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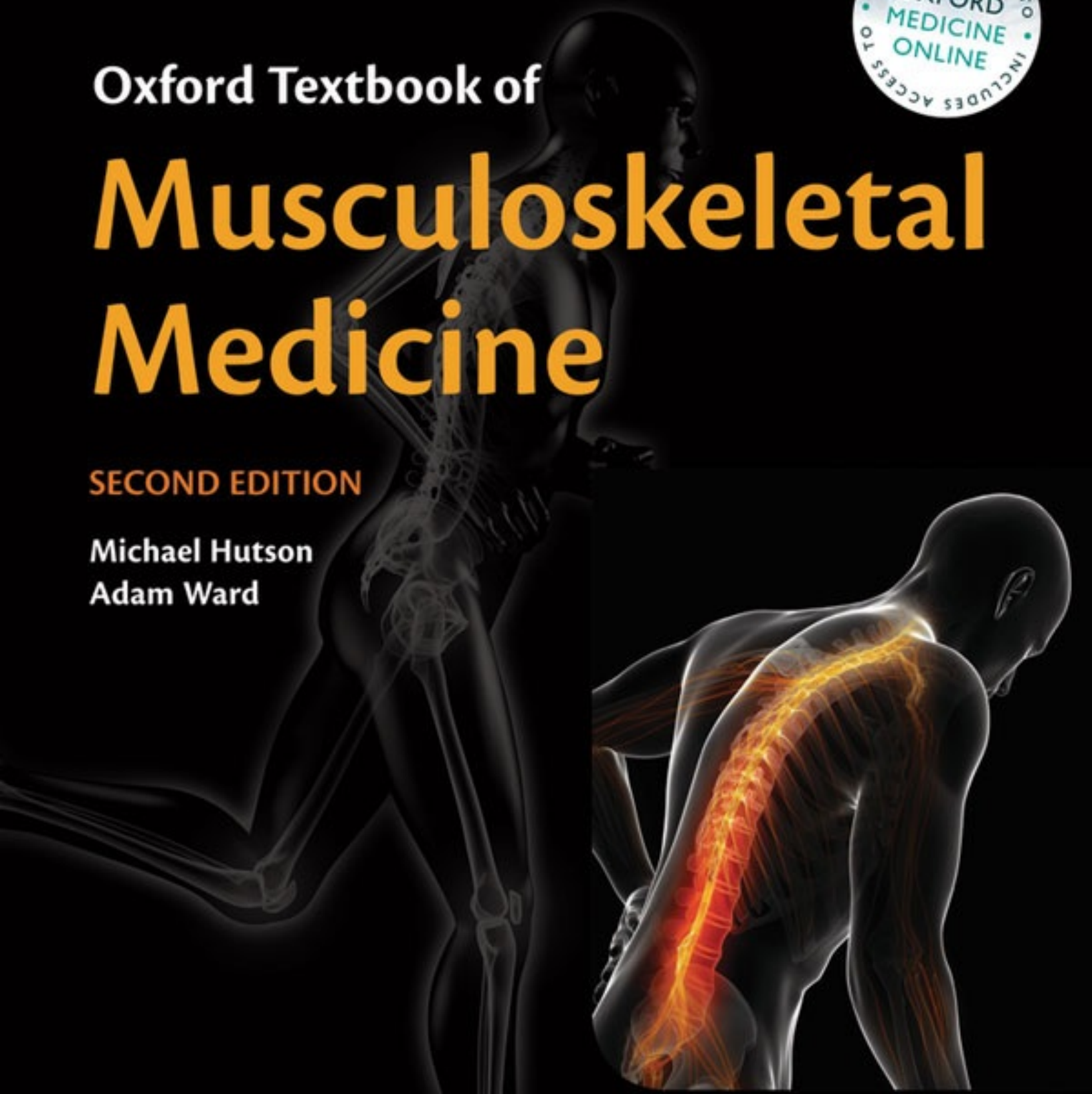
Oxford Textbook of Musculoskeletal Medicine

SECOND EDITION

Michael Hutson
Adam Ward



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Oxford Textbook of
Musculoskeletal Medicine

SECOND EDITION

Edited by

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Foreword to second edition

What is your first approach when it comes to musculoskeletal conditions? Is a back strain almost always attributable to one or two dysfunctional lumbar spine segments, and is an elbow pain almost certainly correctable by injection? Or is your attitude to the back sufferer that his or her life situation, family, or employer is likely to be a problem, and the elbow pain a sign that work or domestic duties need to be changed?

This attitude of yours will probably lead you to certain chapters in this book. Thus, those who favour the anatomical, structural approach will head straight for those chapters with masterly descriptions of presentations of regional disorders, be they the shoulder or ankle or others. Or your preference may lead you to those chapters which discuss biomechanical and occupational factors, or those which discuss the psychological and social background to so many of your patients' problems. There are many jewels to be found.

The true benefit of this book will come to you, I suspect, when you finally turn to what you thought of as 'the other chapters'. Many advances have arrived in recent years, since this book's first edition, both in the understanding and best management of physical disorders, anatomical injuries, and dysfunctions—and also in the understanding of the interplay of our body's function with our life's activities, occupations, and preoccupations.

Your reading will reassure you that musculoskeletal medicine is a fascinating and rewarding specialism which amply repays study, research, and practice. This book will not always serve up easy answers, but it will entice you into thinking more deeply about what you are doing with your musculoskeletal cases. In this respect, you will see how very experienced authors admit openly that not everything is straightforward, and they show you their way of navigating the minefields—just look at Blomberg's map for the back, for example. I am glad too that, again and again, it comes through that while technical excellence is a help, it is the doctor or therapist who communicates well, who 'understands', and who takes trouble to be kind to his or her patient, who will get the best results.

Richard Ellis, London, 2015

Preface to second edition

For this second edition of the *Oxford Textbook of Musculoskeletal Medicine*, I have chosen to provide an accompanying preface, which I hope will be read as a logical sequence to the preface to the first edition. By that means, the reader will be aware of the more advanced position of musculoskeletal (MSK) medicine in 2015 compared to the situation in 2005.

At the time of writing this second preface, the general practitioner with a special interest (GPwSI) in MSK conditions has become well established in NHS service provision in the UK. The General Medical Council has engaged the Council of BIMM (British Institute of Musculoskeletal Medicine) in the development of a 'credentialling' process for practitioners with competence in MSK medicine. Additionally, discussions have led to a Master's degree and a faculty or a 'standing committee' in MSK medicine in order to provide an appropriate infrastructure to secure its future. Less encouragingly, my co-editor, Adam Ward, to whom I am indebted with respect to this second edition, has not been replaced as a consultant at the Royal London Hospital for Integrated Medicine (formerly the Royal London Homeopathic Hospital) following his retirement, a situation seen by many as a considerable disappointment in the progression of MSK medicine to specialty status.

Although it could therefore be argued that *plus ca change plus c'est la meme chose* prevails, I am more than satisfied that the contents of this second textbook, nearly 10 years after the first, are ample demonstration of the considerable advance of the body of understanding and practice of MSK practice at the present time.

In 2015, the terms 'musculoskeletal medicine' and 'manual medicine' are in common usage internationally, supported medico-politically by the International Federation for Manual/Musculoskeletal Medicine (FIMM) and, with regard to the demonstration of and advancement of the scientific content of our discipline, by the International Academy of Manual/Musculoskeletal Medicine. Clinical evaluation of musculoskeletal disorders demands specific expertise that is developed by 'hands-on' experience. Accordingly, it is recognized that there is

no substitute for continued honing of haptic evaluative and therapeutic skills by repeated practice. It is worth emphasizing that the detection of relatively subtle soft tissue signs, such as loss of joint play, oedema, myofascial disturbance, and abnormal muscular and neural tension, which requires patience and much practice, brings its own rewards.

The contributors to this book have understood that the editors have encouraged an eclectic approach to this second edition, which inevitably creates an overlap between authors' contributions and, not infrequently, a base for further debate. However, a common theme has been maintained throughout, as stated in my first preface—the absolute requirement for the predication of a clinical diagnosis based upon manual examining skills.

Michael Hutson, 2015

Preface to first edition

Multi-author textbooks take some years to come to fruition. Hopefully, the wait will have been worthwhile, both for those readers who have been aware of the impending completion of the text and for the authors themselves. When ‘penning’ this first paragraph of the draft preface, I wrote: ‘Musculoskeletal medicine is a relatively new term, encompassing much if not all of orthopaedic medicine, manual medicine, and osteopathic medicine’. Several years on, in 2005, the terms ‘musculoskeletal medicine’ and ‘neuromusculoskeletal medicine’ are in common usage. Service provision is well advanced in the UK for instance, where a new category of intermediate care provider has been established at the initiative of the Department of Health and the Royal College of General Practitioners—the general practitioner with a special interest (GPwSI) in musculoskeletal conditions. The International Federation for Manual/Musculoskeletal Medicine (FIMM) incorporated ‘musculoskeletal medicine’ into its title in 1995, and numerous national societies do the same: the British Institute of Musculoskeletal Medicine (BIMM) was established in 1991 when the British Association of Manipulative Medicine (BAMM) merged with the Institute of Orthopaedic Medicine (IOM).

(Neuro)musculoskeletal medicine comprises the theoretical basis, diagnosis, and treatment of disorders of the musculoskeletal system, incorporating manual diagnostics, a variety of therapeutic techniques such as manipulation and injections, and preventive and rehabilitative procedures. The intrinsic components of disorders of the musculoskeletal system are twofold: structural (pathomorphological) and functional (pathophysiological). Within the text, a comprehensive account is provided of both structural and functional disorders of the spine and of the extremities.

Early pathomorphological changes reflect adaptive processes to biomechanical stresses. *Advanced structural pathology* such as intervertebral disc prolapse, meniscus derangements, and tendinopathies are the consequences of the failure of adaptation of the soft tissues to postural and dynamic stresses. They are described in some detail in the text. When appropriate, the relevant

stressors, particularly but not exclusively biomechanical, are identified and discussed.

Pathophysiological (neuromuscular) disturbances are classified using the accepted international term ‘somatic (or ‘segmental’ when applied to the spine) dysfunction’. The recognition, diagnosis, and management of these reversible dysfunctional states, manifesting clinically as reduced joint mobility, tight muscles, disturbances of the autonomic nervous system, and abnormal neurodynamics, differentiate the discipline of musculoskeletal medicine from rheumatology. The non-surgical management of these disorders, both structural and functional, differentiates the discipline from orthopaedic surgery.

Clinical evaluation of musculoskeletal disorders demands specific expertise that is developed by ‘hands-on’ experience. Accordingly, it is recognized that there is no substitute for continued honing of these evaluative skills by repeated practice. For those clinicians who are new to the discipline, welcome—interesting insights await those with a receptive mental attitude (Mooney 1995).

Inexperienced physicians may experience initial difficulty accepting dysfunction as a ‘disease’ model. It does not have ‘hard’ physical signs, such as those associated with gross trauma seen in orthopaedic surgical practice, as a predominant feature (Gargan 1995). However, the detection of relatively subtle soft tissue signs, such as loss of joint play, (troph)oedema, myofascial disturbance, and abnormal neural tension, which requires patience and much practice, brings its own rewards.

The contributors to this book have international reputations in musculoskeletal medicine, particularly in those topics with which they are identified in the text. Inevitably, there is some overlap between the individual contributions, but a common theme has been maintained throughout—the absolute requirement for the predication of a clinical diagnosis based upon manual examining skills.

The concept of ‘syndromes’ is eschewed, although some would argue that many diagnoses, especially spinal dysfunction, are inherently syndromic. Whenever possible, the specific soft tissues associated with the dysfunctional process, their anatomical location, and aetiological factors are identified. The interaction between a decompensated musculoskeletal system and the human environment is explored with particular reference to behavioural responses to chronic pain.

A major development in recent years has been our increased knowledge of the mechanisms involved in the perception of pain, particularly pathological pain. The neurophysiological and neurodynamic abnormalities associated with (chronic) regional pain syndromes are correlated with their clinical expression in the text.

Management strategies are explored in considerable detail. The association between specific diagnoses and patients' responses to pain and dysfunction is developed. Inappropriate advice from inadequate training in musculoskeletal medicine (Hutson 1993) causes iatrogenic disease. Conversely, an active approach to management predicated upon expertise and experience, reaps its own rewards and reduces the likelihood of progression from acute musculoskeletal dysfunction to chronic pain, distress, and disability.

Although patient education is recognized as a priority, and given appropriate exposure in the text, a change in attitudes of doctors, particularly to back pain, is seen as essential (Ellis 1995). Emphasis is placed on keeping patients at work whenever possible. Specific therapeutic options, including spinal and peripheral joint manipulation and injection techniques, are described in detail, and their role identified in the wider strategem of resolution of dysfunction, pain relief, and rehabilitation.

Finally, the inclusion in the text of the best available documented research in this field provides the reader with an opportunity to integrate clinical expertise and scientific evidence, and thereby to pursue evidence-based musculoskeletal medicine as far as this is possible.

Michael Hutson, 2005

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PART 1

Introduction to musculoskeletal medicine

Chapter 1

Fundamentals of musculoskeletal medicine

Michael Hutson

Eclecticism: deriving ideas, tastes, style, etc. from various sources; not didactic in the sense of being tediously pedantic.

(The Concise Oxford Dictionary)

So is the word ‘eclectic’ defined. This (second) edition of the *Oxford Textbook of Musculoskeletal Medicine* is based on the same principles as the first. It is an eclectic mix of concepts, diagnostics, and treatment of musculoskeletal disorders, written by leading proponents of their specific interests within this medical specialty and associated specialties.

Concepts of musculoskeletal medicine

> ‘There are more things in heaven and earth, Horatio, Than are dreamt of in your philosophy.’
>
> Hamlet

Readers with limited knowledge of the history of the development of the diverse ‘schools’ of manual medicine, the core components of which are manual diagnosis and treatment of neuromusculoskeletal disorders, may be somewhat confused by the plethora of terminology used to describe the medical discipline embraced by these schools and the conceptual variants themselves. This diversity is the beauty and perhaps the frustration of musculoskeletal medicine. It epitomizes its eclecticism and reflects its philosophical challenges.

The distinctiveness of musculoskeletal medicine is undoubted and perhaps unparalleled in the medical sciences. At its heart is the recognition and management of dysfunctional states of the neuromusculoskeletal system, now formally defined as *somatic dysfunction*. The historical background of the emergence of the underlying concepts of somatic dysfunction is provided by MacDonald in Chapter 2, and the characteristics of somatic dysfunction are further identified by Kuchera in Chapter 10. In this introductory chapter, I review the development and principles of musculoskeletal medicine; in Chapter 65, I review integrated medicine, with my co-editor Adam Ward.

I wish to address the characteristics of orthopaedic medicine, osteopathic medicine, manual medicine, and musculoskeletal medicine. By this means it will become apparent that there are a number of important conceptual models common to and underpinning these disciplines: structural (pathomorphological), pathophysiological (‘functional’), biomechanical, and biopsychosocial.

Orthopaedic medicine

Orthopaedic medicine was founded upon the structural (anatomic or morphological) disturbances of the neuromusculoskeletal system as defined by James Cyriax. Orthopaedic medicine may be seen as the natural consequence of the application of the disease–illness model (which has provided the framework for most medical disciplines for several centuries) to orthopaedic derangements that come under the province of the physician. It is archetypically ‘allopathic’ (for those readers who wish to distinguish between allopathic and osteopathic medicine).

Cyriax (1969) envisaged derangements of the intervertebral disc as the primary spinal pathology to account for the vast majority of ‘simple’ back pain and nerve root pain. He described the capsular and non-capsular patterns of articular disturbances at peripheral joints, and devised selective tissue tension tests to differentiate between articular, ligamentous, contractile, and neural lesions. Based on reductionist principles, his views represented a seminal breakthrough in the evaluation of lesions of the soft tissues. Conceptually (in the 1940s), this was the first time since the work of Sir William Gowers, at the end of the nineteenth century, that allopathic medicine was able to throw off the mantle of soft tissue rheumatism and the somewhat nebulous conditions it embraced such as fibrositis.

Although distinct by definition (with respect to management of musculoskeletal problems) from orthopaedic surgery, a further breakthrough made by orthopaedic medicine was in nosology. Orthopaedic medicine became recognized as the application of a unique systematized clinical evaluation (including inspection, active movements, passive movements, resisted muscle contraction, and palpation) of the soft tissues of the locomotor system. Predicated primarily on pathomorphology (such as degenerative, histopathologic, inflammatory, neoplastic, or infective lesions) with a relatively simple view of loss of function (pain, weakness, loss of movement), terminology accorded to the disease–illness model of scientific modernism. Specific diagnoses such as tendinitis, bursitis, ligament sprains, and peripheral nerve entrapment replaced fibrositis and associated syndromes.

According to Cyriax, the principal challenges to osteopathy were the basic morphological concepts of annular disc tear, nuclear disc prolapse, and dural tension as the pathologies underlying the vast majority of spinal derangements. Although Cyriax soon discarded the theory of sacroiliac derangement (for which a mobilization technique was illustrated in his first textbook only), he allowed

Barbor to describe the development of sclerotherapy (prolotherapy) for ligamentous disturbances of the spine, including sacroiliac ligamentous insufficiency, in the subsequent editions of his textbook. As will be seen later, the adoption by osteopathic physicians of the concept of fibroproliferative treatment techniques for ligamentous disturbances is an example of the increasingly ‘broad church’ attitudes adopted by both allopathic and osteopathic medicine and demonstrated with increasing maturity by musculoskeletal medicine over recent years.

Osteopathic medicine

Osteopathic medicine, founded on the work of Andrew Taylor Still who ‘threw the banner (of osteopathy) to the breeze’ in 1874, represented a seminal breakthrough in conceptual thinking. It provided a radical model for ill health and disease. Although revised and redefined, Still’s basic concepts continue to underpin osteopathic principles and practice. Interestingly, there has been a resurgence of interest at Kirksville Osteopathic Medical School, Missouri, USA, (founded by Still) in his original manual techniques. Stated simplistically, the rationale was that health and ill health are related to spinal function and dysfunction. However, somatic dysfunction should never be considered in isolation. Viscerosomatic reflex patterns are the very essence of osteopathic medicine.

Originally described as the ‘osteopathic lesion’, somatic dysfunction is now the accepted international term for the dysfunctional lesion. It is more formally defined by the Clinical Guideline subcommittee on Low Back Pain (American Osteopathic Association, 2010) as ‘impaired or altered function of related components of the somatic (body framework) system: skeletal, arthrodial, and myofascial structures, and related vascular, lymphatic, and neural elements’.

Somatic dysfunction is essentially a pathophysiological phenomenon. Anatomic derangements should always be considered as contributory factors, as should adverse posture and abnormal biomechanics. Of interest is that, at the height of James Cyriax’s influence in the UK in the middle and later decades of the twentieth century, there could not be two more diametrically opposed schools than osteopathic manipulative (sometimes referred to as neuromusculoskeletal) training (the branch of osteopathic medicine that focuses particularly on neuromuscular problems) on the one hand and the structuralism of orthopaedic medicine on the other. However, during and since the last two decades of the twentieth century, there has been a gradual convergence of these schools; for instance, the acceptance by allopathic medicine of dysfunctional neuromusculoskeletal states characterized by somatic dysfunction, and the incorporation of prolotherapy into advanced osteopathic training.

Manual medicine

In Europe, manual medicine was substantively influenced by osteopathic medicine. Chiropractic also played a role (Neumann 1989). An emphasis on articular dysfunction, using ‘blockage’ as old terminology, is a distinguishing characteristic. In this regard, there is much in common with the theories and practice advanced by John Mennell (Zohn and Mennell 1976) who, having trained in London, based his work (in the USA) on the concepts of his father (James Mennell) and the elder (Edgar) Cyriax. However, muscle hypertonus/contraction and the associated features of somatic dysfunction are consistent features in European manual medicine. The Czech school of manual medicine, led by Karel Lewit and Vladimir Janda, places a particular emphasis on muscle dysfunction. Contributions by Vladimir Janda and Alena Kobesova are included in this book (Chapters 8, 12, and 61).

In general terms, ‘manual medicine’ has come to be regarded as the relatively pure core model of manual diagnostics and manual therapeutics. To practitioners of manual medicine in some European countries, ‘musculoskeletal medicine’ is a somewhat wider subject, incorporating other management strategies such as injections.

Musculoskeletal medicine

Musculoskeletal medicine has emerged from a background of orthopaedic medicine (as previously described, developed by James Cyriax at St Thomas' Hospital, London), manual medicine, and osteopathic manipulative medicine. Musculoskeletal medicine may easily be distinguished from allied specialties such as rheumatology and orthopaedic surgery. The distinctive and underlying concepts of musculoskeletal medicine are:

- the scientific basis of function of the neuromusculoskeletal system;
- the pathophysiological and structural basis of dysfunction of the neuromusculoskeletal system.

With respect to management strategies, there is an overlap with other disciplines such as pain management and rehabilitation. There is a close working relationship with allied non-medical professions, particularly physiotherapy. Knowledge of functional anatomy, ergonomics, biomechanics, podiatry, exercise physiology, and general medicine is essential. Clinical application of this knowledge is reflected in distinctive manual diagnostic techniques. Management skills include spinal mobilization and manipulation (both allopathic and osteopathic), injections, and a wide range of other manual techniques. Complementary, mind–body, and holistic approaches to health are particularly relevant to chronic musculoskeletal disorders and are nowadays often described as 'integrated medicine' (see Hutson and Ward, Chapter 65).

In short, musculoskeletal medicine has accepted the concept of neuromusculoskeletal dysfunction, as developed by osteopathic medicine and manual medicine, but retains many of the allopathic characteristics of orthopaedic medicine. It has an established evidence base (upon which this textbook has been constructed), yet it retains the art and compassion of the healthcare professional who is well versed in the biopsychosocial as well as the biomechanical, pathophysiological, and pathomorphological models of care. It incorporates holism and eclecticism and is an archetypal post-modern medical discipline.

Biosocial model of Engel (and other healthcare constructs)

George Engel, Professor of Psychiatry and Medicine at University of Rochester School of Medicine, Rochester, New York, threw down a challenge by identifying the need for a new medical model. In a seminal article (Engel 1977), he stated that the adherence to a model of disease was no longer adequate for the scientific tasks and social responsibilities of either medicine or psychiatry. The existing biomedical model, with molecular biology as its basic scientific discipline, embraced reductionism and mind–body dualism. It developed as medicine became 'scientific', particularly as taxonomy and other analytical scientific methods were applied to disease and suffering.

Engel proposed a biosocial model that 'takes account of the patient', the social context in which he lives, and the complementary system devised by society to deal with the disruptive effects of illness—that is, the physician role and the healthcare system. Clearly, it embraces psychosocial factors, including the status of the patient and the sick role, and addresses the apparent paradox that illness and wellness may not be related closely to 'positive' laboratory findings. It explains the variations of response by patients to health issues—from 'illness' or 'injury' to 'problems of living'. Not only has this model stood the test of time over recent decades, it is even more important now in an era of technological development and (often) dependency, in which there appears to be increasing reliance by clinicians generally, and particularly those who do not have the benefit of musculoskeletal medical training, on imaging for both diagnosis and invasive (usually injection) techniques.

Henrik Wulff developed a somewhat different view when he described the two cultures of medicine: objective facts versus subjectivity and values (1999). In clinical practice, there are scientific components (reasoning from theoretical knowledge, and reasoning from past experience—evidence-based medicine, for instance) and humanistic components based on wisdom and personal interpretation of findings from patient psychology and ethical reasoning.

McDonald (1996) went further when he suggested that physicians often make clinical decisions based on insufficient evidence-based medicine from randomized trials or epidemiological studies, and by the use of rules of thumb (or 'medical heuristics'), derived from personal theories, assumptions, experience, traditions, and lore.

My own views are similar to those of Suarez-Almazor and Russell (1998) who wrote that 'the art of medicine' is not about applying anecdotal experiences to the solution of clinical problems; it is about critically appraising the evidence in

front of us and linking it to our focus of interest, the individual patient.

The biopsychosocial model of Waddell is discussed in the section ‘Models of care in neuromusculoskeletal medicine’ in this chapter.

Distinctiveness of musculoskeletal medicine

Numerous references are made in this textbook to the distinctiveness of musculoskeletal medicine. This is associated with improved and more widespread understanding of neural plasticity and neuromusculoskeletal dysfunction, and the application of appropriate diagnostic manual techniques to problems that more often than not present as pain syndromes.

The clinician who acquires knowledge of neuromusculoskeletal dysfunction gains insight into conditions, such as whiplash and upper limb pain, that may manifest in diverse ways, defy the established disease–illness model, and present a substantive diagnostic challenge to the ‘uninitiated’.

By way of illustration, some of those dysfunctional problems that commonly cause epistemological errors in conceptual thinking, diagnosis, and management, in the absence of insight into neural plasticity, are discussed here.

Whiplash

Traumatic injuries to the musculoskeletal system caused by vehicular collisions are universal, apparently becoming more prevalent (or at the very least more frequently complained of), and subjected to insurance claims. However, they are by no means a modern phenomenon. ‘Railway spine’ was just as much a suitable topic for the honing and application of polemical skills in the second half of the nineteenth century as whiplash and whiplash-associated disorders are today. In the nineteenth century, opinion was divided between those physicians who were aligned to neurobiological explanations for traumatic backache and associated symptoms and those who identified psychosomatic fundamentalism as more congruent with their own beliefs (Cohen and Quintner 1996). In many respects, the debate has not moved on to any substantive degree other than for the increasing recognition of the neurophysiological basis for many symptoms that were previously unexplained. Even so, ‘spinal concussion’ was not too far off the mark as an expression of a disturbed spinal cord when contrasted with the modern views regarding neuronal activity in the dorsal horns.

A recognition of the concept and features of somatic dysfunction facilitates an understanding of the myriad complaints in whiplash-associated disorders ranging from dizziness, visual disturbances, and headaches; pain and dysaesthesiae in the upper limbs; discomfort in the lower back, sacroiliac regions, and buttocks—to name but a few. Temporomandibular joint dysfunction (jawlash) occurs in a significant subgroup of patients. The symptoms of vertigo, dizziness, visual disturbances, etc. are sometimes grouped together as the Barré–Lieou syndrome (Barré 1926). Proximal thoracic spinal dysfunctions are common, as are sacroiliac disturbances.

The Lithuanian experience of the low incidence of symptomatic whiplash, one year after the index event (Schrader et al. 1996), is not surprising given the intrinsic modulating effect on pain pathways of the descending cerebrospinal tracts operating outside a medicolegal context. By contrast, it is hypothesized that the inhibitory function of these tracts is often compromised by perpetuating factors that are associated with the ‘advanced’ culture of the Western world.

The lack of ‘hard physical signs’ (Gargan 1995) inhibits most orthopaedic surgeons from making a meaningful evaluation within a biopsychosocial model of ‘injury’ in those who continue to complain one year after the index event. Over-reliance on delta forces and other mechanistic concepts associated with the application of the laws of physics to the cervical spine (in particular) in whiplash leads to the denial of the possibility of soft tissue whiplash strains in low-

velocity collisions. (I reject this argument on the basis of biological implausibility.) Without appropriate manual diagnostics, the absence of identifiable ‘organic’ pathology invites a suspicion (in the clinician’s mind) of wilful exaggeration by the patient or frank malingering, thereby contributing (should the scepticism of the examiner be obvious to the patient), in some, to distress, chronicity of symptoms, and disability.

Upper limb pain

The concept of neuropathic arm pain is explored by Hutson in Chapter 33. Regional pain syndromes are relatively incomprehensible without an understanding of neural function, soft tissue dysfunction, and spinal dysfunction. The application of neurodynamics to a functional assessment of the neck, upper back, and upper limb is a fruitful exercise without which diagnoses are presumptive and based on exclusion. The medical profession is indebted to the work of Australian physiotherapists such as David Butler (see Chapters 15 and 56 by Hall and Robinson) who have improved our understanding of the application of basic anatomy and physiology to neuronal circuitry between the neck and the hand. Musculoskeletal physicians should at the very least become acquainted with and hopefully skilled at evaluative diagnostic manual tests for soft tissue and neural dysfunction.

Although ‘adverse neural tension’ has become somewhat dated as medical shorthand and medical jargon (and replaced by AND—adverse neural dynamics—in deference to improving knowledge of neural plasticity), it should meanwhile become as familiar a concept for the expression of neural sensitivity or irritability as ‘dural tension’ in the lower limbs (as assessed by the straight leg raise and femoral stretch test).

Back pain

That appropriate diagnostic skills are prerequisites for meaningful and effective management strategies is a theme throughout this textbook. Nowhere is this more relevant than in the diagnosis and management of back pain, particularly lower back pain (LBP). Over the last decade, the term ‘non-specific’ back pain has (regrettably) become established in medical practice. In this condition, clinical examination undertaken by practitioners with limited or no specific musculoskeletal medicine training or understanding of dysfunction yields no abnormalities, a situation ‘confirmed’ by negative serology and/or imaging. Although ‘non-specific’ LBP (or its companion term ‘mechanical back pain’) appears fixed in the current medical lexicon, it ignores the possibility of a wealth of clinical signs diagnostic of dysfunction, which when treated, for instance by mobilization, manipulation, or other means of release of soft tissue tension, produces relief of pain (Lewit 2011).

A time-consuming but potentially rewarding part of my own clinical work is to disabuse many patients of misconceptions regarding the nature of their back pain and to reverse the effects of its past mismanagement, instilled by ‘conventional wisdom’ of the medical profession over recent decades. These misconceptions so often arise from the discussion of ‘crumbling spine’, ‘worn out discs’, and ‘arthritis’ arising from X-ray appearances, paying no heed to the clinical findings in a competent musculoskeletal examination. Old habits die hard. The inculcation of healthy attitudes, appropriate rehabilitation programmes, and early return to premorbid levels of daily activities is predicated on evaluation strategies that differentiate nociceptive and neuropathic pain, and recognize the role of red flags (for serious disease), yellow flags (for psychosocial factors with particular relevance to chronicity), and illness behaviour. Rehabilitation for musculoskeletal conditions is well served by a number of authors in this textbook.

Tender points

The concept of tender points and trigger points is explored throughout this textbook. Proponents of myofascial pain syndromes (MPS) as an important diagnostic group propose a primary dysfunctional state within the muscle as the explanation for tenderness, muscle hypertonus, the jump sign, and referred pain phenomena. The proposition of primary muscle dysfunction is contested by many clinicians, and the reader is referred to Quintner and Cohen (Chapter 14) for a comprehensive review of the MPS debate and a deconstruction of untenable hypotheses.

A hypothesis with which I personally am comfortable is that tender/trigger points are, for the most part, a manifestation of tension within the musculoskeletal system, possibly in the form of secondary hyperalgesia. As such, they reflect the process of neurosensitization, whether locally, regionally, or centrally.

Fibromyalgia, which is explored in considerable detail, particularly by Jens Foell (Chapter 13), may be considered to be an expression of a widespread pain syndrome in vulnerable individuals. Regional pain syndromes also abound; for instance, neuropathic arm pain (type II work-related upper limb disorder). At a more local level, neurosensitization may well be an expression of recent neural trauma but may also arise as a consequence of local dysfunction, infection, or inflammation.

Allodynia indicates a reduced threshold to potentially nociceptive stimuli; hyperalgesia indicates reduced tolerance of nociceptive stimuli; and hyperpathia indicates a prolonged nociceptive response to provocative stimuli.

Practitioners of musculoskeletal medicine will be familiar with the ubiquitous tenderness and muscle hypertonus in the proximal scapular fixator muscles, and also in the glutei, which are common accompaniments (or responses) to gravitational or postural cervicodorsal spinal stresses and lower back stresses respectively.

Red flags and yellow flags

The terms ‘red flags’ and ‘yellow flags’ refer to the relevant factors that emerge at interview or examination of a patient that act as ‘markers’ for serious spinal pathology (red flags) or psychosocial factors and coping mechanisms associated with chronicity (yellow flags). Red flags include onset of back pain in the elderly, thoracic spinal pain, a history of malignancy, general ill health, weight loss, etc. Psychosocial yellow flags include social deprivation, poor job satisfaction, incorrect beliefs, a history of inappropriate or ineffective coping strategies, abnormal behaviour, and fear/pain avoidance. ‘Blue flags’ and ‘black flags’ refer to the work environment, and may be viewed as subdivisions of the yellow flag psychosocial group. Blue flags are defined as an individual’s perceptions about work conditions and their impact. Black flags refer to objectively established work conditions, contracts, sickness policy, entitlements, and legislation that impact on the employee.

Illness behaviour

Behavioural responses to illness and injury are manifold. Accordingly, it is not unusual for emotional responses to be manifest by patients during contact with others, including examining clinicians. As a consequence, it is somewhat arbitrary as to when behavioural reactions identified by the examiner at interview or on clinical examination are ‘abnormal’. The more common findings of established illness behaviour are hesitancy on movement (particular in response to instructions during examination), pain gesturing and vocalization, dizziness, and other somewhat inappropriate reactions.

Abnormal illness behaviour (first described by Pilowsky in 1969) is ‘an inappropriate or maladaptive mode of experiencing, perceiving, evaluating or responding to one’s own state of health’. It is sometimes, mistakenly, assumed to have a conscious aspect. However, a more appropriate interpretation is that abnormal illness behaviour, with its accompanying concept ‘the sick role’, is the overt expression of distress, misattribution, and maladaptation, often reflecting poor or exhausted coping mechanisms.

Inappropriate signs

'Inappropriate' signs in assessment of low back pain were described by Waddell et al. in 1980, but have been open to abuse. Waddell was instrumental in distinguishing 'non-organic' or 'inappropriate' symptoms and signs of abnormal illness behaviour from the symptoms and signs of 'organic pathology' or 'physical impairment' (see Box 1.1). The signs in particular have been used extensively by orthopaedists.

Box 1.1 Symptoms of 'inappropriate' illness behaviour

- Non-dermatomal numbness and pain
- Non-myotomal ('global') weakness in the leg
- Constant symptoms
- Refractoriness to and often intolerance of treatments

Signs relating to low back pain complaints

- Lumbar pain on axial loading
- Lumbar pain on simulated rotation
- Improvement of straight leg raise on distraction
- Regional sensory changes
- Superficial widespread non-anatomical tenderness
- Regional jerky resisted muscle contraction
- Over-reaction generally

Unfortunately, the detection of inappropriate features, particularly inappropriate clinical signs, sometimes leads to inappropriate interpretation of the underlying clinical problem. ‘Non-organic’ does not necessarily equate to deliberate exaggeration or fabrication of symptoms. It should mean what it sets out to state: that there is probably no significant or relevant abnormality of tissue morphology—which, in the context of the underlying concept of neuromusculoskeletal dysfunction in this textbook, should come as no great surprise in many disorders. Additionally, in the light of our present understanding of neurosensitization, the sensory signs, and possibly most of the other ‘inappropriate’ signs, are capable of interpretation as abnormal neural processing.

Disability

Disability is the adverse effect on activities of daily living, particularly work, caused by illness or injury. It has a large subjective component, which is difficult, if not impossible, for the examining clinician to forecast or quantify in an individual. Reliance on demonstrable pathology (for instance by radiography or magnetic resonance imaging—MRI) is epistemologically unsound because it ignores the behavioural responses to life's problems, illnesses, and injuries. A constant theme throughout this text is 'treat the patient, not the MRI'.

Disability should be contrasted with impairment of function. Loss of function may be relatively easy to quantify (for instance, the loss of movement at a peripheral joint in a compliant patient), and sometimes more difficult (such as the evaluation of loss of movement at the lumbar spine). Nevertheless, the range of passive movements represents an objective assessment made by the examiner. Naturally, impairment of function is often a major contributor to disability but it may not be the most important factor. As previously stated, psychosocial factors are often paramount in the development and chronicity of disability.

In addition to societal factors, the role of the medical profession is often contributory. It is a truism to state that patients sometimes recover despite the 'best' attentions of the medical profession. In patients with neck and back pain, iatrogenesis is often a major aetiological, perpetuating, or aggravating factor (see 'Evidence-based medicine' in this chapter). Disability is commonly the product of dysfunction, fear avoidance, distress, and iatrogenesis.

Iatrogenesis

The following factors are often relevant to the role of the medical profession:

- failure to understand somatic dysfunction
- failure to distinguish between neuropathic and nociceptive pain
- failure to recognize illness behaviour and psychosocial factors
- failure to differentiate impairment from disability
- inappropriate labelling, misattribution, and medical jargon
- catastrophizing (by the doctor)
- unjustified restriction of activity
- buck passing (for instance, delaying therapy by use of tests or secondary referral)
- readiness or willingness to provide sickness certification.

The non-medical professions are not exempt: the domination of spinal manipulation at the expense of the inculcation of positive self-help and self-stabilization strategies in some osteopathic and chiropractic regimes leads to patient dependency. (An example of the biopsychosocial model cast aside in favour of the biomedical model.) The lack of mobilizing or manipulating techniques in some physiotherapists' armamentarium is a contrasting deficiency.

In some countries, the ill-defined status of musculoskeletal medicine and the uncertain role of the musculoskeletal physician within the medical community are factors that affect the credibility of the examining doctor, and as a consequence, the effectiveness of his or her management strategy.

Evidence-based medicine

Evidence-based medicine (EBM) has been defined by Sackett as the conscientious, explicit, and judicious use of the current best evidence in making decisions about the care of individual patients (Sackett 1998). Universally accepted as concordant with best and most cost-effective practice at the turn of the millennium, it is equally applicable to musculoskeletal medicine. By definition, EBM is reliant upon the best available evidence being brought to bear on a patient's problems. Physicians are expected to use diagnostic techniques that are both reliable and valid, and therapies that have proven efficacy. Sackett softened his approach to EBM by stating that inherent in its practice is integration of the best available external clinical evidence from systematic research with individual clinical expertise. In view of the acceptance within musculoskeletal medicine of tacit knowledge and acquired wisdom from experience (Aristotelian 'episteme') by practitioners, it is probably more appropriate to combine expertise, experience, and evidence into the concept of evidence-informed practice (EIP).

The use of mathematics in musculoskeletal medicine has been refined by Bogduk (1999). Interobserver reliability for diagnostic examining techniques is crucial if sense is to be made of dysfunctional neuromusculoskeletal conditions. Unlike other branches of medicine, there are few gold standards for dysfunctional states. Serological, radiological, neurophysiological, and histopathological investigations may be normal in somatic dysfunction. As a consequence, validation of diagnostic techniques is dependent upon agreement on the basic characteristics of dysfunction. Despite the difficulties, critical appraisal of the evidence for its validity and usefulness is possible (see Patijn, Chapter 3).

The development and testing of hypotheses, allowing them to stand unless proven false (Popper 1959), combined with clinical observations, has provided the empiric basis of advancement of knowledge in musculoskeletal medicine in the past (Dorman 1995). Knowledge is based on evidence, which in its broadest sense includes everything that is used to determine or demonstrate the truth of an assertion, and is also context-dependent. On a deeper philosophical basis, there are problems with truth, which is contemporary and different in different cultures (cultural relativism). To quote Dawkins (1998): 'Is a truth just a so-far-unfalsified hypothesis? What status does truth have in the strange, uncertain world of quantum theory? Is anything ultimately true?' (Dawkins, R. (1998) *Unweaving the Rainbow*. Penguin Books, London.)

Regrettably, independence, objectivity, and neutrality in research are not always obvious or achievable. Emerging facts have to be ‘interpreted’ (given meaning and value), placed in context, and disseminated. An additional problem is that successful dissemination of knowledge is a potentially complex process: the availability of evidence and its transmission may be limited; service-level agreements may not encourage the use of evidence or guidelines; incentives (moral, ethical, or financial, for instance) may disproportionately influence decision making; credibility of opinion leaders may be variable, at best; and political support may be lacking, though it is to be hoped that hypothesis, innovation, and implementation of evidence will not be stultified unduly by political considerations.

Sometimes, in the frequent absence of ‘gold standard’ diagnoses in functional disorders, it is only when a putative syndromic diagnosis (that is ‘recognized’ by a specific test) responds to a specific therapeutic procedure that the test may be considered to be valid. This is essentially a pragmatic approach to diagnosis and management (see Blomberg, Chapter 60). For example, some clinicians (including myself) are satisfied that the three features—tenderness of the posterior superior iliac spine, reduced mobility of the sacroiliac joint, and gluteal hyperalgesia—constitute, in combination, an appropriate diagnostic test for sacroiliac joint dysfunction; but, in the absence of a gold standard diagnostic test for this condition, the subjective (patient’s) approval of the results of appropriate therapy and the objective (observer’s) assessment of improved sacroiliac mobility immediately after the procedure provide second-best validity for the diagnostic test.

Models of care in neuromusculoskeletal medicine

Four conceptual models are described: biomechanical, pathomorphological, pathophysiological, and biopsychosocial.

Biomechanical model

The biomechanical model of dynamic stability in which the components of the musculoskeletal system (bones, joints, ligaments, muscles, fascia, and other soft tissues) contribute to efficient load transference and, as a consequence, to movement of the body with least energy expenditure and injury risk, underpins the text of this book. However, the emphasis is on the clinical aspects of somatic disorders that arise when the body's adaptive processes to physical stresses (for instance, gravitational, environmental, work- and sports-related) are overwhelmed—rather than biomechanics. For a greater understanding of basic biomechanics of the musculoskeletal system, the reader is referred to other texts. The more advanced biomechanical concepts and their clinical application to the pelvis, developed in recent decades by Levin and Dorman (see Chapters 16 and 17) and by researchers in the Netherlands, prompts me to make reference to sacroiliac dysfunction, and to provide a short summary of recent 'trends' by way of illustration.

The concepts of *form closure* and *force closure* at the sacroiliac joint were introduced by Vleeming et al. (1990). Form closure is due to the close apposition of the joint surfaces, their 'irregular' but complementary pits, ridges, and grooves, and the wedge shape of the sacrum. Force closure is the biomechanical contribution to stability (maximal in nutation—forward movement of the base, or 'promontory', of the sacrum) made by the muscles, ligaments, and fascial systems. When shear forces at the sacroiliac joint are adequately controlled by the stabilizing effects of form closure and force closure, loads can be transmitted between the lower limbs and the trunk in a cost-effective manner. When pelvic functional stability is not achieved, and shear is uncontrolled, the 'cost' to the body is the state of functional and biomechanical decompensation, manifest as painful syndromes, particularly (but not exclusively) low back pain and somatic pelvic pain. The reader is also directed to Chapter 63 in which Mottram and Comerford address the motor control of the lower back and pelvis, the relationship between muscular balance and pain syndromes, and rehabilitation strategies for a return to dynamic stability.

The editors are excited by the introduction of new neuromuscular concepts in this second edition of the textbook. In Chapter 61, Kobesova introduces, from the Czech Republic, the concept of dynamic neuromuscular stabilization. Biederman writes on functional disorders of the spine in small children in Chapter 22. In Chapter 11, Rutte provides a stimulating insight into the practical application of biomechanics in musculoskeletal medicine, with particular

reference to the Preferential Mass Mechanics Method (PMMM) used in the Netherlands.

The ‘pathobiomechanics’ of disorders in the upper and lower limbs is often of primary importance. This applies particularly to sports-related problems in the pelvis and lower limbs (dealt with comprehensively by Hutson and English, Chapter 34; Peirce, Chapter 37; English, Chapters 41, 43, 44, and 46; and Higgins, Chapter 42) and to both sports- and work-related problems in the shoulder and upper limbs (covered by Tanner, Chapters 28 to 30; Funk and colleagues (shoulder), Chapters 31 and 32; and Hutson et al. (upper limb), Chapter 33). Ergonomics is an associated healthcare model worthy of study in patients with shoulder and arm pain due to repetitive or stereotyped movements. Knowledge of sports technique is essential for the diagnosis, rehabilitation, and prevention of further injury in overuse conditions of the lower limb.

Pathomorphological ('structural') model

One cannot consider the nature of musculoskeletal disorders without reference to structural abnormalities. After all, 'organic pathology' has always been, and indeed continues to be, the primary focus for orthopaedists (and surgeons in general, from which corporate body orthopaedic surgeons have emerged during the last hundred years). Disorders of bone, other than stress fractures, receive scant attention in this textbook; they are dealt with very adequately in numerous orthopaedic texts. However, physicians with expertise in neuromusculoskeletal disciplines should always consider bone pathology in the differential diagnosis of axial and peripheral pain, both traumatic (or 'acute') and overuse (or 'chronic'). Examples are to be found in the text: avulsion fractures, osteochondral injuries, epiphyseal fractures, and metastatic carcinoma, for instance.

Traumatic injuries to the soft tissues, particularly in the limbs, may arise primarily as a consequence of external factors. A trip or stumble leading to a fall may cause a ligament sprain, joint dislocation, or muscle tear in members of the community of varying degrees of fitness; of course, constitutional factors may increase vulnerability to injury and reduce the rate of recovery. When repetitive stresses cause failure of the adaptive processes inherent in collagenized tissues, the degree of decompensation may be assessed functionally by clinical examination, assisted when necessary by a variety of investigative tools. Experience is required in decision making as to whether or when further investigations (with the inevitable financial cost) are desirable or necessary. Experience is essential with regard to the interpretation and relevance of pathomorphological findings (for instance, disc degeneration, disc bulge, or even frank disc prolapse in back pain, or increased uptake in bone scans of the lower limbs in runners).

Terminology changes over time to keep abreast of improved understanding of pathomorphology. An example is the current use of the term 'tendinopathy' (replacing 'tendinitis') as the consequence of overuse and/or degeneration. Disruption of collagen with histological features of degeneration, rather than an invasion of inflammatory cells, is seen in Achilles tendinopathy, patellar tendinopathy, and rotator cuff tendinopathy. Evidence has accumulated over more than a decade (see Khan et al. 1999, 2002) that rehabilitation for tendinopathy affecting the weightbearing tendons (Achilles, patellar) should comprise eccentric contraction regimes. At the shoulder, assessment and rehabilitation of rotator cuff lesions (see Gibson et al., Chapter 32) demand an

evaluation of the provocative factors (associated with shoulder girdle biomechanics, ergonomics, posture, sports dynamics) involved in subacromial impingement. Ligamentous laxity at the glenohumeral joint, often acquired by sportspeople as a consequence of repeated or forceful stretching at the shoulder, is often a confounding factor in sports that demand substantive upper limb activity (Hutson 2001).

Meniscus derangements, particularly at the knee, require careful evaluation. The ‘classical’ presentation of a twisting sprain, joint effusion, and locking of the knee is an indication for the attention of the traumatologist or orthopaedic surgeon. Recurrent, self-resolving bouts of knee pain in the young may be assessed most effectively by arthroscopy, but in middle life and beyond, critical appraisal of the patient by the application of clinical examination techniques of the type devised by Cyriax, augmented by stress tests for cruciate insufficiency (see Bickerstaff and Ali, Chapter 36), will serve the musculoskeletal physician best. When degenerative tears of the menisci, as evident on MRI, become symptomatic, the clinician becomes increasingly reliant on a sound knowledge of functional rehabilitation. As degenerative changes in the soft tissues advance, tissue preservation and maximization of functional capacity become paramount.

Pathophysiological model

The pathophysiological model provides the framework for the construct of *somatic dysfunction*, sometimes referred to as 'functional pathology' (Lewit 2011). As neurobiology and pathoneurobiological processes are further elucidated and defined, it becomes conceptually easier (even for allopathically trained physicians) to take a leaf out of the manual therapist's book in appreciating the limitations of chasing the nociceptive source of the pain, and to think in terms of evaluating the reasons behind the overt manifestations of dysfunction. Kuchera eloquently provides both an overview and an in-depth analysis of the factors associated with somatic dysfunction in Chapters 10, 27, and 50.

The analgesic response to manual therapy is very probably associated with significant neurophysiological effects in addition to the effects on joint mechanics and the chemical environment of injured tissue. Although unproven as yet, it is postulated that for treatment of spinal dysfunction to be successful, activation of descending pain inhibitory systems may be as important as local responses at (spinal) segmental and peripheral levels. Neurodynamics is also an important consideration in disorders of the upper and lower limbs. Neural dysfunction may be the primary or a contributory cause of shoulder and/or elbow pain or of buttock and/or posterior thigh pain. No musculoskeletal examination is complete, whether for axial or peripheral pain, without a neural assessment.

Butler (2000) refers to 'an emerging new construct in neurodynamics' by advising that the neurophysiological aspects of mechanosensitivity should be considered when undertaking neural tension tests. The changing concepts, over recent decades, with respect to the upper limb neural tension tests provide the reader with an insight into how increasing recognition of neural plasticity affects our thinking. The Australian manual therapist Robert Elvey revived the concept of neural tension in the upper limb at an international manual therapy conference (Elvey 1979). 'Revival' perhaps does not do Elvey justice, but it is a fact that the London neurologist Vivian Poore wrote of arm pain in the 1870s and 1880s (a hundred years before Elvey's introduction of the term 'brachial plexus tension test'). Poore (1887) included details of tension tests for the median, ulnar, and radial nerves. The upper limb tension test was introduced by Kenneally et al. in 1988 and used by Butler in his textbook *Mobilisation of the Nervous System* in 1991. (Kenneally described the upper limb tension test as the 'straight leg raise of the arm'.) Currently, the neural tissue provocation test is used as a means of assessing mechanosensitivity of the neural tissue, though Butler demurs on the

basis that neurosensitization may play a role and on the recognition that other soft tissues, besides the neural tissues, are challenged on the upper limb tests. As a consequence, Butler prefers the term ‘upper limb neurodynamics testing’. The subject is reviewed and brought up to date by Hall and Robinson in Chapters 15 and 56.

The concept of secondary hyperalgesia as the pathophysiological explanation for referred tenderness (palpatory hyperalgesia) and discomfort on active and passive movements (articular hyperalgesia) has gained much ground. It reflects the increasing awareness of abnormal sensory processing. Cohen et al. (1992) can take much credit for their projection of neural dysfunction as the cause of some cases of previously undiagnosed upper limb pain.

Biopsychosocial model

The demand for an alternative to the disease–illness (biomedical) model, which had supported medical practice for centuries and was reinforced by the pathomorphological concepts of Virchow (1858), gathered pace through the 1980s. The following points became recognized:

- Contrary to the Cartesian theory of pain (subsequently—though somewhat unfairly with respect to René Descartes—described as the ‘duality of pain’), pain perception and pain behaviour vary enormously from person to person.
- Pain does not equate to tissue ‘injury’ in most cases of back pain.
- Chronicity of back pain, also neck pain arising from whiplash, and some upper limb pain syndromes, correlates poorly with tissue injury or structural disorder.
- Psychosocial factors are better predictors of recovery or chronicity than pathomorphological considerations.
- Disability is distinct from somatic dysfunction. Although impairment of function is a component in the development of disability, there are often significant psychological, social, and iatrogenic factors.

The biopsychosocial model of pain, healthcare, and disability, for which much credit should go to Waddell and colleagues (1984, 1987), addresses these and other issues. In effect, this model is an extension of Waddell’s views on the distinction between distress, disability, and dysfunction (with which I entirely concur). The psychosocial factors are explored further, elsewhere in this text. A useful synopsis is the recognition that:

- Acute pain is a complex sensory and emotional experience, often associated with distress. Although pain is distinct from disability, both are subjective phenomena.
- The chronicity and severity of pain, particularly (but not exclusively) spinal pain, correlate well with psychosocial factors that include premorbid psychological profile, environmental stresses, misattributions and beliefs, iatrogenesis, and litigation.

Pragmatism and complexity in musculoskeletal medicine

Patients' expectations in the twenty-first century are increasing. Across the spectrum of health issues, patients are very likely to have and to declare values and preferences. They expect to be involved in decision making, seeking quality of treatment that is predicated upon their individual circumstances. In parallel with patients' 'New Age' views (a phrase that ushered in the twenty-first century), there have been significant societal anxieties and cultural changes in more recent years. The widespread use of the internet by patients, to support their understanding of their medical conditions, has added another dimension to the clinician's management of musculoskeletal problems. Accordingly, clinicians need to be increasingly flexible to address the complexity of health-related problems. Herein lies an enigma. Evidence-based medicine is virtually *de rigueur* in the current decade, demanded by commissioning groups and viewed as an essential component of 'governance' (the medical profession's all-encompassing self-regulating mechanism). However, individual tailor-made treatment programmes providing value, and independent of meta-analytical medical judgements, are demanded by patients. A multidisciplinary approach is often required. Can we square the circle? To do so, we must understand the application to science of modernism, post-modernism, and complex adaptive systems ('post-normal science').

Based on the science of Galileo and Newton *inter alia*, and the philosophy of thinkers such as René Descartes and Hume in the Age of the Enlightenment, the fundamental principles of modernism were (and remain) logic, reason, rationalism, and reductionism. Theories about disease and illness are based on measurements, thereby explaining reality. If theories have no measurable components, they are essentially invalid. Much of medical practice since the eighteenth century, and continuing to this day, adopts modernist principles based on a biomedical model. Orthopaedic surgery is a prime example.

Post-modernism, on the other hand, is essentially anarchic and eclectic. It rejects dogma, rejects the concept of universal truth, and rejects modernism. Friedrich Nietzsche developed some of these principles, but there have been many subsequent advocates, in particular Lyotard and Fourcault. Specifically, post-modernism rejects the (modernist) mantra that objectivity is possible in scientific work. Objectivity is often compromised by the quest for, or the achievement of, power. Post-modernism espouses non-conformity and diversity. Such principles are congruent with complementary and alternative medicine, and to some extent with manual therapy (in its broadest sense).

Post-normal science has adopted some post-modern ideas (Laugharne 2002). However, its essential principle is that uncertainty and unpredictability are inevitable in complex systems. This often applies for instance to healthcare. The search for absolute truth is viewed with grave suspicion. In post-normal science, science itself is not rejected. However, its boundaries should be expanded to allow discourse regarding socio-cultural implications with all interested parties (of which there are many). There are numerous applications of post-normal science. In the so-called 'civilized' countries, issues such as genetically modified foods, stem cell research, and cloning have implications for society in general, engaging many stakeholders.

The introduction of complexity (in the form of uncertainty, unpredictability, and an expanded peer community)—a feature of post-normal science referred to as non-linearity— demands adaptability and flexibility on the part of the physician (Wilson and Holt 2001). This type of healthcare paradigm is known as a *complex adaptive system*, in which patients' problems vary from the simple (with a high degree of agreement between clinicians and a high degree of certainty of diagnosis) to—at the opposite extreme—'chaotic' in which there is very low agreement and a very low degree of certainty. Most cases are situated between these two extremes, demanding the need (in many cases) for multiple approaches, creativity, and (above all) pragmatism.

An appropriate problem for the study of the often complex relationships between pathomorphology and pathophysiology, and the pertinence of the complexity theory, is posterior thigh pain, or 'hamstring dysfunction'. A 'tear' or 'pull' of the hamstrings is a common problem in sport. Posterior thigh pain has a high prevalence in the general population. Why is hamstring dysfunction so often a 'pain in the butt' and/or thigh, and how do we explain its frequently recurring nature? The answer perhaps lies in the fact that whichever model or paradigm (pathomorphological, biomechanical, biopsychosocial, or pathophyisological) is chosen, there is underlying neuromusculoskeletal weakness, decompensation, or 'vulnerability'.

In the pathomorphological model, hamstring dysfunction is the consequence of intrinsic muscle deficiency, commonly a tear of the biceps femoris muscle. The severity may be based on the clinician's experience, but tissue injury is more accurately graded by MRI: Grade 1, anatomy preserved, oedema; Grade 2, muscle fibre disruption; Grade 3, haematoma. Inevitably, rehabilitation demands attention to restoration of muscle function.

In the biomechanical model, factors such as muscle fatigue, flexibility, strength, and imbalance are considered. Additionally, ageing and muscle function with respect to dynamic stability and range of movements of the hip,

spine, and knee are valid issues. Gait analysis is often required in investigation. Other factors involved in aetiology are incomplete rehabilitation, inappropriate warm-up before sport, training errors, and associated issues including those enumerated in the pathophysiological model.

The biopsychosocial model, incorporating the psychological aspects of pain, is explored by a number of authors in this textbook.

In many patients, adherence to the pathophysiological model is maximally productive. This model is predicated upon neural dysfunction arising in the lower back or pelvis, and adversely affecting hamstring contraction. A likely cause of hamstring inhibition is ‘false’ or ‘disturbed’ proprioceptive input from the lower back and pelvis, particularly the spinal facet (apophyseal) joints and sacroiliac joints, and possibly from the periphery such as ankle or knee following lower limb trauma. Characteristic clinical features are spinal dysfunction, sacroiliac dysfunction, myofascial trigger points, neural dysfunction, and muscle weakness patterns, primarily of the S1 myotome. These patterns of lower limb discomfort in young adults, often sportspeople, are mostly ‘pseudoradicular’ insofar as there is usually no evidence of nerve root compression, merely disturbed neurodynamics, though intervertebral foraminal neural irritation (as a consequence of recess stenosis) is increasingly the cause of thigh pain in the ageing population.

Management strategies are essentially pragmatic. Treatment is directed towards the identifiable dysfunctions, commonly at the spine and pelvis. Rehabilitation should continue until restoration of full functional capacity is achieved. Treatment options include spinal and paravertebral injections in the form of epidural injections, foraminal blocks, and facet blocks. Other injections and needling techniques, particularly for trigger points, are usually helpful. Controversial treatments that are not yet validated but are gaining popularity include injections of enzymes to ‘enhance re-absorption of haematomas’, injections that include a homeopathic remedy ‘to modulate factor P and oxygen radicals’, and injections of protein-free ultrafiltrate of calf’s blood ‘to increase oxygen uptake, to accelerate the processes of granulation and vascularization, and to improve microcirculation’. Additionally, prolotherapy may be required for refractory or recurrent cases (see Dorman, Chapter 54; Petrides, Chapter 55; and Blomberg, Chapter 60).

Management of sclerotomal or ‘pseudoradicular’ syndromes is a good example of a complex adaptive system paradigm. Mobilization/manipulation, soft tissue treatment, paravertebral blocks, epidural injections, and sclerosant injections (prolotherapy) may all have a place, followed by a comprehensive rehabilitation protocol. Diverse treatments may of course be given sequentially,

but many clinicians, including myself, prefer combined therapy on the basis that individual treatment modalities may have a ‘synergistic’ rather than additive effect. The pragmatic approach, based on an antidysfunctional management strategy, is discussed more fully by Blomberg (Chapter 60).

Hutson and Ward discuss an integrated approach to healthcare in Chapter 65. The essential characteristics of musculoskeletal medicine, as practiced by the editors of this textbook when engaged by their patients who are suffering from somatic symptoms and distress, are summarized by Foell in Chapter 5: ‘the haptic exploration of the body that experiences this hurt, paired with the capacity to listen to the patient’s story, and knowledge about the healthcare system itself, provides at least the basis for a good working relationship in order to bring things forth.’

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Chapter 2

Somatic dysfunction: the life of a concept

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N.B. In this usage, somatic does not mean pertaining to the soma (body), rather than the psyche (mind), but to structures innervated by the somatic nervous system rather than the autonomic. Embryologically, the adjective chosen might more pedantically have been 'somitic', to distinguish involvement of structures derived from primitive mesodermal somites (from which skeleton and voluntary muscle derive) rather than viscera.

Approach to writing this chapter

This chapter attempts to chart the history of an idea over a century and a half and involves judging the thoughts of people by viewing a selection of their writings and inferring the reasons for their actions. The author is resigned to the fact that sampling the mass of available sources has been an arbitrary process, so that what is presented is not claiming perfect objectivity or accuracy. However, it is hoped that the narrative will indicate that the most effective way to progress in healthcare may not be just to use the output of data from established science to formulate reviews and guidelines but also to be aware of the processes, intellectually and practically, that are necessary for the institutions of science to keep steering an optimal path, without their momentum taking them down blind alleys. Such awareness starts with the realization that theory guides science, whether it leads to a change in a manual technique or to building a multi-billion dollar particle collider. What may hinder identifying and developing the theories needed to bring about necessary changes in direction? We will try to trace the progress of ideas from conception, through dissemination, investigation, and acceptance to implementation—the competitive struggle and obstacles.