. The US Food and Drug Administration has approved growth hormone therapy for adults with documented pituitary disease, cachexia in HIV infection, idiopathic short stature, and with an abnormal growth hormone response to a stimulation test (Jones et al 2007). Persons with FMS usually have normal growth hormone stimulation tests. Bennett has established that administering growth hormone reduced and, in some cases, eliminated the symptoms of FMS (Bennett 2002a, Bennett et al 1998).

Psychological diagnoses

Patients with psychological diagnoses and widespread pain are appropriately treated with an interdisciplinary approach combining medications with psychological interventions, exercise and stress management techniques, emphasizing the psychosocial,

behavioural and organic aspects of chronic pain (Turk & Okifuji 1999, van Koulil et al 2007, 2008). Patients with FMS are reported to have higher rates of lifetime and current depression, notwithstanding a few studies that did not find any evidence of increased depression (Ahles et al 1991, Hudson & Pope 1996, Offenbächer et al 1998, Piergiacomi et al 1989, Yunus et al 1991). Multiple studies have shown that 30–54% of chronic pain patients suffer from severe forms of depression, which limits their mobility, increases disability and interferes with most activities (Alschuler et al 2008, Keogh et al 2006). Depression, anger, anxiety and illness behaviour have a negative impact on patients' feeling toward themselves, which is reflected in poor expectations of patients and their health professionals, and poor outcomes in physical therapy and rehabilitation (DeVellis & Blalock 1992, Jensen et al 1999, McCracken et al 1999, Okifuji et al 1999b).

Several questions remain. Can depression cause or significantly contribute to FMS? Do patients with FMS get depressed because of pain or increased pain sensitivity, allodynia and hyperalgesia? There is some evidence that depression may be secondary to pain and may completely resolve once the pain has been eliminated (Hendler 1984, Wallis et al 1997). Persons diagnosed with FMS routinely maintain that the psychological and emotional symptoms are the result of FMS and not the cause. Or are both disorders the result of a common underlying abnormality? Depression and widespread pain may be the result of an insufficient catecholaminergic or serotonergic neurotransmission or hyperactivity of corticotropin-releasing hormone (Ackenheil 1998, Hudson & Pope 1996, Neeck & Riedel 1999).

It is likely that having a diagnosis of FMS combined with constant pain, poor expectations regarding recovery, and a sense of hopelessness may also become perpetuating factors for depressive mood disorders. Fassbender and colleagues observed that patients with FMS had significantly more tender points than patients with depression (Fassbender et al 1997). Several studies have shown that patients with FMS demonstrated significantly higher lifetime prevalence rates of mood, anxiety and somatization disorders than patients with rheumatoid arthritis (Burckhardt et al 1993, Hawley & Wolfe 1993, Katz & Kravitz 1996, Walker et al 1997). Wolfe and colleagues found that persons with FMS are more than four times as likely to be divorced compared to the general population without FMS (Wolfe et al 1995).

Rather than diagnosing these patients with FMS, a diagnosis based on the criteria of the *Diagnostic and Statistical Manual of Mental Disorders* of the American Psychiatric Association seems more appropriate, and may include dysthymia, depression, or somatoform pain disorder (DSM-IV 2000). A psychiatric diagnosis of depression or somatoform pain disorder may give some patients the impression that physicians do not take their pain seriously. Yet, there is evidence that some patients with the typical fibromyalgia symptoms are so psychologically distressed that the syndrome may indeed become an excuse not to deal with their difficult life circumstances (Ford 1997, Hellström et al 1999).

Myofascial pain and myofascial trigger points

A survey of members of the American Pain Society showed general agreement with the concept that myofascial pain exists as an entity distinct from FMS (Harden et al 2000). Myofascial pain is often thought of as a localized problem, yet nearly half the patients with myofascial pain in a chronic pain management centre featured pain in three or four body quadrants (Gerwin 1998). These patients may meet the ACR criteria and erroneously be diagnosed with FMS. Even though both diagnoses may represent central sensitization (Fernández de las Peñas et al 2007a), there are distinct advantages of a diagnosis of myofascial pain over a diagnosis of FMS. In most cases, myofascial pain can be treated effectively as part of a comprehensive treatment regimen (Dommerholt et al 2006a, Gerwin & Dommerholt 2006, Issa & Huijbregts 2006). The rheumatology literature suggests that currently there is no effective treatment for FMS.

The FMS tender points do not represent any anatomical abnormality. Therefore, treatments to resolve the tenderness at these points are doomed to fail. On the other hand, myofascial trigger points function as peripheral nociceptors that can initiate, accentuate and maintain the process of central sensitization (Borg-Stein & Simons 2002, Fernández de las Peñas et al 2007a). As a source of peripheral nociceptive input, myofascial trigger points are capable of unmasking sleeping receptors in the dorsal horn, which may result in spatial summation and the appearance of new receptive fields. Input from previously ineffective regions can now

stimulate the neurons (Hoheisel et al 1993, Mense 1997). Patients with chronic widespread pain or FMS not only experience pain at the tender point sites, but also throughout their entire bodies (Vecchiet et al 1994).

Hypermobility syndrome

Joint hypermobility syndrome or hypermobility syndrome has been classified as a hereditary connective tissue disorder, and is synonymous with Ehlers–Danlos hypermobility type (Simmonds & Keer 2007). The prevalence in adults ranges from 5% in the USA to 43% in the Noruba tribe in Nigeria (Birrell et al 1994, Jessee et al 1980). In rheumatology clinics or outpatient rehabilitation centres, the prevalence can be as high as 58% in one sample of non-Caucasian female patients (Simmonds & Keer 2007).

Somewhat surprisingly, subjects with hypermobility syndrome do not always have pain problems. However, widespread myalgia is the predominant complaint, presumably because of muscle imbalances and constant compensation of muscles in an effort to stabilize unstable joints (Russek 1999, Simmonds & Keer 2007). Hypermobile patients with widespread myalgia commonly meet the ACR criteria (Acasuso-Díaz & Collantes-Estévez 1998, Gedalia et al 1993), but there are no compelling reasons to make the diagnosis of FMS in addition to the diagnosis of hypermobility syndrome.

Persons with hypermobility syndrome are often challenging to treat. A comprehensive treatment programme emphasizing patient education, activity modification and a progressive strengthening regime can decrease the associated symptoms and improve functional abilities (Russek 1999, 2000, Simmonds & Keer 2008).

Whiplash-associated disorders

In 1997, Buskila and colleagues suggested that FMS is common following motor vehicle accidents (Buskila et al 1997b). Other researchers have also suggested a relationship between trauma and FMS. In spite of the now commonly held belief that motor vehicle accidents frequently result in FMS, in subsequent publications Buskila and colleagues, as well as White and colleagues, have concluded that there really is no scientific evidence of a causal relationship between trauma and FMS (Buskila & Neumann 2000, 2002, White et al 2000b). In a German study of nearly 1100 subjects involved in low-velocity collisions, 80% were found to have muscle pain (Schuller et al 2000). Persons with chronic whiplash pain developed more widespread hypersensitivity to mechanical pressure and thermal stimuli than subjects with chronic idiopathic neck pain (Scott et al 2005). Reduced cold tolerance has been confirmed in patients with chronic whiplash symptoms (Kasch et al 2005).

There is no question that involvement in motor vehicle accidents may result in central sensitization, hypersensitivity and widespread pain (Banic et al 2004, Curatolo et al 2001, 2004, Herren-Gerber et al 2004, Johansen et al 1999, Kosek & Januszewska 2008, Munglani 2000, Sterling et al 2002, 2003), but there is no benefit to the additional diagnosis of FMS (Dommerholt 2005). In a retrospective review, Gerwin & Dommerholt (1998) found that all patients with chronic pain complaints following a motor vehicle accident had myofascial pain and myofascial trigger points, which were not considered in Buskila's studies. However, even if trigger points would have been considered by applying the inclusive ACR criteria, the diagnosis of FMS would still have been made.

Some persons involved in whiplash injuries may suffer from post-traumatic stress disorder, which can also feature many of the symptoms of FMS (Sherman et al 2000). Furthermore, it is conceivable that in some whiplash patients the thyroid gland may be injured. This may contribute to the development of post-traumatic hypothyroidism with widespread pain, fatigue and other symptoms commonly attributed to FMS (Sehnert & Croft 1996).

Summary – differential diagnoses

There are no studies that indicate how frequently the diagnosis of FMS is made in the presence of other diagnoses. However, it is very likely that published research studies on FMS include subjects with other clinical diagnoses responsible for the pain, sleep disorder and fatigue. This could contribute to the poor results of long-term outcome studies, which frequently show that patients diagnosed with FMS do not improve (Wolfe et al 1997). Could it be that after making the diagnosis of FMS, physicians and patients may not consider any

other causes of chronic widespread pain? In these cases, would that make FMS an iatrogenic syndrome, as the appropriate diagnosis and effective treatment options would not be entertained or implemented? Or is it appropriate to diagnose FMS and other diagnoses responsible for widespread pain simultaneously?

The question remains how an additional diagnosis of FMS improves the medical management, particularly when the rheumatology literature suggests that currently there are very limited treatment options for FMS (Bennett 1999, Russell 2001). If that's true, then why are patients labelled with this diagnosis in the presence of another diagnosis that provides a mechanism for the reported symptoms and for which effective treatment options are available? While it is known that the diagnosis of FMS initially offers patients a meaningful confirmation of their pain syndromes, most of the other diagnoses that can cause similar symptoms accomplish the same. How does a diagnosis by inclusion influence the thinking about FMS if these patients are included in research studies but do not receive the appropriate medical intervention for the possible underlying cause of pain and dysfunction?

Physicians that are willing to consider the common principles of differential diagnoses and accept that at best the diagnosis of FMS is a diagnosis by exclusion may not diagnose patients so rapidly with FMS syndrome and avoid risking illness behaviour and feelings of hopelessness, depression, anxiety, fear and poor expectations (Dommerholt 2002, Gerwin 1999). From an epidemiological perspective, FMS does not meet the basic criteria to be considered a distinct clinical entity (Makela 1999). Persons diagnosed with FMS are a rather heterogeneous group (Russell 2002). More research is needed to determine whether there really are several subgroups of FMS or whether patients should be diagnosed with other medical diagnoses that also feature widespread pain.

Myofascial pain syndrome

Schneider & Brady (2001) suggested that 'pseudo FMS' can be categorized into three categories, namely organic diseases (e.g. Lyme disease and hypothyroidism), functional disorders (e.g. nutritional deficiencies and intestinal dysbiosis) and musculoskeletal disorders (e.g. myofascial pain and undiagnosed disc and facet lesions). After excluding organic diseases and functional disorders, the diagnosis of myofascial pain offers a valuable approach to reduce or eliminate pain and other associated symptoms, and to restore function. Myofascial pain should be considered in the differential diagnosis not only of FMS, but also of radiculopathies, angina, joint dysfunction, craniomandibular dysfunction, migraines, tension headaches, complex regional pain syndrome, carpal tunnel syndrome, repetitive strain injuries, whiplash injuries and most other pain syndromes (Dommerholt et al 2006a).

Trigger points have also been associated with visceral dysfunction, including endometriosis, interstitial cystitis, irritable bowel syndrome, urinary/renal and gall bladder calculosis, dysmenorrhea and prostadynia (Anderson 2002, Anderson et al 2005, 2006, Doggweiler-Wiygul 2004, Gerwin 2002, Giamberardino et al 1999, Jarrell 2004, Jarrell et al 2005, Weiss 2001, Zermann et al 1999). Trigger points have been reported as the most common diagnosis responsible for chronic pain and disability, but are frequently overlooked (Fricton 1990, Hendler & Kozikowski 1993, Rosomoff et al 1989, Skootsky et al 1989). They are common in all age groups, except infants (Alfven 1993, Cimbiz et al 2006, Kao et al 2007, Vecchiet 2002, Zapata et al 2006). There is no evidence that myofascial pain develops into FMS, although this is frequently suggested in the literature (Meyer 2002, Russell 2001, Yunus 2008).

Trigger points are divided into active and latent trigger points. An active trigger point produces symptoms, including local tenderness and pain, referral of pain or other paraesthesia to a distant site, and peripheral and central sensitization. A latent trigger point is only painful when stimulated. Trigger points have characteristic motor, sensory and autonomic features. Motor phenomena associated with trigger points include disturbed motor function, muscle weakness as a result of motor inhibition, muscle stiffness and restricted range of motion. Nociceptive input can perpetuate altered motor control strategies and lead to muscle overload or disuse (Falla & Farina 2007, 2008). In a study of the influence of trigger points on muscle activation patterns, Lucas et al (2004) demonstrated that subjects with latent trigger points in several shoulder muscles featured altered shoulder abduction patterns when compared to healthy subjects. Autonomic aspects may include, among others, vasoconstriction, vasodilation, lacrimation and piloerection (Ge et al 2006).

During the last few decades, myofascial pain has received much attention in the scientific and clinical literature. Already during the early 1940s, Dr Janet Travell (1901–1997) realized the importance of myofascial pain and its hallmark feature, the myofascial trigger point. Recent insights into the nature, aetiology and neurophysiology of trigger points and their associated symptoms have propelled interest in the diagnosis and treatment of persons with myofascial pain worldwide (Bennett 2002b, Dommerholt et al 2006a).

Historically, pain from muscles has been described by multiple terms, including fibrositis, myofasciitis, muscular rheumatism, rheumatic myositis, muscle hardening, myogelosis, myofascial pain and myalgia (Simons 1975). The phenomenon of myofascial trigger points was already described in 1816 by the British physician Balfour as 'nodular tumours and thickenings which were painful to the touch, and from which pains shot to neighbouring parts'. These nodules were considered a result of inflammation in the fibrous connective tissue in muscle (Stockman 1904). The term 'trigger point' was coined by the American physician Steindler in 1940 (Steindler 1940).

Over the last 60 years several assessment and treatment approaches have emerged independently of each other both in Europe and in the United States, including myofascial trigger point therapy (USA), neuromuscular technique or NMT (UK), neuromuscular therapy, also abbreviated as NMT (USA), and manual trigger point therapy (Switzerland). It is intriguing that these approaches share many similarities and have common goals and objectives. The various schools of thought have more in common than they are different. Some techniques are slightly different and there is some disagreement about terminology and methodology. The terminology and definitions formulated by Simons, Travell and Simons are most widely accepted and will be applied in this chapter: 'myofascial pain syndrome can be described as the sensory, motor, and autonomic symptoms caused by myofascial trigger points' (Simons et al 1999). A myofascial trigger point is clinically defined as 'a hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band. The spot is painful on compression and can give rise to characteristic referred pain, referred tenderness, motor dysfunction, and autonomic phenomena' (Simons et al 1999).

There are no laboratory or imaging studies available for the diagnosis of myofascial pain or myofascial trigger points. To make a diagnosis of myofascial pain requires a systematic palpation of pertinent muscles across the direction of the fibres. Only by palpating perpendicularly to the fibre direction will a clinician be able to locate the taut band. A taut band feels like a rope or string of contracted fibres that may extend from one end of the muscle to the other, depending on the specific muscle architecture. Recent elastography studies have been able to visualize the taut band, but these techniques are not yet available in clinical practice (Chen et al 2007, 2008). Taut bands are stiffer than relaxed muscle fibres, and the degree of stiffness can be assessed by phase-contrast analysis of vibration-induced cyclic shear waves (Chen et al 2007, 2008).

Microscopic and electrodiagnostic research of muscles has revealed that many muscle bellies are divided into compartments of one or more fibrous bands or inscriptions. Each compartment has its own nerve supply and motor endplates. The number of inscriptions and compartments varies per muscle. For example, the biceps femoris and gracilis each have two compartments, the semitendinosus has three and the sartorius has four. Because of these inscriptions, the longest human muscle fibres are approximately 12 cm, which corresponds to 55 000 sarcomeres (McComas 1996). When palpating for taut bands, clinicians must be aware of these inscriptions, as different taut bands can be found throughout the muscle belly of one particular muscle. Palpation along a taut band may reveal a nodule that is exquisitely tender and that with firm pressure stimulation may produce referred pain sensations in typical patterns for each muscle. These painful spots are known as trigger points. Patients often recognize the localized or referred pain as 'their pain', and this recognition of pain is now considered one of the diagnostic criteria for active myofascial trigger points in addition to the presence of a taut band and the trigger point itself (Gerwin et al 1997, Simons et al 1999). Taut bands and trigger points are found in asymptomatic individuals and are only considered clinically relevant when the patient recognizes the elicited pain or when the functional limitations imposed by the taut band contribute to mechanical dysfunction secondary to muscle shortening (Gerwin & Dommerholt 2002, Scudds et al 1995).

The minimum criteria that must be satisfied in order to distinguish a trigger point from any other tender area in muscle are a taut band and a tender

point in that taut band. The presence of a local twitch response, referred pain or reproduction of the person's symptomatic pain increases the certainty and specificity of the diagnosis of myofascial pain syndrome (Gerwin et al 1997). The taut band, trigger point and local twitch response are objective criteria, identified solely by palpation, that do not require a verbal response from the patient. A local twitch response is an indication of the presence of an active trigger point. It is a brief involuntary contraction of the taut band that can be recorded electromyographically, can be felt with the needle during trigger point injection or dry needling, or observed visually on diagnostic ultrasound. It is mediated primarily through the spinal cord without supraspinal influence (Hong 1994a, 1999). High resolution sonography is not yet sensitive enough to visualize the actual trigger point, but allowed researchers to visualize the twitch response of the taut band following stimulation of the trigger point by insertion of a hypodermic needle (Gerwin & Duranleau 1997, Lewis & Tehan 1999). The patient's body type, the skill level and experience of the clinician, and the nature of the muscle determine the ease of soliciting a local twitch response.

Several studies have considered the inter-rater reliability of the trigger point examination; however, this was only recently established by the groups of Bron, Gerwin and Sciotti and other researchers (Bron et al 2007, Gerwin et al 1997, Lew et al 1997, Nice et al 1992, Njoo & Van der Does 1994, Sciotti et al 2001, Wolfe et al 1992). In Gerwin's study, a team of recognized experts could initially not agree. Only after developing consensus regarding the criteria did the experts agree, which indicates that training is essential for the identification of myofascial trigger points (Gerwin et al 1997). Bron and colleagues confirmed that well-trained physical therapists can agree on the identification of myofascial trigger points in three different shoulder muscles (Bron et al 2007).

The integrated trigger point hypothesis

Combining all available supporting evidence of the existence of myofascial trigger points, Simons has developed the 'integrated trigger point hypothesis' (Simons et al 1999). The integrated trigger point hypothesis has evolved through several steps of progress since its first introduction as the 'energy crisis hypothesis' in 1981 (Simons & Travell 1981). The energy crisis hypothesis postulated that direct trauma and subsequent damage to the sarcoplasmic reticulum or the muscle cell membrane would lead to an increase of the calcium (Ca^{2+}) concentration, an activation of actin and myosin, a relative shortage of adenosine triphosphate, and an impaired calcium pump, which in turn would increase the intracellular calcium concentration even more, completing the cycle. Calcium is a prerequisite for muscle contractions. Muscle contractions occur after actin and troponin are activated by Ca^{2+}, allowing tropomyosin to shift its position and expose myosin-binding sites on actin, thus regulating the cross-bridge interactions between actin and myosin (Clark et al 2002). Under normal physiological conditions, the calcium pump is responsible for returning intracellular Ca^{2+} to the sarcoplasmic reticulum against a concentration gradient, which requires a functional energy supply.

The integrated trigger point hypothesis builds on the finding that excessively released acetylcholine from the motor nerve terminal causes miniature motor endplate potentials that produce the endplate noise observed with needle EMG of trigger points (Couppé et al 2001, Macgregor & Graf von Schweinitz 2006, Simons et al 2002). Endplate noise occurs more frequently in trigger points than in the same endplate zone away from the trigger point, but is not unique to trigger points. The excessively released acetylcholine maintains a sustained depolarization of the post-junctional membrane, which in turn stimulates voltage-gated sodium channels of the sarcoplasmic reticulum and triggers an excessive release of calcium (Simons et al 2002). This results in ongoing activation of nebulin, troponin and tropomyosin, and may cause persistent muscle contractures consistent with myofascial trigger points. Shenoi & Nagler (1996) confirmed that an impaired reuptake of calcium into the sarcoplasmic reticulum induced by calcium channel blockers may cause myofascial trigger points.

The original energy crisis hypothesis assumed that the excessive release of calcium was due to some traumatic event, such as a mechanical rupture of the sarcoplasmic reticulum or of the muscle cell membrane. Now it is known that any muscle trauma that triggers the excessive acetylcholine release is sufficient to initiate the vicious cycle. The presence of excessive acetylcholine can be the result of acetylcholinesterase insufficiency, an acidic pH, hypoxia, a lack of adenosine triphosphate, certain genetic

mutations, drugs and particular chemicals, such as calcitonin gene-related peptide, di-isopropylfluorophosphate, or organophosphate pesticides, and increased sensitivity of the nicotinic acetylcholine receptors (Bukharaeva et al 2005, Gerwin et al 2004, McPartland & Simons 2006). Myofascial tension or muscle hypertonicity, as seen in trigger points, may also enhance the excessive release of acetylcholine (Chen & Grinnell 1997, Grinnell et al 2003).

There are many possible vicious cycles capable of maintaining the resulting contractures and trigger points. For example, one study has shown that the oxygen saturation in the centre of a trigger point is far below normal values (Brückle et al 1990). Hypoxia leads to an acidic milieu, muscle damage and an excessive local release of multiple nociceptive substances, including calcitonin gene-related peptide, bradykinin and substance P, and may even trigger an immediate increased acetylcholine release at the motor endplate (Bukharaeva et al 2005, Graven-Nielsen & Arendt-Nielsen 2003). An acidic pH enhances the release of calcitonin gene-related peptide and downregulates acetylcholinesterase and causes hyperalgesia (Gerwin et al 2004, Sluka et al 2001, 2003). Calcitonin gene-related peptide stimulates the release of acetylcholine from the motor endplate, decreases the effectiveness of acetylcholinesterase and upregulates the nicotinic acetylcholine receptors. Bradykinin is known to activate and sensitize muscle nociceptors, which leads to inflammatory hyperalgesia, an activation of high threshold nociceptors associated with C fibres and an increased production of bradykinin. Furthermore, bradykinin stimulates the release of tumour necrosis factor alpha (TNFα), which activates the production of the interleukins IL-1β, IL-6 and IL-8. IL-8 in particular can cause hyperalgesia that is independent from prostaglandin mechanisms. Via a positive feedback loop, IL-1β can also induce the release of bradykinin (Poole et al 1999).

Researchers at the US National Institutes of Health have developed a clinical protocol to assess the local biochemical milieu of myofascial trigger points by fabricating a 30-gauge microdialysis needle capable of the in vivo collection of minute volumes of solutes from muscle tissue (Shah et al 2005, 2008). In the immediate proximity of active myofascial trigger points, they found consistently higher concentrations of substance P, calcitonin gene-related peptide, bradykinin, serotonin, norepinephrine, TNFα and interleukin IL-1β, but not in latent trigger points or normal muscle tissue (Shah et al 2005). A second study confirmed and expanded these findings and included sampling of analyte levels from the biochemical milieu of a remote uninvolved site in the upper medial gastrocnemius muscle. They found that the analyte concentrations of the tested biochemical substances in the gastrocnemius were almost always lower than concentrations in the trapezius. The second study also revealed that substances associated with pain and inflammation are not limited to local areas of trigger points or a single anatomical locus, as subjects with an active trigger point in the upper trapezius had relatively elevated levels of these analytes in a remote, uninvolved muscle compared to gastrocnemius levels in latent and normal subjects (Shah et al 2008).

Stimulation of the autonomic system has been shown to increase the endplate potentials. For example, an increase in psychological arousal resulted in an immediate increase of endplate spike rates (Lewis et al 1994, McNulty et al 1994). Autogenic relaxation and the administration of the sympathetic blocking agents phentolamine and phenoxybenzamine inhibited the autonomic activation (Banks et al 1998, Chen et al 1998a, Hubbard 1996). Induced autonomic nerve activity could explain the observed autonomic phenomena and further contribute to the abnormal release of acetylcholine, possibly by increasing the permeability of calcium channels in the cell membrane of the nerve terminal (Chen et al 1998b, Hou et al 2002a). A study examined the effects of trigger point massage therapy on the cardiac autonomic tone in healthy subjects. The researchers observed that following trigger point therapy, there was a significant decrease in heart rate, and systolic and diastolic blood pressure, indicating a significant increase in parasympathetic activity (Delaney et al 2002).

The integrated trigger point hypothesis is summarized in Figure 8.1. The hypothesis is a 'work in progress' that is beginning to be subjected to rigorous scientific review and verification. If this hypothesis is basically correct, myofascial trigger points are primarily a muscle disease with secondary but important sensory, motor and autonomic phenomena (Borg-Stein & Simons 2002, Dommerholt et al 2006a).

Clinical assessment

Any time a patient presents with a diagnosis of FMS or with any of its symptoms, a diagnosis of myofascial pain should be suspected. As Schneider & Brady

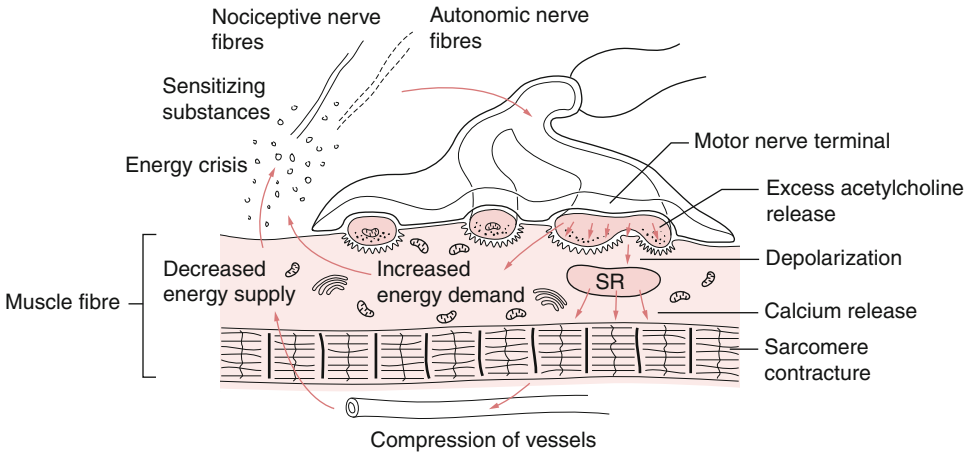

Figure 8.1 • Integrated trigger point hypothesis (after Simons et al 1999; reproduced with permission from Chaitow & DeLany 2000, p 68).

(2001) have outlined, a thorough differential diagnosis is critical and should include an assessment of the presence of organic diseases, functional disorders and musculoskeletal disorders. The initial task of a clinician in evaluating a patient is to obtain information regarding differential diagnostic characteristics, the supposed cause of the problem, the patient's local tissue and global stress adaptability, and the expected prognosis. Clinicians must strive for completeness in their observations. A thorough examination requires a detailed patient history, observation, functional evaluation and palpation, and drawing relevant conclusions (Materson & Dommerholt 1996). Following the initial assessment and formulation of diagnostic hypotheses, new data must be collected at each encounter. The initial hypotheses may need to be modified to facilitate the most efficient and effective management of patients with myofascial pain. A diagnosis of myofascial pain does not exclude other diagnoses, such as joint dysfunction, a metabolic insufficiency or visceral pathology.

Jarrell found that the presence or absence of a trigger point in the abdominal wall helps to determine whether there is evidence of current or previously treated visceral disease. The presence of an abdominal wall trigger point predicted evidence of visceral disease in 90% of subjects. However, the absence of a trigger point was associated with no visceral disease in 64% of the subjects (Jarrell 2004, Jarrell & Robert 2003). A Spanish study showed that trigger points in the upper trapezius were correlated with cervical spine dysfunction at the C3 and C4 segmental levels, although a cause-and-effect relationship was not established (Fernández de las Peñas et al 2005). A single spinal manipulation did induce changes in pressure pain sensitivity in latent trigger points in the upper trapezius muscle (Ruiz-Saez et al 2007). At all times, the diagnostic process must consider all possible contributing factors to the pain syndrome.

Of particular importance in the evaluation of patients with chronic pain is the psychosocial assessment. A patient's psychosocial history can provide insights into possible cultural influences of the pain experience, the patient's family background and interpersonal dynamics. The patient's coping skills, perceived self-efficacy and the presence of fear-avoidance behaviour are examples of interpersonal dynamics that should be recognized (Bandura et al 1987, 1988, Bates 1996, Bennett 2002c, Vlaeyen & Linton 2000). The chronicity of a pain problem may also be related to certain stressful work conditions, the work environment and physical demand, and participation in leisure activities (Berg Rice 1995, Khalil et al 1994).

A sudden onset or a clear remembrance of the onset of pain may indicate an acute activation of trigger points due to mechanical stress or trauma, but it may also indicate a sudden change in the patient's environment or habits. Mechanical stress or trauma may be the result of sudden or abrupt movements, motor vehicle accidents, falls, fractures, joint sprains or dislocations, a direct blow to a muscle or joint, excessive exercise or activity, or performing new or unaccustomed activities. When

the sudden onset of widespread pain occurs in close relation to a change in medication intake, the clinician should suspect that the change in medication intake may have triggered the pain response. In other cases the onset of pain may follow an illness, metabolic deficiencies or exposure to certain parasites.

A gradual or insidious onset is usually the result of chronic overloading of tissue, but may also be due to metabolic insufficiencies and parasitic infestations. Typical overload causes include postural imbalances, poor body mechanics, repetitive movements, and tension as a consequence of psychological or emotional stress. The symptoms of certain parasitic infestations, such as fascioliasis, may develop insidiously over a period of weeks, months and sometimes even years.

Questioning the patient regarding the nature of their pain and functional limitations will give insight into which structures may be responsible. Myofascial pain caused by trigger points tends to be dull, poorly localized and deep, similar to visceral referred pain and in contrast to the precise location of cutaneous pain (Gerwin 2002). It can present as a constant or intermittent deep ache, but rarely as throbbing or burning. Occasionally, patients describe pain from myofascial trigger points as a sharp or stabbing pain. The term 'referred pain' not only encompasses pain, but may also include other paraesthesias and dysaesthesias. Referred sensations of trigger points need to be distinguished from peripheral nerve entrapment and nerve root irritation. Functional limitations due to trigger points include muscle weakness, poor coordination of movement, fatigue with activity, decreased work tolerance, lack of endurance, and joint stiffness. Finally, limitations in active and passive range of motion may be due to myofascial hypertonicity that occurs as a result of trigger points.

Once the possible cause has been identified, it is useful to gain a better understanding of the course of the symptoms, prior diagnostic tests and previous treatments. Are there recurrent exacerbations and remissions, and if so, what are their triggers? Characteristically, myofascial pain is aggravated by strenuous use of the muscles, rigorous stretching of the muscles harbouring trigger points, repeated trigger point compression, overloading and overcompensation of muscles during assumed prolonged postures, repetitive contractions of the involved muscle, cold and damp weather, viral infections, and periods of increased stress, anxiety and tension. Pain symptoms caused by trigger points may be alleviated with periods of rest, gentle stretching, massage, use of ice or heat, positional supports, and activities that may induce relaxation, including breathing re-education and yoga.

What previous treatments were administered and what were the outcomes of those treatments? Often times, acute problems develop into chronic problems due to poor insight and unawareness by the individual, inadequate management by medical professionals, and their inability to recognize myofascial trigger points as the source of the problem or as a significant contributing factor. Due to the chronicity of the problem, muscle guarding and abnormal movement patterns persist, other muscles become involved, and latent trigger points may become active. Peripheral and central sensitization leads to other complications, including depression, anxiety and anger, and other musculoskeletal problems. Clinicians who routinely consider myofascial trigger points as part of the clinical picture are often the last resort for patients who have been given endless diagnoses that do not explain or address their pain and/or associated dysfunctions (Hendler & Kozikowski 1993). Patients often appear relieved when the practitioner can literally put the finger on the source of the pain, which usually results in instant rapport between patient and clinician.

Physical examination

The physical examination starts with a general impression of the patient's physical expression, body type, static and dynamic posture, and movement patterns. The patient's breathing pattern may reveal potential overuse of accessory respiratory muscles, such as the scalene muscles, and indicate possible higher levels of stress (Chaitow 2004). Structural abnormalities and asymmetries, which result from a congenital or acquired movement impairment, will invariably lead to persistent musculoskeletal pain and dysfunction with the inclusion of trigger points. Pelvic obliquity, scoliosis, forward head posture, leg length discrepancy, small hemipelvis, short upper arm syndrome, long metatarsal syndrome and scapular abnormalities are a few of the most common structural variations that can lead to myofascial pain (Simons et al 1999).

Leg length discrepancies are divided into structural and functional leg length discrepancies. Structural discrepancies are due to true anatomical

differences in length of the femur or tibia, while functional discrepancies can be caused by hip adductor contractures, trigger points in the quadratus lumborum muscles, hip capsule tightness, or by unilateral innominate pelvic rotations. Leg length discrepancies and pelvic asymmetries may produce muscle imbalances and postural adjustments that result in the development of trigger points (Janda 1994). Leg length discrepancies may be due to congenital, developmental, traumatic or pathological changes in one of the osseous links of the lower extremity kinetic chain.

Identifying the specific posture type from a thorough structural spine assessment in sitting and standing will indicate the muscle imbalances that are present. The upper and lower crossed syndromes, described by the late Dr Vladimir Janda, recognize muscle imbalances on the basis of muscle fibre type and its inherent characteristics. Janda distinguished 'tonic' or 'postural' muscles from 'phasic' or 'dynamic' muscles. Tonic and phasic muscles are physiologically different in their oxidative ability and their ability to contract over a specified time period. Tonic muscles are slow twitch, slow oxidative and fatigue resistant posture (type I) muscles. Phasic muscles are divided into fast twitch, oxidative-glycolytic and fatigue resistant movement (type II-a) muscles, fast twitch, glycolytic and easily fatigued movement (type II-b) muscles, and superfast (type II-m) muscles found primarily in the jaw muscles. Myofascial trigger points can develop in both tonic and phasic muscles. Tonic muscles include the hamstring muscles, rectus femoris, iliopsoas, quadratus lumborum, the paraspinals, the pectorals, the sternocleidomastoid, upper trapezius and levator scapulae (Fig. 8.2). Phasic muscles include the rectus abdominus, serratus anterior, rhomboids, the middle and lower trapezius, the deep neck flexors, suprahyoid, and mylohyoid (Janda 1983, 1993). Tonic muscles have a tendency to tighten in response to abnormal stress or dysfunction, while phasic muscles have a tendency to become weak. These typical response patterns will result in the upper and lower crossed syndromes (Figs 8.3 and 8.4). The upper crossed syndrome or forward head posture is the most common postural

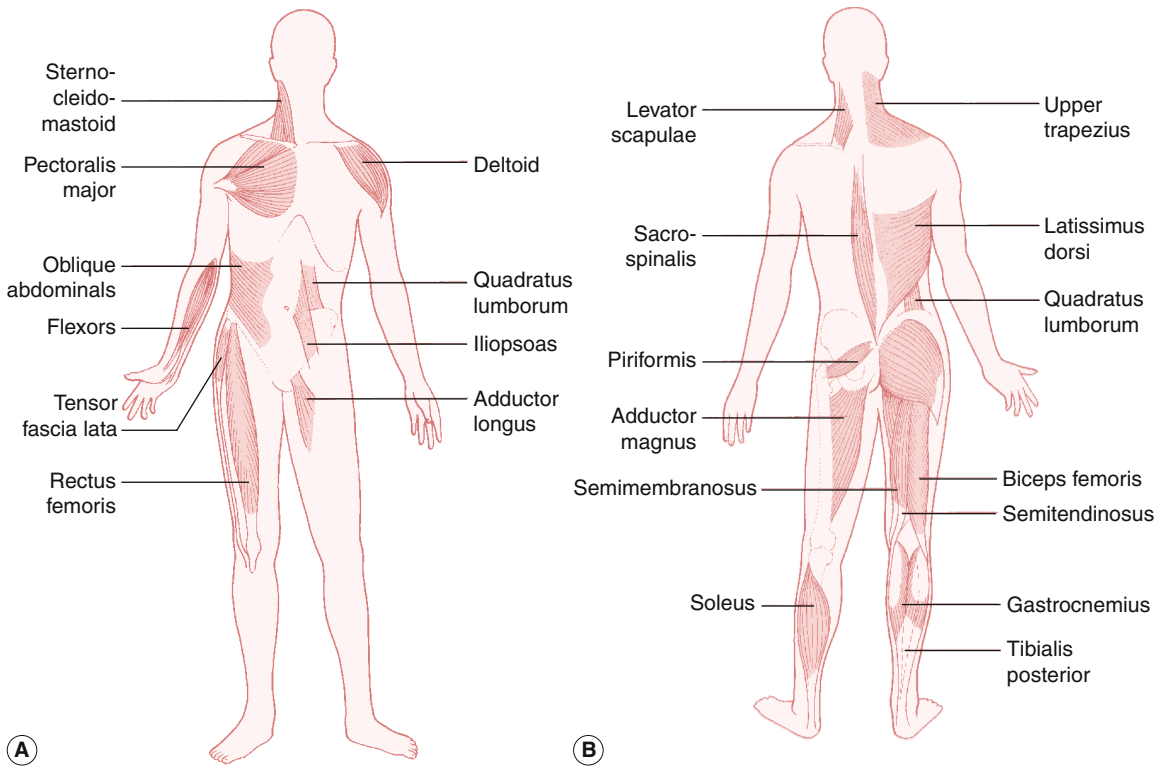

Figure 8.2 • Major postural muscles **A** Anterior. **B** Posterior. (Reproduced with permission from Chaitow & DeLany 2000, p 23.)

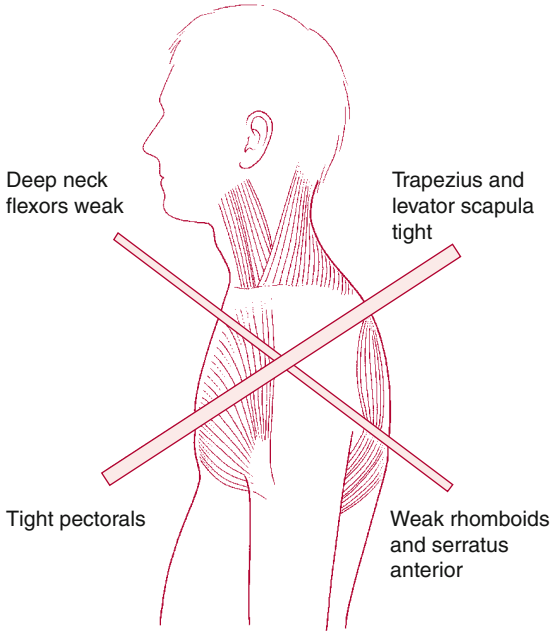

Figure 8.3 • Upper crossed syndrome (after Janda). (Reproduced with permission from Chaitow & DeLany 2000, p 56.)

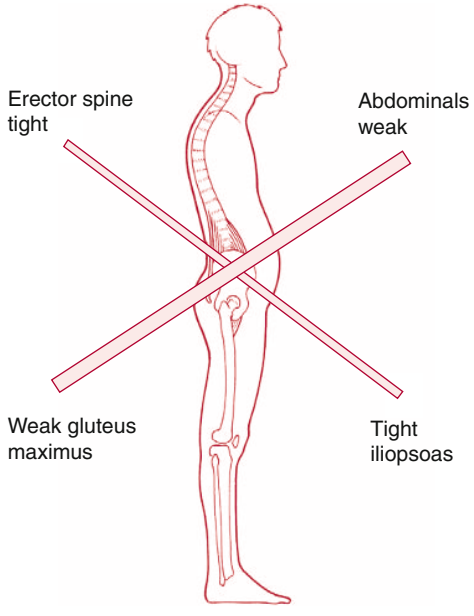

Figure 8.4 • Lower crossed syndrome (after Janda). (Reproduced with permission from Chaitow & DeLany 2000, p 56.)

deviation in patients with myofascial pain (Fricton et al 1985, Janda 1994).

Forward head posture is usually associated with a posterior rotation of the cranium, flattening of the cervical spine and a protracted shoulder girdle (Rocabado 2001). Myofascial restrictions and trigger points related to forward head posture are commonly seen in the suboccipital muscles, cervical paraspinals, splenius capitis and cervicis, levator scapulae, upper trapezius, anterior and medial scalenes, sternocleidomastoid, and pectoralis minor and major muscles (Simons et al 1999). Myofascial dysfunction also needs to be evaluated in the weak phasic musculature found in muscle imbalances. Trigger points will arise in any muscle that is functioning in a lengthened position or in a compromised manner as a result of muscle imbalances and structural abnormalities. Fernández de las Peñas and colleagues demonstrated an association between active trigger points in the suboccipital muscles and forward head posture in chronic tension-type headache subjects. Chronic tension-type headache subjects with active suboccipital trigger points described a greater headache intensity, duration and frequency compared to those with latent trigger points (Fernández de las Peñas et al 2006a).

Observing structural alignment and abnormal neuromuscular movement patterns during functional activities will also identify specific muscles or regions with myofascial restrictions. Much information can be gathered by watching how someone bends over and picks up an object from the floor, or how an individual walks down the hall, or balances on one leg. Someone with complaints of sciatica exacerbated by walking may exhibit instabilities in hip rotation during single leg stance due to poor neuromuscular control of the hip external and internal rotation muscles. Myofascial trigger points in the piriformis, gluteus medius and minimus, and adductor muscles are likely.

As part of the physical examination, the clinician should include a thorough evaluation of myofascial trigger points relevant to the patient's current pain presentation. The patient's current area(s) of pain can be visualized through patient pain drawings. Myofascial trigger points of each muscle have their own specific pain pattern. While patients communicate their pain patterns, the clinician can begin identifying those muscles and active trigger points most likely involved in the pain problem. The localization of pain is not always the source of pain, hence the importance of a thorough differential diagnosis.

Sources of referred pain are well known and include trigger points, facet joints, intervertebral discs, nerve roots, peripheral nerve entrapments, viscera and sclera (Bogduk & Simons 1993, Giamberardino et al 1999, Simons et al 1999). Referred pain from myofascial trigger points has been mistaken for pain from angina, radiculopathy, trigeminal neuralgia and thoracic outlet syndrome, among others. A study showed good inter-rater reliability among four physicians considered experts in the field for the identification of five characteristics: tenderness, presence of a taut band, referred pain, local twitch response and reproduction of the patient's pain; a global assessment was made regarding the presence of a trigger point (Gerwin et al 1997).

In addition to considering the pain component, the mechanical aspects of myofascial trigger points provide further insights. Both active and latent trigger points may be associated with restricted range of motion and functional limitations. During the assessment, the sensory, motor and autonomic aspects of trigger points must be considered. For example, in a patient with complaints of headaches, the pain complaint may direct the clinician to the sternocleidomastoid, upper trapezius, temporalis and inferior oblique capitis muscles (Calandre et al 2006, Fernández de las Peñas 2006a, 2006b, 2006c, 2007a, 2007b, 2007c, Giamberardino et al 2007). The patient's head posture in slight side bending and rotation may implicate the scalene muscles. The referred pain pattern from myofascial trigger points in the scalene muscles may include the head region (Dejung et al 2003). If in addition the patient presents with a paradoxical breathing pattern, it will be necessary to examine and treat the accessory breathing muscles as well, including the pectoralis minor, scalenes, sternocleidomastoid and upper trapezius musculature, that may be overloaded due to increased demands. Teaching the patient a normal diaphragmatic breathing pattern and fostering awareness of relaxation techniques for the upper chest and neck region will aid in the long-term management of the headaches (Chaitow 2004).

In the context of FMS, it is easy to understand how clinicians would conclude that a patient has a positive FMS tender point count when the pain is due to either localized or referred pain from myofascial trigger points. A quick FMS tender point count will not reveal the cause of the increased sensitivity as the corresponding trigger points frequently are not identified. Yet, the specificity of the diagnosis would increase dramatically and the prognosis would be far superior. The most common myofascial trigger points and their referred pain patterns that may be responsible for the tenderness at the FMS tender point locations are summarized in Table 8.2. It is recommended that when a positive FMS tender point is identified, the clinician evaluates the patient for the presence of trigger points that could cause the increased sensitivity at the FMS tender point location. Myofascial trigger points that correspond to the FMS tender points at the occiput, gluteal muscle, lateral epicondyle and knee are summarized in Figure 8.5A–D. When a clinician identifies a positive FMS tender point, an examination of these trigger points may direct the clinician to the cause of the pain and result in the initiation of an effective treatment approach. For the other FMS tender point locations, corresponding muscles should be examined for trigger points (see Table 8.2).

The treatment of a patient with myofascial pain falls beyond the context of this chapter. Myofascial pain can be approached from many perspectives; however, the therapy must address the various components of dysfunction. The local contraction knot or trigger point must be released either manually, by dry needling, or by trigger point injections to improve the local circulation and to decrease pain in order to restore range of motion and facilitate functional movement patterns (Dommerholt 2004, Dommerholt et al 2006a, 2006b, Issa & Huijbregts 2006). There are many different manual techniques, including myofascial release techniques, ischaemic compression, trigger point compression combined with active contractions of the involved muscle, post-isometric relaxation, connective tissue stretches and general massage therapy (Gröbli & Dejung 2003, Gröbli & Dommerholt 1997). Massage therapy has been found to be effective in the treatment of low back pain for patients with myofascial trigger points (Chatchawan et al 2005). Several studies have explored different compression techniques, including ischaemic compression technique, transverse friction massage and trigger point pressure release of active and latent trigger points, and found that all techniques showed significant improvement in pressure pain threshold and significant difference in visual analogue scale scores (Fernández-de-las-Peñas et al 2006d, Gemmell et al 2008). No significant differences were found comparing the various techniques. Manual pressure release of latent trigger points in the upper trapezius

Table 8.2 Fibromyalgia tender point locations and overlapping myofascial trigger point areas and referred pain patterns

FMS TPs	Location of FMS TPs	Common overlapping MTrPs and referred pain patterns
Occiput	At the suboccipital muscle insertion	Suboccipitals, upper trapezius, splenius capitis, sternocleidomastoid, semispinalis cervicis, multifidi
Low cervical	At the anterior aspect of the intertransverse space at C5–C7	Upper trapezius, splenius cervicis, levator scapulae, multifidi, sternocleidomastoid
Trapezius	At the midpoint of the upper border	Upper trapezius, scalenes, levator scapulae supraspinatus, multifidi
Supraspinatus	At origin above the scapula spine near the medial border	Supraspinatus, levator scapulae, upper trapezius, middle trapezius, iliocostalis, thoracis
Second rib	At the second costochondral junction, just lateral to the junction on upper surface	Pectoralis major, pectoralis minor, sternalis
Lateral epicondyle	2 cm distal to the epicondyle	Subscapularis, triceps, subclavius, scalenes, serratus posterior superior, supraspinatus, infraspinatus, brachioradialis, supinator, anconeus, extensor carpi radialis longus, extensor digitorum
Gluteal	In upper outer quadrant of the buttock in anterior fold of muscle	Quadratus lumborum, gluteus maximus, gluteus medius, gluteus minimus, piriformis, iliocostalis lumborum
Greater trochanter	Posterior to the trochanteric prominence	Quadratus lumborum, gluteus maximus, gluteus minimus, piriformis, iliocostalis lumborum, vastus lateralis
Knee	At the medial fat pad proximal to the joint line	Vastus medialis, rectus femoris, sartorius, adductors longus and brevis

has shown a reduction in perceived pain and a significant increase pressure tolerance (Fryer & Hodgson 2005).

Needling techniques include superficial and deep dry needling, and trigger point injections. A Cochrane Review endorsed that dry needling might be useful in combination with other therapies in the treatment of chronic low back pain (Furlan et al 2005). A systematic review of 23 randomized controlled trials of needling therapies in the treatment of myofascial pain found that direct needling of trigger points is an effective treatment in decreasing symptoms, but efficacy compared to placebo could not be proven or disproved (Cummings & White 2001). Several studies suggested that deep needling of myofascial trigger points may be more effective than traditional acupuncture or superficial needling (Ceccherelli et al 2002, Itoh et al 2004, 2007). A study comparing lidocaine injections, botulinum toxin injections and dry needling of trigger points found a decrease in pain pressure thresholds and pain scores in all three groups (Kamanli et al 2005). Another study that looked at lidocaine injection versus dry needling of trigger points in the upper trapezius showed significant improvement in pain intensity, pain threshold and cervical range of motion in both groups; the lidocaine injection resulted in less post-treatment soreness (Hong 1994b). The authors concluded that the elicitation of local twitch responses was essential in obtaining a therapeutic benefit (Hong 1994a). It should be noted that in the last two studies, the dry needling procedures were administered with syringes and not with solid filament needles, which are more commonly used in clinical practice (Dommerholt et al 2006b). In a more recent study, trigger point injections were compared with dry needling using solid filament needles and both techniques were found to be equally effective (Ga et al 2007). More research is needed (Tough et al 2009).

Various modalities have been suggested as being clinically relevant in the treatment of myofascial trigger points, including electrical stimulation, ultrasound and laser therapy (Rickards 2006). Hsueh

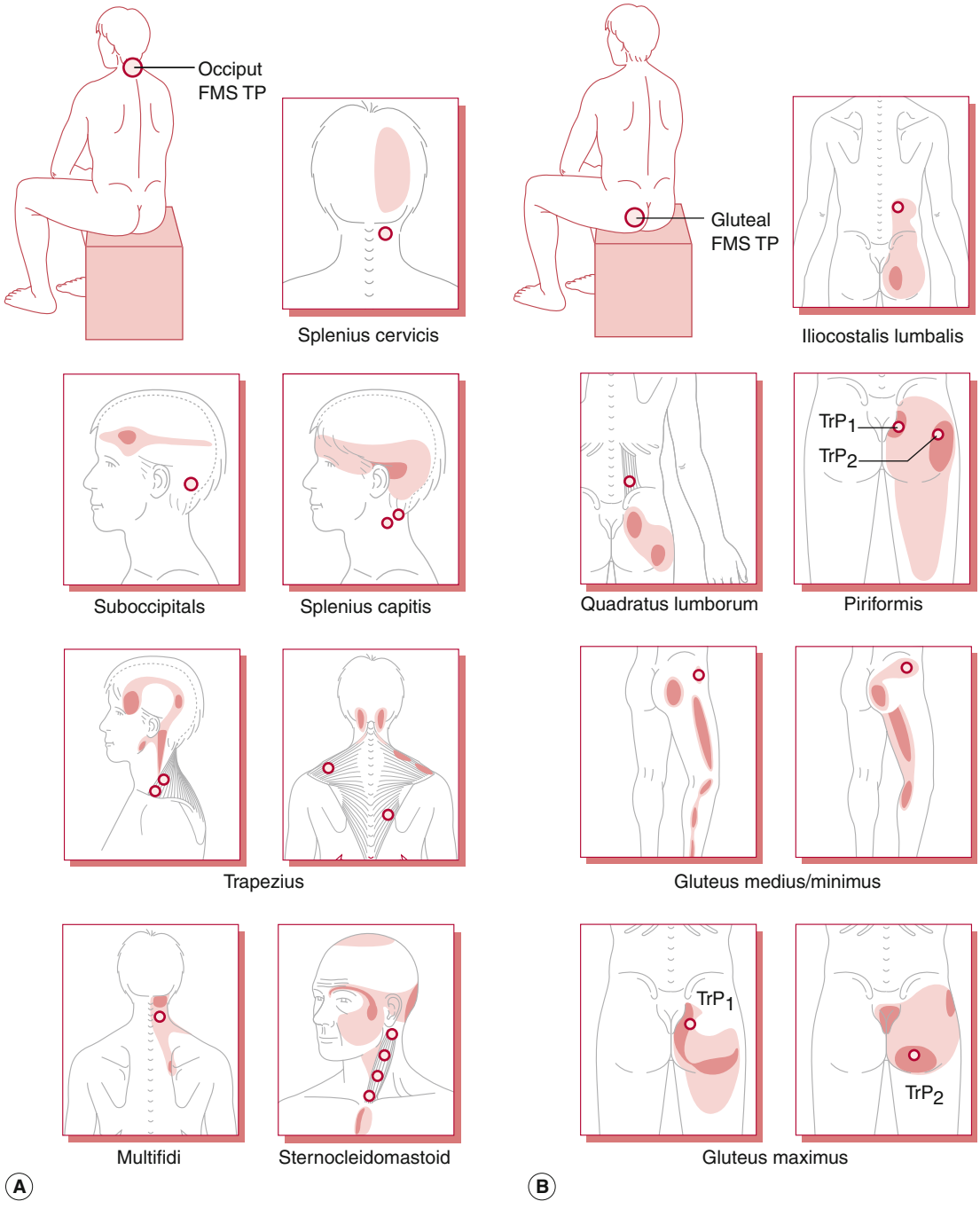

Figure 8.5 • **A** Occiput FMS tender point and MTrPs. **B** Gluteal FMS tender point and MTrPs.

(Continued)

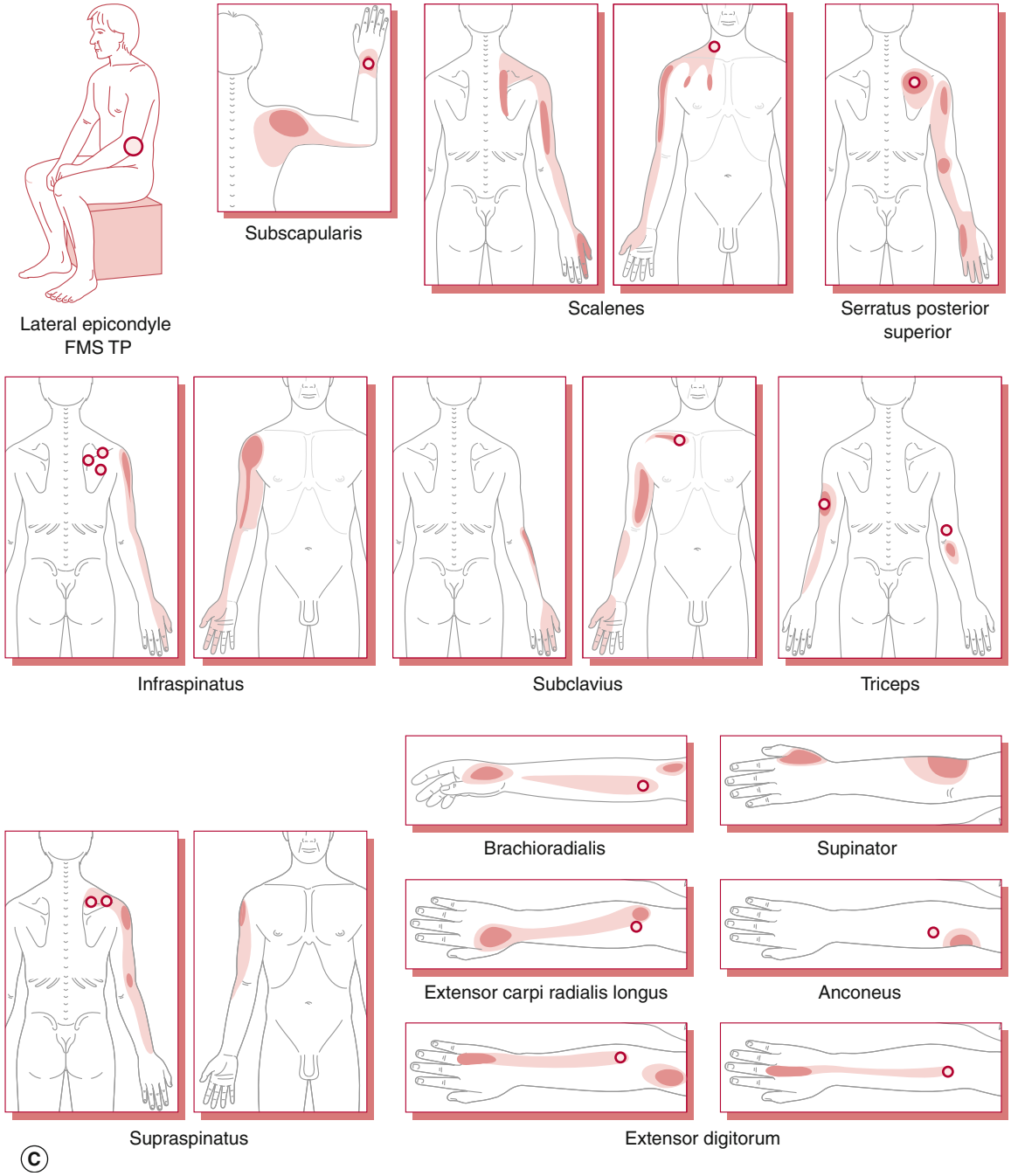

Figure 8.5—cont'd. **C** Lateral epicondylitis FMS tender point and MTrPs.

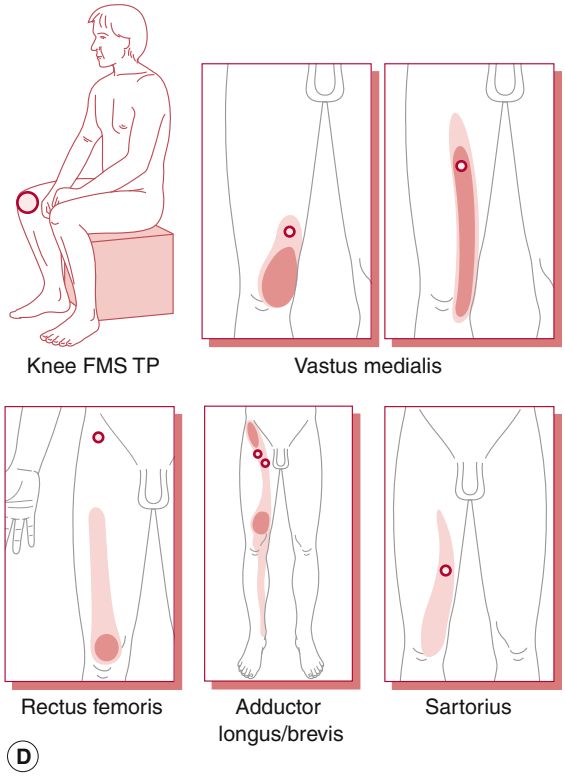

Figure 8.5—cont'd. **D** Knee FMS tender point and MTrPs.

and colleagues studied the immediate effectiveness of electrical stimulation on myofascial trigger points in the upper trapezius and found that transcutaneous electrical nerve stimulation (TENS) was significantly more effective in reducing subjective pain intensity and pressure pain thresholds than placebo (Hsueh et al 1997). Electrical muscle stimulation was significantly more effective in improving range of motion than placebo and the TENS groups (Hsueh et al 1997). Graff-Radford and colleagues reported that high frequency/high intensity TENS of 100 Hz with 250 µs stimulation was the most effective of four tested TENS combinations in reducing myofascial pain, but it had no effect on the sensitivity of myofascial trigger points (Graff-Radford et al 1989). This was also found by Smania and colleagues who demonstrated that TENS had an immediate effect on pain, but not on the sensitivity of the trigger point by algometric measurement (Smania et al 2005). Hou and colleagues claimed that TENS or interferential currents, when combined with other listed treatments (manual or physical therapies), was more effective in attenuation of trigger point pain (Hou et al 2002b).

Frequency-specific microcurrent therapy has shown positive empirical findings in the treatment of chronic low back pain of myofascial origin (McMakin 2004, McMakin et al 2005). Ultrasound trials for trigger points yielded conflicting results. In a randomized controlled trial, Majlesi & Ünalan (2004) found that a high-power, pain-threshold, static ultrasound technique was more effective in the reduction of pain and significantly decreased overall treatment duration as compared to a conventional ultrasound technique. Gam and colleagues concluded that ultrasound offered no pain reduction to patients with shoulder and neck pain (Gam et al 1998), which was also found by Lee and colleagues (Lee et al 1997). In contrast, Esenyel and colleagues reported that ultrasound improved pain intensity, the trigger point pressure threshold and cervical range of motion (Esenyel et al 2000). Srbely & Dickey confirmed that ultrasound can reduce the short-term sensitivity of trigger points (Srbely & Dickey 2007, Srbely et al 2008). Laser therapy is demonstrating favourable results in pain reduction (Ceccherelli et al 1989, Hakguder et al 2003, Simunovic 1996, Simunovic et al 1998), improved algometry thresholds (Hakguder et al 2003, Ilbuldu et al 2004), improved thermography (Hakguder et al 2003) and improved functional recovery (Ilbuldu et al 2004, Simunovic 1996).

Hou and colleagues used a randomized controlled trial to evaluate six different therapeutic combinations on cervical myofascial pain, trigger point sensitivity and cervical range of motion in 119 subjects. The most effective combinations in decreasing pain and improving range of motion were: hot pack plus active range of motion and stretch with vapocoolant spray; hot pack plus active range of motion and stretch with spray as well as transcutaneous electrical stimulation; and hot pack plus active range of motion and interferential current as well as myofascial release technique (Hou et al 2002b). This suggests that effective treatment strategies of trigger points may involve the combination of various treatment techniques and modalities, which is most likely indicative of true clinical practice.

The therapeutic programme must address the various perpetuating factors, including metabolic insufficiencies, mechanical discrepancies and psychosocial factors. The patient with chronic myofascial pain may benefit from an interdisciplinary approach to include medical pharmacological management, psychosocial therapy, physical therapy, chiropractic care, osteopathy, massage therapy or

more specific neuromuscular therapy. Patients with more acute myofascial pain may only require treatment by a physician and either a physical therapist or neuromuscular therapist.

The patient and the clinician need to identify appropriate goals and develop the means to reach them through therapy. Inactivation of myofascial trigger points is a means to achieve pain relief and improved biomechanical function, and thus to improve the ability of the patient to better perform whatever desired tasks have been selected as goals. Relief of pain or increased range of motion, both of which can be the result of trigger point inactivation, are not in themselves the final goals of treatment. For some individuals, an initial goal may be to simply sleep through the night. For another patient, it may be walking the dog or fastening a bra behind the back. For yet another, it may be regaining sexual ability, returning to work or participating in a recreational activity. Reasonable goals that can be achieved and measured as being reached or not, are more important to focus on than simply the inactivation of a trigger point or an increase in the range of a particular movement (Gerwin 2000).

Summary

Many arguments can be made to consider the normal differential diagnostic process in the diagnosis of individuals with widespread chronic pain. The notion that the diagnosis of FMS should be made irrespective of other diagnoses seems to be too simplistic and may actually deprive patients of required treatments. Clinicians and patients may not consider other possible causes of widespread chronic pain once the diagnosis of FMS has been established. Empirically, the diagnosis of myofascial pain appears to be a reasonable alternative, especially when myofascial trigger points are identified that mimic the patient's pain complaint. Other diagnoses, including organic diseases and functional disorders, must be ruled out.

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