The physiotherapy perspective

InTouch

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Editorial

Welcome fellow members of Physio First to the first edition of *In Touch* for 2020.

As a physiotherapist, is there anything more satisfying than having something you can pull out of your clinical toolkit that you know will bring about a successful outcome for your patient? On those occasions, the reward is instantaneous and makes the years of studying anatomy and the further years of developing treatment skills all worthwhile.

I would argue that by using our clinical toolbox every day we become pretty good at recognising what works best for the best patient outcome, but is this "box of tricks" all there is to what we do? Personally, I find it annoying whenever the clinical skill involved in physiotherapy is described as a "dark art" because I know that we, as a profession, are underpinned by scientific research which informs the clinical decisions we make with regard to prescribing the most appropriate treatment for the wide range of presentations we see in our clinics. So, rather than being a "dark art", physiotherapy can, in fact, be illuminated by evidence.

As Physio First members, we have access to our Data for Impact (DfI), Quality Assured Practitioner (QAP) and Quality Assured Clinic (QAC) pathways by which we can demonstrate our evidence-based worth individually, and as a profession as a whole. This is a massive benefit both to ourselves, our patients and everyone who, in their dealings with physiotherapy in whatever capacity, seeks out Assured Quality.

The articles featured in this edition of *In Touch*, as with all of our articles, demonstrate how scientific knowledge can guide us to more precise decision-making. Indeed, my own research work outlined on p18 is a case in point as it describes the 3T – 10,000 Tendons Study and how those of us involved, by interrogating the data collected, are looking at refining treatment options from the "let's try this" approach to "this is the appropriate treatment" for the individual patient.

The point is that data underpins our profession and our clinical decisions. Our skills are more than just recommending "some" exercise or "pressing on things", but to prove this we need to engage with the research by collecting and analysing data in order to demonstrate treatment pathways and also our collective worth as a profession.

As always, I am hugely grateful to everyone who has contributed to this edition, and particularly to our clinical authors for sharing their knowledge and expertise with us to help us to be better at what we do.

I hope you enjoy the edition.

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COVER IMAGE:

What no one tells you about in ACL rehabilitation

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Anterior Cruciate Ligament (ACL) injury, reconstruction and rehabilitation are key topics for any MSK physiotherapist, and these have evolved in many formats over the past 30 years. What warrants a successful outcome varies between the non-athletic and professional athlete patient, and involvement with each end of the spectrum educates any therapist who works in this field. Dedication to a full recovery is a key component of the make-up of the patient and this needs to be mirrored by the physiotherapist's role in the process. A majority of professional athletes will return to sport within a six to nine month window. This article aims to demonstrate some of the possible reasons for such a recovery process which may be educational and beneficial to both patient and therapist alike.

LEARNING OUTCOMES
TO SUPPORT PHYSIO FIRST QAP

1 Four out of every five patients who undergo surgery for ACL reconstruction can be expected to return to play; however, only 65% of those will return to their pre-injury participation level (Ardern *et al* 2014).
2 Only one third of Australian sub-elite competitive team sport athletes return to competitive sports 12 months after surgery (Ardern *et al* 2011).
3 Almost all male professional football players in Europe return to their pre-injury level within a year following ACL reconstruction (Walden *et al* 2016, Zaffagnini *et al* 2014).
4 Female athletes are up to eight times more likely to incur non-contact ACL injuries than male athletes (Mandelbaum *et al* 2005).

Introduction

In all the time I have worked as a Chartered Physiotherapist in professional sport, Anterior Cruciate Ligament Reconstruction (ACLR) and the accompanying rehabilitation of athletes with this injury has played a key part in my clinical and professional development. High-profile players acquiring major knee injuries is a common theme in sports such as rugby, football, and Gaelic football (which I have been lucky enough to work within), and the extremely high return-to-play success rate for these athletes has ensured that my workload has never seemed to diminish.

For as long as I can remember I receive, on a weekly basis, correspondence from an unknown source who has somehow obtained my mobile number, email or work address (occasionally home address as well!), with this common request: "I have just read in the media that one of your patients has returned to play professional sport approximately six months after ACLR. I had the same problem 18 months ago and I am nowhere near returning to sport. What can I do?"

Unfortunately, it is essential for the injured amateur/casual sportsperson to understand the differences that exist in their world of rehabilitation and that of the professional athlete.

Elite athletes usually have invested greater time in their sport through longer training and rehabilitation hours, and this has been shown to favour a return to the pre-injury level of sport following ACLR surgery (Ardern *et al* 2014). The aim of this article is, therefore, to demonstrate the various key differences in the route to rehabilitation between elite and non-elite individuals, albeit with the same injury. You may note that the references range from 40 years ago to the present day. I make no excuse for this as this is how we build our clinical experience and often, on the clinical "coal face", we continue to use what has personally worked for us over the period of our working careers.

Patient selection or the self-selecting patient?

What type of person makes the best patient? In sport, goal setting is happening every day of the week so, once a player who has sustained an injury has refocused their purpose, we can begin to lay the pathway forward with various goal setting target criteria markers to take them along the road to recovery.

In his autobiography, former England rugby union coach Clive Woodward talks about being able to divide groups of players into two distinct groups. The first group, energisers, are ideal patients. Energisers are the players who are committed to the recovery process

> "PATIENTS CAN BE DIVIDED INTO THOSE WHO ARE COMMITTED TO RECOVERY AND THOSE WHO MAKE EXCUSES FOR WHY THEY ARE NOT PROGRESSING"

and work hard. They are tough, robust and resilient individuals who take up the challenge of rehabilitation to full recovery. The second group, energy sappers, tend to have a more laid-back approach to recovery and are very demanding and time-consuming. They tend to be fragile, unreliable, and make excuses when their road to recovery is not smooth.

It is important to remember that there are often a number of interested parties when it comes to the recovery of the professional athlete; agents, team chief executives, coaches, medical team, and their family, so it is essential that the clinician is able to work within this structure and involve all parties where and when appropriate.

Prime time for surgery

In 66% of the incidence of ACL injury, other associated injuries, such as ligament, meniscal, bone or soft tissue damage will also be indicated, and these do not include the "dark shadow" of bruising that can often be seen on the femoral or tibial bone surfaces on an initial MRI scan, the effect of which may not rear its ugly head until several years later, in the form of osteochondral issues (Nagelli & Hewett 2017).

For injuries requiring surgery, pre-operative rehabilitation is essential. The one to two-week period between the date of injury and the date of surgery is not a time for the player to convalesce. Eitzen *et al* (2009) reports that ACL-injured individuals, with pre-operative quadriceps strength deficits of above 20%, have a lower Cincinnati functional knee score (Noyes *et al* 1983; Lysholm & Tegner 2007) and significantly larger quadriceps strength deficits two years post-surgery, and that ACLR treated patients who undergo pre-operative rehabilitation have higher functional outcomes and return-to-sport (RTS) rates. This was compared with the benchmark cohort that used a criterion-based post-operative rehabilitation programme two years after ACLR injury (Failla *et al* 2016).

Rehabilitation

The ability to compromise and adapt in sports medicine is essential for clinical practice. In many situations the physiotherapist may have to work with only basic facilities in both the treatment and rehabilitation settings and, in specific treatment terms, expensive equipment will never be a substitute for manual skills that can be used anywhere, never need a power supply, and are essential for continued clinical development. In rehabilitation terms, basic facilities often means adapting basic pieces of equipment to produce a multitude of sport specific exercise drills. The average single station weight machine can cost several thousand pounds, allows only for a limited number of different exercises and, more often than not, is a non-functional activity. A plate loading barbell on the other hand is relatively inexpensive, can help develop balance, co-ordination and strength, and can be used with a variety of gym exercises. With a three-dimensional approach to lateral thinking, functionality and sports specific rehabilitation, the number of exercises that can be achieved can be endless.

That is not to say that the expensive pieces of equipment that are available are not invaluable. The imaginative therapist can create a library of exercises with the multi-axial weighted pulley machine and a cable crossover unit and, while isokinetic and balance units are expensive, and often castigated for being non-functional and become redundant in idle hands, with the knowledge and appreciation of what they can bring to the clinical setting, they can be used as functional tools in the rehabilitation stage of treatment. To use our skills, we must incorporate and appreciate the many different rehabilitation options that are available. Exercise rehabilitation programmes need to be specific and not purely a photocopied handout!

The following are the three stages which the rehabilitation journey for ACL injuries can be divided into.

1. MAXIMUM PROTECTION PHASE (0-4 WEEKS)

Mobility

The first rule of thumb following any injury, and none more so than in the ACL patient, is to regain a maximum range of movement in the affected joint. Failure to do so can lead to excessive fibrosis of the connective tissue or poorly organised scar tissue in and around the knee, and the donor tendon site, i.e. the patella tendon or hamstring. Full knee extension is sought as soon as possible after surgery and flexion is progressed throughout the various stages of rehabilitation.

In the early stages of rehabilitation, acute pain from the injury site may limit the amount of force the patient can generate when exercising. Muscle atrophy rates of 2% - 6% per day for the first eight days (Mueller 1970), or 40% over six weeks (Psatha *et al* 2012) of immobilisation, will lead to a negative effect on long term functional outcome. Submaximal exercise must begin on the first day post-op, before progressing to fully active modes as the acute symptoms

> "EXPENSIVE EQUIPMENT WILL NEVER BE A SUBSTITUTE FOR MANUAL SKILLS THAT CAN BE USED IN ANY SETTING"

Light submaximal contraction	0-30%	Initiate contraction in slow twitch fibres (ST)
Moderate submaximal contraction	0-65%	Initiate contraction in ST and the next most sensitive fibre type, fast twitch (FTa / FTb)
Maximal contraction	65%-Maximum	Initiate recruitment in all muscle fibre types ST, FTa and FTb as well as other neurophysiological responses such as disinhibition and synchronisation

TABLE 1: Phases of contraction and the effect on muscle tissue

subside. Intensity of contraction can be subdivided into three categories (table 1).

It is important to remember that, as exercise is now classified as a medicine, dosage measurements related to intensity, frequency and duration need to be specific, particularly in the highly motivated patient. The fragile nature of injured or acute post-surgery tissue may only need very small changes in progression of one or all of the aforementioned parameters, certainly in the case where the patient is seen on a daily basis.

2. MODERATE PROTECTION PHASE (4-12 WEEKS)

Stability

As already stated, muscle function plays an important role in many rehabilitation programmes. Knowledge of the various aspects of muscle function and how it influences athletic performance and injury is essential for all therapists who work in the sporting environment.
My preference for introducing muscle workloads in the maximum to moderate protection phases of rehabilitation, i.e. at 0-12 weeks, is to use time-based bouts of exercise, allowing the repetition count to be patient-driven (table 2).

The incorporation of isolated open-chain exercise versus those of antagonistic bi-articular closed kinetic chain, has fluctuated over the past four decades of ACL rehabilitation. As surgical techniques and materials have improved, open-chain exercises have been reintroduced into the ACL rehabilitation programme at a far earlier stage, often as early as six to eight weeks post-op (Perry *et al* 2005; Pinczewski *et al* 2009). These exercises ensure that work on isolated quadriceps, which is essential for a full functional recovery, can be introduced safely at an earlier stage (Nagelli & Hewett 2017; Podraza & White 2010) than would be the case if open-chain exercises were not introduced.

WEEK	TIME (SECONDS)	SETS
0-2	30	3
2-4	60	3
4-6	90	3
6-8	120	3
8-10	150	3
10-12	180	3

TABLE 2: Moderate protection phase exercise parameters

When can I run?

This key question is usually one of the first asked by any sportsperson recovering from an ACL injury. In the majority of rehabilitation programmes the answer is usually a time-based rather than a criterion-based one and would normally be at around 12-14 weeks post-op. However, where a patient still has marked muscle atrophy, and/or has put on extra weight due to inactivity, it should be considered whether this is the right time-scale in which to stress an unsupported, overloaded post-operative knee. Bilateral isokinetic testing (figure 1) at 12 weeks post-op (table 3), and utilising torque with body weight data, ensures this is a more clinical based decision. Range of movement is limited to between 90° to 40° of knee flexion, test speeds are between 180° and 300° per second, and the anti-shear device is used on both limbs to keep all variables similar. Familiarisation with the test speeds should commence the week before testing (Wilk *et al* 1990).

FIGURE 1:. Bilateral isokinetic testing using the Biodex System 4

TEST	180°	300°
Reps	10	15
Hamstring / quadriceps ratio	70-79	80-89
Quads peak torque % BW	60-65	45-55
Ham peak torque % BW	40-50	33-42
Quads total work % BW	85-95	70-80
Quads average power % BW	170-190	170-185

TABLE 3: Isokinetic test for ACLR knee rehabilitation at 12 weeks post-op (Wilk *et al* 1990)

It is important to determine which data targets the non-operated leg can achieve per individual. Ideally, professional athletes should be able to achieve six out of 10 parameters before progressing to the running stage of rehabilitation.

Controlled mobility

In the sporting environment an individual muscle, muscle groups or an entire extremity will need to generate and absorb forces that may exceed their strength potential. Interruptions in normal transmissions of these muscular and joint forces can occur in structures proximal to other injury sites, for instance in the case of the ACL, associated acute or chronic injury to the foot and ankle. When applied to physiotherapy, the link system emphasises the interdependent nature of individual components and their ultimate contribution to the entire system. Recognition of this disruption to the knee, hip, pelvis, abdomen and upper limb is essential in designing a

> "WITHOUT HIP STABILISATION, THE KNEE CANNOT EXTEND WITH MAXIMUM STRENGTH"

complete rehabilitation programme (Nicholas & Marino 1987).

Single joint-muscle factors, such as strength ratios, may only be relevant in isolated cases. Physical deficits in the multi-joint muscle linkage system can affect whole body performance in recreational and high-performance sporting activities. Further up the chain, active knee extension requires co-contraction of the hip extensors to prevent hip flexion. Without this stabilisation, the knee cannot extend with maximum strength. The type of exercises which may be reproduced can be very functional and utilise a total movement pattern.

Functional progression is required for a safe return to activity. By breaking the action down into a hierarchy then performing that in sequence allows for re-education and redevelopment of a specific skill. Reactive neuromuscular training (RNT) drills are designed to restore functional stability in the injured joint, and in those specifically distal and proximal to it, while enhancing various motor skills. The initial priority is to regain dynamic stability around the injured joint as research suggests that dynamic stabilisation produced by co-contraction is inhibited due to abnormal firing patterns of the joint mechanoreceptors following trauma (Voight & Cook 1996; Kennedy *et al* 1982).

Once stability has been achieved, active movement such as walking / running can be incorporated before the patient progresses to more complex motor and sports specific skills. There are three specific phases of stabilisation progression which incorporate numerous interphase variables:

1. Static stabilisation
2. Transitional stabilisation
3. Dynamic stabilisation.

There are many possible adaptations to the stabilisation phases, depending on the demands of the athlete and their sport. Some rehabilitation tools such as cliniband / tubing, harness, single station pulley, as well as proprioceptive aids and

FIGURE 2: Single leg lunge with hip adduction / extension using a Torg-King omni wheel system

FIGURE 3: Single leg lunge on an unstable base. With use of an air stability wobble cushion, and anterior force applied via the Westminster pulley attached to the player's belt

sports-specific equipment (figures 2 and 3) are required, and a logical notation system should be used for record keeping (Voight & Cook 1996).

Each joint in the human skeleton must work at a specific angular velocity in order to produce a total movement pattern, e.g. table 4 highlights the functional velocity speeds of the knee.

Following injury, the athlete is often reluctant to work the injured joint at the desired functional speed and this will have a long-term derogatory effect on gait pattern. Advantages of fast / functional contractile velocity exercises include:

- Re-education of functional activity
- Decrease in joint compressive forces
- Increase in synovial fluid lubrication with nourishment of the articular cartilage
- A physiological overflow from faster to slower speed exercise.

Performing rehabilitation programmes which include fast / functional contractile velocity exercises therefore supports the principle of specific training for high performance activity.

3. MINIMUM PROTECTION PHASE (12 WEEKS-RETURN TO PLAY)

Load

Many elite sports warm-up drills use concentric / eccentric pre-activation exercises prior to performance. Active movement involves the interaction of concentric / eccentric muscular activity with a far greater torque in the high-speed sporting setting. Eccentric muscle action is needed for both athletic performance and in a protective role. It is selectively recruited during any change in momentum, either from the entire body or in an individual limb segment. It is essential to appreciate that the intramuscular force produced per motor unit is larger eccentrically than concentrically. The eccentric / concentric strength ratio for an individual muscle is normally 1:2-1:5.

In the current sports medicine literature, there appears to be an obsession with return to play (RTP) criteria. It is important, however, to establish test protocols for various other key performance goals appropriate to the individual patient which may include all or some of the following:

1. Return to non-manual work (RTNMW)
2. Return to run (RTR)
3. Return to train (RTT)
4. Return to manual work (RTMW)
5. Return to play /sport (RTP / RTS).

For most amateur or semi-professional athletes who sustain an ACL injury, phases one to four, where appropriate to the patient, are just as important and are key stepping stones to the rehabilitation

JOINT	ACTIVITY	VELOCITY	REFERENCE
Knee	Walking Running	233°/sec 1105°/sec	Wyatt & Edwards 1981 Parker 1981

TABLE 4:. Functional velocity speeds of the knee

pathway before they reach the holy grail of RTP / RTS.

In relation to rehabilitating the patient for RTT and RTP there are a battery of functional ability tests (FAT) available. Itoh *et al* (1998) assessed 50 subjects with anterior cruciate ligament deficiency (ACLD) against a normal population group of 60 subjects and over a stage of four hopping tests; figure-of-eight hop, up and down hope, side hop and single hop. They identified that more than 95% of the normal population control group exhibited symmetrical function in each test, while the ACLD group showed 68% abnormal symmetry in the figure-of-eight hop, 58% in the up-down hop, 44% in the side hop, and 42% in the single hop (figure 4). The percentage of ACLD patients with functional asymmetry in at least one of the four tests performed was 82%.

These findings were further supported by Ardern *et al* (2014) who also showed a positive relationship using symmetrical hop test with a favourable return to pre-injury level of sport. There are a multitude of functional tests available, and through clinical experience and applied research, the clinician can collate and apply an individual appropriate testing regime at the various stages of recovery.

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Skill

The therapist working in any specific sport must be prepared to look outside the realms of the medical textbook when dealing with associated issues such as ACL injury. Knowledge of the functional factors that are required for the role of the single competitor or team player is essential. From this, specific drills (figure 5) that test the physical and/or mental approach post injury to the task required can be created. The player must be able to demonstrate that they can perform competently, even in pressure situations.

A number of variables can contribute to the intensity of a rehabilitation plan and the clinician will adjust these as appropriate in order to progress the programme from simple to complex movements. These variants that can be adjusted include:

- the size of the playing area
- the number of players involved
- alterations in the equipment used, i.e. introduction of balls, cones, manikins, tackle shields and bags and then changes in numbers used
- intensity of the exercises performed
- increase in time taken for drills and for total rehabilitation sessions

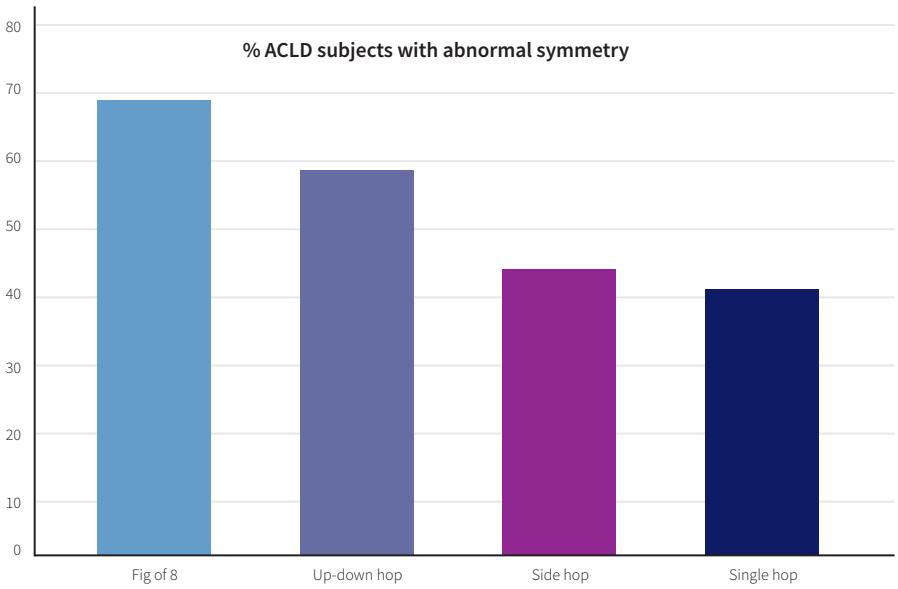

FIGURE 4: Percentage of ACLD subjects with abnormal symmetry using four functional ability tests

FIGURE 5: Football drills working towards the rehabilitation of ACL injury

- changes from non-contact to full-contact drills
- use of unopposed and opposed exercises
- introducing and increasing physical functional components such as jumping, falling and cutting
- adding skill functional components such as crossing, shooting, attacking, and defending.

Many top-level sports teams therefore now use performance analysis systems which relay what actually happens in competition, rather than what is perceived to have happened, to the player, coach and support staff, so there is no hiding place in the modern professional sport for the athlete. The information from these performance analysis systems is also of use to the medical team as it provides footage of the mechanics of the individual athlete in competition, giving game-related information that informs rehabilitation drills and programmes to ensure that they are even more specific to competition.

Summary

The rehabilitation pathway from moment of injury to return to play is a long, winding and uphill road from start to finish. This applies not only to the patient but also to the therapist. For those treating sporting professionals, it may be that they spend eight hours a day, six-seven days a week, over six to nine months, working with just one individual athlete. It is, therefore, a full-time commitment for both parties, a period during which there will be ups and downs in the rehabilitation journey, so it is important to be able to focus and refocus when the need arises.

About the author

David Fevre is currently working as a freelance clinician / lecturer in physiotherapy and sports injury rehabilitation. He has consultancy roles with several European, Premiership and Championship football clubs and is on the teaching faculty for both the Football Association (FA) and Rugby Football League (RFL). He was Head of Sports Medicine for Blackburn Rovers FC until January 2017, having been in post since July 1999. Prior to this, he was the Chartered Physiotherapist for the Welsh national football team (2002-2005), for Manchester United FC (1994-1999), Great Britain rugby league (1990-1994), Wigan RL (1989-1994), and Leigh RL (1984-1989). He has also worked in the NHS and within a number of sports injury clinics based in the private hospital sector.

David lectures extensively, internationally and in the UK, on subjects related to sports injury rehabilitation, and has had articles / research papers published in several rehabilitation related journals as well as authoring the book *Collision Sports Injury and Repair*. In 2012, he was invited to the European (London) and World (Belgium) soccer conferences to present oral abstracts on his research work in professional football. He is also an honorary lecturer at Salford University and Manchester University and, in 2014, was presented with the award for Outstanding Contribution to Professional Football by the Football Medical Association (FMA) and The Fabrice Mouamba Outstanding Contribution to Professional Football Award in the NW of England in 2015.

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Hamstring injuries

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Hamstring injuries are common in athletes at any level of their sport. Rehabilitation methods should aim for a safe return to sport, while reducing the risk of recurrence of the injury once the athlete is back in competition. This article explores how best the physiotherapist can work with the patient towards their goal of a timely return to sport, while at the same time achieving the best patient outcome with regard to reducing the risk of further injury.

LEARNING OUTCOMES
TO SUPPORT PHYSIO FIRST QAP

1 Achieve a greater understanding of mechanisms of hamstring injury.
2 Implementation of best practice clinical assessment.
3 Understand the principles and rationale of rehabilitation in hamstring injury.
4 Be aware of how exposure of high-speed running can be tailored to the needs of the individual.

Background

Depending on where you look, hamstring injuries (HSI) are either on the rise (Ekstrand *et al* 2016) or in status quo, with an average of one occurrence per 1,000 hours in multiple sports (Ekstrand *et al* 2011). Either way, HSI do have a high recurrence rate which usually means an average of 25 days lost to sport, so they are costly to professional sports teams and leagues. Hamstring injuries frequently present in clinic, often with repeated episodes. It is difficult to predict HSI. Computer algorithms actually show worsening results with repeated analysis (Ruddy *et al* 2018). The only truly identified risk factors for HSI are age (>26 years old), previous history of hamstring injury, and loss of strength (Freckleton & Pizzari 2013). Researchers continue to investigate other factors such as running mechanics, lumbopelvic kinematics and / or fatigue but the evidence is limited and needs to be considered carefully on a case by case basis. Discussion on defining the number "hamstrings" often arises, i.e. three, four or five?, with the long head and short head biceps femoris (LHBF / SHBF) often referred to as separate entities, and adductor magnus being 100% active in hip extension (Benn *et al* 2018).

Mechanism of injury

The mechanism of injury is often split into two groups:

1. High-speed running (HSR)
While there's keen scientific discussion on the specific mode of muscle contraction, the debate with regard to eccentric action (Shield & Murphy 2018) vs concentric action (van Hooren & Bosch 2018) continues. However, most high-speed running injuries occur at the terminal swing phase as the hamstrings slow the shank down prior to ground contact; the classic "sniper" ping!

2. Stretch mechanisms
Another common mechanism of HSI is "over-stretching". This can often be seen in sport, for instance as a player reaches for a ball, or in the performing arts in the execution of a high kick, or in an end-of-range stretch, such as the splits.

In addition to these two groups, a third subgroup may be identified in people who present with a prolonged gradual onset of pain high in the hamstring that is often made worse by sitting. This type of presentation should be considered a proximal hamstring tendinopathy (PHT) and, as such, is not within the scope of this article.

The mechanism of HSI that occurs in athletes is often reported by the patient as a "pop" with a subsequent inability to generate force / run. There may be bruising, but this tends to be evident only in major injuries, or if the injury occurs near to the individual's vascular bundle.

Assessment

When assessing the athlete presenting with a potential HSI, the starting point should always be a thorough history, allowing the individual to describe the mechanism, any repeat issues, load management, their own apprehension and any other factors they feel may be relevant. If we listen carefully enough, the individual will often tell us their needs, worries and timeframe, all of which will inform an individually tailored rehabilitation plan.

> "IDENTIFIED RISK FACTORS FOR HAMSTRING INJURIES ARE AGE, PREVIOUS HISTORY OF INJURY, AND LOSS OF STRENGTH"

"OWING TO THE MULTIFACTORIAL NATURE OF HAMSTRING INJURY, THERE IS NO SET RECIPE FOR TREATMENT"

As part of his PhD studies, Nicol van Dyk, with his colleagues at Aspetar, collected masses of data (Whiteley *et al* 2018) that allowed them to critically evaluate their clinical outcomes on a large number of athletes. The Aspetar assessment and rehabilitation protocols are available online (see supplementary information) and can be used as a guide for clinicians. Primarily, the key assessment findings that were discovered to be clinically relevant to a successful outcome were:

- Maximal hip flexion and knee extension (MHFAKE), where the hip is flexed maximally, and the knee is actively straightened and measured with a digital inclinometer. Comparison is made between the injured and uninjured sides.
- Straight leg raise. This is a key indicator of hamstring range of motion. The aim should be for symmetry between the injured and uninjured sides as measured with a digital inclinometer.
- Askling's active straight leg raise. The individual completes three rapid straight leg raises (with no warm-up), with a fixed 180 degree knee brace. Comparison is made between the injured and uninjured side. This test is thought to be more about the psychological readiness of the athlete to perform ballistic movements.
- Palpation. The length of the pain site, as measured with a tape measure, appears to be related to the rehabilitation time. When the pain length has halved, the athlete is half-way through their rehabilitation process. It may also be worthwhile to measure the distance from the ischial tuberosity the pain site if further investigations (Ultrasound / MRI) for the location of tissue damage are required. It is the distance from the ischial tuberosity to the pain site that determines the rehabilitation time, so I would suggest repeating this measurement against ultrasound / MRI investigation.
- Strength. This is measured in two ways. First, the patient lies in supine, with the knee of the injured leg at 90 degrees to the hip. By using of one of the many handheld dynamometry devices available on the market, the clinician places it under the patient's heel, instructing them to pull the heel down on the device, while keeping their bottom and contralateral leg in full contact with the lying surface. The second measurement is undertaken with the patient in the prone position with the knee of the injured leg flexed at approximately 30 degrees, while the therapist applies a downward force to the heel with the dynamometer.

Other methods of strength evaluation that are used elsewhere in the research include using the Nordboard to assess strength during Nordic hamstring exercise (Opar *et al* 2013), and several positions have been utilised with the use of force plates (Constantine *et al* 2019), but these were not undertaken within the Aspetar protocol. The single leg bridge is often quoted as an assessment tool (Freckleton *et al* 2014) but delve deeper into the paper and you will discover that the > 25 reps applies only to one side. By using the presented assessment methods in the Aspetar protocol, clinicians should acquire a solid foundation on which to base HSI rehabilitation with specific outcomes.

Physiotherapists may also use their own clinical reasoning to assess, on a case by case basis, the patient's spine, hips and ankle range, stability and strength. In my experience, hip extension and medial rotation are important, and some limited evidence suggests a loss of ankle dorsiflexion may predispose HSI (van Dyk *et al* 2018). There is no set recipe for HSI because of its multifactorial nature, but by employing the basics outlined in the Aspetar protocol you will be using the best evidence we presently have available to provide an outcome-based rehabilitation programme.

Classification

Classification scales of muscle injuries have been applied in order to aid prognosis and enable clinicians to indicate meaningful timeframes for return to work / activity. Peetrons' (2002) 1-3 injury grades may be familiar, as might the Munich consensus statement on muscle injury (Mueller-Wohlfahr *et al* 2013). More recently, Dr Noel Pollock and colleagues at British Athletics (2014) have added a letter to Peetrons' 1-3 scale of tissue damage to show the location of the injury within the tissue, and to try to improve the prognosis:
(a) Myofascial
(b) Musculotendinous
(c) Intratendinous.

Pollock *et al* (2014) then retrospectively reviewed their own injury data and found a high recurrence rate within the type C injuries, especially in those individuals returning to elite sprinting in under 12-weeks post-injury. They believe that, due to the nature of greater tendon involvement and increased tissue healing time, this type of injury requires a prolonged period of rehabilitation. The downside of this conclusion is that it is based purely on MRI findings and, therefore, not necessarily available to all clinicians. It has been suggested that the role of the central tendon is not as important in rehabilitation outcomes (van der Made *et al* 2018), but we must be careful to consider patient groups, i.e. British Athletics elite track athletes vs Qatar football players, and we must consider the demands of their individual sports. The use of MRI as an assessment of injury, and repeated MRI as a marker of recovery, has been well researched (Wangensteen *et al* 2015). This study suggests that MRI is the gold standard in identifying injury and its location, but notes that clinical examination at days one and seven offers reasonable predictive ability in the duration of return to play, and that MRI offers no additional clinically meaningful information. Jacobsen *et al* (2016) demonstrated that the change in pain by day seven of

strength tests at inner range and outer range strength, expressed as a % of the range of the uninjured leg, offered good predictive measures of return to play.

With the use of real-time ultrasound imaging in the clinical setting, research has increasingly focused on whether it can be harnessed to aid / facilitate HSI prevention / prediction. Although there is debate within literature on the true nature of what it shows, researchers are using ultrasound to assess fascicle length within the biceps femoris. Fascicles are too long to be seen on a single image but by taking a longitudinal image (LHBF) and reviewing muscle thickness and pennation angle using trigonometry, it is possible to calculate length. Timmins *et al* (2016a) investigated fascicle length in Australian soccer players and showed that those with previous HSI had 14% less fascicle length than those with no history of HSI. Their data suggested that those with less than 10.5cm fascicles had a higher chance of injury. It should be noted, however, that the research process undertaken has a 1cm to 1.5cm probable error measurement, and that to be suggestive of adaptation it would be necessary to see greater than 1.5cm of change.

Rehabilitation

Rehabilitation from HSI can be broken into two parts. The physical preparation, and a graded exposure to high speed running. Rehabilitation and "prehab" should, therefore, enable the athlete to "earn the right to run fast". Another description of how rehabilitation should work is "to put on your seatbelt and then drive carefully", but how is this aim best achieved?

A thorough assessment leads to a list of key objective markers that are specific to the individual and will guide clinical reasoning. One question often asked is whether it is possible to specifically target individual hamstring muscles? Bourne *et al* (2017) investigated the specifics of the response of individual hamstrings to a variety of exercises, and highlighted two key approaches; exercises with a knee bias such as Nordic hamstring exercise (NHE), where the individual eccentrically falls forwards from a kneeling position with their feet fixed and is aimed at patients with a medial and SHBF, and those with a hip bias aimed at individuals with LHBF. Hip extension exercise (HEE) requires the feet and knees to be fixed, and the athlete to flex at the hip.

Both NHE and HEE have shown to create similar levels of muscle soreness (Whyte et al 2019). However, while NHE is often criticised for being non-functional, it still has the highest level of electromyographic (EMG) activity in total biceps femoris when compared with all other exercises. If we're trying to give the athlete the best set of physical characteristics, NHE should be considered vital to a hamstring conditioning programme. In their systematic review and meta-analysis, van Dyk et al (2019) suggested a 50% reduction in HSI where NHE was implemented as a preventative measure. Another criticism from clinicians is often with regard to the limited nature of the available evidence for NHE, and that many RCTs only focus on single element / intervention. The multifactorial nature of HSI provides further challenges to researchers to continue to develop large, multi-factor, multi-site data groups. Vatovec *et al* (2019) contradicted the van Dyk *et al* (2019) findings by suggesting, with a systematic review, that the weekly frequency and load progression are not among the most important variables to consider when designing a prevention programme.

In attempting to ascertain why NHE is effective in preventing HSI, Timmins *et al* (2016b) investigated the NHE, HEE, and concentric and eccentric contractions. Using fascicle length as a marker this research shows that, over a 10 week training programme, fascicle length is increased by both NHE (21.1%) and HEE (12.6%) when compared to the control group in which fascicle length was decreased by 1.9% over the same timeframe. This suggests that NHE is a more potent method for simulating hamstring adaptation. The research also showed that a concentric training programme resulted in a 13.3% loss of fascicle length, while the eccentric group gained by 14.1%, suggesting that eccentric overload is a key component of HSI rehabilitation.

Much of the early NHE research included high volumes of bodyweight exercises which was explored in more detail by Presland *et al* (2018). Two groups were given a six week NHE training programme, the first group undertook a progressive, high volume programme consisting of 48 reps in week one building to 100 reps by week six, while group two followed a low volume formula of 48 reps in week one, decreasing to eight reps in weeks three to six. Both groups increased hamstring strength and fascicle length over the six weeks and were followed-up for a further five weeks, during which time the participants did no NHE training. It was noted that hamstring strength gradually decreased, and fascicle length dropped off sharply, returning to pre-training level in only two weeks into the follow-up period. This should guide clinicians to be aware that, while strength gradually decreases, fascicle length declines rapidly after only a two-week break from eccentric exercise. It appears, therefore, that fascicle length has a strong association with eccentric loading. In their follow-on research, Pollard *et al* (2018) compared a weighted NHE, body-weighted NHE, and control group that undertook razor curls over a six-week period. While the control group dropped 1.0% of fascicle length, the bodyweight NHE group increased fascicle length by 3.0%, and the weighted NHE increased fascicle length by 16.1%. This again guides us, as practitioners, that although we can get away with low volume, i.e. eight reps NHE following the two week introduction period of 48 reps per week, the lower volume of reps need intensity (by adding weight to a participants chest) in order to gain maximal improvements.

In their excellent work, Hickey *et al* (2019) explored the use of an accelerated HSI rehabilitation protocol using a four-stage plan progressing from a 45 degree

"THE RELATIONSHIP BETWEEN EFFORT AND SPEED IN RUNNING IS NON-LINEAR"

double to single leg hamstring bridge (figure 1) to a 45 degree double leg to single leg HEE to which was added a 5kg weight. This progressed to an eccentric sliding leg curl before moving on to NHE. All participants trained twice a week and one group were allowed to progress to the next exercise only when they were able to perform the desired number of reps through full range pain free, while the second group could continue as long as they could do the reps through full range within a pain threshold of 4/10 or less on a visual analogue scale (VAS). Interestingly, there was no statistical difference in the time it took to return to play (RTP), but the pain threshold group gained 15% more isometric knee flexor strength at 90/90, and longer biceps fascicles when compared to the pain-free group. This suggests that we can push rehabilitation if needed, and that athletes don't need to be pain-free in order to progress their loading protocols. However, as a note of caution the diagnosis and tissue healing time should be respected, i.e. where a type C injury (intratendon) is suspected, the tendon must be allowed to heal and, given that this type of injury has a high recurrence rate, we should be less inclined to push rehabilitation.

The single straight leg bridge (figure 1) is a simple and easy exercise for HSI rehabilitation. It achieves approximately 60% medial and lateral hamstring activation and can be used to provide progressive overload. In early rehab the athletes can start with double leg isometrics and / or shorten the lever, progressing to double leg eccentrics, before transferring to single leg eccentrics. Towards the end of the rehabilitation period athletes may be able to perform single leg eccentrics, and / or plyometric variations, while adding weights to their hips.

FIGURE 1: Single straight leg bridge

Running

The best training for running is running, and it is an activity that achieves the most hamstring activation (van den Tillaar *et al* 2017). The skill of running and producing force must also be considered regardless of sport that is being trained for. Stuart McMillan, a widely respected sprint coach, suggests that "team sport athletes are going to run differently to sprinters, but it's important that they understand the 'rules' of acceleration and upright sprinting, before allowing their sport to show them how to break those rules" and, in my opinion, this technical aspect of high-speed running (HSR) is often overlooked. Morin *et al* (2015) and Edouard *et al* (2018) showed that eccentric hamstring strength is associated with sprint performance, and that we get a greater gluteus maximus hip extension force with a fatigued set of hamstring musculature. Avrillon *et al* (2018) suggested that the larger the imbalance is between specific hamstring muscles, the lower the muscle endurance performance, resulting in a potential increase of fatigability.

When considering hamstring muscle activation in HSR, the LHBF appears to be most active in acceleration when greater hip extension is required, and maximum speed sprinting involves high levels of semitendinosus activation (Higashihara *et al* 2018). Running at greater speeds also increases the load proximally (Chumanov *et al* 2011). In 2019, Hegyi *et al* undertook some exciting work using high density surface EMG showing individuals have unique activation patterns while running, but these patterns remain the same as the speed of running increases, potentially suggesting that early running is likely to utilise an individual's natural pattern. The only downside was that they were only able to test at speeds of up to 6.8m/s, when most elite team sports participants can reach speeds of >10m/s, and 12m/s for elite sprinters.

The key aspect of any return to running should be in understanding that the relationship between effort and speed is

non-linear, and that the steepest curve in the graph is seen as the athlete heads towards maximum speed (Schache *et al* 2014). Essentially 50% effort achieves around 75% top speed, 75% effort results in 85% top speed, 90% effort gets 95% top speed, and 100% effort equals 100% speed (figure 2). Clinically this means that the progressing from 90% to 100% is a massive step for the patient, and the final progressions into HSR should be minimal.

For example, an athlete returning to running would need to progress their effort through 90%, 94%, 96%, 98% to 100% over several running sessions rather than move through from 80%, 90%, directly to 100%.

Acceleration speed mechanics must also be carefully considered. As acceleration increases, braking impulses also progressively increase while propulsive impulses progressively decrease (Schache *et al* 2019). We must also be aware of the differences between various sports. Wild *et al* (2018) compared sprint kinematics in sprint athletes with those in rugby players and demonstrated that the latter had a higher shin angle to that of sprinters, and that rugby players reach top speed at 40m compared to sprinters who don't reach top speed until 70m.

Much of this can be explained by the physical environment. Sprinters operate on a track, running straight lines from blocks, while rugby players do so on grass with multiple changes of direction. Further research (Douglas

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et al 2019) shows that sprint athletes have a briefer and more forceful ground contact when compared with team athletes. The number of accelerations and decelerations in team sports (Bowen *et al* 2019) may also play a key part in better understanding HSI. Sweet spots of exposure to HSR have been reported in the literature (Duhig *et al* 2016) but whilst these provide guidance, the findings should be treated with caution as the speeds were pre-defined (HSR = greater than 24kph). We also know that, for athletes with higher top speeds, these arbitrary numbers may under report exposure to HSR (Murray *et al* 2019). It might therefore be naive to just use speed as the outcome, as how an athlete achieves speed can also be important. Exploratory data from Mendiguchia *et al* (2014) shows soccer players returning to sport at reduced power and reduced maximum force, but with previous maximum velocity. These values returned to normal two months after return to sport, again suggesting that athletes are susceptible to further injury even after a return to play.

Return to sport

Returning any athlete to any sport requires an understanding of the demands, training and performance needs of that sport. It may be better to view return to training and return to performance as two different clinical entities, both with different requirements, i.e. a sprinter may be able to return to training with an emphasis on running drills and foot contacts very early after injury, but the physical preparation required to run at speed maybe weeks or even months away.

Communication is key and this should incorporate a shared decision making process that involves the athlete providing the subjective information, the healthcare team supplying the objective data, and the coach giving the context (Dijkstra *et al* 2017), which allows a risk assessment to be made. For an excellent example of rehabilitation of HSI in an elite environment with classification and tissue healing guiding the return to sport in a shared decision-making continuum, see MacDonald *et al* (2019). It should be stressed that it is important to acknowledge the influence of context. Teams or athletes may be more inclined to take risks when preparing for and participating in major championships / competition, but this should not be at the detriment of an athlete's long-term health. From an external standpoint, not being fully aware of the whole picture, it can be easy to criticise, but particularly in this era of social media, the clinician's professionalism must be maintained.

There is intense discussion on the influence of acute to chronic workloads (Gabbett 2016), and assertions on "control-chaos continuum" (Taberner *et al* 2019), specifically that training should be more demanding than competition, are still contested. However, the principles of load management and building base are the cornerstones of rehabilitation and those with a more consistent training programme can show a 7% decrease in injury risk per training session undertaken prior to a return to play following muscle injury (Bengtsson *et al* 2019).

Monitoring

Wollin *et al* (2019) suggest a model of post-game monitoring that aims to highlight the minimal detectable change (14%) in hamstring strength, and then

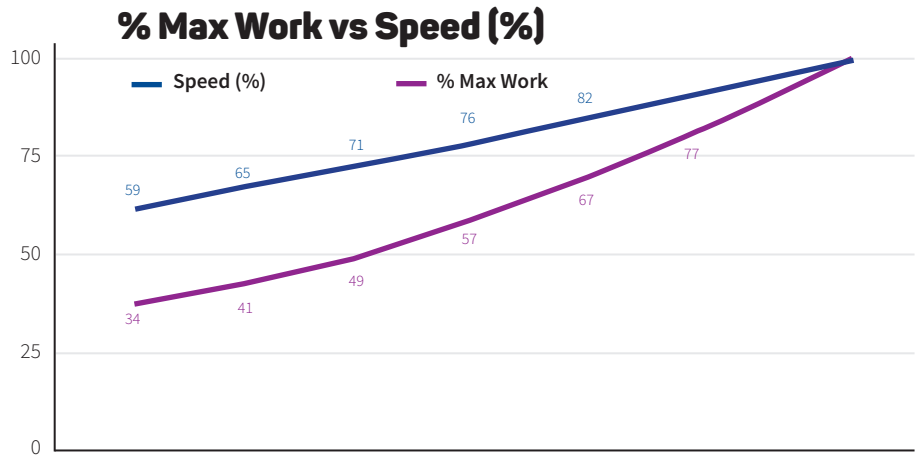

FIGURE 2: Graph indicating the relationship of effort and speed in running (adapted from Schache *et al* 2014)

flags those athletes in a "subclinical stage", leading to clinical examination and interaction with coaching and sport science teams to closely monitor load and exposure to HSR until strength has returned. This protocol led to an incident rate decrease of 0.5 per 1,000 hours in the monitored group, as opposed to 0.8 per 1,000 hours in the non-intervention group. This potentially gives clinicians a role in reassessing agreed outcome measure post-competition.

Summary

Hamstring injuries are common with a high recurrence rate, especially in the first 25 days of return to play. Clinicians need to provide objective data to facilitate rehabilitation. Assessment should include, although not exclusively, active straight leg raise (ASLR), MAFAKE, palpation for pain length, and strength evaluation. Further assessment of hips, lumbar spine and running mechanics can be applied on a case by case basis, taking into account the holistic health of the individual. More proximal pain tends to be linked to a tendon injury and an increased recovery time. HSI rehabilitation should come from communication and a shared decision making process, and include physical preparation through eccentric hip and knee biased exercises, and / or isometrics where tendon involvement is suspected. A graded exposure to high speed running, with monitoring of the identified key outcomes, should also be employed.

About the author

Stuart is a private practitioner physiotherapist in Guildford, Surrey and the Medical Lead at England Athletics. He has been fortunate to travel internationally with track and field teams and, in 2018, led the athletics team in at the Gold Coast Commonwealth Games. Stuart has a keen interest in running biomechanics, hamstring injuries and high-speed running.

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Supplementary information

Aspetar Hamstring Protocol: https://www.aspetar.com/AspetarFILEUPLOAD/UploadCenter/636209313253275549_Aspetar%20Hamstring%20Protocol.pdf

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The knowns and unknowns of Greater Trochanteric Pain Syndrome

TOBIAS BREMER MSc MCSP
Physiotherapist
with expert input from Rebecca Mellor PhD, Prof Dylan Morrissey and Alison Grimaldi PhD

Physiotherapists will be aware that defining Greater Trochanteric Pain Syndrome (GTPS) is difficult. The work presented here provides some background to my PhD studies for the 3T – 10000 Tendons Study, the main aim of which is to build a usable clinical model that predicts outcomes for GTPS patients by comparing their data, in terms of prognostic factors, to that of individuals with other hip pathologies and healthy controls in order to predict a treatment outcome based on how patients present and are managed, using the various options available.

LEARNING OUTCOMES
TO SUPPORT PHYSIO FIRST QAP

1 Understand the aetiological complexity of greater trochanteric pain syndrome.
2 Understand the conservative management of greater trochanteric pain syndrome.
3 Understand when to refer on for successful treatment outcome.

Introduction

Over the past several decades Greater Trochanteric Pain Syndrome (GTPS) has undergone a myriad of different names. Trochanteric bursitis, gluteal tendinopathy, peri-trochanteric pain syndrome (Reid 2016) are just some of the terms used to describe what, up to now, has been an ill-definable condition. One reason for the struggle in characterising GTPS is that it appears to be of multifactorial origin depending on the individual's tendon structure, muscularity and their biomechanical make up with variable pain patterns and often co-existing pathology and syndromes of the hip joint and particularly the spine. There is also a strong psycho-social component that can blur the biomedical presentation (Plinsinga *et al* 2018). The term syndrome is therefore warranted, but it also indicates the need to understand the pathology and affected demographic further.

Prevalence

The presentation of GTPS is common in both males and females (Ganderton *et al* 2016). It affects both the sedentary population, as well as the athletic one, where it is especially common in long distance runners (Grimaldi *et al* 2015). The prevalence and incidence rate of GTPS are similar to those of hip osteoarthritis (Fearon *et al* 2014; Albers *et al* 2016), and indistinguishable levels of symptom duration, age of the affected and levels of activity are shown between individuals with hip osteoarthritis and those with GTPS (Fearon *et al* 2014). Indeed, Fearon *et al* (2014) demonstrated that participants from both hip osteoarthritis and GTPS groups demonstrated equally diminished quality of life, employment status and high levels of pain leading to poor worker retention, and a significant negative effect on the public health service.

The demographic for those affected by GTPS is men and women between 40 and 60 years old, although females are more likely to develop the condition (Ganderton *et al* 2017). In their 2017 study, Fearon *et al* reported that 23.5% of females aged over 50 had suffered from lateral hip pain. This echoed earlier findings by Segal *et al* (2007) who studied a cohort of 3,026 community-based adults aged between 50 and 79 years and discovered an incidence rate in the male to female ratio of 6.6% and 15% respectively. In their research of general medical practice in the Netherlands, Albers *et al* (2016) found gluteal tendinopathy to have the highest prevalence of 4.22 per 1,000 person years, and incidence of 3.29 per 1,000 person years, of all presenting lower limb tendinopathies.

It is proposed that the increase in GTPS is owing to a combination of factors that include an ageing population seeking to stay active, but with possible poor biomechanics and muscular strength imbalances (Grimaldi 2015). Indeed,

> "PARTICIPANTS FROM BOTH THE HIP OSTEOARTHRITIS AND GTPS GROUPS SHOWED EQUALLY DIMINISHED QUALITY OF LIFE"

> "THE AIM IS TO FIND MARKERS THAT WILL PREDICT WHICH TREATMENT IS SUITABLE FOR WHICH TYPE OF GTPS PATIENT"

Albers *et al* (2016) suggest that a distinct association between sporting activity and GTPS was present in 29.4% of 126 lower limb tendinopathy cases. Albers *et al* (2016) suggest that a combination of the reduction in the elasticity of the musculo-tendinous junction, high training demands and biomechanical issues are all central to the development of GTPS in the ageing population, especially with regard to elite athletes. Both studies also identify that the relationship between the cause and effect of GTPS is poorly understood and that loss of muscle function around the hip, and its possible relationship with GTPS, warrants further research. There is also an agreed consensus in the literature that GTPS is due to a pathological dysfunction of either a single tendon of the medial or minimal gluteal muscles, or a combination of both tendons being involved (Mellor *et al* 2016; Ganderton *et al* 2017). Research has identified that the muscle activation of gluteus minimus is changed in participants presenting with GTPS (Ganderton *et al* 2017) and that bilateral and asymmetrical muscle weakness of the gluteal muscle complex can be present (Allison *et al* 2017).

As, by 2025 the ageing sporting population will add a new dimension to the healthcare costs of treating GTPS (Grimaldi *et al* 2015), it is imperative that we, as physiotherapists, seek to better understand the phenomenon of this condition and develop evidence-based treatment strategies for use in our clinics (Fearon *et al* 2017).

Anatomy

Fearon (via personal communication 2018) demonstrated that the medial gluteal muscles arise from the pelvis proximally and attach to the femur distally via the greater trochanter. The proximal attachment extends from the anterior inferior iliac spine (AIIS) to the posterior superior iliac spine (PSIS) on the external aspect of the ilium, the attachment being approximately 1cm in width. The gluteus medius (Gmed) has three fan shaped segments; anterior, middle and posterior, which have individual nerve branches from the superior gluteal nerve. These three muscle bellies form a broad tendon which inserts into the greater trochanter. The tendon of the anterior muscle belly seems to intertwine with the gluteus minimus (Gmin) tendon at insertion (Gottschalk *et al* 1989) and the posterior border of the posterior muscle belly may blend with or overlay the piriformis muscle (figure 1).

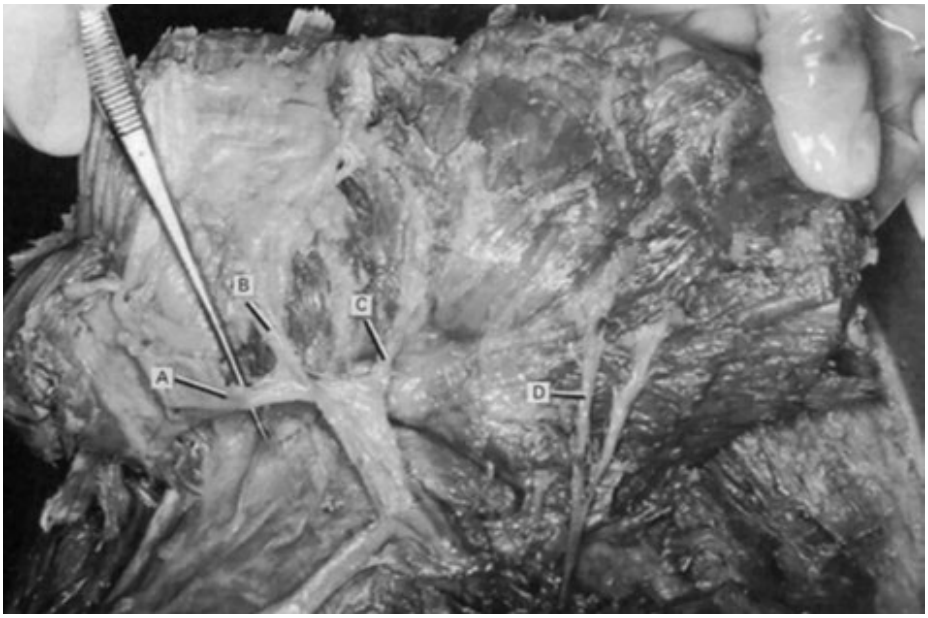

FIGURE 1: Reflected specimen of gluteus medius with the superior gluteal nerve. The image is demonstrating the branches of individual innervation of the three bellies of the muscle. A= to the tensor fascia latae; B= to the anterior glutimus medius; C= to middle glutimus medius; D= to posterior glutimus medius (from Gottschalk *et al* 1989, reproduced with permission)

A further consideration for the morphology of the gluteal tendon is the precise position of its insertion on the greater trochanter (Benjamin & Ralphs 2001). There are a variety of nomenclatures used in the literature regarding the exact insertion of the Gmed tendon, for example, Pfirrmann *et al* (2001) state that the Gmed tendon inserts laterally, while Gottschalk *et al* (1989) describe it as *anterosuperior portion of the greater trochanter*. One hypothesis is that the change in load through the tendon due to the difference in insertional angle may well lead to tendinopathies. Presently it is difficult to say if this is just a case of semiotics, or if a true causal relationship between the insertion angle and the development of a tendinopathy can be established.

Another consideration is that of the individual innervations of the three muscle bellies. These potentially function independently, as each one has its own innervations from the superior gluteal nerve. The research findings by Allison *et al* (2017) and Ganderton *et al* (2017) highlight the abnormal muscle function of GTPS patients when compared to asymptomatic participants. Allison *et al* (2017) demonstrated through the use of electromyographic (EMG) readings that GTPS patients had lost the functional ability to independently select the minimal and medial aspects of the gluteal muscle complex within

the gait pattern, potentially leading to a force overload within the tendon complex. Similar abnormal muscle bursts were demonstrated within the osteoarthritis research (Rutherford *et al* 2015). Patients with osteoarthritis and GTPS demonstrated an initial extended activation of both the posterior aspects of Gmin and the Gmed in the early stance phase, compared to the control groups. Indeed, similar intra-group patterns of a distinctive muscle motor activity have been observed in other research fields, namely low back pain, patella femoral pain and femur acetabular impingement, which may be the result of a reduced availability of movement strategies (Allison *et al* 2017).

Presently, there is little understanding of prognosis factors within the GTPS demographic. The aim of the 3T – 10000 Tendons Study is to find markers that will predict which treatment is suitable for which type of GTPS patient. Being able to confidently predict the prognosis of treatment should ultimately improve how patients with GTPS are managed, as well as reduce the burden on the healthcare system.

Clinical testing

Diagnosing GTPS either with magnetic resonance imaging (MRI) or clinical testing can, if either are used in isolation, be a difficult task and lead to wrong diagnosis. Ganderton *et al* (2017) demonstrated that 88% of a symptom-free population who underwent MRI scanning, had abnormal tendon structures. Grimaldi *et al* (2015) recommend a battery of tests as a way of establishing a working diagnosis, as single tests are not conclusive enough. In previous research, Grimaldi *et al* (2015), also suggest that pain with palpation of the greater trochanter had a sensitivity of 80% and a specificity of 100%. Their work describes the single leg stance test to be a value diagnostic tool. Pain reported within 30 seconds of standing on the affective limb conclusively moves a (nominal) 50% pre-test probability of the presence of GTPS on MRI to a post-test probability of 98% (Grimaldi *et al* 2015).

Other clinical diagnostic tools include the FABER test, resisted external rotation, and resisted adduction (Ganderton *et al* 2017). In their very comprehensive study Mellor *et al* (2018) used tenderness on palpation of the greater trochanter, together with a positive result from one of the following five tests as diagnostic criteria for GTPS:

1. FABER test
2. Static muscle contraction in FABER position
3. FADER test
4. Adduction test
5. Static muscle contraction in adduction position, i.e. resisted abduction or single leg stand to diagnose GTPS
6. Single leg stand.

It is clear to see from this approach that we can enhance the accuracy of clinical diagnosis by employing a "basket" of tests approach in conjunction with a detailed subjective assessment. As part of the 3T – 10000 Tendons Study, the research team found that subjective questioning specific to tendon pathologies is a very useful tool in the diagnostic process. Evidence-based questions, outlined in table 1, were therefore added to the examination process.

Management

There is currently no defined treatment protocol for GTPS, although Mellor *et al* (2018) LEAP trial findings have added a new level of understanding on how to progressively load the gluteal muscles and thereby rehabilitate the tendinopathies.

LEAP is a large, randomised trial of people with GTPS, comparing the effects on pain and global rating of change in symptoms, of a programme of education on load management plus exercise with a corticosteroid injection against a "wait and see" group.

QUESTION	REASONING / EXPLANATION	ASSESSMENT / RATIONALE
Does the patient have comorbidities / habits that affect vascularity?	Smoking, diabetes mellitus, obesity and hypertension are all known to alter or diminish vascularity (Holmes 2006) and are presumed to have an effect on tendon healing.	These domains need to be examined as part of the subjective assessment, and their importance to the individual's case, including in terms of prognosis and possible rehabilitation evaluation.
What is the patient's menopausal status, and are they using hormone replacement therapies (HRT)?	Tenocytes have been demonstrated to possess oestrogen receptors within their structures which respond to varying levels of oestrogen in the blood stream. A reduction of blood oestrogen level is associated with reduction in tensile strength, decrease in collagen synthesis, fibre diameter, density and increased degradation in tendon tissue (Frizziero *et al* 2014).	The evidence regarding an effect (HRT) on tendons is at present poor. The systematic review conducted by Ganderton *et al* (2016) found no positive or negative link between HRT and tendon pathologies and this was certainly echoed in our clinical findings.
Are they taking statins?	Statins can increase muscle pain and stiffness as well as reduce the size and function of the tendon. It is argued however that the pre-cursor to being prescribed statins is hyperlipidemia (Esenkaya & Unay 2012).	Clinicians are aware that this comorbidity and pharmacological interventions have detrimental effects on the tendon and its associated muscle belly, but it is unclear whether statins impair the tendon's recovery.
Are they currently taking, or have they previously used steroids?	Anabolic steroids are prevalent in certain demographics as a controversial way to elicit maximal athletic gain (Laseter & Russel 1991), whereas corticosteroids are often used to reduce the acute pain patients experience with good immediate effects (Reid 2016).	The consideration with this patient group is regarding the tensile strength post injection or steroid abuse, which will be reduced and therefore the rehabilitation programme needs to respect this.
Has there been a change in activity levels?	Spikes in activity levels such as a new vigorous gym routine or even well-meant physiotherapy exercises can lead to a flare up in an affected tendon.	It is important to ascertain the level of current and previous activity, over years if possible, and establish what may have led to any significant changes. Questions such as "what made you take up the activity" may well illicit new subjective information that will guide the diagnosis.

TABLE 1: Assessment questions specific to tendon pathologies

FIGURE 2: Early activation of gluteus medius in side-lying

Grimaldi *et al* (2015) suggest that adequate tendon loading, hip strengthening especially the abductors, and frontal plane pelvic control is the key for a successful rehabilitation, and this is echoed by Mellor *et al* (2018) in their progressive, eight-week LEAP trial rehabilitation programme.

The education and exercise programme is split into three sections. The first week consisting of a familiarisation period intended to retrain selective contraction of the gluteal muscles, while progressively loading the tendons without causing a symptom flare (figure 2). This initial part of the programme may include the participant lying in supine or standing and taking up the slack of a clinic band into hip abduction, bridging (figure 3), squatting and side-stepping exercises in various forms aimed at improving functional loading and pelvic control. One take-home message for clinicians is in the consideration of intensity / loading

FIGURE 3: The bridging exercise

of the tendon during these exercises. It was interesting to see in the clinical setting how many patients with GTPS had "failed" physiotherapy at the initial stage as the early dosage of the home exercises only resulted in a flare-up of their symptoms, suggesting too rapid a progress.

In weeks two and three the exercises increased very gradually by adding one more set to some activities, and by modifying the bridging and squat activities with single leg bias (figure 4) to others, i.e. by offsetting the stance to bring more focus on to one leg, and by employing single leg abduction foot slides.

At weeks three to eight, exercises were modified further with the introduction of a slide board to enable the pelvic muscles to work more dynamically. Side sliders and scooter exercises can easily be adapted in the clinical setting with the use of towels (figures 5 & 6), Pilates reformer machines, or skateboards where no slide board is available.

The results from previous research (Mellor *et al* 2018) have been very

FIGURE 4: The bridging exercise with off-set leg position

FIGURES 5&6: Adapting slide board exercises in a clinic setting with the use of a towel and resistance bands

promising. The change in symptoms of the participants was monitored using the global rating of improvement and numerical ratings scale and at eight weeks. The group which received education plus exercises reported better global improvements and reduction in pain than those who received corticosteroid injection, and both groups did better than the group that received no treatment. The follow-up results at 52 weeks showed that participants in the exercises plus education group reported better outcomes on the global improvement scale but experienced no difference in pain intensity compared to the corticosteroid injection group.

Education about the condition and load management, with an appropriately graded exercise regime, is therefore a validated method of treating GTPS. Another treatment option that should be considered for non-invasive pain management is extracorporeal shock wave therapy (ESWT). In their systematic review Schmitz *et al* (2015) reported that ESWT can reduce pain in the short to medium term, and more recent research (Carlisi *et al* 2019) clearly demonstrates the effectiveness of ESWT for individuals with GTPS, with participants who, similar to other tendon pathologies, reported a reduction of pain in the short- to mid-term.

Conclusion

Greater trochanteric pain syndrome is a multifactorial pathology with a high incidence and prevalence rate. The prognostic factors at the outset of this condition are currently poorly understood, however the 3T – 10000 Tendons Study is aiming to further our knowledge.

Currently, the best route to clinical practice is through obtaining a clear diagnosis using a comprehensive, subjective, and objective assessment approach with the use of GTPS specific questions and specific physical tests.

Education plus a specific and bespoke graded exercise programme has been shown to be the best treatment option for patients presenting with GTPS

CONTACT DETAILS
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(Mellor *et al* 2018), and this is certainly something private practitioners can offer. A further consideration to reduce pain in the short- and medium-term should be ESWT or corticosteroid injections.

As practicing clinicians, you could help to close the gap between the "coal face" of treatment and the research and be instrumental in helping to develop a clinical model to treat these stubborn conditions. If you have any patients who are diagnosed with GTPS, or any of the other sites of pain illustrated in the 3T – 10000 advert on the following page, then please let them know that they could join the study, with the contact details provided.

About the author

Tobias is a musculoskeletal physiotherapist with a keen interest in clinically applicable research. He is the Editor of *In Touch* and is currently studying for his PhD. He graduated from Phsyio-Akademie Wittlich, Germany in 2008 and has worked extensively in the private sector both in Germany and in the UK. He attained his Master's degree at Sheffield Hallam University and has recently embarked on studying for a PhD.

As a dedicated runner himself, Tobias has a particular interest in treating runners. His philosophy is that whether the patient is an elite marathon runner, or is just starting on "couch to 5K", pathologies do not differ and the challenge is in helping clients of all ages and abilities to achieve, and where possible, go beyond their own individual rehabilitation goals. His treatment approach is through the use of hands-on techniques and progressive exercise programmes.

Acknowledgements

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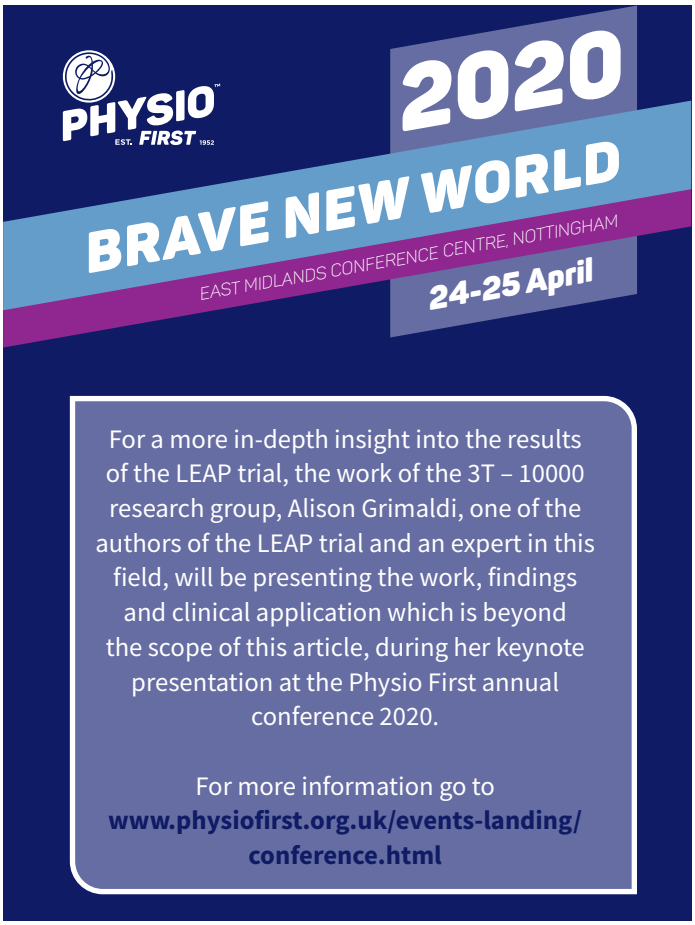

Aren't children just small adults?

DI COGGINGS MCSP MBE
Paediatric Chartered Physiotherapist

Children and young people are different from adults. They are continually developing physically, emotionally and psychologically. Due to the physiology and biomechanics of growth, young people show a unique set of age-related symptoms. While many conditions seen in childhood are self-limiting, some more serious pathology can occur. The differential diagnosis relevant to musculoskeletal symptoms is so broad that adequate paediatric training is essential. Clinicians working in this specialist field must have a clear understanding of the biological differences between children and adults. Physiotherapists are personally accountable for their practice and are responsible for their own actions. This article provides an insight, but is not exhaustive, of common paediatric MSK conditions.

LEARNING OUTCOMES
TO SUPPORT PHYSIO FIRST QAP

1 Understand the differences in children and young people compared to adults.
2 Be aware of the legal requirements involved in assessing and treating children.
3 Recognise the unique, age-related musculoskeletal symptoms.
4 Identify when to be concerned and when to reassure.

Introduction

Aren't children just small adults in the world of physiotherapy? The answer is most definitely not. All physiotherapists working with neonates, children and young people must have the appropriate competencies and legal statutory and mandatory training. Competency supports the delivery of consistent high quality standards of care for children and, as part of that, we should not forget their families and carers. Supervision and peer support are essential criteria of any physiotherapy treatment, and paediatric physiotherapy is no different. It is highly unlikely that a young child will be able to tell you where their pain / problem is, therefore we rely on their parents or carers for that communication which, as in all therapy sessions is essential, but particularly so when dealing with children. Observation during play, and learning how to communicate with the child, is all part of the clinical assessment and we must be aware of recognised normal developmental milestones to ensure that we know what is normal for the age-range of each child we treat, and what is abnormal.

Legal responsibilities

Physiotherapists who treat children have different / additional legal responsibilities that include:

- **Safeguarding and protecting children from radicalisation**. Any physiotherapist who treats children or young people is required to undertake Safeguarding Level III training, and has a duty of care to work collaboratively with other health and family services to safeguard and protect child patients from maltreatment. This may involve sharing information and liaising with other agencies about any concerns that may arise, in accordance with local policies and procedures and national guidance as recommended in the Laming Report (2003). Essential training should be regularly updated to ensure that we, as physiotherapists are able to recognise non-accidental injury and signs of neglect in any child patient we treat.
- **Resuscitation.** Techniques for resuscitation are very different for younger children than for adults. Statutory and mandatory training must be kept up to date by physiotherapists who treat children.
- **Consent.** We all know consent must always be documented, but a young child is unlikely to understand the concept of "consent" so, when treating young children, consent should always be obtained from the parent / legal guardian.
  By the age of 16/17 there is a presumption of competence to give consent, but the child cannot legally refuse treatment at this age. However, providing the individual is deemed to fully understand the procedure / outcome of the proposed treatment,

> "OBSERVING PLAY AND LEARNING TO COMMUNICATE WITH THE CHILD IS ALL PART OF THE CLINICAL ASSESSMENT"

refusal by a young person of this age-group would be fully respected in a court of law except where it would risk and / or cause them serious and permanent disability.
Consent must be given voluntarily.
A child may be deemed to be Gillick competent and adhere to the Fraser guidelines (NSPCC 2019) if they fully understand the reason and outcome of physiotherapy intervention. Where a child consenting to treatment is deemed Gillick competent, the parent or guardian cannot over-ride that consent. As previously highlighted, legally, the parent or guardian can over-ride their child's refusal of treatment but taking such a serious step is rare.
It is advisable that all children under the age of 18 are accompanied by a parent or guardian during their first physiotherapy appointment. However, once the child is deemed to be Gillick competent, follow-up appointments can be agreed with the parent or guardian that are undertaken without their presence and with regular feedback. It is always advisable to obtain written consent when a treatment modality has a risk of harm, e.g., serial casting, hydrotherapy, respiratory theatre treatments and horse riding.

- **Outcome measures**. As with all patients, obtaining outcome measures is an important part of the treatment process, and there are numerous outcome measures / validated tests for children (figure 1), including options available on the Association of Paediatric Chartered Physiotherapy (APCP) website.

For children and young people (0-24yrs) with substantial education needs (SEN), the Education, Health and Care (EHC) plan is a legal document written by the Local Authority which summarises the views, aspirations, needs, outcomes, and includes health and care provision. Plans are based on consultation with the young person themselves, advice from people who

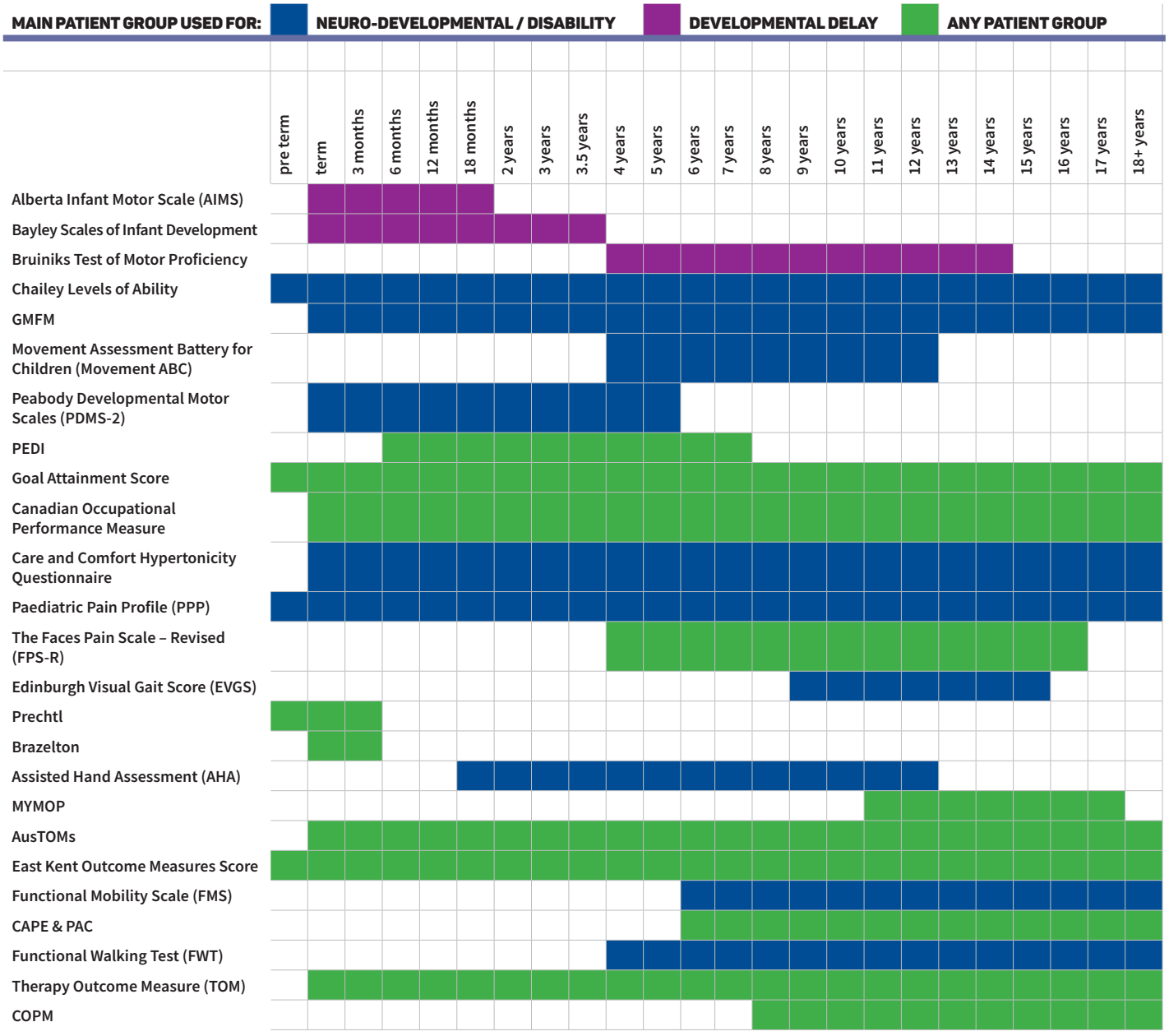

FIGURE 1: Outcome measure matrix (adapted from the Association of Paediatric Chartered Physiotherapists Outcome measures 2015)

know them including parents or carers, and supporting health practitioners, and evidence of the individual's needs, support and response to support over time. A caseworker is allocated to communicate with the parent and / or carer with regard to SEN and, ultimately, a pre-assessment panel will decide whether an EHC plan is necessary. As a physiotherapist treating a SEN child or young person, you will need to be aware of this process and of the review process of any EHC plan in place. See further resources for a link to education, health and care plans.

Neonates

New-born babies may present with congenital / traumatic deformities or problems, or issues that are purely "positional". These are totally different to adult presentations, although an adult may attend for treatment for a problem that they were born with. So, the question for the physiotherapist is what do you treat, and when? Foot deformities are common in neonates and, while the majority of conditions resolve themselves, some may require intervention.

POSITIONAL TALIPES

This foot deformity, where the mid and front part of the foot is turned in, and the hindfoot is normal, is often known as metatarsus adductus, and has shown to be a positional issue in-utero that occurs during the final trimester of pregnancy.

FIGURE 2: Club foot deformity in a new-born

There is little evidence on whether stretches for this condition should be prescribed and even a consensus survey undertaken by the APCP delivered an inconclusive result. It is thought that if the foot has a full range of movement into abduction, no treatment is required. However, if there is not full abduction then the parent / guardian should be taught how to apply stretch movements and the baby should be reviewed. In most cases it is likely the baby will require no further intervention.

CONGENITAL TALIPES EQUINOVARUS

A baby with a structural fixed equinovarus deformity, better known as club foot (figure 2), often with supination and cavus, may be treated with the Ponseti intervention and likely a tenotomy at around five to seven weeks post a treatment of weekly casting (Gray *et al* 2004). All babies presenting with this condition should be referred to a centre that specialises in Ponseti treatment. For links to the Ponseti method and "STEPS", see further resources.

TALIPES CALCANEOVALGUS

It is common in new-borns with this dorsi-flexion and eversion for the dorsum of the foot to be dorsi-flexed to the shin. The majority will resolve either without intervention, or with a programme of stretches. We should, however, be aware that calcaneovalgus is associated with developmental dysplasia of the hip (DDH) and therefore ALL babies born with calcaneovalgus should be referred for a hip ultrasound screening at six weeks (Paton & Choudry 2009).

VERTICAL TALUS

This condition is not as common as talipes calcaneovalgus but can often look like it. Vertical talus is, in fact, a bony problem where the talus, instead of lying horizontally, is on the vertical. Determining whether the condition is calcaneovalgus or vertical talus can usually be achieved by examining the sole of the foot. In vertical talus it will have what is known as "rocker bottom"; there is no arch present (figure 3) and the sole of the foot looks like the bottom of a boat that is curved outwards. This condition requires treatment, usually reversed Ponseti casting followed by surgery (Wright *et al* 2014).

OBSTETRICAL BRACHIAL PLEXUS PALSY

A musculoskeletal condition in neonates not related to the foot, is obstetrical brachial plexus palsy (OBPP) also known as Erb's palsy. This can occur when, during delivery, there is a shoulder dystocia resulting in an injury to the brachial plexus. Unfortunately, the level of any nerve damage caused during such a birth is not immediately obvious, and so careful assessment needs to be carried out and advice given with regard to handling and bathing the infant, as well as on how to administer passive stretches, the latter implemented five days post-delivery. If, after 12 weeks post-delivery, the baby has not recovered elbow flexion +/- shoulder abduction, they should be referred to a specialist centre for electromyography (EMG) and considered for a nerve graft/repair. Further information on this condition can be found at **www.erbspalsygroup.co.uk**.

Children and young adults

As children grow, their anatomy changes, and these changes can result in different presenting pathologies. So, what is a normal variant, and what is abnormal? Children and young people also have different "Red Flags" to those of adult patients. We must, therefore, always be aware of any asymmetry of a child's anatomy, and of the fact that children can develop bone tumours / cancer.

NORMAL VARIANTS

The most perceived problems in child aged patients are not pathological but merely normal variants (Jones & Khandekar 2013). Around 90% of all childhood orthopaedic problems will resolve. However, when a child presents for physiotherapy treatment, it is crucial to identify whether the problem is neurological, systemic, pathological or merely a normal variant. Once it has been determined that the problem is due

FIGURE 3: Vertical talus

to normal variant, it is again essential to explain this to, and reassure the child's parents / guardian.

So, what might a paediatric physiotherapist see as common variant growth issues in their patients?

PES PLANUS

Also known as flat feet, this is a condition that affects 97% of children until at least 18 months old (Uden *et al* 2017), and 4% of those will remain flat-footed until the age of 10. The medial arch occurs within three years of walking when baby fat diminishes and ligaments tighten. In the main, flat feet are pain-free and flexible. The Staheli test is the most appropriate for assessing the flexibility of the foot (Staheli *et al* 1987). Ask the child to stand on tip toes and, if a visible arch forms, they are flexible and require no physiotherapy or insoles. In cases where the condition is painful, insoles with a medial arch support may help alleviate this. If the child presents with a stiff, painful flat foot, tarsal coalition should be ruled out, and this can only be determined by x-ray.

FIGURE 4: A child showing symptoms of toe walking

IDIOPATHIC TOE WALKING

Approximately 30% of children have a family history of toe walking, however it is more common in boys than in girls (Dietz & Khunsree 2012). Toe walking (figure 4) will usually resolve during childhood, however a thorough assessment should be made in order to rule out any neurological cause such as Duchenne Muscular Dystrophy or mild Cerebral Palsy. Many children on the autistic spectrum toe walk, and often continue to do so despite interventions such as serial casting or orthotics.

JOINT LAXITY / HYPERMOBILITY

Children who are joint lax / hypermobile often present with an awkward gait, have frequent trips and falls, poor walking endurance, flat feet, knock knees and night pains (**https://www.nhs.uk/conditions/joint-hypermobility-syndrome**). Once an organic diagnosis has been ruled out, and the hypermobility has been scored for children over the age of five years, using the "Beighton" score (**https://www.ehlers-danlos.com/assessing-joint-hypermobility/**), an explanation and reassurance can be given to the parent / guardian that, as the child grows, their ligaments will tighten and that it is rare for these symptoms to persist into adulthood.

Bone development

Bony growth remains parallel between boys and girls until the age of 9-11 years. At around the age of 11, girls experience a growth spurt that, in boys, does not occur until around the age of 13 years (Tanner *et al* 1976). This is because the linear growth decelerates with menarche, or the first menstrual cycle. Girls will usually have reached their maximum height at around 16-17 years, whereas boys again usually achieve this two years later.

With regard to bone formation, the skeletal pattern of the individual is formed eight weeks after conception, in cartilage and connective tissue membranes and the start of the ossification process. At 11 weeks there is rapid differentiation of the hip joint and infantile configuration of femoral head and acetabulum. At 16 weeks the lower extremities lie in a position of stability for the foetal hip joint, specifically flexion, adduction and external rotation.

HIP DEVELOPMENT

One of the most significant changes within hip development are the changes between femoral anteversion and femoral retroversion. In an 11-week foetus there is between 5-10 degrees of femoral anteversion (Lee & Eberson 2006), and at 36 weeks this is increased to 45 degrees. By the time the child is a year old, the range has decreased to around 39 degrees, to 24 degrees by the age of 10 and, by the time the individual has become a young adult and stopped growing there will be only 16 degrees of anteversion.

Many young children present to paediatric physiotherapy with "intoeing". It is initially important to make sure that the intoeing is symmetrical, and then it is important to look for where the rotational profiling is coming from, i.e. from the hips by checking anteversion, from tibial torsion by looking at the thigh / foot angle, or does the child have a foot deformity such as metatarsus adductus?

The majority of children presenting with intoeing have femoral anteversion (**https://www.hss.edu/condition-list_hip-femoral-anteversion.asp**). It is a normal variant of anatomical development in the angle of the femoral neck that no amount of physiotherapy will change. Children with this condition tend to sit on the floor in a "W" position, i.e. they sit between their heels, as this is the most comfortable way of sitting for them. It is important to explain to parents / guardians that this is normal for the age of their child, there is no reason for them to try to change the way their child sits, and that the condition will improve over time. While some individuals do retain a degree of femoral anteversion into adulthood, it is not something that hinders them in any way. Next time you are walking in a street, look at individuals for the variation between femoral anteversion and retroversion.

PRESENTATION	ASSESSMENT CONSIDERATIONS	ACTION
A normal foot that develops a non-congenital deformity, often cavus, varus and equinus.	Is this coming from the spine or is it a neuropathy such as Charcot Marie Tooth disease?	If either diagnoses are suggested, always refer to a Paediatric Neurologist.
Delayed walking, frequent falls, toe walking, difficulty rising from lying or sitting to standing and perhaps with a waddling gait.	Consider whether this might suggest a dystrophy.	Always refer on to a Paediatric Neurologist.
Young child limping, with no pain.	Consider developmental dysplasia of the hip as this can be missed at the neonatal GP checks and generally not then identified until the child starts to walk.	Check for uni-lateral limitation of hip abduction and leg length discrepancy with use of the Galeazzi test (Storer & Skaggs 2006). If in doubt, always refer for an anterior / posterior x-ray of the pelvis.
Four- to eight-year-old presents with knee/ hip pain, a limp, a low grade ache in the groin / thigh / knee and limitation of hip abduction and internal rotation.	Consider Perthes disease, i.e. osteochondrosis of the femoral head.	Refer on to a Paediatric Orthopaedic surgeon.
Nine- to 16-year-old presents with pain in the knee / groin / hip. Limited internal rotation and at rest the affected leg lies in external rotation with flexion.	Consider whether this suggests slipped capital femoral epiphysis. Commonly linked with rapid growth and obesity. The slip symptoms may be mild, however a total slip will result in increased pain and a positive Trendelenburg gait. This is the most common hip disorder in adolescents.	Refer on to a Paediatric Orthopaedic surgeon.

TABLE 1: Red Flags to consider when assessing uncommon paediatric presentations

KNEE DEVELOPMENT

At birth, genu varum is a common secondary to intrauterine positioning leading to medial knee joint capsule contracture, also known as knock knees (**www.nationwidechildrens.org/conditions/knock-knees-genu-valgum**). Mild internal tibial torsion is common and becomes most noticeable when weight-bearing. This physiological genu varum corrects itself over time as the contracture stretches and at 2+ years a genu valgum alignment occurs. The normal degree of genu valgum is between 10 and 15 degrees and generally develops in children of between three and four years. By the time the child is six or seven years of age the genu valgum should have corrected itself to the normal adult range of between seven and eight degrees. It is important to note that variants in the genu valgum range may be accentuated by fat thighs, pes planus and ligamentous laxity. Again, education and reassurance to parents / guardian is the mainstay of treatment, providing that the child falls into the normal developmental parameters. There are, however, conditions to be aware of such as Blount's Disease and Rickets. These behave differently to usual physiological developments which is why it is important to determine what is normal for the age of the child and what is abnormal. If in doubt, always seek a paediatric orthopaedic opinion.

Growth plates enable children to grow. The growth plate at the junction of the epiphysis / metaphysis is vulnerable to force from contact, such as that incurred through trauma or sports injury, while at the apophyses the areas of growth are prone to avulsion. Rapid growth of long bones during a growth spurt can cause muscle shortening and pain. A condition that is seen in adolescents, and more commonly in boys, is Osgood-Schlatter Disease. The symptoms include pain, swelling and tenderness over the tibial tuberosity (Indiran & Jagannathan 2018), which is caused by repeated avulsion stresses (traction apophysis).

FIGURE 5: The Adams forward bend test

The young athlete is more likely to injure cartilage and bone or avulse an apophysis than have a ligament sprain. Traumatic injuries may result in fractures of growth plates, which can lead to shortening, and the possibility of conditions e.g. Sever's disease, should be considered as a differential diagnosis of foot and ankle pain presentations in this population.

SPINE DEVELOPMENT

The anatomy of the young spine is different to that of adults, therefore any low back pain presentation in a child will likely have a different cause to that of an adult patient. Children do not get spinal stenosis and osteoarthritis, but it is not uncommon to see a spondylolysis stress fracture in the adolescent. It is important to remember that children without any neurological condition can develop scoliosis.

There are two types of scoliosis; infantile idiopathic scoliosis that can be seen in children of up to three years of age, and adolescent idiopathic scoliosis that is seen in children over 10 years. Girls are more likely to develop adolescent idiopathic scoliosis than boys (Balague & Pellise 2017) and approximately 90% present with right sided curve. When assessing children with a possible leg length discrepancy, always look at the spine with a forward bend (figure 5), applying Adams forward bend test (**https://medlineplus.gov/ency/**

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imagepages/19465.htm), and in sitting as well as standing. The evidence with regard to physiotherapy and bracing for adolescents with scoliosis is inconclusive and much depends on the orthopaedic surgeon who is treating the child.

Red Flags

As with all patients, it is essential for the paediatric physiotherapists to look for the Red Flags in any assessment, to know what to always be aware of and what to rule out. Table 1 highlights some of the presentations which, although uncommon can present, and the Red Flags to consider.

Conclusion

Children and young people are different from adults. They are continually developing physically, emotionally and psychologically. While many conditions seen in childhood are self-limiting, some more serious pathology can occur. Delays in diagnosis may lead to long-term disability. The differential diagnosis relevant to musculoskeletal symptoms is so broad that adequate paediatric training is essential. We are all still learning and if in doubt, always ask, but never be afraid of assessing children providing you have the knowledge.

About the author

Di Coggings trained as a remedial gymnast in Wakefield and qualified in 1972. She undertook the conversion course in physiotherapy and has worked in paediatrics since 1974, initially in Newcastle and then London. Her experience and expertise are in MSK / orthopaedics and neuro-orthopaedics. She currently leads a large team of paediatric therapists and play therapists and she continues to participate in the clinical setting.

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Further resources

Association of Paediatric Chartered Physiotherapists https://apcp.csp.org.uk/publications/paediatric-outcome-measures

Education, health and care plans https://apcp.csp.org.uk/documents/guidance-paediatric-physiotherapists-writing-advice-education-health-and-care-plans

Ehlers-Danlos Society https://www.ehlers-danlos.com/assessing-joint-hypermobility/

Erbs Palsy advice www.erbspalsygroup.co.uk

HSS Education www.hss.edu/condition-list_hip-femoral-anteversion.asp

Nationwide Children's Hospital www.nationwidechildrens.org/conditions/knock-knees-genu-valgum

NHS UK conditions https://www.nhs.uk/conditions

Ponseti method www.ponseti.info

Steps: national charity for lives affected by lower limb conditions www.steps-charity.org.uk

All you need to know about collecting patient recorded outcome measures (PROMs)

Why should we collect PROMs?

- To adhere to Health and Care Professional Council (HCPC) standards of proficiency for physiotherapists (see box)
- To capture the patient's voice; views on their symptoms, functional status and health related quality of life
- To provide patients with the opportunity to evaluate the outcome of treatment
- To provide an objective measure of treatment effectiveness
- To facilitate the patient identifying their own goals and participating with their treatment
- To meet the Physio First Quality Assured Practitioner (QAP) / Quality Assured Clinic (QAC) requirements
- To meet BUPA / other medical insurance companies' requirements.

What outcome measure can we use?

Physio First are not currently defining which outcome measure should be used, but the PROM needs to be validated. There is a list of suggested outcome measures in Frequently Asked Questions (FAQ) on the Physio First website **www.physiofirst.org.uk**.

Using the Brighton musculoskeletal patient recorded outcome measure (BmPROM)

For Physio First members participating in the Data for Impact (DfI), we are encouraging you to access the free-to-use, validated, eight item outcome BmPROM. It is sensitive enough to measure clinical effectiveness in MSK physiotherapy across a range of conditions, and records both functionality and wellbeing. Patients are asked to complete the BmPROM independently, before their first treatment and after their final treatment. A paper version of the BmPROM is available to download from the FAQ page of the Physio First website **https://www.physiofirst.org.uk/benefits/data-for-impact-reports.html**.

If you are participating in the DfI project your patients have the option of accessing the BmPROM online. The University of Brighton team will set you up with a unique code to give to your patients who can then complete the BmPROM independently, pre and post treatment, via their own electronic device, i.e. tablet, smartphone or computer. The University of Brighton will send you a summary of your BmPROM data three times a year.

HCPC Standards of Proficiency

Standard 12: Physiotherapists

The clinician must be able to assure the quality of their practice

12.1 Be able to engage in evidence-based practice, evaluate practice systematically and participate in audit procedures

12.2 Be able to gather information, including qualitative and quantitative data, that helps to evaluate the responses of service users to their care

12.3 Be aware of the role of audit and review in quality management, including quality control, quality assurance and the use of appropriate outcome measures

12.4 Be able to maintain an effective audit trail and work towards continual improvement

12.5 Be aware of, and be able to participate in, quality assurance programmes, where appropriate

12.6 Be able to evaluate intervention plans using recognised outcome measures and revise the plans as necessary in conjunction with the service user

12.7 Recognise the need to monitor and evaluate the quality of practice and the value of contributing to the generation of data for quality assurance and improvement programmes

12.8 Be able to evaluate intervention plans to ensure that they meet the physiotherapy needs of service users, informed by changes in circumstances and health status.

A personal experience

My own patients find the BmPROM easy to use although, like all PROMs, it does require a reasonable level of literacy. The wellbeing aspect of the questions regarding the patient's attitude and anxiety levels, information that can take time to surface within treatment times, has been an education to me as well. The pre-treatment information gives me knowledge that enables me to address the patient's fears early on in the process and facilitate their recovery. To get patients to complete the BmPROM before commencing treatment, a pdf of the document or an electronic link can be supplied by email. Alternatively, the patient can be asked to arrive five minutes early so that they can be asked to fill in the PROM prior to their appointment.

It can sometimes be a challenge to ensure that the patient completes the PROM on discharge, but it is definitely worth persevering to get them to do so because this information is not only important for our profession, it is satisfying to see the results of what we do written down. So, if you have any successful approaches in encouraging the reluctant patient to participate in the PROM, particularly the end stage, it would be good to hear from you. Give us your "killer tips" on the Physio First LinkedIn forum, or email **minerva@physiofirst.org.uk** for the attention of R&D. We can all learn from each other on how we can make the PROM process as easy as possible both for our patients and ourselves.

Liz Palmer
R&D committee member, Physio First

Tips from our team

MEMBER SUBSCRIPTIONS 2020/21

Your new Physio First membership year begins on 01 April 2020. Members without a current direct debit authorisation already in place will need to renew their membership by card or cheque.

The cost of membership for the year is:

Full member **£240***
Affiliate member **£221***
Part-time subscription for the year is .. **£120***

Don't forget that we have a monthly payment plan available. For details of how to Pay As You Go please visit* **www.physiofirst.org.uk/join

Direct debits

Members who pay their annual subscription by direct debit are eligible for a £10 discount. Unfortunately, it is too late to process direct debit instructions in time for this year's subscriptions, but if you would like to ensure that you pay the best possible price for your Physio First membership, you can download a direct debit form here **www.physiofirst.org.uk/renewals** and submit it to us to ensure that it is in place for your 2021/2022 membership.

Benefits of being a Physio First member

Are you making the most of the benefits of membership? If you're not sure, you can remind yourself of our unique benefits here **www.physiofirst.org.uk/benefits**, or contact our office team to make sure that you are getting the most out of your Physio First organisation. Call on **01604 684960** or email **minerva@physiofirst.org.uk**

We can help you with your CPD

The PPEF invite all Physio First conference attendees to come and visit us at **stand 24** in the exhibition hall at the East Midlands Conference Centre (EMCC). Come and talk to us to find out how PPEF can help with your continued professional development (CPD), find out what grants we awarded during 2019, take away our information leaflet, and submit your application to be considered for the Louis Gifford Award for conference 2021.

Our priorities for 2020/21 will be in PPEF awarding grants for individual scholarships and education. This year we have increased the funding for these awards from £2K to £3K.

The PPEF AGM will be held on Friday 24 April at 1pm at the EMCC and all are welcome to attend, although only PPEF members are eligible to vote.

If you would like to become a PPEF member, and have a voice in the future direction of our charitable organisation, please go to our website **www.ppef.org.uk** For more information on how to join us, and for access to our quarterly newsletter, contact us at **admin@ppef.org.uk**.

VISIT OUR CONFERENCE STAND

Louis Gifford Award 2021

We are pleased to continue to commemorate the memory of Louis Gifford through offering places for one Physio First member, and one non member, at the Physio First annual conference. Louis was a private physiotherapist who made an outstanding contribution to Physio First, and to the physiotherapy profession in general. The two winners of the award will each receive a free place, accommodation and return travel for the Physio First conference 2021, which will be held on Friday 19 and Saturday 20 March at the EMCC. You can either obtain a form to complete and submit by visiting us on stand 24 at the EMCC at this year's Physio First conference, or apply online by going to our website **www.ppef.org.uk**. Applications should be submitted prior to 01 September 2020.

If you are attending conference, we look forward to seeing you at our stand and at our AGM.

Are you making the most of our strategic partnerships?

Physio First membership offers a range of benefits, including favourable discounts and offers from a range of culturally aligned third party commercial companies. Our commitment to Quality, and our culture of business through respect, no blame, good communication, structure and planning has attracted a wide range of companies to want to build a relationship with us and our members and be part of our journey.

Here are some of our Physio First partners who will be attending our annual conference in Nottingham on 24-25 April 2020. Visit their stand to find out more about what they are offering you as a Physio First member or go to **www.physiofirst.org.uk/resources/commercial** for more details.

Exercise and practice management software

TM3 is industry leading practice management software, offered by our long-term strategic partners Blue Zinc. TM3 is packed with innovative features designed to help group businesses of all sizes, and it can be used on multiple devices. The flexible nature of the software means that it is ideal for every style of physiotherapy practice. **Visit Blue Zinc on stand 1**.

Track Active is an easy to use online platform that can efficiently design, deliver and monitor patient rehabilitation programmes via all electronic methods. Built by a UK-based physiotherapist and technology team with user experience, the software was designed with the principle of being as efficient as possible to use. **Visit Track Active on stand 39**.

PhysioTools makes creating exercise programmes quick and easy, that result in saved time and the ability to provide outstanding service. Patients can be supplied with a plan from the PhysioTools comprehensive library, in print, by email or via a free app. The range of more than 16,000 exercise plans have been created in co-operation with world-renowned authors and cover all major specialist fields. **Visit PhysioTools on stand 27**.

Clinic supplies

Meglio manufacture and distribute their own range of premium quality products such as resistance bands, kinesiology tape and acupuncture needles. They also have a range of FREE training and exercise materials, that includes professional videos, that support your patients during their rehabilitation and recovery process. **Visit Meglio on stand 21**.

Physique Management have supplied physiotherapy products that are trusted in the most demanding of situations, to medical professionals and elite sports teams for more than 20 years.

Their range includes taping and strapping, pitch-side first aid, hot and cold therapy, and massage and exercise products, all of which help patients and athletes in top condition. **Visit Physique Management on stand 2**.

Education and training

Painless Practice provides Physio First members with business workshops with the aim "to see every health practitioner loving their work and achieving their vision". See page 35 for detailed information of the Painless Practice courses available and / or **visit stand 26** to find out more.

Why Painless Practice?

Practitioners spend a lot of time learning, developing and honing clinical skills, but often their business skills end up growing organically, and not always in the desired direction.

Painless Practice offers a set of courses that will help you to be proactive and enjoy all the non-clinical elements of your business, and to ensure quality in all of the different aspects of your practice.

Personal

Physiotherapists often go into private practice because they desire autonomy and the freedom to enjoy a "quality of life". What matters to you personally needs to be given huge consideration. For those not meeting their personal goals, running a practice can feel like an uphill battle.

If this is you, you may need to define what your personal goals are, and what needs to happen for you to achieve them?

Purpose

Initially, going into business is about earning a living, but once that is achieved there has to be a higher level of motivation for getting out of bed in the morning. For private physiotherapists the motivation is in providing effective quality care and helping patients to achieve their goals and get back to what they love doing.

What is the greater purpose of your practice?

Pipeline

Attracting new patients and retaining them for the duration of their treatment programme is important. In order to do this, patients must be able to differentiate one practice from another, and increasingly this comes down to proof of results and the quality of care they receive.

How do you attract and retain your patients, and how do you demonstrate quality?

Patients

At the centre of every physiotherapy practice is the patient, for whom the journey to recovery has many steps. It is important to have clearly defined standards for every stage and to obtain feedback from the patient on their perception of their quality of care experience.

How do you provide and measure the quality of care you provide?

People

When the physiotherapist has defined their personal goals, the purpose of their practice, the type of patient they want to attract, and how to provide quality in the patient journey, the next stage is in identifying who might be needed to help achieve their vision, and perhaps who is no longer needed.

How do you ensure that your entire team are on board with your vision for your business?

Profit

One of the requirements for a successful and sustainable practice is for the owner to know their numbers. Obtaining accurate information requires good quality data. This will lead to the ability to make appropriate decisions that can steer the practice in the desired direction.

How do you capture the information about your patient care and practice performance?

Plan

There is a far greater chance of goals coming to fruition if they are captured either in writing or electronically. Outlining a three to five year plan for each of the areas above is recommended and, from this, a succinct 12-month plan can be created that lists the key actions that need to be taken to move the business towards its goals.

What plans do you have in place to ensure quality every step of the way?

Celia Champion
Painless Practice

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24-25 April

Painless practice have also scheduled a suite of courses around the country, specifically created with the needs of the private physiotherapy business in mind.

For more information visit www.painlesspractice.com/events

Our Physio First Data for Impact (DfI) programme and Quality Assured Practitioner and Clinic schemes support each of the areas listed.

If you're not yet involved, do consider joining the DfI today.
www.physiofirst.org.uk/benefits/data-for-impact-reports

Where, when and how much?

	Investment	London	Bristol	Manchester	Belfast	Glasgow
How to run your practice proactively	PF Member £150	28th Jan	12th Feb	18th Feb	11th Feb	13th March
Budgeting made easy	PF Member £175	25th Feb	8th July	7th May		
Patient Management and Communication	PF Member £150	22nd April	31st May	16th July		
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Book reviews

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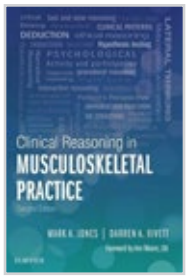
Clinical Reasoning in Musculoskeletal Practice (2nd edition)

Mark A Jones & Darren A Rivett

- **Publisher: Elsevier**
- **ISBN: 9780702059766**
- **RRP £51.99**



Quite simply, this is a must-have book if you are interested in the foremost practice applicable knowledge, written by the leading authorities from the physiotherapy world.

The content covers all aspects of clinical physiotherapy practice through case studies presented by experts in their field. Clinically reasoned cases discussing areas such as the specifics for assessing particular conditions, considerations for a variety of pathologies, and treatment options are presented for the reader to learn from and be inspired by.

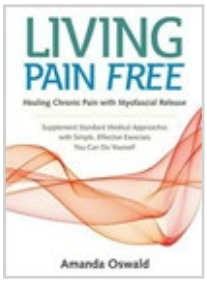
As its title suggests, the aim of this book is based and built on the clinical reasoning process of the musculoskeletal practitioner and is certainly not written as a "painting by numbers" physiotherapy approach for each condition, which is obviously a good thing.

Tobias Bremer

Living Pain Free. Healing chronic pain with myofascial release

Amanda Oswald

- **Publisher: Lotus Publishing**
- **ISBN: 978-1905367818**
- **RRP £14.99**



This is an excellent self-help book that empowers the reader with current knowledge and techniques.

The author acknowledges that the current "buzz" phrase in pain relief is myofascial release, however the content of this book is anything but hype as it is born out of her own recognition of the need to address her own pain niggles. In an effort to do so, Amanda studied massage and fascial release and applied this knowledge to treating herself before she went on to apply what she had learned to her clients.

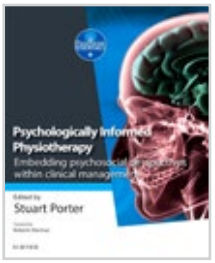
The result is something that is informative and empowering in that it offers the reader an understanding of the pain mechanism associated with fascial dysfunctions, some simple self-help mobilisations to help with pain relief.

Tobias Bremer

Psychologically Informed Physiotherapy

Stuart Porter

- **Publisher: Elsevier**
- **ISBN: 978-0702068171**
- **RRP £39.99 Paperback**



This publication is a really good introduction into how psychological treatment approaches can be integrated within physiotherapy.

Obviously, specific psychology training for the therapist cannot be recreated in a single book, and this one doesn't set out to do so. It does however give the reader an insight into the interplay between the bio-psychosocial model and bio-medical facts, how to differentiate between them and, with this information, make clinical decisions.

The subject-matter is wide reaching, from red flags which you should never forget in your assessment, to the role of the endocrine system to the psychology of the athlete as seen by the treating physiotherapist. Each chapter is written by an expert in their field and the whole book is pulled together by a final chapter on how to use psychological strategies within your practice.

Each of the chapters would be worth reading on their own, but together they make up a very decent clinical text.

Tobias Bremer

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My journey with Physio First

I qualified in 1993 and never planned to work privately, but when my husband was made redundant in 2015 it made sense for me to step up from working part time and, as at the time there were no more hours available in my employed role in the NHS, I had to consider other streams of income, so I decided to test the water with seeing some private clients.

I had no idea where to start and, when I did, I realised that I hadn't so much dipped my toe in the water, I had instead fallen into a big chasm! Thankfully, I was encouraged by various people to consider membership of Physio First and when I did the chasm suddenly did not seem quite so vast.

At the time, it was a challenge for me to meet the membership fees but, as someone pointed out "you will have saved your fee a hundred times over", I was encouraged to join early in 2018. I was immediately reassured by the understanding, supportive team at Minerva House who patiently answered my questions and pointed me in a positive direction.

Coming from the vastness of the NHS and all the support services available there, I felt very vulnerable when faced with going it alone. Being a member of Physio First helped me to feel connected to something so much bigger and this was reinforced when I applied for, and was granted, a sponsored place on the Physio First 2018 conference, thanks to the Private Physiotherapy Educational Foundation (PPEF). This excellent event gave me an opportunity to see the bigger picture of Physio First as an organisation and speak to others who were much further along their private physio journey than I was.

It was a weekend where I also met many colleagues who were in a similar position to myself and it was so encouraging to hear their stories.

Physio First offers many opportunities to connect fellow members and with other organisations that provide for the needs of a budding private physio, such as Painless Practice whose invaluable training helped to propel me further into the world of private practice and renewed my zeal for giving my clients alternative options to the restrictions of NHS treatment.

As a member of Physio First, I feel that I am being cheered on from the sidelines and as a private practitioner, I am free to express myself more fully through the work that I do and to give a service at a standard I am happy with. My passion for ensuring quality care is met by the Physio First Data for Impact (DfI) project. Even though I wasn't sure that I would see 50 patients in a year I resolved, at the beginning of 2019, to participate in DfI and input as much data as I could. As it was, by the end of 2019 I had input data on 54 patients, and the results were fascinating. Rather than groping around in the dark with my main driver being the desire to give my patients the quality treatment they needed, I now had the ability to understand my practice from the point of view of the national picture, which was truly illuminating. Collecting data led to me achieving Quality Assured Practitioner status which is another landmark on my journey as a private physiotherapist.

My clinic now includes a home-visiting service and Physio-fit exercises classes in the local community centre, and not only offers a personal and flexible service to my clients, it also gives me the flexibility I need for family life. There are plenty of challenges for the sole practitioner but having a community of experienced therapists on hand to help me navigate through so many aspects of private practice has been very reassuring.

Physiotherapy is the easy part of the job. It's what we have trained for and it's our passion. However, the private physiotherapist often finds themselves in a legal, financial and business world that we are not quite so sure of, and Physio First is excellent in supporting us in this. Thank you to everyone at Physio First who has helped me in my journey so far. I have no idea where it could end, but I know it will be a better journey with you than it will be without you.

Judith Hayhow
MCSP

IMAGE: Judith Hayhow, right, with PPEF Chairman Fleur Kitsell at the Physio First annual conference

> "AS A MEMBER, I FEEL THAT PHYSIO FIRST IS CHEERING ME ON FROM THE SIDELINES"

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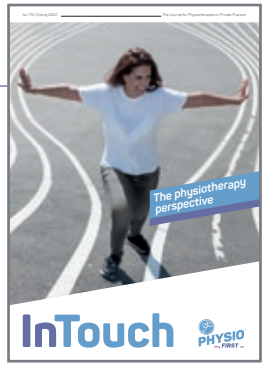

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