

Australasian Musculoskeletal Medicine



- Age-related muscle wasting
- Treatment of chronic pain with opioid therapy
- Truth in musculoskeletal medicine
- Obesity
- Spinal pain
- Case studies - piriformis syndrome

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Editorial and AAMM President's Report

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“Errors using inadequate data are much less than those using no data at all.” - Charles Babbage

Welcome to the 2014 edition of our *Australasian Musculoskeletal Medicine* journal and once again thanks to the contributing authors for some interesting and thought-provoking papers.

At the AGM held during the conference at Leura in the Blue Mountains last October there was a change in several committee positions including president where I was honoured to be elected to replace Dr Geoff Harding who had fulfilled the role for several years. Dr Peter Cooke was elected secretary and Associate Professor Michael Yelland vice-president, replacing Dr Steve Jensen. Dr Margi Taylor offered to continue as treasurer and Drs Chris Homan, Bruce Jones and Thomas Choong were elected to the committee, replacing Drs Ramona Chryssidis, Ken Steffenson and Neil Harden. Thanks to both the outgoing and incoming committee members for their service to the AAMM.

Also at the AGM, Associate Professor Michael Yelland nominated Dr Geoff Harding to become a life member of the Association. Dr Yelland provided a detailed description of the work and sacrifice that Dr Harding had undertaken on behalf of the Association over many years in furthering the cause of musculoskeletal medicine in Australia. It has included multiple teaching commitments, presentations, attendance at meetings, press releases and publications and other activities. All present felt that life membership was warranted and the motion was duly passed unanimously. Dr Harding expressed some reservations but accepted the honour and noted that he would continue to be actively engaged in the affairs of the AAMM. He joins an elite few who have been granted the honour of life membership, including Professor John Murtagh and Professor Nik Bogduk.

The Association has now been in existence for over 40 years. When first established in 1971 the group was known as the Australian Association of Manipulative

Medicine. This was an indication of the main treatment focus at that time. It is interesting that manipulative medicine still forms a component of the musculoskeletal medicine treatment toolbox even though scientific evidence fluctuates regarding any actual clinical effect. Recent Cochrane reviews indicate limited or no effect with the proviso that the trials are of limited scope and the conclusions could be quite different if and when additional studies are published.^{1,2} In spite of the lack of solid published evidence, at the coal face some members find that it is a useful and valid treatment whilst others are more sceptical of the value of spinal manipulation.

This raises an important point about the AAMM. There is a diversity of professions – medical practitioners, as well as myotherapists, chiropractors, osteopaths, physiotherapists, and others who are members. Each approaches the musculoskeletal patient from a different perspective with different skills and clinical approach. The AAMM is indeed a multi-roomed professional “house”. Even within one group such as the medical practitioners of the AAMM, different treatments are applied, with some having preferred treatments such as acupuncture, prolotherapy, and dry needling whilst others prefer using steroid and local anaesthetic injections. There do not seem to be any core treatments that the AAMM can claim as being representative of the group.

In some ways this reflects also the diversity of pathology that musculoskeletal conditions can present. The over-riding patient concern is usually pain, and the desire to be free from it, but the underlying condition can be from myriad causes ranging from arthritic joints, intervertebral disc pathology, nerve impingement, ligament and tendon disorders and general medical issues such as polymyalgia rheumatica. There are often associated mental health issues arising from the consequences of

the musculoskeletal problem that need addressing using psychological techniques. Overall musculoskeletal medicine is not a neat distinct entity like, for example, cardiology or renal medicine. It seems to be whatever the individual practitioner wants to delineate it as being. The conclusion can arise that the AAMM is really a group of health professionals with an interest in the broad field with different approaches and treatment techniques.

The reason for raising this is that recently the question was asked whether the AAMM endorsed trigger point injections, prolotherapy or neural prolotherapy as treatments in the absence of scientific evidence. Indeed the particular person was of the opinion that trigger point injections had been disproven scientifically and this treatment was also a physiologically implausible construct. A recent PubMed search performed using the terms “trigger point injections review” doesn’t really provide a definitive answer either way to such a question, with a review in 2009 of 18 trials concluding that there is insufficient evidence of the use of injections, including trigger points, for subacute and chronic low back pain, with the proviso that it may help subgroups.³ Another broader study also concluded that there is no clear evidence for or against⁴ and this probably, in general terms, is the current state of knowledge regarding trigger point injection as a treatment. Trigger point injections also currently lack a plausible mechanism of action in relieving pain although activation of the endocannabinoid system may be an explanation as activation of this system is also possibly occurring with acupuncture.⁵

So the question remains does the AAMM endorse any particular treatment, to which the reply must be that treatments should be evidence based but it is not a function of the AAMM to endorse anything. It is up to the individual practitioner to conduct a regular assessment of the evidence for a particular

favoured treatment and this knowledge should be applied clinically and it can be shared with like-minded colleagues within the AAMM.

This is probably the real function of our organisation as a melting pot of knowledge and diversity of treatment approaches within which an individual patient hopefully can obtain a modicum of pain relief. Overall, however, we should maintain reverence for the scientific method, respect for evidence from reputable trials and reviews and apply such knowledge accordingly.

Continuing with this line of thought about “evidence” one of the privileges of being editor of the AMM journal is in selecting articles to be published each year. Whilst there have been many papers of importance published over the years a few have had more impact than others. Being able to assess “how good” or the validity of “tests” is a fundamental aspect of our discipline and quite a number of years ago Professor Nik Bogduk published a series on this particular topic. This edition of the AMM journal contains a reprint of one of these important papers from the 1999 journal. The application of 2 x 2 tables provides much valuable insight and it is worthwhile to revisit this in 2014. Thanks

to our now retired Professor Nik Bogduk for permission to reprint this paper. Some exercises are included with this paper that assist in understanding the application of the concepts.

The 2014 journal contains details of the upcoming seminar in Brisbane “dilemmas in musculoskeletal medicine - when to refer to the surgeons”, the combined NZAMM/AAMM/AFMM conference in Rotorua and advance notice of the 2015 conference in Melbourne. I look forward to seeing many of you at these events. Such events provide a useful way to meet and “chew the fat” with colleagues and learn new treatments and techniques to help our many patients with acute and chronic musculoskeletal pain.

Finally, mention needs to be made of the updated website. After much tribulation and “hair pulling” the website is functional. Note the different address of www.aamm.org.au. The login name and password are available by email request. The member’s section provides details of the process of login into the IMM journal and will be an archive of the AMM journal.

I trust that you benefit from the 2014 AMM journal.

- Tom Baster

References

1. Rubinstein SM, van Middelkoop M, Assendelft WJ et al. Spinal manipulative therapy for chronic low-back pain: an update of a Cochrane review. *Spine* 2011;36(13):E825-46. doi: 10.1097/BRS.0b013e3182197fe1.
2. Rubinstein SM, Terwee CB, Assendelft WJ et al. Spinal manipulative therapy for acute low back pain: an update of the Cochrane review. *Spine* 2013;38(3):E158-77. doi: 10.1097/BRS.0b013e31827dd89d.
3. Staal JB, de Bie RA, de Vet HC et al. Injection therapy for subacute and chronic low back pain: an updated Cochrane review. *Spine* 2009;34(1):49-59. doi: 10.1097/BRS.0b013e3181909558.
4. Scott NA, Guo B, Barton PM, Gerwin RD. Trigger point injections for chronic non-malignant musculoskeletal pain: a systematic review. *Pain Med* 2009;10(1):54-69. doi: 10.1111/j.1526-4637.2008.00526.x. Epub 2008 Nov 5.
5. Fu LW, Longhurst JC. Electroacupuncture modulates vIPAG release of GABA through presynaptic cannabinoid CB1 receptors. *J Appl Physiol* 2009;106(6):1800-9. doi: 10.1152/japplphysiol.91648.2008. Epub 2009 Apr 9.

From the NZAMSM President

We are creatures of habit and I proved this yet again when at the last minute I completed the spreadsheet of activities for my continuing professional development (CPD), part of our professional “red tape”. Most everything in life is governed by regulations: what we eat, where we live and work and the goods and services, including medical services. Regulations theoretically protect our rights and make sure markets work fairly. The Medical Council is charged with protecting the public by taking steps to ensure we are safe to practice and part of the mechanism for this is CPD.

Yet to be answered is whether CPD protects the public. The cohort of NZ doctors on the general vocational registration who are doing their reaccreditation through bpac are being followed to see if there is a difference in the number of complaints in this group before and after they commenced a formal reaccreditation process. In the meantime, as part of reaccreditation we attend conferences.

I have been reflecting on my attendance at the NZAMM and AAMM conferences over the years and the pearls of wisdom, often in the form of a throwaway comment that stick in the memory. The 2003 muscle conference in Queenstown organised by Steve Bentley established the NZAMM concept of taking a tissue and making it a conference theme. While David Simons of Travell and Simon’ was the drawcard speaker, it was Mense’s elegant experiments into the neurophysiology of muscle pain which I remember most. In his talk titled “Spinal Mechanisms: pain referral and transition from acute to chronic pain”, he said, “The nociceptive input from muscles has more influence on changing spinal neural relations than input from skin receptors.”

At the 2010 and 2012 conferences a keynote speaker was the Dane, Lars Arendt-Nielsen, whose work on muscle pain complements that of Mense, so it is no surprise that these two researchers are two of the three editors of the IASP publication *Fundamentals of Musculoskeletal Pain*, surely worth a look.

In 2007 Palmerston North conference on tendons with Jill Cook and Karim Khan, their presentations and workshops supplemented by Jill Cook’s November 2007 article in the this journal have given me concepts and tools that I use on a daily basis, tweaked by advice from a keynote

speaker at the 2012 Wellington conference.

A personal highlight of the 2008 Melbourne conference on low back pain and sciatica, was the study presented by the late Brian McGuirk who, along with Nik Bogduk, had given staff at two teaching hospitals in Newcastle the option of having their low back injury treated by their GP (25%) or by the staff specialist in musculoskeletal occupational health, namely Brian McGuirk (75%). This was published in *Australasian Musculoskeletal Medicine* in May 2007. The figures were striking for the difference in immediate return to work by 63% of those under evidence-based care and that 98% recovered; rates of recurrence were 6% whereas in those with GP care, no patients returned to work immediately, 84% recovered and 27% suffered a recurrence. Subsequent to the study, the staff voted with their feet and those seeking evidence-based care increased to 90%. To me this is surely a case of “what might have been” if the results of the National Musculoskeletal Medicine Initiative had not been embargoed.

The 2010 Auckland conference on “Low back pain – can chronicity be prevented” tantalised us with the Chinese study on intra-discal methylene blue for discogenic back pain, but sadly this treatment does not appear to work outside of China.

This contrasts with the paper presented by MacVicar and Borowczyk (*Pain Medicine* 2012; 13: 647–654) at the 2012 Wellington Conference which showed that this treatment works outside of Newcastle, Australia, provided it is done “à la Newcastle”.

At this same conference the engaging Jeremy Lewis’s advice to “sneak up on the tendon every third day” instead of the daily slog of the Alfredson’s regime has fundamentally changed my prescription of exercise therapy for tendinopathy for the better. The common denominator here is adherence and compliance (patients doing what they agree to do and doctors actually following the guidelines).

The Blue Mountains 2013 conference on burning issues in musculoskeletal medicine was notable for the presentation on sacroiliac joint examination and treatment by the sports physician Mel Cusi.

During the 2014 New Zealand pain conference in Dunedin, the psychologist Mike Nicholas presented example after example where guidelines were irregularly

followed, confirming that our habits are hard to change even if it means better patient outcomes as demonstrated by the low-tech McGuirk and Bogduk study and the high-tech MacVicar and Borowczyk study.

The 2014 NZ pain conference focused on pain as a public health issue. The keynote speaker from the USA was Mac Gallagher who is coordinating the treatment of the military injuries from the Afghanistan and Iraq wars (56% of returning veterans have musculoskeletal pain). It is likely these veterans will feature in numerous studies so that a positive legacy from these conflicts is hopefully better evidence-based treatments.

The epidemiologist, Fiona Blyth, provided us with a website that enables you to look at the changing makeup of the global burden of disease, I suggest you look it up and use the “square” pie chart to compare various nations and our changing patterns of disease, www.healthmetricsandevaluation.org/gbd/visualizations/country.

I can’t predict what pearls you will take home from the September 2014 Rotorua scientific conference “Nerves ‘n Pain”. The hope is that it will result in an incremental change in your practice habits. Even if it doesn’t, there is still the camaraderie of doctors who leave the coalface for a few days to see which way the coal seam is running.

So please come to the conference and do make sure that when you return home that you put it in your CPD spreadsheet there and then.

- Mike Clearly

From the AFMM President

Dear musculoskeletal colleagues

I write this with a somewhat heavy heart, as I do believe that the Faculty, and the discipline of musculoskeletal medicine (MM) itself, is an endangered species, and really is at the precipice in terms of its long-term future.

I firmly believe that we, as a group, do very good work. Our patients, as well as their GPs and the multitude of other medical specialists and allied health professionals who refer people directly to us, speak with their feet, and, in Australia at least, also their hip pockets, and keep knocking on our door, thus contributing to our very heavy clinical load. It seems that all Fellows who practise full time in the discipline have waiting times for new patients of at least several weeks. As a group we also make significant contributions to teaching and the published literature.

If we do become extinct, then the real losers will be our patients, and the health systems on both sides of the Tasman. The problem is convincing the wider medical community, and particularly our medico-political opponents, who, it seems to me are a powerful minority, of this fact.

Thus, this is a call to arms! For those of you who have thus far not contributed, please consider giving back to the Australian and New Zealand Associations and/or the Faculty a few hours of your time and consider becoming actively involved in the running of activities, such as joining the committee.

Almost all of the current office bearers have put in many long hours and copious amounts of physical, mental and emotional energy into your faculty over many, many years, and, quite frankly, we are all getting tired and losing our passion and drive. We need all of you, as members and Fellows, to start to give back to the Faculty some time and energy, to contribute to the many challenges facing us, and to reinvigorate us as a group, much like a new pup breathes life into an old dog.

At risk in the long term is the current good standing and vocational recognition that our New Zealand Fellows have with the NZ Medical Council, which is up for consideration again in four years' time. So we have just four years to get our house in order!

Meeting with New Zealand Medical Council

On 31 October 2013, Gary Collinson, Mark Johnson and I met with the New Zealand Medical Council (NZMC).

The upshot of this meeting was that NZMC pointed out their concerns regarding the small size and advancing age of our group, which potentially compromises our long-term viability as a stand-alone organisation.

It was suggested that we need to find a bedfellow who will take us under their umbrella and assist us in the future. These are by no means new concepts, and all members of the executive have been acutely aware of this predicament for many years.

As was attempted several years ago, the NZMC suggested that we need to try to open up dialogue with various learned colleges, preferably one whose work at least in part transcends our own, in order to try to instigate this. Mind you, if past experiences, and more recent informal discussions are anything to go by, breaking down the substantial barriers within such established Colleges is a very daunting task of gigantic proportions. Nonetheless, nothing ventured, nothing gained!

If any of you has any special relationship with Fellows of other learned Colleges who may be able to exert some influence on AFMM's behalf, please sound them out, or let the executive know.

Constitutional change

At a special general meeting in Auckland in March, numerous changes to the constitution of AFMM were passed, almost unanimously.

These changes brings us into the 21st century, such as allowing members to attend meetings via electronic means, and make us compliant with various legal requirements on both sides of the Tasman.

The new constitution will be on the website in due course for those wishing to review it.

Auckland retreat and ASM

I attended the recent retreat in Auckland in March 2014 and it was a great success, with 24 attendees.

I personally found the case presentations interesting and the discussions around them informative and stimulating.

I attended the Level 5 Advanced Cardiac Life Support course. I am somewhat ashamed to confess that I have not been to such a course for about 20 years, and so had a deep-seated apprehension about ever being confronted with such an emergency "collapse" situation. However, I came away feeling much more confident that I could manage adequately if I were so confronted, whether in the course of my medical practice or out in the community. There is no doubt that these are skills that everyone in the community should have. I would remind everyone that it is part of the NZMC's CPD requirements that such a course be undertaken every three years.

A cultural and language diversity (CALD) program was also held as part of the retreat, which I did not attend, but I understand was also well received by the participants. Those attendees have now satisfied their CPD requirements in this sphere for the next three years.

The next retreat is scheduled for Friday 27/Saturday 28 June in Queenstown, New Zealand. There will also be an all-day retreat on Thursday 4 September in Rotorua, which is the day before the next annual scientific meeting. The meeting program looks exceptional.

Keep the dates free and come and join in. Remember you receive valuable CPD points when you attend.

I'm sure I don't have to remind you that the formal educational side of the conference is one thing, but it is the catching up with our numerous musculoskeletal colleagues, both informally and formally, that is always the real highlight of this annual event. For me personally it has been the one "must attend" event of the year for many, many years now.

We will hopefully see you all in Queenstown in June, or at the very least in Rotorua in September.

Regards

Steve Jensen

Spinal pain: Interdisciplinary management in a primary care setting

Dr Scott Masters, MBBS FRACGP FAFMM Dip MSM Musculoskeletal Physician, Sunshine Spine Clinic

Persistent spinal pain is a common problem in the community, affecting around 10% of the Australian population. It is one of the most common causes of work insurance claims and causes of disability. Care of these people is often left in the hands of primary care health practitioners. These patients often fall outside the scope of specialist care in that they are most commonly suffering from a non-operative, non-rheumatologic condition.

Often they do the rounds of specialist care, have innumerable investigations, multiple allied health care visits, only to be deposited at the back end of a public pain clinic waiting list. It is often difficult for them to access public persistent pain clinics. Even if they do make it to the pain clinic, they will often realise that the public pain clinics are not set up to deal with their ongoing musculoskeletal pain problem.

These particular patients present a difficult management problem as there is often no clear direction for treatment. They will often migrate to alternative therapies, seek multiple opinions and end up broke and disillusioned. In the shadow of this backdrop, a group of like-minded health professionals came together to offer a unique service.

Sunshine Spine Multidisciplinary Clinic (SSMC) was set-up in 2011 to provide general practitioners with a referral option for complex persistent spinal pain patients. Our main objective was to prevent patients spending months seeing differing health providers, receive different opinions and have their healthcare fragmented to such a degree that they end up without a clear management plan. The expectation was to provide patients with a diagnosis, prognosis and management strategy at one sitting. Then communicate the plan effectively to the referring practitioner(s) and follow-up progress through one or more members of the team.

The clinic is run out of a primary care setting and involves a physiotherapist, pain and rehabilitation physician, musculoskeletal physician and neurosurgeon. Patients are referred by GPs and an initial assessment is made to determine the need for spinal



Spinal rehabilitation physiotherapist Sean Campbell, musculoskeletal physician Dr Scott Masters and Dr David Johnson, Brain and spinal neurosurgeon. Dr Peter Georgius, pain and rehabilitation physician, absent.

MRI. If required, this is arranged prior to the clinic. At the clinic, patients fill in a four-page assessment form covering pain and disability questions.

Two patients are seen per hour and alternate between two rooms initially. One room involves clinical evaluation with the musculoskeletal doctor and physiotherapist, the other room with the neurosurgeon and pain physician. Roles of the individual practitioners have been clearly delineated to avoid doubling up evaluations. The four practitioners then meet to discuss a management plan. Patients return separately to discuss the suggested management plan which is then moulded to suit individual patient preference. Follow-up is arranged and a letter sent to the patient and the health team that will be involved with ongoing care, summarising the management plan.

The single biggest advantage of this structure is the time advantage to the patient. Things can normally be sorted in one session that otherwise could have potentially taken six months or more. The second advantage is patients hearing a coherent explanation for their problem, its likely outcome and the best ways to achieve optimal results. The fact it is coming from four professionals at the same time with the patient able to

ask questions regarding the diagnosis and management has important ramifications for compliance to treatment in the future.

Difficulties also are involved with this interdisciplinary care. Firstly, practitioners involved must agree on the overall principles and philosophy of running the clinic. Often there needs to be some compromise in order to present a united front. Secondly, communication can be an issue. In this clinic settling, patients tend to be overawed when four professionals give them their opinion. A great deal of information is communicated in a short period of time which can leave some patients confused. Thirdly, there is a cost factor associated with the appointment that may deter some patients. Lastly, despite extensive efforts, Medicare was unable to confirm or deny that we were using the correct item numbers for our interdisciplinary clinic. This obviously leaves us exposed to bureaucratic interrogation down the track.

After two years of running the clinic, our overall experience has been very positive. We feel the clinic could serve as a template for other chronic disease problems that are difficult to manage in primary care. Over the next two years we plan to gather data on outcomes for patients presenting to our clinic.

Practical insights for medical practitioners into age-related muscle wasting

Christine M Brooks is in the Department of Applied Physiology and Kinesiology at the University of Florida where she teaches anatomy, physiology and exercise testing and prescription

Abstract

Age-related decline in lean body mass is often associated with serious functional impairment during the older years. In 1988 Irwin Rosenberg suggested using the term “sarcopenia” to bring attention to the condition and to stimulate research that would provide an understanding of what caused skeletal muscle wasting as one ages.

In this paper the medical practitioner is provided with a clinically relevant base of knowledge for counselling older patients about how to avoid or delay the onset of disability due to their gradual reduction in muscle mass as they get older.

Six issues are briefly discussed, including how to categorise sarcopenia, progression of sarcopenia throughout the lifespan, impact of an inactive lifestyle, the effect of age on muscle composition, how to detect sarcopenia in the clinical setting, and the effect of exercise interventions.

Age-related skeletal muscle decline is often accelerated due to inactivity. Data from master athletes suggest it is possible to slow the progress of muscle wasting through physical activity. Inactivity, on the other hand, accelerates muscle wasting. Resistance training is a useful intervention strategy for the medical practitioner to recommend highly to all patients.

Introduction

While addressing the 1988 conference on ageing, diet, health and disease, Irwin Rosenberg brought attention to the serious functional impairment associated with the dramatic decline in lean body mass with age.¹

He noted the glaring scarcity of research on the topic and suggested that this phenomenon would be taken seriously only if it was given a Greek name. He proposed the use of either sarcomalacia or sarcopenia.

The term “sarcopenia”, meaning “poverty

of the flesh”, was subsequently adopted. Since 1988 over half a million articles have explored various basic science and clinical aspects of sarcopenia, including how the condition might be minimised so disability during the older years can be delayed and even avoided.

The word “sarcopenia” was originally intended to refer to skeletal muscle wasting due to ageing. However, over the years the use of the word has gradually been broadened to include all forms of skeletal muscle mass decline regardless of the cause.

The literature currently uses sarcopenia to refer to at least four causes of skeletal muscle wasting in humans:

- **Cachexia** where the cause is due to disease such as cancer, congestive cardiomyopathy and end-stage renal disease.² Cachexia derives from Greek meaning “bad condition”. Skeletal muscle loss is unintentional and cannot be reversed unless the underlying illness or disease is eliminated.
- **Sarcopenia** is skeletal muscle mass decline associated with healthy ageing in the absence of other causes. Age-related sarcopenia is considered a geriatric syndrome and not a specific disease. As a syndrome it is characterised by progressive loss of skeletal muscle mass and strength accompanied by an increased risk of disability during the later years of life.³
- **Disuse atrophy** refers to the decline of muscle mass due to more than 10 days of inactivity such as occurs with a sedentary lifestyle, bedrest,⁴ or prolonged immobility.⁵ Disuse atrophy can be reversed by reintroducing exercise and better nutrition. However, depending on the circumstances, the muscle may never regain its original size, strength, or power.
- **Anorexia nervosa** is a psychological

disorder associated with extreme eating restriction, or with long-term maintenance of an inappropriate low body weight. The medical diagnosis is starvation.⁶ Individuals with this condition equate thinness with self-worth, or in the case of athletes, with superior performance. Anorexia nervosa is difficult to treat, and it is unclear whether the damage done to organ systems is completely reversible.

Frequently, more than one cause of muscle wasting is evident, compounding the functional and health consequences incurred by the individual.

In older adults, for example, disuse atrophy due to a gradual reduction in physical activity over the lifespan has an additive effect on muscle loss due to the ageing process itself.⁷ A decrease in activity with advancing age is commonly observed throughout nature, including insects and rats, etc.⁸

The focus of this paper is on age-related sarcopenia and disuse atrophy in humans. The goal is to provide the medical practitioner with a clinically relevant base of knowledge for giving advice to older patients about how to delay and possibly avoid the onset of disability due to age-related muscle mass decline.

The following six issues are briefly discussed:

1. How to categorise sarcopenia.
2. Progression of sarcopenia throughout the lifespan.
3. Impact of an inactive lifestyle.
4. The effect of age on muscle composition.
5. Detecting sarcopenia in the clinical setting.
6. The effect of exercise interventions.

The reader is referred to an excellent book on sarcopenia⁹ for more detailed information than is possible in this paper.

1. How to categorise sarcopenia

The European Working Group on Sarcopenia in Older People (EWGSOP) divides sarcopenia into three functional categories depending on whether the individual exhibits one or more of the following characteristics: (1) decline in skeletal muscle mass, (2) a reduction in strength, and/or (3) reduced ability to perform necessary activities of daily living.¹⁰

- Pre-sarcopenia is a decrease in skeletal muscle mass *without* significant decline in muscle strength or performance.
- Sarcopenia is a decrease in skeletal muscle mass accompanied by an impairment of *either* strength or performance, but not both.
- Severe sarcopenia includes all three characteristics, i.e., a decrease in muscle mass, strength and performance.

You will also see sarcopenia categorised according to the cause. Age-related sarcopenia without any other additive cause is defined as *primary sarcopenia*. *Secondary sarcopenia* is due to any other cause unrelated to age, including cachexia, disuse atrophy and anorexia nervosa.¹¹ This is a useful classification because age-related muscle wasting involves a different metabolic process than all other causes of muscle wasting. However, it is very difficult to separate age-related muscle wasting from disuse atrophy. For this reason, primary sarcopenia usually includes muscle wasting due to ageing plus the additive effect of disuse atrophy even though it is not officially defined this way.

Everyone over 30 years is at various stages of pre-sarcopenia. The goal after age 30 is to prevent pre-sarcopenia from progressing into sarcopenia where symptoms become obvious.

2. Progression of sarcopenia throughout the lifespan

An autopsy study of adults who were healthy until their sudden death indicated that a reduction in muscle volume begins as early as 25 years. Approximately 10% of the muscle area is lost by age 50. By 80 years of age almost half the muscle area is wasted.¹³ In other words, 100% of the population will experience varying levels of muscle mass decline with age.

The more clinically relevant issue is to identify individuals who are at risk of disability. The research literature has

coalesced around defining high risk individuals as two standard deviations below the mean muscle mass for young healthy adults.¹² In this case the prevalence of high risk sarcopenia is 5-13% of 60-to-70-year-olds, and 11-50% of those 80 years and older. In other words, before age 70 years very few of your patients will likely be classified as severely sarcopenic. By aged 80 years, however, half of them may be severely affected. One method for identifying these individuals is to assess their strength.

Skeletal muscle strength is a complex variable reflecting the muscle's composition, such as the amount of fat and connective tissue in the muscle, and the status of its neural input. The size of the muscle itself is not highly correlated with its strength.¹⁴ For this reason, simply observing the patient's muscle size does not indicate the patient's strength. The strength of the muscle is the more critical issue because it reflects the general functional health of the muscle including its neural status.

Pattern of strength decline: Men and women show a similar pattern in the way strength and force of the muscle declines. However, women lose their strength at a faster rate. For example, men average a 3% reduction in grip strength per year, while women average a 5% reduction.¹⁵ In general, a healthy 70-80-year-old can expect to have 20-40% less strength compared with younger age categories. Unfortunately, these data do not isolate age-related muscle decline from that due to disuse atrophy or, in some cases, cachexia.⁸

Insights from senior athletes: Senior athletes provide valuable insights into the natural progression of age-related muscle wasting because data from this cohort are less likely to be confounded by disuse atrophy or cachexia. The performance of senior olympic track and field participants and master track record holders progressively declines at a very slow rate until age 50 years, then declines at a more noticeable rate between 50 and 75 years, and then plummets from age 75 until death.⁸ This suggests that if disuse and disease are eliminated as confounding variables, skeletal muscle loses mass even in the most active individuals. However, the effect on strength and performance is not large until after 75 years of age. A significant loss of functional performance before 70-75 years of age is most likely due to disease, inactivity, or destructive lifestyle habits, and not to the natural ageing process.⁸

Other interesting insights related to age and physical performance of master athletes include:

- Similar to the general population,

rates of decline is slower for male senior olympic athletes than for female senior olympic athletes. The explanation for this gender difference is unclear.

- Rates of decline are more rapid for speed (3.5% per year) than for endurance (1.8% per year) indicating that muscle fibres responsible for strength and power are affected to a greater extent than are those responsible for endurance capacity.⁸
- The ability to activate the available motor neuron pool remains intact. Therefore, the decline in functional performance with age is related to a decrease in the active muscle fibre mass rather than to the inability to adequately recruit the remaining muscle fibres.¹⁶
- Reduced muscle mass alone does not fully explain age-related reduction in force and strength.¹⁶ The ability to recruit motor units is also a factor.

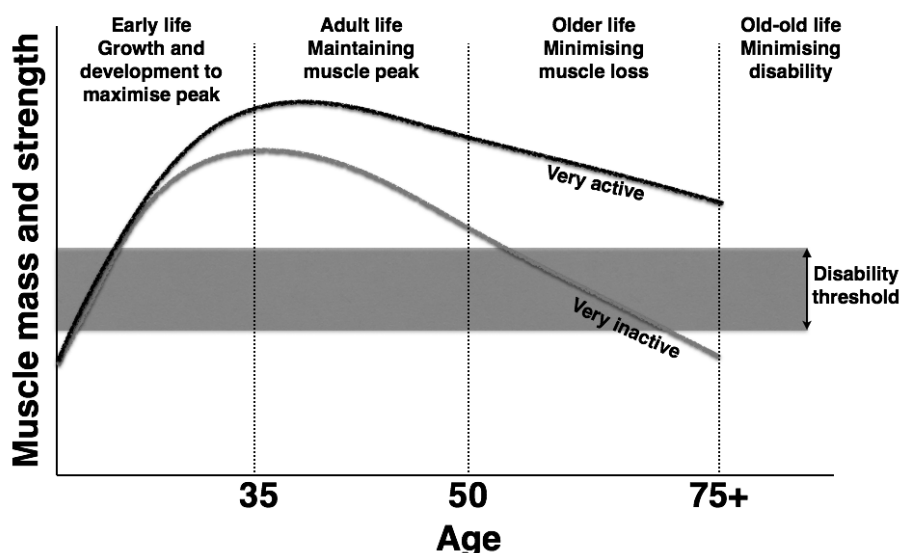
Keep in mind that senior athletes do not represent the typical ageing population. They are largely white, well educated, and report better health than the general population.

3. Impact of an inactive life-style

The rate at which skeletal muscle mass and strength decline varies widely among adults. One explanation for this variability is believed to relate to two factors:¹⁷

- The peak muscle mass and strength attained earlier in life.
- The level of physical activity of the individual through middle age.

Figure 1 illustrates this phenomenon. Compared with inactive individuals, senior olympic athletes show a much slower decline in performance until 75 years of age. We can surmise from these data that an accelerated decline before 75 years is likely due to the additive effect of disuse atrophy to the ageing effect. In addition, because inactivity is highly related to disease and disability, cachexia may also be a contributing factor in the acceleration of muscle mass decline for very inactive individuals. Indeed, physical inactivity throughout life is the most significant reason for loss of strength and performance in later years.¹⁸ Total muscle mass available to those who are over 75 years of age depends on physical activity before age 20 years where adaptive alterations in tissue structure are stimulated, and a physically active lifestyle during middle years where maintenance of muscle mass is possible.¹⁷



Adapted from: Sayer, A. A. et al. The Developmental Origins of Sarcopenia. *J. Nutr. Health Aging* 12, 427–32 (2008).

Figure 1.

The evidence is overwhelmingly in favour of exercise as an intervention for minimising loss of skeletal muscle throughout the older years. Even those over 90 years of age can increase muscle size and strength with the appropriate resistance training.

4. The effect of age on muscle quality

Lean muscle tissue of an elderly adult is different from that of a young adult. Besides having a smaller muscle, the muscle fibres in older individuals are less tightly packed and contain more non-contractile tissue.¹³ This difference in muscle structure and composition is thought to partly explain the age-related decline in strength and performance.

Research into four categories of age-related skeletal muscle composition changes provide interesting insights into: (a) the number and size of the muscle fibres, (b) the amount of contractile versus non-contractile tissue (sarcomeres) in the muscle, (c) the relative ratio of type I (slow) versus type II (fast) fibres in the muscle, and (d) the number and characteristics of the motor units. The research referred to in this section does not distinguish between age-related skeletal muscle decline and that due to disuse atrophy or cachexia.

- **Muscle fibre number and size.** While the data are conflicting, the fibres of older muscle are reduced both in size and number.¹³ An 80-year-old can have up to 50%

fewer fibres in a muscle than a 50-year-old. Loss of muscle fibres is commonly due to the deterioration of the motor nerve innervating the muscle fibre. If muscle fibres are not reinnervated from collateral motor nerves they are lost and replaced with fat and fibrous tissue.¹³ There are also fewer functioning motor units.

- **Contractile versus non-contractile tissue.** There is a two-fold increase in non-contractile content (especially fat) in skeletal muscles in older adults.⁷ This decreases the muscle's total force production capability. It is unclear whether the remaining contractile tissue has a reduced force capacity.¹⁹ The issue with ageing, therefore, is not related to absolute muscle size, but rather loss of contractile tissue.²⁰
- **Muscle fibre type.** The overall size of type I (slow) fibres does not change substantially with age. However, type II (fast) fibres are much smaller. Both type I and type II fibres decline at the same rate with age.¹³ This suggests that protein degradation/resynthesis ratio is compromised more in the type II fibre than in the type I fibre.
- **Motor unit characteristics.** A portion of muscle weakness in seniors is also associated with a reduction in the number of functioning motor units.^{21,22} Muscle fibres left without nerve innervation are often reinnervated by one of the existing motor units through

collateral sprouting. This results in larger motor units that have reduced motor control. In addition, the motor unit firing rates decrease and become more variable. This accounts for deficiencies in motor control and coordination in addition to reduced force production. The reinnervation of denervated type II muscle fibres by neighbouring type I motor units has been implicated in the increased co-expression of type I and type II fibres observed in the skeletal muscle of older individuals.²³

5. Detecting sarcopenia in clinical practice

An accurate identification of sarcopenia in clinical practice is an important step if age-related disability is to be avoided. The EWFSOP recommends screening all patients over 65 years for those who are at risk for disability.¹⁰ It proposes a stepwise method, beginning with gait speed. The 6-minute walk test is recommended. A gait speed of less than 0.8 m/s identifies those at risk for sarcopenia. The Timed Up-and-Go (TUG)²⁴ test is probably more practical for the general practitioner and provides the same observational information. Those with low gait speed can be tested further to determine their muscle strength. The grip test is an effective and inexpensive method for measuring strength.²⁵ If muscle strength is low then a dual energy x-ray absorptiometry (DEXA) or bioelectrical impedance analysis (BIA) may be used to confirm the severity of the sarcopenia. BIA is the most cost-effective method for determining fat mass and by default lean body mass. This provides a reasonable method for tracking skeletal muscle mass over the long term.

If sarcopenia is confirmed the next step is to search for the underlying cause, with a special emphasis being placed on nutrition and physical inactivity.

Because the skeleton and skeletal muscle are tightly intertwined there is a relationship between sarcopenia and osteoporosis.²⁶ If osteoporosis is confirmed the patient may also have severe sarcopenia.

6. Effect of exercise interventions

Given that chronic inactivity is associated with an accelerated rate of muscle mass decline the most obvious advice for all patients, regardless of age, is to incorporate regular resistance training to the exercise routine. Resistance exercise is the most

appropriate for skeletal muscle health while aerobic exercise is more appropriate for cardiovascular health. The physiological, cardiovascular and neuromuscular adjustments to exercise of healthy sedentary older adults is qualitatively similar to those of young adults although the improvements are smaller.¹⁸ Physical activity can't stop age-related sarcopenia, but it can minimise its effect.

Resistance exercise has proved effective even for adults 60-90 years, although the gains in strength are generally much greater than the gains observed in muscle cross-section. It is well-known that neural adaptations such as changes in the recruitment and firing rates of motor units are a training effect of resistance exercises.

A note of caution

The skeletal muscle of older people is easily damaged if loads are inappropriately high. Muscle injuries and soreness after exercise is a common complaint. In addition, older people who regularly resistance train may need higher dietary protein than younger people who perform similar exercise.

Conclusions

Aerobic exercise is essential for general cardiovascular health and resistance exercise is essential for muscle health. Neither aerobic nor resistance exercises can prevent the ageing process; however, they can prevent accelerated ageing thereby delaying and possibly preventing future disability.

The problem the general practitioner faces is that cardiovascular and skeletal muscular health initially deteriorates at such a slow rate that the effect on health is not noticeable until the patient enters the middle years of 40-60. If the patient has compounded age-related muscle mass decline with disuse atrophy he/she will be well on their way to slipping into the disability window before age 75. Aerobic and resistance exercise will help patients over 60 years and should be recommended, but the effect on health after age 60 will be much greater if they adopt a more physically active lifestyle before age 40.

Awareness is the first step in the patient's decision to change their sedentary behaviour. The general practitioner is an important link in the awareness process about the state of the patient's ongoing muscle health.

References

1. Rosenberg IH. Sarcopenia: Origins and clinical relevance. *J Nutr* 1997; 127: 990S-991S.
2. Evans W J. What is sarcopenia? *J Gerontol A Biol Sci Med Sci* 1995; 50 Spec No: 5-8.
3. Cruz-Jentoft AJ, Landi F, Topinková E, Michel J-P. Understanding sarcopenia as a geriatric syndrome. *Curr Opin Clin Nutr Metab Care* 2010; 13:1-7.
4. Kortebein P et al. Functional impact of 10 days of bed rest in healthy older adults. *J Gerontol A Biol Sci Med Sci* 2008; 63: 1076-1081.
5. Wall BT, Dirks ML, van Loon LJC. Skeletal muscle atrophy during short-term disuse: Implications for age-related sarcopenia. *Ageing Res Rev* 2013; 12: 898-906.
6. Athey J. Medical complications of anorexia nervosa. *Prim Care Update OBGYNS* 2003; 10: 110-115.
7. Kent-Braun JA, Ng AV, Young K. Skeletal muscle contractile and noncontractile components in young and older women and men. *J Appl Physiol Bethesda Md* 1985 2000; 88: 662-668.
8. Wright VJ, Perricelli BC. Age-related rates of decline in performance among elite senior athletes. *Am J Sports Med* 2008; 36: 443-450.
9. Cruz-Jentoft AJ, Morley JE, eds. *Sarcopenia*. Wiley-Blackwell, 2012.
10. Cruz-Jentoft AJ et al. Sarcopenia: European consensus on definition and diagnosis: Report of the European working group on sarcopenia in older people. *Age Ageing* 2010; 39: 412-423.
11. Hepple RT. Muscle atrophy is not always sarcopenia. *J Appl Physiol* 2012.
12. Lexell J, Taylor CC, Sjöström M. What is the cause of the ageing atrophy? Total number, size and proportion of different fiber types studied in whole vastus lateralis muscle from 15- to 83-year-old men. *J Neurol Sci* 1988; 84: 275-294.
13. Morley JE, Cruz-Jentoft AJ. In *Sarcopenia*, ed. AJ Cruz-Jentoft AJ and JE Morley, op cit, pp 8-19.
14. Dyer M, Bauer JM. In *Sarcopenia*, ed. AJ Cruz-Jentoft and JE Morley, op cit, pp 226-237.
15. Kallman D A, Plato CC, Tobin JD. The role of muscle loss in the age-related decline of grip strength: cross-sectional and longitudinal perspectives. *J Gerontol* 1990; 45: M82-88.
16. Doherty TJ. Invited review: Aging and sarcopenia. *J Appl Physiol* 2003; 95: 1717-1727.
17. Sayer AA et al. The developmental origins of sarcopenia. *J Nutr Health Aging* 2008; 12, 427-32.
18. Peterson MD, Serra-Rexach JA. In *Sarcopenia*, ed. AJ Cruz-Jentoft and JE Morley, op cit, pp. 252-274.
19. Larsson L, Ramamurthy B. Aging-related changes in skeletal muscle: mechanisms and interventions. *Drugs Aging* 2000; 17: 303-316.
20. Jacob S et al. Association of increased intramyocellular lipid content with insulin resistance in lean nondiabetic offspring of type 2 diabetic subjects. *Diabetes* 1999; 48: 1113-1119.
21. McNeil CJ, Doherty TJ, Stashuk DW, Rice CL. Motor unit number estimates in the tibialis anterior muscle of young, old, and very old men. *Muscle Nerve* 2005; 31: 461-467.
22. Kaya RD, Nakazawa M, Hoffman RL, Clark BC. Interrelationship between muscle strength, motor units, and aging. *Exp Gerontol* 2013; 48: 920-925.
23. Roos MR, Rice CL, Vandervoort AA. Age-related changes in motor unit function. *Muscle Nerve* 1997; 20: 679-690.
24. Podsiadlo D, Richardson S. The timed 'Up & Go': a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc* 1991; 39: 142-148.
25. Rantanen T, Guralnik JM, Foley D et al Midlife hand grip strength as a predictor of old age disability. *JAMA* 1999; 281: 558-60.
26. Cruz-Jentoft A. Sarcopenia: a clinical review. *Rev Clin Gerontol* 2013; 23: 267-274.

Truth in musculoskeletal medicine

Truth in diagnosis - Validity

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This article continues the consideration of truth in diagnosis by addressing validity. Whereas reliability measures the extent to which two observers agree when using the same test on the same population, validity measures the extent to which the test actually does what it is supposed to do.

Validity

Validity is determined by measuring how well a test performs against a senior standard, referred to as the criterion standard, or in former language as the gold standard.

What the criterion standard might be depends on the test in question and the available opportunities. For a clinical test, the criterion standard could be a radiographic finding, a postmortem finding, or perhaps a surgical observation. What makes the criterion standard more senior is that, by consensus, the criterion standard is less susceptible to errors. As far as possible the criterion standard relies on direct observation as opposed to the clinical test in question which may rely on drawing inferences following palpation or taking a history.

Sometimes, a clear-cut criterion standard might not be available or possible. Under those circumstances, the criterion standard might be a consensus view — say, agreement by a panel of experts using some other test, that an index condition is either present or absent. The results of the test in question are then compared to the results of the consensus panel.

In either case, the validity of the test is revealed in a 2 x 2 contingency table (Figure 1). In order to generate such a table, the same sample of patients is assessed with the test in question and with the criterion standard. Four cells are generated in which a is the number cases in which the test and the criterion standard are both positive; b is the number of cases in which the test was positive but the criterion standard was negative; c is the number of cases in which the test was negative but the criterion standard was positive; and d is the number of cases in which the test and the criterion standard were both negative.

Result of test	Criterion Standard	
	Disease is present	Disease is absent
Positive	a: True positive	b: False positive
Negative	c: False negative	d: True negative

Figure 1. The structure of a 2 x 2 contingency table comparing the result of a test to the results of a criterion standard.

Clearly, the a cases and the d cases are correct, but the b and c cases are mistakes. In the b cases the test was positive but should not have been positive. Such cases are false-positive. In the c cases the test was negative but should have been positive. These cases are false-negative. A good test is one which carries few, if any, false-positive and false-negative results.

Sensitivity and specificity

From the contingency table, two properties of the test can be derived. They stem from the columns of the table, and should be read downwards and upwards respectively.

The first is the sensitivity of the test. Numerically it is defined as $a / (a+c)$. It measures the proportion of the cases that have the index condition (a+c) that the test correctly detects.

The second property is the specificity of the test. Numerically it is defined as $d / (b+d)$. It measures the proportion of the cases that do not have the condition (b+d) that the test correctly detects.

Both statistics are required in order to appreciate the validity of the test. All too often, investigators in the past have proclaimed only the sensitivity of the test, celebrating how good the test is at detecting an index condition. But sensitivity alone is

useless. A test must have discriminating power; to be of value it must detect negative cases as well as positive ones. If one claimed that all abdominal tenderness was a sign of appendicitis, one would have good sensitivity; one would always detect every case of appendicitis. But countless patients who had cholecystitis, salpingitis or ileitis, would be misdiagnosed, because that test does not discriminate these latter conditions. It is specificity that measures that property of the test.

In order to secure mastery of the arithmetic involved, the reader is invited to complete the exercises in Appendix A, before proceeding to the next section.

Positive predictive value

Although sensitivity and specificity define the properties of the test, these statistics are of no value in a single case. What a physician wants to know, when a test is positive in a given a patient, is what the chances are that the test result is truly positive as opposed to false-positive. In other words, how dependable is this positive result? This question is answered across the rows of the contingency table (Figure 2).

Result of test	Criterion standard		
	Positive	Negative	
Positive	a	b	a+b
Negative	c	d	c+d
	a+c	b+d	a+b+c+d=N

Figure 2. An expanded contingency table for validity. The figures (a, b, c and d) inside the highlighted rectangle represent the observed results. The figures outside the square represent the sums of the respective columns and rows. Positive predictive value = $a/a+b$. Negative predictive value = $d/c+d$.

On the average, the test is positive (a+b) times in N patients. In these cases, however, it is truly positive in only a cases. Thus, on the average, the test is truly positive a times out of every (a+b) times that it appears to be positive. The ratio $a/(a+b)$ measures what is known as the positive predictive value of the test. It describes the chances of a positive result being true-positive.

For example, if the positive predictive value of a test is 80%, out of every 200 positive results, 160 will be true-positive and 40 will be false-positive. In a given patient who has a positive result, the chances of that result being true-positive are 80%.

An opposite statistic is also calculable. The ratio $d/(c+d)$ measures the negative predictive value, which describes the chances of an apparently negative result being true-negative.

The positive predictive value appears to answer the physician's question. It seems to answer: in a patient with a positive result, what are the chances of that result being true-positive. However, this is illusory, because the positive predictive value is dependent on the prevalence of the index condition.

In order to appreciate this, undertake the exercises outlined in Appendix B. Those exercises ask you to calculate the positive predictive value of a test with a known sensitivity and a known specificity, but in populations in which the prevalence of the index condition varies. In order to assist your calculations the process for the first data set is as follows.

Assume that the sample size is some large number, e.g., $N = 1000$. If the prevalence of the condition is 10%, this means that the total of column one (a+c) will be 10% of 1000, i.e., 100, for by definition (a+c) measures all the cases that have the index condition. This means that the total of column two will be $1000 - 100 = 900$. By definition, the sensitivity of the test is $a/(a+c)$. If the sensitivity of the test is 0.8, in this example, a will equal $0.8 \times 100 = 80$, which means $c = 20$. By definition, the specificity of the test is $d/(b+d)$. If the sensitivity of the test is 0.7, in this example d will equal $0.7 \times 900 = 630$, leaving $b = 900 - 630$, which equals 270. Thereby the components of the contingency table are completed. Having completed the table, the positive predictive value, for this prevalence, can be calculated as

$$\begin{aligned} \text{PPV} &= a / (a+b) \\ &= 80 / (80+270) \\ &= 80 / 350 \\ &= 0.22 \\ &= 22\% \end{aligned}$$

You should now complete the remaining

exercises. The sample size, sensitivity and specificity remain the same, but the prevalence is different in each case.

Note that as prevalence increases so does the positive predictive value; but the test is the same. Without changing the test, the positive predictive value improves. When the prevalence is 10% the positive predictive value is 22%. When the prevalence increases to 40% the positive predictive value increases to 64%. With a prevalence of 80% the positive predictive value is 91%.

A score of 91% is impressive; it offers the examiner a 91% chance that a positive test result is true-positive, but this virtue does not stem from the test; it stems from the prevalence of the condition. When the same test is used when the prevalence is only 10%, the positive predictive value is only 22%.

This illustrates an important principle: positive predictive value is critically dependent on prevalence; it is not an intrinsic, constant property of the test. Furthermore, it illustrates a common illusion: for many tests their apparent validity lies not in the power of the test but in the prevalence of the index condition.

The reason for this frailty lies in the false-positive rate. In terms of the contingency table (Figure 2), the false-positive rate is the ratio $b/(b+d)$, which happens also to be equal to $[1 - \text{Specificity}]$. It describes how often patients without the index condition are positive for the test in question. Because these patients do not have the index condition but are nevertheless positive for the test, their test result is false-positive.

For a condition with a low prevalence, the number of normal patients in a sample will be relatively large, i.e., $(b+d) \gg (a+c)$. Consequently, even if the false-positive rate is relatively low, there will be an inordinately large number of false-positive results, i.e., $b \gg a$. This imbalance reduces the positive predictive value. In essence, the false-positive rate compromises predictive value.

Conversely, when the prevalence is high, the relative number of normal patients is low, and the false-positive responses are few; which renders the positive predictive value better.

Because of these idiosyncrasies, different impressions about a given test will arise in different circumstances. A physician who sees patients who commonly have an index condition will have the impression that the test is good because it is so often true-positive. However, the same test, applied in another practice where few patients have the index condition, will appear to be useless because it is so often wrong.

The fault lies not with the test but with the different prevalence. The first physician is under an illusion: it is not the test that is the basis for his acumen but the prevalence of the condition; the patients provide the diagnosis not the test.

The positive predictive value is not a convenient index of the utility of a test. Some other measure is required.

Likelihood ratio

The likelihood ratio is a statistic that measures the predictive power of a test but independently of the prevalence.¹ Thus, it can be used in any epidemiological circumstances. Formally, the likelihood ratio is defined as:

$$\text{Likelihood Ratio} = \frac{[\text{Sens}]}{(1-[\text{Spec}])}$$

The derivation of this definition is outlined in Appendix C.

The likelihood ratio, however, does not operate on conventional measures of prevalence. A change in perspective is required in order to appreciate the likelihood ratio.

Physicians are accustomed to thinking in percentages. Prevalence is viewed as a percentage — e.g., 25% of the population have the condition. Diagnostic certainty is viewed as a percentage — e.g., the chances that a test result is true-positive are 82%. Because of the peculiarities of the mathematics involved (Appendix C), the likelihood ratio does not operate on percentages. It nonetheless operates on prevalence and diagnostic certainty, but in different forms. The form is odds.

Odds are the ratio of chances in favour of a condition versus the chances against that condition being present. They are related in a simple manner to percentages.

If a condition has a prevalence of 40%, the chances of it being present are 40/100. Meanwhile the chances of it being absent are 60/100, i.e., $(100 - 40)/100$. In decimal terms, if the prevalence is 0.4, the chances in favour of the condition are $0.4/1.0$; the chances against are $(1.0 - 0.4)/1.0 = 0.6$. In this example, the odds in favour of the condition being present are 40 : 60, or 0.4 : 0.6, which both amount to $4 : 6 = 2 : 3$.

The general rule, using decimal terms, is that if

$$\begin{aligned} \text{prevalence} &= z \\ \text{odds} &= z : 1-z \end{aligned}$$

An identical operation pertains to diagnostic certainty. If the chances of a test being correct are 80%, the chances of it being wrong are 20%. Consequently, the odds in favour of the test being correct are 80 : 20, or 4:1.

Odds can be converted back to decimals and percentages if required. If the odds are $p : q$, the chances in favour of the condition are $p / (p + q)$, and the chances against are $q / (p + q)$. The percentage chance in favour becomes $p / (p + q) \times 100\%$. Thus, for example, if the odds for diagnostic certainty are $5 : 2$, the chances in favour are $5 / (5 + 2) = 5 / 7 = 0.71 = 71\%$. If the odds are $4 : 1$, the chances in favour are $4 / (4 + 1) = 4 / 5 = 0.8 = 80\%$.

With this adaptation in mind, the rule that emerges (Appendix C) is:

$$[\text{Prevalence Odds}] \times [\text{Likelihood Ratio}] = [\text{Diagnostic Confidence Odds}]$$

The diagnostic confidence odds, are the odds of positive predictive value. Thus, if the positive predictive value is 70%, the diagnostic confidence is also 70%. In this case the odds of positive predictive value and the diagnostic confidence odds are $7 : 3$. This means that the odds are 7 to 3 that the test result is true-positive.

Clinical epidemiologists prefer two different terms. they replace "prevalence odds" with "pre-test odds", and "diagnostic confidence odds" with "post-test odds", i.e., $[\text{Pre-test Odds}] \times [\text{Likelihood Ratio}] = [\text{Post-test Odds}]$

Pre-test odds means the odds in favour of the index condition being present before the test is performed. Obviously this is a function of the prevalence of the condition, (as the patient walks in through the door). Post-test odds means the odds in favour of the condition being present after the test has been applied and found positive. It establishes your diagnostic confidence.

A critical feature to recognise at this stage is that if the likelihood ratio is 1.0, the test makes no difference to the diagnostic process. The post-test odds are the same as the pre-test odds. Nothing has changed. For a diagnostic test to make a useful difference it has to have a likelihood ratio substantially greater than 1.0, for otherwise what the physician is using to make the diagnosis is nothing more than the frequency of the condition in his practice.

More striking is the effect of a test with a likelihood ratio less than 1.0. In that event the physician is worse off for having applied the test; his diagnostic confidence is less than if he had simply guessed the diagnosis on the basis of the prevalence of the index condition.

Consider these examples.

A condition has a prevalence in your practice of 60%. To find that condition you use a test with a likelihood ratio of 40. What is your diagnostic confidence?

As the patient walks through the door, the chances of them having the condition are

60%. The odds in favour of them having the condition are $6 : 4$.

$$\begin{aligned} \text{Accordingly, } [\text{Pre-test Odds}] \times [\text{Likelihood Ratio}] &= [\text{Post-test Odds}] \\ 6/4 \times 40 &= [\text{Post-test Odds}] \\ [\text{Post-test Odds}] &= 60 \end{aligned}$$

$$\begin{aligned} \text{Diagnostic Confidence Odds} &= 60 : 1 \end{aligned}$$

$$\begin{aligned} [\text{Diagnostic Confidence}] &= 60 / (60 + 1) \\ &= 60 / 61 \\ &= 98\% \end{aligned}$$

As a result of the test you have improved your confidence from 60% to 98%. This is a good test.

A condition has a prevalence in your practice of 30%. Again you use a test with a likelihood ratio of 40. What is your diagnostic confidence?

As the patient walks through the door, the chances of them having the condition are 30%. The odds in favour of them having the condition are $3 : 7$. Accordingly, $[\text{Pre-test Odds}] \times [\text{Likelihood Ratio}] = [\text{Post-test Odds}]$

$$\begin{aligned} 3/7 \times 40 &= [\text{Post-test Odds}] \\ [\text{Post-test Odds}] &= 17 \\ \text{Diagnostic Confidence Odds} &= 17 : 1 \\ [\text{Diagnostic Confidence}] &= 17 / (17 + 1) \\ &= 17 / 18 \\ &= 94\% \end{aligned}$$

As a result of the test you have improved your confidence from 30% to 94%. This is a good test.

A condition has a prevalence in your practice of 60%. This time you use a test with a likelihood ratio of 2. What is your diagnostic confidence?

As the patient walks through the door, the chances of them having the condition are 60%. The odds in favour of them having the condition are $6 : 4$. Accordingly, $[\text{Pre-test Odds}] \times [\text{Likelihood Ratio}] = [\text{Post-test Odds}]$

$$\begin{aligned} 6/4 \times 2 &= [\text{Post-test Odds}] \\ [\text{Post-test Odds}] &= 6 : 2 \\ \text{Diagnostic Confidence Odds} &= 6 : 2 \\ [\text{Diagnostic Confidence}] &= 6 / (6 + 2) \\ &= 6 / 8 \\ &= 75\% \end{aligned}$$

As a result of the test you have improved your confidence from 60% to only 75%. This is a mediocre gain. The test is not as powerful as the previous test.

A condition has a prevalence in your practice of 30%. You use a test with a likelihood ratio of 2. What is your diagnostic confidence?

As the patient walks through the door, the chances of them having the condition are 30%. The odds in favour of them having the condition are $3 : 7$. Accordingly, $[\text{Pre-test Odds}] \times [\text{Likelihood Ratio}] = [\text{Post-test Odds}]$

$$\begin{aligned} 3/7 \times 2 &= [\text{Post-test Odds}] \\ [\text{Post-test Odds}] &= 6 : 7 \\ \text{Diagnostic Confidence Odds} &= 6 : 7 \\ [\text{Diagnostic Confidence}] &= 6 / (6 + 7) \\ &= 6 / 13 \\ &= 46\% \end{aligned}$$

As a result of the test you have improved your confidence from 30% to only 46%. This is a useless gain. You are still less than 50% certain about your diagnosis. The test is of no value in this circumstance.

A condition has a prevalence in your practice of 60%. This time you use a test with a likelihood ratio of 1.2. What is your diagnostic confidence?

As the patient walks through the door, the chances of them having the condition are 60%. The odds in favour of them having the condition are $6 : 4$. Accordingly, $[\text{Pre-test Odds}] \times [\text{Likelihood Ratio}] = [\text{Post-test Odds}]$

$$\begin{aligned} 6/4 \times 1.2 &= [\text{Post-test Odds}] \\ [\text{Post-test Odds}] &= 7.2 : 4 \\ \text{Diagnostic Confidence Odds} &= 7.2 : 4 \\ [\text{Diagnostic Confidence}] &= 7.2 / (7.2 + 4) \\ &= 7.2 / 11.2 \\ &= 64\% \end{aligned}$$

As a result of the test you have improved your confidence from 60% to only 64%. This is a trivial gain. The test has not improved your diagnostic certainty beyond the prevalence of the index condition.

A condition has a prevalence in your practice of 60%. This time you use a test with a likelihood ratio of 0.8. What is your diagnostic confidence?

As the patient walks through the door, the chances of them having the condition are 60%. The odds in favour of them having the condition are $6 : 4$. Accordingly, $[\text{Pre-test Odds}] \times [\text{Likelihood Ratio}] = [\text{Post-test Odds}]$

$$\begin{aligned} 6/4 \times 0.8 &= [\text{Post-test Odds}] \\ [\text{Post-test Odds}] &= 1.2 \\ \text{Diagnostic Confidence Odds} &= 1.2 : 1 \\ [\text{Diagnostic Confidence}] &= 1.2 / (1.2 + 1) \\ &= 1.2 / 2.2 \\ &= 55\% \end{aligned}$$

As a result of the test you have decreased your confidence from 60% to 55%. This test is not only useless, it is damaging. This occurs when the test has too high a false-positive rate. Using the test you will diagnose as positive, patients who do not have the index condition.

The messages from these examples are that:

- in order to be useful, diagnostic tests must have high likelihood ratios;
- tests are next to useless if their likelihood ratios are close to 1.0;
- tests with likelihood ratios less than 1.0 give false results.

The remaining exercise is to

understand the definition of the likelihood ratio.

The likelihood ratio is defined mathematically as (Appendix C):

Likelihood Ratio = [Sensitivity] / [1 - Specificity]

Intuitively this ratio may not relate to any recognisable, material property of a test, but in order to explain, it can be recast as Likelihood Ratio = [Sensitivity] / [False-positive Rate]

Likelihood Ratio = [True-positive Rate] / [False-positive Rate]

Thus, the likelihood ratio represents the power of a test to find an index condition but discounted by the false-positive rate of the test. It is this discount that protects the test from being over-rated in its ability to detect an index condition.

All that is required to calculate the likelihood ratio of a test is a knowledge of its sensitivity and its specificity. since sensitivity and specificity were immutable, intrinsic properties of the test, so too is the likelihood ratio. It is constant regardless of the prevalence of the index condition. For this reason, it is the cardinal measure of the power of a diagnostic test.

Practitioners of musculoskeletal medicine should master the concept of likelihood ratio, how to calculate it, and how to use it in operations on the pre-test odds in order to determine diagnostic confidence. This ability will protect them from adopting and using tests of no value. In learning any new test, and in reviewing traditional diagnostic tests, practitioners should call for the likelihood ratio, or at least for the sensitivity and specificity of the test so that they can calculate its likelihood ratio for themselves.

Clinical examples

The following are a selection of examples drawn from musculoskeletal medicine that illustrate the concepts and operations described in this article. The list is not exhaustive, but is intended to prompt the reader into undertaking an evaluation for themselves of the tests that they use in practice, and thereby check if they using valid tests or are operating under an illusion generated by the epidemiology of their practice.

Consider the data in Table 1. None of the commonly used clinical tests for fracture of scaphoid have a likelihood ratio greater than 2.0; most are barely above 1.0; and some are less than 1.0.

These figures render scaphoid fracture hardly diagnosable by clinical examination. What makes a sore wrist likely to be

Clinical features	Sens	Spec	Likelihood ratio
Swelling in snuff-box	0.61	0.52	1.27
Discolouration in snuff box	0.22	0.76	0.92
Pain in snuff-box	0.78	0.52	1.63
Tenderness in snuff-box	0.87	0.38	1.40
Clamp sign	0.26	0.79	1.23
Pronation with ulnar deviation	0.83	0.17	1.00
Pronation with radial deviation	0.70	0.31	1.01
Resisted pronation	0.65	0.24	0.86
Resisted supination	0.83	0.38	1.34

Table 1. The validity of clinical signs for scaphoid fracture, based on Waizenegger et al.¹

Clinical sign	Sens	Spec	Likelihood ratio
Straight leg raise	0.97	0.11	1.09
	0.96	0.10	1.07
	0.78	0.47	1.47
	0.96	0.15	1.13
Weak dorsiflexion of ankle or hallux	0.51	0.54	1.10
	0.61	0.50	1.22
Weakness	0.47	0.53	1.00
Depressed ankle jerk	0.51	0.62	1.34
	0.51	0.80	2.55
	0.51	0.62	1.34
Weak dorsiflexion and depressed ankle jerk	0.18	0.85	1.18
	0.21	0.85	1.40
	0.19	0.85	1.27
Weak dorsiflexion or depressed ankle jerk	0.81	0.31	1.17
Sensory deficit	0.60	0.57	1.40
	0.28	0.65	0.80
Muscle atrophy	0.38	0.50	0.76

Table 2. The validity of selected tests and combinations of tests for lumbar disc herniation, based on Kosteljanetz et al,² Knuttson³ and Spangfort.⁴

a scaphoid fracture is not the clinical examination but the pre-test likelihood that it is a scaphoid fracture.

For the commonly used clinical tests of lumbar disc herniation (Table 2), all have likelihood ratios barely greater than 1.0. Thus, the diagnosis of lumbar disc herniation cannot be made with confidence on clinical grounds. If readers are accustomed to diagnosing disc herniation accurately by clinical examination it is not because of their clinical acumen and the tests that they use; it is because the condition is so common in patients presenting with radicular pain. The prevalence makes the diagnosis, not the test.

A final example combines reliability and validity, and good news with bad news. In a recent study a chiropractor and a physiatrist each examined the same sample of 80 patients with suspected sacroiliac joint pain.

They used a selection of preferred clinical tests, and compared their observations in order to determine inter-observer reliability.

Their kappa scores for most tests were extraordinarily good for tests in physical medicine (Table 3).

When their clinical diagnoses, however, were compared to diagnostic blocks of the

putatively painful joint, the validity of the tests proved to be nil. The likelihood ratios of the various tests were either little greater than 1.0, or less than 1.0 (Table 4).

Sign	Kappa
Pain over SI joint	0.7
Groin pain	0.7
Buttock pain	0.7
Pointing to PSIS	0.6
Thigh thrust	0.6
Patrick test	0.6
Gaenslen test	0.6
Sulcus tenderness	0.4
Sacral thrust	0.3
Spring test	0.2
Sitting posture	0.2
Gillet test	0.2

Table 3. The reliability of selected tests for sacroiliac joint dysfunction, based on Dreyfuss et al.⁵

Conclusion

The cardinal message of this article is that: **all truth comes in a 2x2 table.**

In order to be useful, any clinical test must

Sign	Likelihood Ratio
Pain over SI joint	0.9
Groin pain	0.5
Buttock pain	0.9
Pointing to PSIS	1.4
Thigh thrust	0.7
Patrick test	0.8
Gaenslen test	1.0
Sulcus tenderness	1.0
Sacral thrust	0.8
Spring test	1.2
Sitting posture	0.3
Gillet test	1.3

Table 4. The validity of selected tests for sacroiliac joint dysfunction, based on Dreyfuss et al.⁵

be both reliable and valid. The reliability and validity of any test can be determined by created a 2 x 2 contingency table. For reliability, the columns and rows are the findings of two independent observers using the same test on the same sample of

patients. For validity, the columns are the results of a chosen criterion standard and the rows are the results of the test in question.

For reliability, the kappa statistic applies. The value of this statistic provides an index of just how reliable the test is. A good kappa score is 0.6 or more. Scores less than 0.4 indicate that the test is essentially useless, for it generates more errors than truth.

For validity, the intrinsic properties of a test are its sensitivity and specificity. From these can be derived the likelihood ratio. The likelihood ratio is the operator that converts pre-test prevalence to post-test confidence in diagnosis. When the likelihood ratio is 1.0 or little greater than 1.0, the test is essentially useless, for it does not improve diagnostic confidence appreciably above the prevalence of the condition.

Practitioners in musculoskeletal medicine should be equipped with an ability to derive kappa scores and likelihood ratios, and should demand these of speakers, writers and teachers, for unless the promulgators of tests provide these data the consumer

cannot be certain that they are not being taught a useless test.

References

Kosteljanetz M, Espersen JO, Halaburt H, Miletic T. Predictive value of clinical and surgical findings in patients with lumbago-sciatica. A prospective study (Part I). *Acta Neurochir* 1984; 73: 67- 76.

Knutsson B. Comparative value of electromyographic, myelographic and clinical-neurological examination in diagnosis of lumbar root compression syndrome. *Acta Orthop Scand* 1961; Supp 49.

Spangfort EV. The lumbar disc herniation. A computer-aided analysis of 2,504 operations. *Acta Orthop Scandinav* 1972; Supp 142.

Waizenegger M, Barton NJ, Davis TRC, Wastie ML. Clinical signs in scaphoid fractures. *J Hand Surg* 1994; 19B: 743-47.

Dreyfuss P, Michaelsen M, Pauza K, McLarty J, Bogduk N. The value of history and physical examination in diagnosing sacroiliac joint pain. *Spine* 1996; 24: 2594-602.

Appendix A

For each of the following contingency tables calculate the sensitivity and specificity

Test result	Criterion standard		Criterion standard		Criterion standard	
	pos	neg	pos	neg	pos	neg
Pos	432	61	206	117	87	46
Neg	126	97	97	342	193	72
Sensitivity						
Specificity						

Appendix B

For a test with a sensitivity of 0.8 and a specificity of 0.7, calculate the positive predictive value of the test as the prevalence of the index condition changes from 10% to 40% and 80%.

Prevalence	10%	40%	80%
Test result	Criterion standard pos neg	Criterion standard pos neg	Criterion standard pos neg
pos			
neg			
PPV			

Answers to Appendix A: 0.77,0.61;0.68,0.75;0.31,0.61.

Answers to Appendix B: 0.22, 0.64, 0.91

Appendix C

Derivation of the likelihood ratio

Consider the contingency table:

Results Of Test	Criterion Standard		
	positive	negative	
positive	a	b	a+b
negative	c	d	c+d
	a + c	b + d	a+b+c+d = N

The objective is to find a general solution for positive predictive value independent of N.

Given are the properties of the test.

$$\text{Sensitivity (Sens)} = a / (a + c) \dots\dots\dots (1)$$

$$\text{Specificity (Spec)} = d / (b + d) \dots\dots\dots (2)$$

Also,

$$\text{Prevalence (Prev)} = (a + c) / N \dots\dots\dots(3)$$

and

$$\begin{aligned} N &= a+b+c+d \\ &= (a + c) + (b + d) \dots(4) \end{aligned}$$

Aim: to solve for positive predictive value (PPV)

$$\text{PPV} = a / (a + b) \dots\dots\dots(5)$$

Step 1: find a

$$\text{From (1)} \quad a = (a + c) [\text{Sens}]$$

$$\text{From (3)} \quad (a+c) = N [\text{Prev}]$$

$$\text{Whereupon} \quad a = N [\text{Prev}] [\text{Sens}] \dots\dots\dots(6)$$

Step 2: find b

$$(b+d)/(b+d) = 1$$

$$b/(b+d)+d/(b+d) = 1$$

$$b / (b + d) + [\text{Spec}] = 1$$

$$b/(b+d) = 1-[\text{Spec}]$$

$$b = (b+d)(1-[\text{Spec}])\dots\dots\dots(7)$$

$$\text{From (4)} \quad (b + d) = N - (a+c)$$

$$\text{From (3)} \quad (b + d) = N - N[\text{Prev}]$$

$$= N (1-[\text{Prev}])$$

$$\text{Substituting into (5)} \quad b = N - (1-[\text{Prev}])(1-[\text{Spec}])(8)$$

Step 3: combining (6) and (8) into (5)

$$\text{PPV} = \frac{N [\text{Prev}][\text{Sens}]}{N[\text{Prev}][\text{Sens}] + N(1-[\text{Prev}](1-[\text{Spec}]))}$$

$$= \frac{[\text{Prev}][\text{Sens}]}{[\text{Prev}][\text{Sens}] + (1-[\text{Prev}](1-[\text{Spec}]))}$$

$$\frac{1}{\text{PPV}} = \frac{([\text{Prev}][\text{Sens}] + (1-[\text{Prev}](1-[\text{Spec}]))}{[\text{Prev}][\text{Sens}]}$$

$$\frac{1}{\text{PPV}} = 1 + \frac{(1-[\text{Prev}](1-[\text{Spec}]))}{[\text{Prev}][\text{Sens}]}$$

$$\frac{(1-[\text{Prev}]) \times (1-[\text{Spec}])}{([\text{Prev}]) \quad ([\text{Sens}])} = \frac{1}{\text{PPV}} - 1$$

$$\frac{(1-[\text{Prev}]) \times (1-[\text{Sens}])}{([\text{Prev}]) \quad ([\text{Sens}])} = \frac{(1-\text{PPV})}{(\text{PPV})}$$

$$\text{Upon inverting, } \frac{([\text{Prev}]) \times ([\text{Sens}])}{(1-[\text{Prev}]) \quad (1-[\text{Spec}])} = \frac{(\text{PPV})}{(1-\text{PPV})}$$

The factor $\frac{([\text{Prev}])}{(1-[\text{Prev}])}$ is the prevalence odds.

The factor $\frac{(\text{PPV})}{(1-\text{PPV})}$ is the positive predictive odds.

Thus, the prevalence odds and the positive predictive odds are related by the coefficient: $\frac{([\text{Sens}])}{(1-[\text{Spec}])}$

and let $\frac{([\text{Sens}])}{(1-[\text{Spec}])}$ be defined as the Likelihood Ratio.

In this manner, the positive predictive odds are a function of the prevalence odds and the likelihood ratio, which in turn is a function of the intrinsic properties of the test: sensitivity and specificity.

Treatment of chronic pain with opioid therapy

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Introduction

Chronic pain has generally been defined as “pain that persists beyond normal tissue healing time, which is assumed to be about 3 months”.¹ It is now well known that the prevalence of chronic pain in Australia is about 20% overall. Of these, 33% of patients experience significant interference of activities of daily living by pain.^{2,3} This high number, coupled with the immense burden of chronic pain, means the management of chronic pain would need to be undertaken at all levels of medical care, mainly at the primary care level and supported by appropriate specialists and secondary and tertiary pain management centres.⁴

In the 1980s and 1990s, there were recommendations to treat chronic non-cancer pain more aggressively, with a consensus view that opioids are an appropriate therapy for some of these patients. The risk for drug abuse was considered low and inadequate treatment led to the phenomenon of “pseudo-addiction” where patients continued to seek more pain relief due to inadequate analgesics. The corrective action would be giving more opioids.^{5,6} As a result, the prescription of opioids increased many folds over the past 30 years.

Epidemiological studies suggest that widespread use of opioids, especially when they are the mainstay of prescribed pharmacotherapy, is associated with persistently high reports of pain, activity limitations, arthritis, poor mental health, and poor overall health and quality of

life.^{7,8} Clearly for some patients with severe chronic pain, strong opioids may be required, which is recognised as an essential tool in the analgesic armamentarium but it should not be the sole answer. Apart from approaches directed at the putative pathology causing the pain (whenever possible), chronic pain management should involve managing the physical deconditioning and musculoskeletal dysfunction, treating mood disturbance, enhancing pain coping strategies, improving social situations and managing co-morbidities arising from the chronic pain condition. If opioids are to be used, this should be undertaken by dedicated skilled clinicians and considered as part of an overall multimodal pain management approach rather than a sole treatment in itself.

This article will focus on the use of opioids in the management of chronic pain unrelated to cancer. It will examine the efficacy of opioids in chronic pain, highlighting some of the current focus of concerns in their use and outlining some practical steps to improve safety in prescribing long term.

Effectiveness of opioids in chronic pain

Meta-analysis of the effectiveness of opioids in chronic pain has shown that they are moderately effective in reducing pain intensity, with a mean of

20-30%. Both neuropathic and nociceptive (e.g., musculoskeletal) pain are opioid-responsive and there is a dose-response relationship. There is never complete pain relief. Most of these data are derived from randomised controlled trials over the short to medium term, i.e., days to weeks. Long-term data are lacking due to difficulty of doing the trials.⁹⁻¹¹ Table 1 summarizes some of the meta-analysis studies which examined the effect of opioids compared to placebo or other non-opioid analgesics in a diverse range of pain conditions.¹²⁻¹⁵

In terms of effectiveness in improving functional outcomes, the data are mixed, with many studies showing better effect with opioids compared to placebo but other studies unable to show a difference.^{9,10}

Studies had shown that of patients initiated on opioids, about 50% would abandon the therapy because of either lack of efficacy or development of intolerable side effects. Longer-term (up to 6 months) follow-up studies after RCTs report satisfactory analgesia for patients who are able to stay on treatment.^{9,12}

However, epidemiological studies tend to associate opioid users with significantly more pain, poorer physical and mental health, higher level of healthcare utilisations and lower quality-of-life (QOL) measures, physical activity and employment.^{7,8} While these associations do not prove causation, it does tend to serve as a reminder that not all patients benefit and many do not achieve the goals of opioid therapy to improve pain, function and QOL. Therefore patients should be selected and managed carefully.⁹

Author (year)	Type of pain	Type of opioid	Duration of treatment	Effect on pain intensity	Effect on function
Noble (2010) ¹²	Diverse chronic non-cancer pain	Tramadol, oxycodone, oxymorphone	6-7.5 months	SMD -1.55/10 points	inconclusive
Eisenberg (2005) ¹³	Diverse range of neuropathic pain	Morphine, oxycodone, methadone	1-8 weeks	SMD -14/100 points (≈0-30% pain reduction)	No consistent effect
Nüesch (2009) ¹⁴	Osteoarthritis knee and hip	Codeine, morphine, oxymorphone, oxycodone, fentanyl	3 days to 3 months (median: 4 weeks)	SMD -0.36 corresponds to improvement of 0.9 pts/10; ≈ 15%	SMD -0.33 corresponds to improvement of 0.7 units/10; ≈ 13%
Martell (2007) ¹⁵	Chronic back pain	Dextropropoxyphene, oxycodone, morphine, oxymorphone	1-16 weeks	SMD -0.199/10 (p=0.136)	Not studied in this paper

Table 1. Meta-analysis of opioids in a range of pain syndromes. SMD (standardized mean difference)

Comparative efficacy of opioids compared with other analgesics

Opioids as a group had not consistently demonstrated improved efficacy compared to comparator analgesic groups such as NSAIDs or tricyclic antidepressants. However, when opioid groups were stratified, the strong opioids (morphine, oxycodone) were found to be more effective.¹⁰

In the treatment of pain of osteoarthritis, tramadol is as effective as diclofenac but seemed to be inferior to celecoxib in the treatment of exacerbation of chronic low back pain.¹⁶ In the treatment of neuropathic pain, opioids have generally been found to be equally effective compared to the gabapentinoids and the tricyclic antidepressants.^{11,17} Interestingly, in the study by Raja (2002), patients reported a preference for opioids for their pain.¹⁴ Thus selection of the most suitable analgesic should be tailored to the patient's comorbidities and risk factors.

Methods to enhance the efficacy of opioids

The principle underpinning improving the efficacy of opioid therapy is firstly that the right patient is selected for opioid treatment and the clinician is well versed in the pharmacology of opioids and care of the patient. Patients may respond variably to different opioids due to a number of pharmacokinetic and pharmacogenetic factors and it is therefore worthwhile trying a different opioid if the first choice is ineffective.¹⁸

Certain drug combinations improve pain relief due to synergistic or additive effects by acting at different sites of nerve transmission. It has been shown that analgesia is improved when opioids such as oxycodone is added to patients with neuropathic pain on gabapentin or pregabalin.¹⁹ Equally, analgesia is also improved when gabapentin or pregabalin is added to patients whose pain is not adequately controlled with an opioid regime.^{20,21} Combination therapy of opioids such as morphine or oxycodone with gabapentin or pregabalin also produces better pain relief and improvement in QOL than either drug alone.^{22,23} Other than this, the value of a combination of NSAIDs, NMDA blockers such as ketamine and the antidepressants with opioids is less certain

in management of chronic pain.

Long-term opioid therapy – areas of concern

In the last 30 years when medical literature began to support the use of opioids for the management of chronic pain, opioid prescribing increased many-fold and this was accompanied by an alarming increase in diversion of prescription opioids, opioids misuse and abuse and fatal overdoses.²⁴ Whilst patients with chronic pain deserve compassionate and committed medical care, there are several areas of concern that need to be understood by clinicians and patients so that risk versus benefits of therapy can be assessed before considering long-term opioid therapy.

1. Development of pharmacologic tolerance, thus limiting the effectiveness of long-term therapy. Tolerance is a state of adaptation in which exposure to the opioid over time induces changes that result in a diminution of the analgesic effects. The need for higher and escalation of doses was also observed clinically. Whilst the mechanism of tolerance remained elusive, opioid-induced adaptations do occur at several levels in the nervous system that involve not only the direct drug effects (pharmacologic tolerance) but also at a psychological level (learned tolerance) that is linked to environmental or contextual cues. So, opioid analgesia can change according to powerful psychological drivers, learned behaviours, circumstances and the environment.⁹

2. Adverse effects of opioid therapy that are burdensome and limit the acceptability of therapy. They account for about 25% of patient withdrawal from treatment trials. The commonest reported adverse effects include constipation (~15-41%), somnolence (~29%), nausea (~21-32%), dry mouth (~25%), dizziness (~20%), itching (~15%).^{25,26}

3. Opioid-induced endocrine dysfunction. Long-term opioid therapy can lead to inhibition of the hypothalamic-pituitary-gonadal axis, with inhibition of release of the hypothalamic gonadotrophic releasing hormone. This results in decreased production of the pituitary LH and FSH, adrenal cortisol and androgen with attendant hypogonadism which is manifested by depression, fatigue, weight gain, osteoporosis, loss of libido, dysmenorrhoea and erectile dysfunction.¹¹

4. Opioid-induced immune dysfunction. Opioids have been known to impair natural killer cell activities, T-cell proliferation, antibody production, phagocyte function and production of cytokines thus rendering the patient on long-term opioid therapy more susceptible to bacterial infection and delayed wound healing.¹¹ However, the clinical significance of this is unclear at present.

5. Opioid-induced hyperalgesia (OIH). Occasionally, prolonged use of opioids can be associated with a sensitisation process causing heightened sensitivity to pain for which increased dose of opioids do not improve pain relief. This condition is difficult to diagnose as patients often exhibit high tolerance to opioids and their underlying disease may have progressed. However, pain of OIH is often qualitatively different, more widespread than the pre-existing pain, and there may be development of allodynia or hyperalgesia. Management options here would include reduction in opioid.^{9,11}

6. Problematic drug use and addiction. The steady increase in opioid prescription for pain relief is paralleled by an increase in misuse and abuse. In community surveys, the estimated rates of prescription opioid abuse range from 4% to 26%.²⁴ The prevalence of addiction in chronic pain patients ranges from 0% to 50%, which is dependent on the population studied and the criteria used.²⁷ Many patients develop compliance problems and problematic drug use behaviours that often lead to adverse effects with opioid use (e.g., over sedation), unsanctioned increase in dosages, obtaining extra opioids from other sources, diversion of opioids and using opioids for effects other than analgesia.^{24,28} Thus there is a need to prevent patients from becoming problematic opioid users by looking for early signs ("yellow flags") indicative of incipient problematic opioid use and "red flags" that are indicative of signs and symptoms of addictive behaviours (Table 2).^{28,29}

Addiction to opioids should be considered not just as a drug issue or an addictive personality but as a chronic relapsing neurobiological disease where there is interaction between:

- The drug – pharmacokinetic and pharmacodynamics factors
- Individual susceptibility – genetic factors, presence of substance use disorder, mental health diagnosis
- Environmental – availability of drugs, cultural, socioeconomic and family factors.

“Yellow flags” – insipient problematic opioid use. Less suggestive of addiction	“Red flags” – indicate true drug misuse and more suggestive of addiction.
<ul style="list-style-type: none"> • Aggressive complaining about need or more drug • Drug hoarding • Requesting specific drugs • Reporting psychic effects not intended by the clinician • Resistance to a change in therapy associated with adverse effects and anxiety • Unsanctioned dose escalation or other non-compliance with therapy on 1 or 2 occasions • Openly acquiring similar drugs from other medical sources 	<ul style="list-style-type: none"> • Concurrent abuse of alcohol or illicit drugs • Deterioration in function that appears related to drug use • Injecting oral formulation • Multiple dose escalations or other non-adherence with therapy despite warnings • Obtaining prescriptions from nonmedical sources • Prescription forgery • Multiple episodes of prescription “loss” • Repeated resistance to changes in therapy despite clear evidence of drug-related side-effects • Repeatedly seeking prescriptions from other physicians without informing prescriber • Selling prescription drugs • Stealing or borrowing drugs from others

Table 2. Spectrum of aberrant drug-taking behaviours^{28,29}

There are several definitions of addiction in the context of patients taking opioids for chronic pain and the reader is referred to a comprehensive review on this topic.²⁷ For the non-specialist, an alarm bell should be sounded if the simple 4Cs criteria are manifested in a patient – Craving for opioids, Compulsive use, loss of Control in use and Continued use despite harm.

7. Mortality related to opioids. The prime cause of mortality is generally related to fatal overdoses and this risk increases with dosage. At more than 200 mg morphine equivalent a day, the risk is nearly threefold that of a lower dose of less than 50 mg daily.³⁰ Characteristically, most of these overdose deaths are accidental (~60%) and occurred in patients on multiple drugs, including sedatives, who are alcoholics, obtaining opioids from multiple sources and who are from the lowest socioeconomic groups.³⁰ This American study parallels that of an Australian study investigating the increasing deaths associated with oxycodone in Victoria which found over a 10-year period 2000-2009 that a nine-fold increase in supply was associated with a 21-fold increase in deaths. The main cause was related to fatal drug toxicity and the demographics of the deceased include use of more than one drug, lower socioeconomic status, young males, dying at home and in rural areas.³¹

Strategies to improve safety in opioid prescribing

One physician should be responsible for prescribing the opioid medication and assesses the response and should have an

established therapeutic relationship with the patient.³² For the more straightforward cases, most primary care physicians can be responsible for prescribing with some support from pain specialist. For the more difficult cases or those on contentious opioid regimen, some form of pain specialist input would be ideal and these patients should be reviewed in a multidisciplinary pain clinic.

The clinician should adhere to the general principles of Universal Precautions in opioid prescribing.^{16,29,33} These include:

1. *Making a diagnosis with appropriate differential.* The patient should be thoroughly evaluated medically where the pain history, comorbidities, psychosocial deficits, drug health history, physical examination and results of investigations are documented.
2. *A psychological assessment including presence of mental health disorder and risk of addictive disorder.* Presence of these increases the risk of problematic and aberrant drug-use behaviours. It is recommended that a short screening questionnaire such as the Opioid Risk Tool (ORT) be used to predict which individuals may develop such behaviours (Table 3).³⁴

A number of indicators had been shown to predict opioid misuse and it is important that these factors are identified early (Turk 2008):

- Personal history of alcohol and illicit drug abuse (Odds Ratio OR 2.34)
- History of mental disorder (OR 1.46)
- History of driving under influence or drug convictions (OR 2.58)
- Family history of drug and illicit drug abuse
- History of childhood sexual abuse
- History of lost or stolen prescriptions
- History of using supplemental

sources.

Following this assessment, patients can be stratified and triaged into three groups:

- Primary care patients – those with no history of substance use disorders or major psychopathology.
- Primary care patients with specialist support – those with a past history of a treated substance use disorder or a past or current psychiatric disorder or significant family history of problematic drug use.
- Speciality pain management – complex patients with active substance use disorder or major psychopathology who pose significant risk to themselves and clinicians who lack the resources or experience to manage them.

3. Informed consent. Risks and benefits of long-term opioid therapy are discussed with the patients at their appropriate level of understanding. This should include risks as detailed above. In addition, patients should be counselled that use of other CNS depressants such as benzodiazepines, alcohol and illicit drugs will increase their risk of overdose; the need for safe use and storage; and potential limitations with regard to opioid prescribing while travelling as some countries have restrictions on availability and importation of opioids.

4. Treatment agreement. Goals of treatment must be agreed on with the patient either verbally or in writing, with an emphasis on improvement in patient's functional status (sleep, work, social and recreational activities and mood) and quality of life and not just pain relief. Some authorities advocate the use of an “opioid treatment contract” outlining the rights and responsibilities of the doctor and the patient. However, whether this improves outcome of management is still unclear.

5. *Pre- and post-intervention assessment of pain and function.* This is needed to assess the results of any medication trial and can be used to support continuation or otherwise of any mode of therapy.

6. *Appropriate trial of opioid therapy with or without adjunctive medication.* The aim is to determine the opioid responsiveness of the patient's pain and function. The goals of the trial should be agreed upon, including the agreement that if the goals are not met then the trial should be discontinued and long-term opioid therapy not pursued. It is recommended that a long-acting or a sustained release oral or transdermal preparations are used.

7. *Regular reassessment of the patient's pain score and level of function.* This combined with corroborative support from family or knowledgeable third parties help document rationale to continue or modify the therapeutic trial.

8. *Regularly assess the 5As – Analgesia, Activity, Adverse effects, Aberrant drug behaviours and Affect.* This will help direct therapy and support pharmacologic options taken.

9. *Periodic review of pain diagnosis and comorbid conditions (including addiction).* This is necessary as underlying disease, diagnostic tests and behavioural indices can change over time. As a result, treatment focus may also change. If an addictive or mental health disorder predominates, sole focus on the treatment of the underlying pain problem is unlikely to be successful if not coordinated with treatment for the concurrent addictive or mental health disorder.

10. *Documentation.* It is important to maintain careful and complete documentation of the evaluation and subsequent treatment process. It goes to the heart of good doctor-patient relationship.

Without documentation, there is no defence.

Which patients to prescribe for long-term opioid therapy:^{24,32}

Careful patient selection before initiating opioid therapy contributes to safety and depends largely on the physician's decisions. Ideally these patients are those who have:

- Documented nociceptive or neuropathic pain syndromes. Those with widespread pain or pain where the aetiology of pain is indeterminate often exhibit a poor analgesic response to opioids.
- Moderate to severe pain which is interfering with functional activities.
- Failed to respond to a reasonable documented trial of non-pharmacologic and non-opioid pharmacological modalities.
- Some psychological stability with no overriding mental health and substance use disorders.
- Reliance on analgesics that are toxic during long-term administration such as NSAIDs, steroids or high dose paracetamol.

Patients who have a past history of substance use disorder (addiction) and mental health disorders are not contraindicated for opioid therapy, but they would require increased vigilance and supervision by an addiction medicine specialist and/or a psychiatrist.

Which opioid for which patient (therapeutic guidelines):³⁵

The clinician should be familiar with the pharmacology of opioid analgesics and experienced with its use so that the best

opioid is matched to the patient.

In general,

- An extended-release opioid preparation should be used rather than short-acting immediate release preparations.³⁶
- The concept of an opioid ladder can also be used with less potent and/or less abuse-potential opioid being used as first line (Figure 1). These include codeine, tramadol, tapentadol and buprenorphine patch which had been shown to be effective for a diverse range of nociceptive and neuropathic pain. There may be some contention in the use of codeine, but it is commonly used in one form or another. In the right patient group, they may have fewer side effects and are better tolerated (Table 4).^{35,37}
- The opioid use should be effective for severe pain, and here the literature suggests that most of the commonly used opioids such as morphine, oxycodone, fentanyl and buprenorphine are equally efficacious.
- Avoid use of opioids where active metabolites accumulate, e.g., morphine in the context of renal failure, where the active metabolite M6G accumulates.
- Avoid potential drug interactions, e.g., use of high-dose tramadol and an SSRI antidepressant.
- Avoid potential side effects, e.g., use of methadone where the QT interval is prolonged.
- Use an opioid with a favourable side-effect profile. For patients who are prone to constipation, the newer oxycodone-naloxone combination would be more advantageous than oxycodone alone. Fentanyl patch may be less constipating than morphine.
- Consider an opioid preparation which has less potential for abuse or misuse. Most of the strong opioids have an equal propensity to be abused and recent innovations have focussed on developing tamper-deterrent formulation such as the new Oxycontin® and Jurnista® (extended release hydromorphone). Although not marketed as such, the oxycodone-naloxone preparation (Targin®) may also discourage abuse by injecting.
- The dosing schedule should be convenient for the patient.
- Patient preference should also be taken into account.

Mark each box that applies	Female (score)	Male (score)
Family history of substance abuse • Alcohol • Illegal drugs • Prescription drugs	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 4	<input type="checkbox"/> 3 <input type="checkbox"/> 3 <input type="checkbox"/> 4
Personal history of substance abuse • Alcohol • Illegal drugs • Prescription drugs	<input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	<input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Age (mark box if between 16 and 45 years)	<input type="checkbox"/> 1	<input type="checkbox"/> 1
History of preadolescent sexual abuse	<input type="checkbox"/> 3	<input type="checkbox"/> 0
Psychological disease • Attention deficit disorder, obsessive compulsive disorder, bipolar, schizophrenia • Depression	<input type="checkbox"/> 2 <input type="checkbox"/> 1	<input type="checkbox"/> 2 <input type="checkbox"/> 1
Total		

Table 3. Opioid Risk Tool.³⁴

Total score risk category: 0-3: Low risk; 4-7: Moderate risk; ≥8: High risk

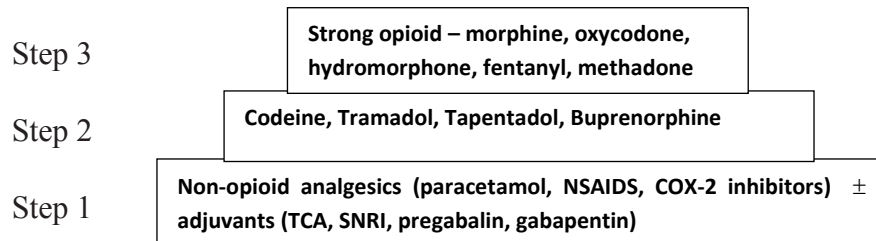


Figure 1. Opioid analgesic ladder

	Codeine	Tramadol	Tapentadol	Buprenorphine
Analgesic action	Partial μ agonist Conversion to morphine	μ agonist + serotonergic / noradrenergic reuptake inhibition	μ agonist + noradrenergic reuptake inhibition	μ agonist / κ antagonist
Potency	Low	Low	Low	High
Reliance on metabolism for action	Pro-drug. Converted to morphine by cytochrome P450 2D6. Low efficacy in ~10% of Caucasians	Pro-drug. Converted to active metabolite by cytochrome P450 2D6	No	No
Drug interactions	Sedatives	Tricyclic, SNRI, SSRI, MAOI antidepressants \rightarrow serotonin syndrome	MAOI	Sedatives
Side effects	Typical opioid, Constipation, \uparrow effect in fast metabolisers, \downarrow effect in slow metabolisers	Typical opioid (less), Stimulatory effects, Seizures, \uparrow effects in fast metabolisers, \downarrow effect in slow metabolisers	Typical opioid (less)	Typical opioid, but ceiling for respiratory depression, Skin reaction, Can precipitate withdrawal in patients taking strong opioids
Caution in comorbidities	Paediatrics – overdose in fast metabolisers. Paracetamol overdose in compound preparations	Epilepsy Antidepressants	Antidepressants	
Preparations (in Australia) suitable for use in chronic pain	IR: Codeine phosphate Compound: in combination with paracetamol	Oral IR and ER available	ER available IR formulation not available yet	IR in tablet for sublingual administration and ER in transdermal patch preparation
Initial starting dose and titration to effect	In compound formulation-varies	ER: 50-100 mg twice daily IR: 50 mg Q4-6Hr prn (limit to 400 mg/day)	ER: 50 mg twice daily (limit to 500 mg/day)	TD: 5mg weekly IR: 0.2 mg Q4-6Hr prn (not applicable in opioid substitution therapy)

Table 4. Step 2 opioids: Tramadol vs. Tapentadol vs. Buprenorphine vs. Codeine^{35,37}

IR: immediate release preparation; ER: extended release preparation; SNRI: serotonin noradrenaline reuptake inhibitors; SSRI: selective serotonin reuptake inhibitors; MAOI: monoamine oxidase inhibitors

Monitoring opioid therapy

This is to ensure that the patients adhere to the treatment plan. It is also important to ensure that patients are complying with the treatment agreement set earlier, with prescription from one prescriber, with

no unauthorised dose increase. Again, regularly re-evaluate the 5As.³⁸ Urine drug screening should form part of routine monitoring to detect drug misuse.^{24,39} The intensity of the monitoring should be in proportion for those with more risk factors.⁴⁰

Patients need education on the limitations of opioid analgesics and appreciation of

the risks associated with opioid therapy. There should be increased caution in dose escalations.²⁴ Daily doses should be kept to a morphine equivalent dose (MED) of less than 120 mg and specialist review is recommended if higher doses are required.³⁸ Clinicians should be aware of increased mortality with MED over 200 mg daily.

Long-term opioid therapy should not be seen as a lifelong treatment and many patients are able to reduce or come off the therapy all together. Opportunities to exit long-term opioid therapy should be given to patients and time and support can be given. Certainly if the goals of therapy are not met, with pain relief as a minimal criterion, then consideration should be given to cessation of opioid therapy. This can be done by tapering the dose over an extended period of time to avoid withdrawal symptoms. On the other hand if patients develop persistent aberrant drug-taking behaviours or frank addiction, then in the author's opinion, an alternative path using the addiction medicine model should be taken with referral to an addiction medicine specialist or drug health service.

Conclusions

Opioid therapy forms an essential armamentarium in the context of a multimodal approach to the treatment of chronic pain and should not be used as a sole therapy. Clinicians who prescribe opioids should be well trained in its pharmacological and clinical aspects so the therapy is applied appropriately. There should be an appreciation of the benefits and risks associated with this therapy and only a small number of patients would benefit. Therefore patients should be carefully assessed and only appropriate patients where the benefits clearly outweigh the risks are selected for long-term therapy. The clinician should accept mild to moderate pain relief, never complete pain relief and start off using step 2 opioids, titrating the dose to effect or side-effects and only using strong opioids if the step 2 opioids are ineffective. There must be continued vigilance and monitoring for opioid abuse and use other than the intended analgesia.

Patients who clearly manifest addiction behaviours should be discontinued from the pain management model and referred to the addiction medicine specialist. The principles of Universal Precautions should be adhered to. Continued monitoring of the therapy matched to analgesic response, activity level, adverse effects, aberrant drug behaviours and affect is important and

opioid doses should be kept to as low as possible. Requirement for doses beyond 120 mg MED should be reviewed and certainly beyond 200 mg MED should trigger alarm. When well-managed, patients on long-term opioid therapy can have their pain moderately relieved, function and quality of life improved and suffering reduced. This requires some concerted effort from both the patient and treating clinician on an ongoing basis.

References

1. International Association or the Study of Pain Task Force on Taxonomy. *Classification of chronic pain*. 2nd ed. Seattle, WA: IASP Press, 1994.
2. Blyth FM, March LM, Brnabic AJM et al. Chronic pain in Australia: a prevalence study. *Pain* 2001; 89: 127-134.
3. Blyth FM, March LM, Cousins MJ. Chronic pain-related disability and use of analgesia and health services in a Sydney community. *Med J Aust* 2003; 179: 84-87.
4. NSW Pain Management Plan 2012-2016: www.health.nsw.gov.au. NSW Ministry of Health 2012.
5. Portenoy RK, Foley KM. Chronic use of opioid analgesics in non-malignant pain: report of 38 cases. *Pain* 1986;25:171-186.
6. American Academy of Pain Medicine and American Pain Society. The use of opioids for the treatment of chronic pain: a consensus statement from the American Academy of Pain Medicine and the American Pain Society. *Clin J Pain* 1997;13:6-8.
7. Toblin RL, Mack KA, Perveen G et al. A population-based survey of chronic pain and its treatment with prescription drugs. *Pain* 2011;152:1249-1255.
8. Eriksen J, Sjøgren P, Bruera E et al. Critical issues on opioids in chronic non-cancer pain: an epidemiological study. *Pain* 2006; 125:172-179.
9. Ballantyne JC, Shin NS. Efficacy of opioids for chronic pain. *Clin J Pain* 2008; 24: 469-478.
10. Furlan AD, Sandora JA, Mailis-Gagnon A, Tunks E. Opioids for chronic noncancer pain: a meta-analysis of effectiveness and side-effects. *CMAJ* 2006;174:1589-1594.
11. Stannard CF. Opioids for chronic pain: promise and pitfalls. *Curr Opin Support Palliat Care* 2011;5:150-157.
12. Noble M, Treadwell JR, Tregear SJ et al. Long-term opioid management for chronic noncancer pain. Cochrane Database of Systematic Reviews 2010, Issue 1. Art. No.: CD006605. DOI:10.1002/14651858.CD006605.pub2.
13. Eisenberg E, McNicol ED, Carr DB. Efficacy and safety of opioid agonists in the treatment of neuropathic pain of non-malignant origin. Systematic review and meta-analysis of randomized controlled trials. *JAMA* 2005; 293: 3043-3052.
14. Nüesch E, Rutjes AWS, Husni E et al. Oral or transdermal opioids for osteoarthritis of the knee or hip. Cochrane Database of Systematic Reviews 2009, Issue 4. Art. O.: CD003115. DOI: 10.1002/14651858.CD003115.pub3.
15. Martell BA, O'Connor PG, Kerns RD et al. Systematic review: Opioid treatment for chronic back pain: prevalence, efficacy, and association with addiction. *Ann Intern Med* 2007; 146: 116-127.
16. Freunhagen R, Geisslinger G, Schug SA. Opioids for chronic non-cancer pain. *Br Med J* 2013;346:f2937.
17. Raja SN, Hayhorntwaite JA, Pappagallo M et al. Opioid versus antidepressants in postherpetic neuralgia: a randomised, placebo-controlled trial. *Neurology* 2002;59:1015-1021.
18. Kalso E. Improving opioid effectiveness: from ideas to evidence. *Eur J Pain* 2005;9:131-135.
19. Barrera-Chacon JM, Mendez-Suarez JL, Jáurequi-Abrisketa ML et al. Oxycodone improves pain control and quality of life in anticonvulsant-pretreated spinal cord-injured patients with neuropathic pain. *Spinal Cord* 2011;49:36-42.
20. Bennett MI. Gabapentin significantly improves analgesia in people receiving opioids for neuropathic cancer pain. *Canc Treat Rev* 2005;31:58-62.
21. Dworkin RH, Barabano RL, Tyrning SK et al. A randomized, placebo-controlled trial of oxycodone and gabapentin or acute pain in herpes zoster. *Pain* 2009;142:209-217.
22. Gatti A, Sabato AF, Occhioni R et al. Controlled-release oxycodone and pregabalin in the treatment of neuropathic pain: results of a multicentre Italian study. *Eur Neurol* 2009;61:129-137.
23. Gilron I, Bailey JM, Tu D et al. Morphine, gabapentin or their combination for neuropathic pain. *N Engl J Med* 2005;352:1324-1334.
24. Von Korff M, Kolodny A, Deyo RA, Chou R. Long-term opioid therapy reconsidered. *Ann Intern Med* 2011;155:325-328.
25. Kalso E, Edwards JE, Moore RA et al. Opioids in chronic noncancer pain: systematic review of efficacy and safety. *Pain* 2004;112:372-380.
26. Moore RA, McQuay HJ. Prevalence of opioid adverse events in chronic non-malignant pain: systematic review of randomised trials of oral opioids. *Arthritis Res Ther* 2005;7:R1046-R1051.
27. Højsted J, Sjøren P. Addiction to opioids in chronic pain patients: A literature review. *Eur J Pain* 2007;11:490-518.
28. Breivik H. Opioids in chronic non-cancer pain, indications and controversies. *Eur J Pain* 2005; 9:127-130.
29. Passik SD. Issues in long-term opioid therapy: unmet needs, risks and solutions. *Mayo Clin Proc* 2009;84:593-601.
30. Gomes T, Mamdani M, Dhalla I et al. Opioid dose and drug-related mortality in patients with non-malignant pain. *Arch Intern Med* 2011;171:686-691.
31. Rintoul AC, Dobbin MD, Drummer OH, Ozanne-Smith J. Increasing deaths involving oxycodone, Victoria, Australia 2000-2009. *Inj Prev* 2011;17:254-259.
32. Grazioti PJ, Goucke CR. The use of oral opioids in patients with chronic non-cancer pain. *Med J Aust* 1997;167:30-34.
33. Gourlay DL, Heit HA, Almahrezi A. Universal precautions in pain medicine: a rational approach to the treatment of chronic pain. *Pain Med* 2005; 6:107-112.
34. Webster LR, Webster RM. Predicting aberrant behaviour in opioid treated patients: Preliminary validation of the opioid risk tool. *Pain Med* 2005;6:432-442.
35. Analgesic Expert Group. *Therapeutic guidelines: Analgesic*. Version 5. Melbourne: Therapeutic Guidelines Limited; 2007.
36. Rauck RL. What is the case for prescribing long-acting opioids over short-acting opioids for patients with chronic pain? A critical review. *Pain Practice* 2009;9:468-479.
37. Vadivelu N, Timchenko A, Huang Y, Sinatra R. Tapentadol extended-release for treatment of chronic pain: a review. *J Pain Research* 2011;4:211-218.
38. Faculty of Pain Medicine and Australian New Zealand College of Anaesthetists. Principles regarding the use of opioid analgesics in patients with chronic non-cancer pain. PM 1 (2010). www.fpm.anzca.edu.au/resources/professional-documents/PM1%202010.pdf
39. Turk DC, Swanson K, Gatchel RJ. Predicting opioid misuse by chronic pain patients. *Clin J Pain* 2008; 24: 497-508.
40. Liebschutz JM, Alford DP. Safe opioid prescribing: a long way to go. *J Gen Intern Med* 2011;26:951-952.

Obesity:

A musculoskeletal physician's perspective

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Abstract

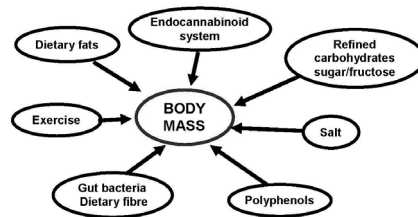
Obesity is a common association with the musculoskeletal pain patient and can create significant treatment barriers. The current advice and treatment for obesity is ineffective in most cases. There are probably components in the contemporary food chain that are contributing to the epidemic of obesity. Such components include an excess of omega 6 fatty acids which contain linoleic acid, trans and saturated fats, excess refined carbohydrates, sugar and salt intake. The saturated fats and linoleic acid result in a low grade inflammatory state and activation of the endocannabinoid system that can lead to obesity. Such dietary items should ideally be minimised. Other food items that need to be increased in consumption are those with omega 3 fatty acids, with polyphenols and containing fructans. Exercise is more of a weight maintenance tool. If obesity is addressed as part of a comprehensive approach to a musculoskeletal pain case, the clinical emphasis should be directed towards providing healthy eating advice, as successful weight loss is difficult for most patients.

Introduction

Any medical or allied health practitioner involved in treating acute and chronic musculoskeletal pain will see a regular procession of patients who are overweight (BMI of 25-30) or obese (BMI >30) and, apart from the presenting musculoskeletal problem, they will also often have related chronic medical conditions such as type 2 diabetes mellitus, sleep apnoea, gastro-oesophageal reflux and other ailments.

Whilst there are treatments available for some of these secondary problems associated with obesity, the management of the primary condition is frustrating and usually unsuccessful. Surgical options such as gastric banding and bariatric surgery can be used to some effect in a minority of cases.

The relevant factors contributing to obesity can be diagrammatically depicted as follows:



There are various interacting hormones including leptin, ghrelin and adiponectin determining body mass that arise from adipose tissue, the gut and the hypothalamic region of the brain. These will not be directly addressed and for a more comprehensive review of this aspect refer to Zac-Varghese¹ and Lee.² For review of obesity as an inflammatory state with increased levels of tumour necrosis factor- α and interleukin-6, see Joffe.³

1. Dietary fats

Several types of fats occurring in the food chain are factors in the obesity epidemic. They include trans fats, omega 3, omega 6 and saturated fats.

a. Trans fats

Trans fats are a chemically modified form of vegetable oils to improve texture, extend shelf life and stabilise flavours. A slightly different form of trans fat occurs in small amounts in the milk and the body fat of ruminants. The industrial form has been shown to have deleterious health effects, including an adverse effect on lipids, triggering systemic inflammation and endothelial dysfunction, and in some studies leading to an increase in visceral adiposity, body weight and insulin resistance.^{4,5,6}

In the Australian food chain, sources of trans fats are deep fried foods (such as the local fish and chip shop and fast food

outlet), commercial cakes and biscuits, and commercial pies and pastries.⁷ Labelling of trans fat content is not currently mandatory in Australia. In contrast in the USA, the FDA has declared trans fats not safe for use in foods and this advice should also be followed here.

b. Omega 3 fatty acids

It is not uncommon for Australian patients to be taking fish oil supplements to relieve joint pain or for cardiovascular reasons. There is some evidence that they also play an important part in the maintenance of body mass.

The omega 3 fatty acids include docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), with the main sources being sea foods, especially oily fish such as salmon and tuna. Alpha linolenic acid (ALA) is a plant based omega 3 fatty acid present in some vegetables such as spinach and kale.⁸ With regards to obesity, several rodent studies indicate this type of fatty acid improves glucose tolerance, lipid profile and prevents further weight gain and even can prevent high fat diet induced obesity.^{9,10} Human studies, however, are inconclusive. There is also suppression of hepatic steatosis which is an associated issue of obesity, once again in a rodent model of obesity.¹¹

With regards krill versus “normal” fish oil capsules, the former has omega 3 fatty acids in a phospholipid form and probably has improved bioavailability¹² but it is uncertain whether this is clinically relevant.

c. Omega 6

The classic study by Keys associating saturated fats and heart disease in the seven countries study¹³ resulted in a large shift in dietary consumption from saturated, largely animal fats, to the omega 6 fats found in the different oil seeds such as canola.¹⁴ A major component of most of the seed oils is linoleic acid and there are now some compelling rodent studies implicating this fatty acid with visceral obesity.¹⁵

Oils with minimal linoleic acid content include extra virgin olive oil and butter.

d. Saturated fats

Several saturated fats ranging from butyric acid to stearic acid are found in food items mainly of animal origin but also occur in palm oil and coconut oil.

A daily high saturated fat diet of more than 30 weeks' duration is associated with permanent weight gain. However, less than 18 weeks of daily exposure to a high fat diet before reverting to a low fat diet does not result in permanent weight gain.¹⁶ It seems prudent to continue to avoid a diet that is high in saturated fats for both cardiovascular and body mass reasons.

2. Endocannabinoid system

This system is intimately involved in many homeostatic functions, including appetite and body mass regulation with the main endocannabinoids and their receptors being upregulated in obesity.¹⁷ The upregulation occurs in response to circulating bacterial lipopolysaccharides¹⁸ and also from dietary intake of linoleic acid.¹⁵ Linoleic acid is readily converted to arachidonic acid which is the template for the two main endocannabinoid system ligands. The result is an increase in appetite and the storage of visceral fat. The system is downregulated by oleic acid (olive oil), omega 3 fatty acids and lauric acid (in coconut oil).¹⁷

As an aside, apart from the possible role in obesity, linoleic acid consumption in the Sydney heart study was associated with increased mortality.¹⁹

3. Refined carbohydrates/sugar/fructose

Rodent studies implicate fructose with obesity but sugar (a 50:50 combination of glucose and fructose) consumption in Australia has actually been declining in spite of the increase in obesity. Human trials indicate moderate dietary quantities of fructose and sucrose increase LDL, total cholesterol and impair insulin sensitivity.²⁰ Refined carbohydrates are readily converted to glucose and possibly have the same metabolic effect.

4. Gut bacterial/dietary fibre

The colon flora (known as the microbiome) plays a significant role in the development of the low grade inflammation that is associated with obesity. This occurs through the leakage of bacterial cell wall components (lipopolysaccharides, LPS) into the portal system. The leakage of LPS is increased by a high fat diet and reduced by omega 3 fatty acids and polyphenols.²¹ Fermentable carbohydrates, such as fructans and inulin found in onions, leeks, asparagus and other vegetables create an altered colon microbiome that has positive metabolic effects on adipose tissue and lipids.²²

5. Polyphenols

Polyphenols are a diverse class of compounds including resveratrol, anthocyanins and curcumin, found in many types of foods such as berries, fruit, tea and coffee and some root vegetables. In animal studies polyphenols have significant anti-obesity activity and have a positive metabolic effects on insulin resistance, leptin sensitivity and adipose tissue inflammation.^{23,24}

6. Exercise

Exercising more and eating less has been the cornerstone of contemporary weight loss advice to patients but the evidence for the benefit of exercise in reducing body mass indicates it only has a slight effect.^{25,26}

Whilst this might be a little disappointing, exercise does, however, have several significant benefits, including a reduction in the systemic inflammation that is a hallmark of obesity.²⁷ Other benefits include improved mitochondrial function, improved lipid oxidation and increased insulin sensitivity in the skeletal muscles.²⁸

In practical terms exercise needs to be considered as a weight maintenance aid rather than a weight loss option. Many different exercise regimes are available and, as long as consideration is given to comorbidities, it probably does not matter too much which exercise program is undertaken

7. Salt

A low salt diet is often recommended for hypertension and there is some evidence a low salt diet also reduces the inflammation

associated with obesity and improves insulin sensitivity.²⁹

Clinical recommendations

Avoid/Reduce	Increase
Trans fats - deep fried foods, some commercial cakes and baked products	Omega 3 fatty acids - eat fish regularly or supplement with fish oil capsules
Saturated fats - use lean meats, trim off any visible fat	Polyphenols - daily consumption of vegetables, fruits and berries
Linoleic acid - avoid seed oils such as canola; use extra virgin olive oil instead	Dietary fibre - especially those with fructans (e.g., onions, leeks, asparagus)
Refined carbohydrates, sugar and salt - minimise regular consumption	Exercise - whatever type the patient prefers and can perform

Conclusion

Although convenient, the notion that obesity is simply a problem of eating to excess and lack of exercise is an increasingly questionable concept and one that has proven to be of little practical value clinically. On an individual basis avoidance of seed oils containing linoleic acid now seems prudent to recommend as does a diet low in saturated fats, refined carbohydrates, sucrose and salt. Other aspects include incorporating into a daily diet foods containing fructans, omega 3 fatty acids and polyphenols. Exercise is more a way of maintaining body mass and improving metabolic function. Treating the obese or overweight patient is probably more about emphasising healthy eating and less about weight loss as there does seem to be a hypothalamic based "set point"³⁰ for body mass. Currently, there seems to be no simple and effective way to dial this "set point" downwards.

References

1. Zac-Varghese S, Tan T, Bloom SR. Hormonal interactions between gut and brain. *Discov Med* 2010;10(55):543-52.
2. Lee H, Lee IS, Choue R. Obesity, Inflammation and Diet. *Pediatr Gastroenterol Hepatol Nutr* 2013;16(3):143-52.
3. Joffe Y, Collins M, Goedecke J. The Relationship between Dietary Fatty Acids and Inflammatory Genes on the Obese Phenotype and Serum Lipids. *Nutrients* 2013; 5, 1672-1705.

4. Mozaffarian D, Katan MB, Ascherio A, Stampfer MJ, Willett WC. Trans Fatty Acids and Cardiovascular Disease. *New England J Med* 2006; 354(15): 1601-1613.
5. Micha R, Mozaffarian D. Trans fatty acids: effects on metabolic syndrome, heart disease and diabetes. *Nat Rev Endocrinol* 2009;5(6):335-44.
6. Kummerow FA. The negative effects of hydrogenated trans fats and what to do about them. *Atherosclerosis* 2009;205(2):458-65.
7. <http://daa.asn.au/for-the-public/smart-eating-for-you/nutrition-a-z/trans-fats>.
8. Gebauer SK, Psota TL, Harris WS, Kris-Etherton PM. N-3 Fatty acid dietary recommendations and food sources to achieve essentiality and cardiovascular benefits. *Am J Clin Nutrition* 2006; 83(6): S1526-S1535.
9. Rossmeisl M, Jilkova ZM, Kuda O et al. Metabolic effects of n-3 PUFA as phospholipids are superior to triglycerides in mice fed a high-fat diet: possible role of endocannabinoids. *PLoS One* 2012;7(6):e38834.
10. Madsen L, Kristiansen K. Of mice and men: Factors abrogating the antiobesity effect of omega-3 fatty acids. *Adipocyte* 2012;1(3):173-176.
11. Rossmeisl M, Medrikova D, van Schothorst EM et al. Omega-3 phospholipids from fish suppress hepatic steatosis by integrated inhibition of biosynthetic pathways in dietary obese mice. *Biochim Biophys Acta* 2013;1841(2):267-278.
12. Schuchardt JP, Schneider I, Meyer H et al. Incorporation of EPA and DHA into plasma phospholipids in response to different omega-3 fatty acid formulations—a comparative bioavailability study of fish oil vs. krill oil. *Lipids Health Dis* 2011;10:145.
13. Keys A, ed. *Seven countries: A multivariate analysis of death and coronary heart disease*. Harvard University Press. Cambridge, Massachusetts, 1980. ISBN 0-674-80237-3.
14. Blasbalg TL, Hibbeln JR, Ramsden CE et al. Changes in consumption of omega-3 and omega-6 fatty acids in the United States during the 20th century. *Am J Clin Nutr* 2011;93(5):950-62.
15. Alvheim AR, Malde HR, Osei-Hyiaman D et al. Dietary linoleic acid elevates the endocannabinoids 2-AG and anandamide and induces obesity. *Obesity* 2012; 20: 1984-1994.
16. Bray GA, Lovejoy JC, Smith SR et al. The influence of different fats and fatty acids on obesity, insulin resistance and inflammation. *J Nutr* 2002;132(9):2488-91.
17. Naughton SS, Mathai ML, Hryciw DH, McAinch AJ. Fatty acid modulation of the endocannabinoid system and the effect on food intake and metabolism. *J Endocrinol* 2013. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3677644/>.
18. Liu J, Batkai S, Pacher P et al. Lipopolysaccharide induces anandamide synthesis in macrophages via CD14/MAPK/phosphoinositide 3-kinase/NF-kappaB independently of platelet-activating factor. *J Biol Chem* 2003;278(45):45034-9.
19. Ramsden CE, Zamora D, Leelarthaepin B et al. Use of dietary linoleic acid for secondary prevention of coronary heart disease and death: evaluation of recovered data from the Sydney Diet Heart Study and updated meta-analysis. *Br Med J* 2013;346:e8707.
20. Aeberli I, Hochuli M, Gerber PA et al. Moderate amounts of fructose consumption impair insulin sensitivity in healthy young men: a randomized controlled trial. *Diabetes Care* 2013;36(1):150-6.
21. Cani PD, Possemiers S, Van de Wiele T et al. Changes in gut microbiota control inflammation in obese mice through a mechanism involving GLP-2-driven improvement of gut permeability. *Gut* 2013;58:1091-1103.
22. Geurts L, Neyrinck AM, Delzenne NM et al. Gut microbiota controls adipose tissue expansion, gut barrier and glucose metabolism: novel insights into molecular targets and interventions using prebiotics. *Beneficial Microbes* 2013:1-15.
23. Eseberri I, Lasa A, Churrua I, Portillo MP. Resveratrol metabolites modify adipokine expression and secretion in 3T3-L1 pre-adipocytes and mature adipocytes. *PLoS One* 2013;8(5):e63918.
24. Bahadoran Z, Mirmiran P, Azizi F. Dietary polyphenols as potential nutraceuticals in management of diabetes: a review. *J Diabetes Metab Disord* 2013;12(1):43 1-22.
25. Donnelly JE, Hill JO, Jacobsen DJ et al. Effects of a 16-month randomized controlled exercise trial on body weight and composition in young, overweight men and women: the Midwest Exercise Trial. *Arch Intern Med* 2003; 163: 1343-1350.
26. Church TS, Martin CK, Thompson AM et al. Changes in weight, waist circumference and compensatory responses with different doses of exercise among sedentary, overweight postmenopausal women. *PLoS One* 2009; 4(2): e4515.
27. Hayashino Y, Jackson JL, Hirata T et al. Effects of exercise on C-reactive protein, inflammatory cytokine and adipokine in patients with type 2 diabetes: A meta-analysis of randomized controlled trials. *Metabolism* 2013: S0026-0495.
28. Devries M, Samjoo IA, Hamadeh MJ et al. Endurance training modulates intramyocellular lipid compartmentalization and morphology in skeletal muscle of lean and obese women. *J Clin Endocrinol and Metab* 2013; 98(12): 4852-4862.
29. Baudrand R, Lian CG, Lian BQ et al. Long-term dietary sodium restriction increases adiponectin expression and ameliorates the proinflammatory adipokine profile in obesity. *Nutr Metab Cardiovasc Dis* 2013: S0939-4753.
30. Speakman JR, Levitsky DA, Allison DB et al. Set points, settling points and some alternative models: theoretical options to understand how genes and environments combine to regulate body adiposity. *Dis Model Mech* 2011;4(6):733-45.

Ten ways to improve radiology reports: For MSM patients

Dr Scott Masters, MBBS FRACGP FAFMM Dip MSM Musculoskeletal Physician, Sunshine Spine Clinic

1. Improve the information we supply.

Our first priority should be to give the radiologist as much relevant information as possible on the request slip. This should include the relevant clinical symptoms/signs along with the condition(s) we suspect or are hoping to rule in/out with the investigation. For example – “Persistent somatic low back pain, no radicular pain, no neurological deficit. Not responding to conservative treatments. Possible discogenic pain. Check for modic changes and high intensity zones. Rule out red flag conditions.” This information should be included on the report back from the radiologist confirming they have read and understood the request. Being available on the phone to discuss results or best radiological choices is paramount for best clinical outcomes.

2. Ask for relevant reports.

When doctors request spinal radiology, reporting of age-related change will be extremely unlikely to change any decision-making process. Yet it inevitably happens and often dominates the report. Why is this so? It has been well documented that degenerative radiological changes are poorly related to symptoms and are widespread amongst asymptomatic patients.

It is time for this aspect of reporting to be minimised and more appropriately worded, e.g., “there are Grade 3 osteoarthritic changes in the lumbar spine. These changes relate poorly to symptoms and are found commonly in this age group.”

3. Avoid firecracker words where possible.

Patients still read reports. They often get alarmed when they see words such as severe, advanced and degeneration. They are best avoided and replaced with a grading system.

4. Put reports into a clinical perspective.

Shoulder ultrasound scanning is commonly performed in patients with shoulder pain and its use has grown exponentially in the last decade. Ultrasound-guided injections of the subacromial bursa likewise. Yet we know that many symptomatic patients will have identical USS findings on their asymptomatic shoulder. Buchbinder has argued that USS is rarely needed for shoulder assessments in GP and USS-guided injections are not more efficacious than office-based injections. These facts are rarely alluded to in the radiologist’s report.

5. Seek accreditation if performing advanced precision diagnostic and therapeutic guided injections.

More advanced injections require a certain critical skill level to be useful to the requesting practitioner. Examples include medial branch blocks, radiofrequency neurotomy for zygapophysial joints. Transforaminal injections, discography and sacro-iliac joint injections also involve specific techniques and equipment. The International Spine Intervention Society runs instructional courses in these procedures. In Australia there is no accreditation process required to be able to perform these procedures.

6. Quote standards.

Following on from 5, when using diagnostic criteria or injection standards, references for these should be included with the report.

7. Utilise pain maps.

Radiological guided diagnostic blocks require close monitoring of the change in pain especially over the first few hours after the block. This is best done with the

patient drawing the location and intensity of their pain before the injection and then crossing out areas on the map where the pain has been relieved.

8. Utilise digital transmission of films, with appropriate marking.

9. Be available to discuss interpretation of the results with the referring doctor.

10. When recommending further investigations, state likely utility.

References

Lewis JS. Rotator cuff tendinopathy. *Br J Sports Med* 2009;43:236–241.

Shanahan M, Buchbinder R. The painful shoulder. *Medicine Today* 2009;11:73–79.

Case studies

A pain in the back, or a pain in the bum? - Piriformis syndrome versus sciatica

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The following two case studies from a clinical myotherapy practice are described to distinguish between piriformis syndrome (PS) and lumbar radicular leg pain (sciatica). The differences in etiology and symptoms will be outlined as well as the administered treatments. Patient identity has been changed to preserve confidentiality.

1. “Miles” – male aged 65

History and presentation: This patient presented with lower back pain (LBP) and stiffness with left buttock pain and referred pain down the left leg to the lateral malleolus. He reported that he had suffered a bout of gout in his foot about 2 weeks earlier which had settled with the use of anti-inflammatory medication. The LBP and stiffness had been present for at least 20 years. His occupation mainly involved sitting at a desk but he had some recreational physical activity including walking and playing golf.

On examination the lumbar active range of movement (LxAROM) was appropriate for age and symptoms were aggravated by bilateral lumbar lateral flexion and forward flexion. There was a positive left lumbar quadrant sign. On palpation there was significant tenderness in the quadratus lumborum (QL), piriformis and gluteus medius muscles and there was subjective clinical hypomobility at the L1-5 facet joints.

Treatment of this patient involved deep tissue massage (DTM) of the lumbar spinal muscles, gluteal muscles and Iliotibial band, dry needling to the piriformis and gluteus medius muscles and grade 2 lumbar unilateral vertebral mobilisation (UVP on the lumbar facet joints).

During treatment the dry needling produced a significant local twitch response, with the patient describing pain down the left leg to the left lateral malleolus. Post-

treatment the patient reported less pain with Lx AROM with an increase of about 15 degrees in lumbar lateral flexion and forward flexion. There was also less pain down the left leg during flexion testing.

On review the following week, he reported that his LBP was still present but overall had decreased. The left buttock and referred leg pain had largely abated. He reported that his intake of prescription analgesics had reduced to only two days in the week following treatment, compared to use every day previously. Examination revealed improved LxAROM compared to the initial consultation and treatment as well as decreased pain sensitivity during palpatory examination.

Further treatment involved DTM of lumbar spinal, gluteal and piriformis muscles, L1-5 facet mobilisation and dry needling to the piriformis and gluteus medius muscles.

2. “Jan” – female aged 47

History and presentation: This patient presented with pain mainly in the left gluteal region but she also reported some pain in the posterior thigh. The symptoms had been present for a number of years and were aggravated after physical activity such as long walks. She also complained of cervical pain and stiffness.

On examination this patient exhibited restricted hip external rotation, and there was subjective clinical tightness of the gluteal muscles. Hypomobility also seemed to be present at the L1-5 lumbar facet joints.

Treatment involved DTM of the lumbar and gluteal muscles, dry needling of gluteus medius and piriformis muscles, and mobilisation of the lumbar facet joints (UVP grade 2).

On review after one week, the patient reported a significant reduction in the gluteal and hamstring pain. She stated it

was “the best she had felt in years” and that she had four consecutive days without pain. Some mild gluteal pain had returned in the 2-3 days prior to follow up treatment but the posterior thigh pain was still absent.

Further treatment involved DTM of the lumbar and gluteal muscles as well as dry needling to the piriformis and gluteus medius muscles combined with lumbar facet mobilisation. There was still a considerable amount of subjective clinical muscle tightness in the gluteal muscles; however there was a decrease in the pain reported by the patient during palpatory examination.

On further review, at two weeks after the initial appointment, the pain symptoms had continued to decrease, there was less pain associated with walking and she was generally feeling that her activities were less restricted.

She was given further treatment on three occasions at weekly intervals but further planned treatments were interrupted by lengthy periods of non-attendance which has possibly impaired further resolution. However, she continues to attend irregularly for treatment and reports her gluteal pain symptoms are more tolerable than previously and the posterior thigh pain has largely resolved.

Comments

Piriformis syndrome (PS) is seen on a regular basis in a clinical myotherapy practice. When taking the history, patients will state that they have “sciatica” with symptoms that have often been present for several years.

There will commonly be a complaint of generalised LBP but the pain, usually unilateral and is more concentrated in the gluteal region. Pain in the hamstring area is also common and it can be referred down to the ankle.

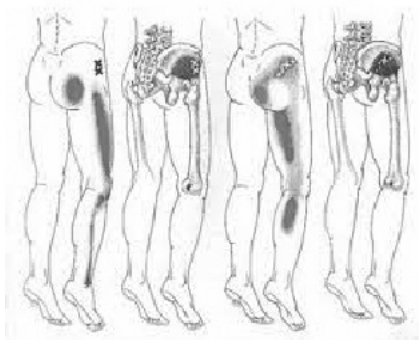


Figure 1. Piriformis syndrome pain pattern¹

PS has been defined as a neuromuscular condition characterised by hip and buttock pain.² This syndrome can be easily overlooked clinically as it has a similar presentation to other pathologies such as lumbar spinal nerve root impingement, sacral or innominate dysfunction and trochanteric bursitis. It is theorised to occur when the sciatic nerve becomes compressed by the piriformis muscle but exactly why this compression occurs is uncertain.

Regardless of the uncertain etiology, and as a consequence of compression, pain can thus be referred down the leg in the distribution of the sciatic nerve.³ Whereas sciatica from spinal causes can have a similar distribution of pain, patients will tend to describe leg pain as more of a “sharp” or “stabbing” or “burning” nature, rather than as an “ache” that is more typical of PS. Descriptive terms, along with any associated distal pins and needles or numbness can be used to suspect a lumbar neurological impingement cause.

Lumbar spinal radicular pain is usually associated with pathologies including herniated lumbar discs, spinal stenosis, spondylolisthesis and rarer causes such as benign or malignant tumours.⁴

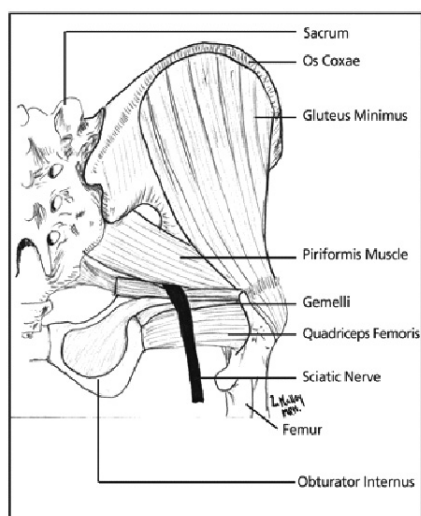


Figure 2. Gluteal region muscles and path of sciatic nerve²

Clinically it is important to distinguish between PS and sciatica as the former is more amenable to myotherapy treatment, as was described in the above two cases. Using different imaging modalities such as ultrasound or MRI the two conditions may be differentiated but in a clinical setting without imaging, by taking a detailed patient history and by examination of the patient using clinical tests such as a slump test, straight leg raise, and dermatomal assessment, a lumbar cause rather than PS can be considered as being more likely to be present. Often a trial of myotherapy treatment will be offered to the patient anyway as clinical differentiation between the two conditions can be difficult.

In the above case studies, both patients presented with LBP and gluteal pain with referral into the hamstring area. Clinical assessment did not favour a spinal etiology and treatment was directed to the PS with good patient outcomes.

References

1. Travell J, Simons D. *Myofascial pain and dysfunction. The trigger point manual: the lower extremities*. Philadelphia: Lippincott Williams & Wilkins, 1993.
2. Boyajian-O’Niell LA, McClain RL, Coleman MK, Thomas PP. Diagnosis and Management of Piriformis Syndrome: An Osteopathic approach. *J Am Osteopath Assoc* 2008; 108: 657-64.
3. Hopavian K, Song F, Riera R, Sambandan S. The clinical features of the piriformis syndrome: a systemic review. *Eur Spinal J* 2010; 19(12):2095-2109.
4. Koes BW, van Tulder MW, Peul WC. Diagnosis and treatment of sciatica. *Br Med J* 2007; 334(7607):1313-7.

Editor comment

Piriformis syndrome is a controversial diagnosis in musculoskeletal medicine, with some rejecting it as a distinct entity. However, some patients do seem to have buttock and leg pain that is relieved by ultrasound-guided local anaesthetic injection into the piriformis and there are other patients who report relief of symptoms by deep tissue massage and stretching. There have also been published reports of the use of botulinum toxin with some positive clinical effect.¹

It is interesting to follow the assessment and treatment provided in the above two cases by this myotherapist and the results for both patients seems to have been beneficial.

1. Kirschner JS, Foye PM, Cole JL. Piriformis syndrome, diagnosis and treatment. *Muscle Nerve* 2009;40(1):10-8.

Book Review

The Principles of Prolotherapy

by Thomas H Ravin, Mark S Cantieri, George J Pasquarello

online orders: <http://www.principlesofprolotherapy.com>

With more than 250 colour photographs and 100 anatomical illustrations, *Principles of Prolotherapy* provides a comprehensive guide to the body's musculoskeletal anatomy as it pertains to the practice of prolotherapy.

This practical resource book is intended for professionals who treat chronic musculoskeletal conditions. Prolotherapy is a valuable component of the non-operative treatment of musculoskeletal pain syndromes. It is best used in combination with other modalities in a comprehensive approach to a patient's problem.

Chapter one introduces musculoskeletal medicine and prolotherapy.

Chapter two details the role prolotherapy can play in healing acute and chronic injuries. The nutrition section provides insight into a subject in musculoskeletal health that does not receive a great deal of emphasis, yet is essential for a patient's recovery.

Chapter three discusses the degenerative postural cascade model and the way in which ligamentous laxity contributes to postural decompensation.

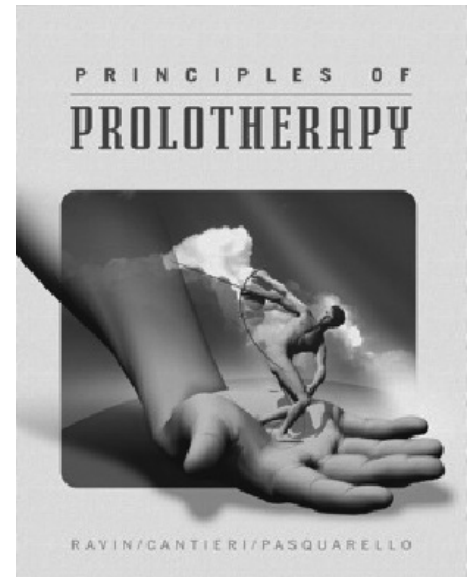
The other nine chapters are organized by body regions. Each chapter details the anatomy of a specific region, its anatomical danger zones, referred pain patterns, and pertinent manipulative treatment. Step-by-step prolotherapy injection procedures for each major musculoskeletal group conclude the chapters.

Colour photographs with specifically created graphic overlays of the underlying ligaments and tendons illustrate precise injection techniques. See www.principlesofprolotherapy.com/ for examples.

Drs Ravin, Cantieri, and Pasquarello have combined their knowledge of treating acute and chronic musculoskeletal pain and their expertise in osteopathic manipulative medicine to train thousands of physicians from the United States and 17 other countries over the course of nearly 20 years. Their pain-staking collaboration has resulted in this concisely written and visually accurate manual.

The book:

- Describes the current rationale and science of wound healing and prolotherapy.
- Demonstrates the role of ligamentous laxity and joint instability in chronic pain.
- Demonstrates the relevance of the tendon's entheses and the role of enthesopathy in chronic pain.
- Illustrates the importance of a thorough understanding of anatomy and danger zones in areas to be injected.
- Emphasises the importance of a systematic approach to physical examination for enthesopathy and joint instability.
- Provides a step-by-step description of injection techniques utilising state of the art computer enhanced photographs.



Journal abstracts

The following are abstracts that have been selected mainly on the interest factor to the commenting authors. Reflective comments are made to provide some clinical context and are the opinion of the author.

Vickers AJ, Cronin AM, Lewith G et al Acupuncture for Chronic Pain: Individual Patient Data Meta-analysis *Arch Intern Med* 2012; 172(19) 1444-53.

Background. Although acupuncture is widely used for chronic pain, there remains considerable controversy as to its value. We aimed to determine the effect size of acupuncture for 4 chronic pain conditions: back and neck pain, osteoarthritis, chronic headache, and shoulder pain.

Methods. We conducted a systematic review to identify randomized controlled trials (RCTs) of acupuncture for chronic pain in which allocation concealment was determined unambiguously to be adequate. Individual patient data meta-analyses were conducted using data from 29 of 31 eligible RCTs, with a total of 17 922 patients analyzed.

Results. In the primary analysis, including all eligible RCTs, acupuncture was superior to both sham and no-acupuncture control for each pain condition ($P < .001$ for all comparisons). After exclusion of an outlying set of RCTs that strongly favored acupuncture, the effect sizes were similar across pain conditions. Patients receiving acupuncture had less pain, with scores that were 0.23 (95% CI, 0.13-0.33), 0.16 (95% CI, 0.07-0.25), and 0.15 (95% CI, 0.07-0.24) SDs lower than sham controls for back and neck pain, osteoarthritis, and chronic headache, respectively; the effect sizes in comparison to no-acupuncture controls were 0.55 (95% CI, 0.51-0.58), 0.57 (95% CI, 0.50-0.64), and 0.42 (95% CI, 0.37-0.46) SDs. These results were robust to a variety of sensitivity analyses, including those related to publication bias.

Conclusions. Acupuncture is effective for the treatment of chronic pain and is therefore a reasonable referral option. Significant differences between true and sham acupuncture indicate that acupuncture is more than a placebo. However, these differences are relatively modest, suggesting that factors in addition to the specific effects of needling are important contributors to the therapeutic effects of acupuncture.

Comment. The role of acupuncture in the management of chronic pain is unclear.

Current evidence has not conclusively demonstrated that acupuncture is more effective than sham treatment for pain relief and functional improvement. Small sample sizes and low methodological qualities are common problems cited by researchers trying to draw conclusions on acupuncture.

In this article, the authors attempt to review the evidence for acupuncture through "Individual Patient Data Meta-analysis" of 29 eligible high quality RCT's, with a total of 17,922 patients, for the treatment of four chronic pain conditions: back and neck pain, osteoarthritis, chronic headache and shoulder pain. Particular emphasis was placed on allocation concealment and quality of blinding. Additionally, a group of studies which produced far superior positive effect size when compared to the average were considered outliers and excluded.

The study showed that acupuncture was superior to sham treatment and no treatment for each pain condition; and the differences are statistically significant. Furthermore the effect sizes were similar across the four pain conditions, although the difference between acupuncture and sham treatment groups is relatively modest.

The authors concluded that acupuncture is effective for the treatment of chronic pain and its effect is more than a placebo. They further proposed that the therapeutic effect of acupuncture is not solely due to specific effects of needling acupuncture points based on traditional acupuncture theory. It must also include non-specific physiological effects and non-specific psychological effects (eg placebo) of needling.

- Dr Thomas Choong

Smith A, Jull G, Schneider G et al. Cervical Radiofrequency Neurotomy Reduces Central Hyperexcitability and Improves Neck Movement in Individuals with Chronic Whiplash. *Pain Medicine* 2014; 15:128-41.

Objective. This study aims to determine if cervical medial branch radiofrequency neurotomy reduces psychophysical indicators of augmented central pain processing and improves motor function in individuals with chronic whiplash symptoms.

Design. Prospective observational study of consecutive patients with healthy control comparison.

Setting. Tertiary spinal intervention centre in Calgary, Alberta, Canada.

Subjects. Fifty-three individuals with chronic whiplash associated disorder symptoms (Grade 2); 30 healthy controls.

Methods. Measures were made at four time points: two prior to radiofrequency neurotomy, and 1- and 3-months post-radiofrequency neurotomy. Measures included: comprehensive quantitative sensory testing (including brachial plexus provocation test), nociceptive flexion reflex, and motor function (cervical range of movement, superficial neck flexor activity during the craniocervical flexion test). Self-report pain and disability measures were also collected. One-way repeated measures analysis of variance and Friedman's tests were performed to investigate the effect of time on the earlier measures. Differences between the whiplash and healthy control groups were investigated with two-tailed independent samples t-test or Mann-Whitney tests.

Results. Following cervical radiofrequency neurotomy, there were significant early (within 1 month) and sustained (3 months) improvements in pain, disability, local and widespread hyperalgesia to pressure and thermal stimuli, nociceptive flexor reflex threshold, and brachial plexus provocation test responses as well as increased neck range of motion (all $P < 0.0001$). A nonsignificant trend for reduced muscle activity with the craniocervical flexion test ($P > 0.13$) was measured.

Conclusions. Attenuation of psychophysical measures of augmented central pain processing and improved cervical movement imply that these processes are maintained by peripheral nociceptive input.

Comment. The authors of this study selected patients for radiofrequency neurotomy (RFN) on the basis of at least 50% pain relief initially following intra-articular injection, then confirmed by medial branch block. They acknowledge that this does not follow the strict diagnostic criteria for the diagnosis of cervical facet

joint pain as espoused by the International Spinal Intervention Society. The description of their technique for RFN using a 21 gauge needle with a 5mm active tip, using only 1 or 2 passes at each level, except for the 3rd occipital nerve where 3 passes were made, also seemed sub-optimal when compared to these same guidelines. Nonetheless, using their diagnostic criteria and RFN technique, their implication that abolition of a nociceptive focus, in this case cervical facet joint pain, in chronic whiplash associated disorder (WAD) sufferers, not only reduces pain and improves motor function, but also improves psychosocial indicators of central sensitization. This in turn suggests that clinically it would seem reasonable to give our chronic pain patients a 'somatic chance' and offer them these relatively safe diagnostic and/or therapeutic injection procedures, even in the presence of clinical features of central sensitization. In some quarters the presence of such central sensitization is suggestive of prominent psychosocial overlay in patient's with (WAD), and is also considered a contraindication to invasive procedures such as interventional diagnostic and potentially therapeutic injections. This study would suggest that those practitioners who continue to hold such negative views of WAD patients should reappraise their beliefs and opinions in the light of such evidence.

- Dr Steve Jensen

Okifuji A1, Donaldson GW, Barck L, Fine PG. Relationship between fibromyalgia and obesity in pain, function, mood, and sleep. *J Pain* 2010 Dec;11(12):1329-37.

Free full article available in PubMed.

Fibromyalgia syndrome (FMS) is a prevalent and disabling chronic pain disorder. Past research suggests that obesity is a common comorbidity and may be related to the severity of FMS. The main objective of the present study was to evaluate the relationships between FMS and obesity in the multiple FMS-related domains: hyperalgesia, symptoms, physical abilities, and sleep. A total of 215 FMS patients completed a set of self-report inventories to assess FMS-related symptoms and underwent the tender point (TP) examination, physical performance testing, and 7-day home sleep assessment. Forty-seven percent of our sample was obese and an additional 30% was overweight. Obesity was related significantly to greater pain sensitivity to TP palpation particularly in the lower body areas, reduced physical strength and lower-body flexibility, shorter sleep duration,

and greater restlessness during sleep. The results confirmed that obesity is a prevalent comorbidity of FMS that may contribute to the severity of the problem. Potential mechanisms underlying the relationship are discussed.

Perspective. This report presents how obesity may be interrelated to fibromyalgia pain, disability, and sleep. We found that obesity is common in FMS. Approximately half of our patients were obese and an additional 30% were overweight. We also found that obesity in FMS was associated with greater pain sensitivity, poorer sleep quality, and reduced physical strength and flexibility. The results suggest that obesity may aggregate FMS and weight management may need to be incorporated into treatments.

Comment. Clinically obese patients, as compared to those with a normal BMI, do seem to report more chronic pain, not only in weight bearing joints but also in the soft tissues. Sleep apnoea and type 2 diabetes mellitus that are commonly present in the obese patient are possibly also relevant as "pain generating" with especially long term diabetes causing a peripheral neuropathy. Obesity is reported to be an inflammatory state with increased levels of TNF- α and IL-6 and focal fatty tissue areas of necrosis which provides an explanation, at least on a superficial level, for this clinical impression.

This study helps confirm clinical impressions, that have already been generally accepted anyway, but does not really advance our understanding and provide any novel treatment ideas. The obese patient with multiple pain areas is difficult to treat with many unfortunately being prescribed opioids and other medications which do not really seem to be effective. A significant follow on question that needs to be clarified is whether losing body mass results in a reduction of soft tissue pain. Intuitively that would be expected but sometimes in medicine desired outcomes do not necessarily occur.

- Dr Tom Baster

Teichtahl AJ1, Wluka AE, Tanamas SK et al. Weight change and change in tibial cartilage volume and symptoms in obese adults. *Ann Rheum Dis* 2014 Feb 11.

Introduction. There is a paucity of data examining the effects of weight change on knee joint structures and symptoms. This study examined the effect of weight change on change in knee cartilage volume and symptoms in an obese cohort.

Methods. 112 obese subjects (Body Mass

Index ≥ 30 kg/m²) were recruited from various community sources to examine the effect of obesity on musculoskeletal health. Tibial cartilage volume, determined by MRI, and knee symptoms, determined by the Western Ontario and McMaster Osteoarthritis Index (WOMAC) were collected at baseline and an average of 2.3 years later.

Results. Percentage weight change was associated with change in medial tibial cartilage volume (β -1.2 mm³, 95% CI -2.3 to -0.1 mm³, $p=0.03$) that was consistent throughout the spectrum of weight loss through to mild weight gain. Percentage weight change was not associated with change in the lateral tibial ($p=0.93$) or patella ($p=0.32$) cartilage volumes. Percentage weight change was associated with change in all WOMAC subscales (all $p \leq 0.01$): pain (β -1.8 mm, 95% CI -3.2 to -0.4 mm), stiffness (β -1.6 mm, 95% CI -2.5 to -0.7 mm) and function (β -6.9 mm, 95% CI -11.6 to -2.1 mm).

Conclusions. The linearity of effect implies that weight loss is associated with reduced medial cartilage volume loss and improved knee symptoms, while weight gain is associated with increased medial cartilage volume loss and worse knee symptoms. These results suggest that in obese people, small amounts of weight change may have the potential for a disease modifying effect on both knee joint structure and symptoms. While weight loss is an important primary management strategy in obese individuals, avoidance of further weight gain should also be a clinical goal.

Comment. The obese patient is normally encouraged to lose body mass as a component of treatment for knee osteoarthritis but the question arises whether or not such advice is valid. This study of 112 patients over an average of 2.3 years partly addresses this question. Knee osteoarthritis is clinically more common in the medial compartment and this study indicates that weight gain does seem to result in increased medial cartilage loss, with increased pain and change in the WOMAC score. Intuitively any increase in body mass would apply increased mechanical stress on a knee joint with potential for "damage" and this seems to have been confirmed here but only with regards to the medial knee compartment. This seems a little peculiar but may simply reflect the mechanical forces of the joint. Thus the advice to patients to try and lose some body mass still seems to be valid. However knee osteoarthritis also occurs in many patients with a normal BMI presumably from genetic or trauma related

reasons and advice to lose weight in those cases would seem to be inappropriate.

- Dr Tom Baster

Bruyère O1, Reginster JY, Bellamy N et al; Clinically meaningful effect of strontium ranelate on symptoms in knee osteoarthritis: a responder analysis. *Rheumatology* (Oxford) 2014 Mar 25.

Objectives. The aim of this study was to assess the efficacy of strontium ranelate in improving symptoms in knee OA. **Methods.** Symptoms were assessed over 3 years in patients with primary knee OA receiving strontium ranelate 2 g/day (n = 454), 1 g/day (n = 445) or placebo (n = 472) in the Strontium Ranelate Efficacy in Knee Osteoarthritis Trial. Clinical response was evaluated using WOMAC subscores, minimal perceptible clinical improvement (MPCI), minimal clinically important improvement (MCII) and a modified OMERACT-Osteoarthritis Research Society International (OARSI) responder definition. Patients who withdrew prematurely from the study were considered non-responders. **Results.** There was no significant effect on symptoms for strontium ranelate 1 g/day. At the dosage of 2 g/day, strontium ranelate was associated with greater response than placebo in terms of $\geq 20\%$ improvement in WOMAC pain from baseline to the last visit (58% vs 47%, $P = 0.002$) and $\geq 50\%$ improvement in WOMAC pain (42% vs 36%, $P = 0.083$). Significant differences were found in MPCI response for WOMAC pain (52% vs 40%, $P < 0.001$), stiffness (47% vs 39%, $P = 0.009$) and physical function (46% vs 37%, $P = 0.009$) and in MCII response for WOMAC physical function (46% vs 37%, $P = 0.013$). There were also more OMERACT-OARSI-like responders with strontium ranelate (44% vs 35%, $P = 0.004$). The treatment-placebo difference in MPCI response for WOMAC pain was significant after 6 months ($P = 0.024$), while that in MPCI and MCII response for WOMAC physical function reached significance after 12 months ($P = 0.027$ and $P = 0.019$, respectively).

Conclusion. Treatment with strontium ranelate 2 g/day over 3 years is associated with a clinically meaningful improvement in pain from 6 months as well as physical function and stiffness as assessed by the number of responders above thresholds of clinical relevance.

Comment. There has been a trickle of reports about Strontium ranelate possibly being useful for knee arthritis and this paper continues to add to the story. There is currently a dearth of treatment options

for quite a number of patients who are unsuitable for knee replacement or who continue to have post joint replacement pain. Many are prescribed opioids with limited effect. Strontium ranelate is already in use in Australia as a treatment for osteoporosis and it is certainly tempting to try it for knee arthritis, especially if the patient has bone density levels or have had a fracture that satisfies the PBS authority criteria. Unfortunately however the drug is currently under investigation as causing an slight increase in cardiac events and thromboembolism and thus may not be available to use for much longer.

- Dr Tom Baster

Oteo-Álvaro A, Ruiz-Ibán MA, Miguens X et al. High Prevalence of Neuropathic Pain Features in Patients with Knee Osteoarthritis: A Cross-Sectional Study. *Pain Pract* 2014; Apr 21.

Objective. The present epidemiological research evaluated the prevalence of neuropathic pain characteristics in patients with painful knee osteoarthritis (OA) and the plausibility that such neuropathic features were specific of OA.

Methods. Outpatients with chronic pain associated with knee OA who attended orthopedic surgery or rehabilitation clinics were systematically screened for neuropathic pain with the Douleur Neuropathique in 4 questions (DN4) questionnaire. Data from medical files and those obtained during a single structured clinical interview were correlated with the DN4 scores. Information on potential confounders of neuropathic-like qualities of knee pain was collected to evaluate as much as possible only the symptoms attributable to OA.

Results. Of 2,776 patients recruited, 2,167 patients provided valid data from 2,992 knees. The DN4 was scored positively (≥ 4) in 1,125 patients (51.9%) and 1,459 knees (48.8%). When patients with potential confounders were excluded, the respective prevalences were 33.3% and 29.4%. Patients who scored positively in the DN4 had more severe pain, greater structural damage, and more potential confounders of neuropathic pain. Three potential confounders conveyed much of the variability explained by regression analyses. However, latent class analyses revealed that the concurrence of other factors is required to explain the neuropathic pain qualities.

Conclusions.

A relevant proportion of patients with chronic pain associated with knee OA featured neuropathic pain qualities that

were not explained by other conditions. The present research has provided reasonable epidemiological grounds to attempt their definite diagnosis and classification.

Comment. The high prevalence (about 30%) of a positive DN4 score for neuropathic pain in this study was surprising and patients with severely arthritic knees attending my practice will need to be scrutinised more carefully as there are now a few treatments for neuropathic pain on the PBS. My practice does have at least two patients with ongoing pain post knee replacement that does seem to be neuropathic but treatment with pregabalin has not been particularly successful.

- Dr Tom Baster

Baron R1, Martin-Mola E, Müller M et al. Effectiveness and Safety of Tapentadol Prolonged Release (PR) Versus a Combination of Tapentadol PR and Pregabalin for the Management of Severe, Chronic Low Back Pain With a Neuropathic Component: A Randomized, Double-blind, Phase 3b Study. *Pain Pract* 2014; Apr 17.

Objective. To evaluate the effectiveness and tolerability of tapentadol PR monotherapy versus tapentadol PR/pregabalin combination therapy for severe, chronic low back pain with a neuropathic component.

Methods. Eligible patients had painDETECT "unclear" or "positive" ratings and average pain intensity ≥ 6 (11-point NRS-3 [average 3-day pain intensity]) at baseline. Patients were titrated to tapentadol PR 300 mg/day over 3 weeks. Patients with ≥ 1 -point decrease in pain intensity and average pain intensity ≥ 4 were randomized to tapentadol PR (500 mg/day) or tapentadol PR (300 mg/day)/pregabalin (300 mg/day) during an 8-week comparative period.

Results. In the per-protocol population (n = 288), the effectiveness of tapentadol PR was clinically and statistically comparable to tapentadol PR/pregabalin based on the change in pain intensity from randomization to final evaluation (LOCF; LSMD [95% CI], -0.066 [-0.57, 0.43]; $P < 0.0001$ for noninferiority). Neuropathic pain and quality-of-life measures improved significantly in both groups. Tolerability was good in both groups, in line with prior trials in the high dose range of 500 mg/day for tapentadol PR monotherapy, and favorable compared with historical combination trials of strong opioids and anticonvulsants for combination therapy. The incidence of the composite of dizziness

and/or somnolence was significantly lower with tapentadol PR (16.9%) than tapentadol PR/pregabalin (27.0%; $P = 0.0302$).

Conclusions. Tapentadol PR 500 mg is associated with comparable improvements in pain intensity and quality-of-life measures to tapentadol PR 300 mg/pregabalin 300 mg, with improved central nervous system tolerability, suggesting that tapentadol PR monotherapy may offer a favorable treatment option for severe low back pain with a neuropathic component.

Comment. Tapentadol (Palexia) is a recent addition to the drug treatment options for pain. It is related to tramadol with dual action as a mu opioid receptor agonist and noradrenaline reuptake inhibitor. It seems to be between tramadol and morphine in clinical effectiveness and there is still a possible adverse interaction with SSRI medications as occurs with tramadol. This study is interesting in the way monotherapy with tapentadol is compared to a combination with pregabalin for patients with chronic low back pain with a neuropathic component. Treatment with pregabalin has become commonplace but many patients do not seem to benefit much from it or have side effects that result in this drug being ceased so tapentadol alone may be an option.

- Dr Tom Baster

Rubinstein SM, Terwee CB, Assendelft WJ et al. Spinal manipulative therapy for acute low-back pain. *Cochrane Database Syst Rev* 2012 Sep 12;9:CD008880.

Background. Many therapies exist for the treatment of low-back pain including spinal manipulative therapy (SMT), which is a worldwide, extensively practised intervention. This report is an update of the earlier Cochrane review, first published in January 2004 with the last search for studies up to January 2000.

Objectives. To examine the effects of SMT for acute low-back pain, which is defined as pain of less than six weeks duration.

Search methods. A comprehensive search was conducted on 31 March 2011 in the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, EMBASE, CINAHL, PEDro, and the Index to Chiropractic Literature. Other search strategies were employed for completeness. No limitations were placed on language or publication status.

Selection criteria. Randomized controlled trials (RCTs) which examined the effectiveness of spinal manipulation or mobilization in adults with acute low-back

pain were included. In addition, studies were included if the pain was predominantly in the lower back but the study allowed mixed populations, including participants with radiation of pain into the buttocks and legs. Studies which exclusively evaluated sciatica were excluded. No other restrictions were placed on the setting nor the type of pain. The primary outcomes were back pain, back-pain specific functional status, and perceived recovery. Secondary outcomes were return-to-work and quality of life. SMT was defined as any hands-on therapy directed towards the spine, which includes both manipulation and mobilization, and includes studies from chiropractors, manual therapists, and osteopaths.

Data collection and analysis. Two review authors independently conducted the study selection and risk of bias (RoB) assessment. Data extraction was checked by the second review author. The effects were examined in the following comparisons: SMT versus 1) inert interventions, 2) sham SMT, 3) other interventions, and 4) SMT as an additional therapy. In addition, we examined the effects of different SMT techniques compared to one another. GRADE was used to assess the quality of the evidence. Authors were contacted, where possible, for missing or unclear data. Outcomes were evaluated at the following time intervals: short-term (one week and one month), intermediate (three to six months), and long-term (12 months or longer). Clinical relevance was defined as: 1) small, mean difference (MD) $< 10\%$ of the scale or standardized mean difference (SMD) < 0.4 ; 2) medium, MD = 10% to 20% of the scale or SMD = 0.41 to 0.7 ; and 3) large, MD $> 20\%$ of the scale or SMD > 0.7 .

Main results. We identified 20 RCTs (total number of participants = 2674), 12 (60%) of which were not included in the previous review. Sample sizes ranged from 36 to 323 (median (IQR) = 108 (61 to 189)). In total, six trials (30% of all included studies) had a low RoB. At most, three RCTs could be identified per comparison, outcome, and time interval; therefore, the amount of data should not be considered robust. In general, for the primary outcomes, there is low to very low quality evidence suggesting no difference in effect for SMT when compared to inert interventions, sham SMT, or when added to another intervention. There was varying quality of evidence (from very low to moderate) suggesting no difference in effect for SMT when compared with other interventions, with the exception of low quality evidence from one trial demonstrating a significant and moderately clinically relevant short-term effect of SMT on pain relief when

compared to inert interventions, as well as low quality evidence demonstrating a significant short-term and moderately clinically relevant effect of SMT on functional status when added to another intervention. In general, side-lying and supine thrust SMT techniques demonstrate a short-term significant difference when compared to non-thrust SMT techniques for the outcomes of pain, functional status, and recovery.

Authors' conclusions. SMT is no more effective in participants with acute low-back pain than inert interventions, sham SMT, or when added to another intervention. SMT also appears to be no better than other recommended therapies. Our evaluation is limited by the small number of studies per comparison, outcome, and time interval. Therefore, future research is likely to have an important impact on these estimates. The decision to refer patients for SMT should be based upon costs, preferences of the patients and providers, and relative safety of SMT compared to other treatment options. Future RCTs should examine specific subgroups and include an economic evaluation.

Comment. Another Cochrane review of a therapeutic modality that will probably never be abandoned in spite of less than convincing results yet again. Some justification of side lying and supine thrust techniques may be gleaned from this review that is of short-term benefit to a patient but prolonged treatment using manipulative therapy and "regular adjustments" do not seem to be supported. Recognising the fluctuating natural history of both acute and chronic low back pain renders any prolonged treatment open to critique that any effect was more related to regression to the mean rather than any actual clinical effect.

- Dr Tom Baster

Educational Activities

Masters, Diploma, and Certificate Courses in Musculoskeletal Medicine

Flinders University Diploma/Certificate in Musculoskeletal Medicine

Date	Title/Key Resource Person	Venue	Provider	Contact	CME Points
2014	Graduate Diploma in Musculoskeletal Medicine	Flinders Medical Centre	School of Health Sciences, Bedford Park SA 5042	Mr Don Bramwell, Ph +61 8 8204 4673; donald.bramwell@flinders.edu.au	TBA

University of Otago Diploma/Certificate in Musculoskeletal Medicine, plus new qualification - Masters/Diploma/Certificate in Health Sciences (Pain and Pain Management)

Date	Title/Key Resource Person	Venue	Provider	Contact	CME Points
2014	<p><i>On campus papers</i> Clinical Diagnosis and Clinical Therapeutics</p> <p><i>Distance taught papers</i> Pain Pain management Regional disorders (Spine and Limbs) Rehabilitation Recreational and sports injuries Pain assessment Neurobiology of pain Biomedical aspects of pain Psychosocial and cultural aspects of pain</p>	<p>On-campus course University of Otago, Christchurch</p> <p>Distance taught papers - fortnightly audioconferences ex University of Otago, Christchurch</p>	University of Otago	<p>Enrolments: Veronica McGroggan Ph +64 3 364 1086 Fax +64 3 364 0909 veronica.mcgroggan@otago.ac.nz or Geoff Harding Ph +61 7 3269 5522 Fax +61 7 3269 6407 drgeoffh@bigpond.net.au website www.uoc.otago.ac/departments/msm</p>	Mixture of points, including small group points

Australian School of Advanced Medicine, Macquarie University - Masters Degree in Musculoskeletal Medicine

Date	Title/Key Resource Person	Venue	Provider	Contact	CME Points
2014	Master of Advanced Medicine in Musculoskeletal Medicine (2-year part-time Distance Learning with 2 on campus Intensives of 1 week each in each year)	Sydney	Macquarie University, Sydney	A/Prof Rod Ayscough or A/Prof Michael Creswick via School Administrator Julie Stone Ph +61 2 9812 3512 Fax +61 2 9812 3600 Email: julie.stone@mq.edu.au or visit website www.medicine.mq.edu.au	

Australian College of Physical Medicine Fellowship Program

Date	Title/Key Resource Person	Venue	Provider	Contact	CME Points
2014	Fellowship Australian College of Physical Medicine, Part II (Part 1 is Masters in Physical Med or Musculoskeletal Med from Sydney or Macquarie Unis)	Sydney	Australian College of Physical Medicine	Michael Creswick Ph +61 2 9481 9585 michael.creswick@mq.edu.au or visit website www.physicalmedicineaustralia.com.au	TBA

Other Musculoskeletal Medicine Educational Activities

Date	Title/Key Resource Person	Venue	Provider	Contact	CME Points
29 June 2014	Prolotherapy, neural prolotherapy and trigger point therapy in podiatry	Physiotherapy Assoc. Kent Town, Adelaide	Dr Margaret Taylor	taylorme@internode.on.net	
26-27 July 2014	Non-malignant pain, the role of acupuncture in an integrative environment	Sofitel Gold Coast, Broadbeach, Qld	Australian Medical Acupuncture College - Queensland	Julie Hill, 0439 549085 amacqadmin@amac.org.au	40 category 1 RACGP points
16-17 August 2014	Dilemmas in musculoskeletal medicine - when to refer for surgery	Qld Museum, Southbank, Brisbane	Australian Association of Musculoskeletal Medicine	Assoc Prof Michael Yelland m.yelland@griffith.edu.au	TBA
4-7 September 2014	Nerves n' Pain	Novotel Hotel, Rotorua NZ	NZAMM, AAMM and AFMM	sue@spconferences.co.nz www.spconferences.co.nz	
October 2014 date TBA	Injection therapies for pain with prolotherapy, trigger point and neural prolotherapy	Physiotherapy Assoc. Kent Town, Adelaide	Dr Margaret Taylor	taylorme@internode.on.net	

Nerves 'n Pain

DATE: FRIDAY 5th to SUNDAY 7th September 2014 **VENUE:** NOVOTEL LAKESIDE HOTEL ROTORUA
9-11 Lake End TUTANEKEI STREET, ROTORUA CENTRAL CITY, ROTORUA, NEW ZEALAND



Convenor's welcome It is with pleasure that we invite you to our next conference that continues our theme of examining the tissues involved in musculoskeletal pain.
(Our previous conferences: 2003 – Muscles, 2007 – Tendons, 2012 - Joints)
We turn this time to the tissue and system at the center of the pain experience – The Nervous System.
Our understanding of the role of the nervous system in pain shapes our interpretation of what our patients tell us about their pain and disability.
It also dictates how we examine, investigate and manage their painful conditions.
It has been said that “brain science has legitimised voices from patients” (Gwyn Lewis).
It is the aim of this conference to better manage our pain patients with the latest in scientific evidence in this field of study and practice of pain medicine."

Prof. Nikolai Bogduk

Bone and Joint Institute
University of Newcastle
New South Wales
Australia

Professor of Pain Medicine

Professor Bogduk is amongst the pre-eminent clinical anatomist of our time.

In 2013 he became a Member of the Order of Australia in recognition of 40 years of research and education into the science behind spinal, neck and back pain.

He is on the editorial board of many publications. He has published at least 9 books and contributed chapters in many more. He will talk on “Pain concepts old and new” and on “Radicular Pain”.

Prof. Paul Hodges

University of Queensland
Queensland
Australia

Director
Centre of Clinical Research
Excellence in Spinal Pain,
Injury & Research

Over the past 14 years, Paul and his team have made discoveries that have shaped conservative management of spinal pain. He has published more than 130 peer reviewed papers and book chapters. Major developments include identification of strategies used by the brain to control the spine. Notably, these strategies were changed in people with spinal pain, providing the basis for novel exercise interventions. He will talk on Cortical changes in LBP and rehabilitation to change the brain program and central neural sensitisation

Supporting speakers:

Dr Barry Snow,
Neurologist, Auckland

Mr Malcolm Johnson
Pain Psychologist, Auckland

Dr Dean Kilfoyle
Neurologist, Auckland

Dr David McBride
Occupational Medicine
Physician, Dunedin

Dr John Alchin
Burwood Pain Clinic
Christchurch

Speaking on painful neurological conditions; pain assessment; nerve conduction studies & EMG; carpal tunnel syndrome; drug treatment of pain stemming from the nervous system; spinal cord stimulation; surgical repair of nerve injuries.

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