PPEF KEYNOTE PRESENTATION

Gluteal tendinopathy: the detail underlying a 'load management and exercise' approach

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Gluteal tendinopathy is a common condition with which patients present to clinical practice, usually reporting substantial impacts on sleep quality, activity levels and quality of life. Recent survey studies, including a UK study, indicate that physiotherapists have received the messages from high-quality research regarding a primary focus on education and exercise in the management of this condition. However, the specifics of what is being provided under that umbrella suggest that there is still more to translate and investigate, to optimise provision of care in the community.

LEARNING OUTCOMES
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This article will encourage clinicians to reflect on:

1. the use of terminology and understanding of pathology and pathoaetiology
2. the robustness of their differential diagnosis of lateral hip pain (are validated tests being applied?)
3. the selection of interventions for gluteal tendinopathy (are they supported by the evidence?).

Introduction

Gluteal tendinopathy is a prevalent lower limb condition, particularly within post-menopausal women (Albers *et al* 2014; Segal *et al* 2007), and has a substantial impact on physical activity and quality of life (Fearon *et al* 2014). There is a growing body of scientific literature and wider information available on gluteal tendinopathy and Greater Trochanteric Pain Syndrome (GTPS). A recent survey of physiotherapists in the United Kingdom reported 97.4% of physiotherapists were somewhat, or very confident in the management of GTPS (Stephens *et al* 2019). Almost all surveyed physiotherapists provide education on load management (98.7%) and self-management strategies (375/381; 98.4%), as well as a strengthening programme (98.4%). This would seem consistent with the evidence base and contemporary approaches of providing education and exercise for management of gluteal tendinopathy (Mellor *et al* 2018), and tendinopathy in general (Cook & Purdam 2012). On face value, it could be interpreted that physiotherapists are confidently managing this condition in an evidence-based fashion, with knowledge translation complete. Variations in outcomes in the scientific literature and details within survey papers would, however, suggest that there is still much to learn. In this age of social media, general principles are easily translated but a deeper understanding of the condition, proposed aetiological mechanisms, diagnosis and the evidence base for treatment strategies are less readily translated via this medium.

Terminology and pathology

In the survey of UK physiotherapists, just over half (54.7%) considered GTPS to be primarily a condition of the gluteal tendons, with another 3.4% believing it to be solely a condition of the gluteal tendons (Stephens *et al* 2019). However, more than a third of physiotherapists (36.1%) understood GTPS as an "overarching term used to describe lateral hip pain of unknown origin". This is where terminology can be problematic. Do these statistics reflect a lack of awareness in this third of the surveyed population, of the local pathologies associated with trochanteric pain, or simply a lack of clarity regarding the definition of GTPS? It is not surprising that there is confusion among clinicians regarding the definition of GTPS, as this diagnostic term is used with wide variation in the literature. Some use this as an "umbrella term", including not only local sources of nociception but more distant sources of referred pain. In the contemporary literature, GTPS is most commonly used to describe a local soft tissue source of greater trochanteric pain, in which the specific pathology has not been established with imaging. Even without imaging, the population should be adequately described to allow interpretation of data.

Clifford and colleagues (2019), in their recent GTPS study, performed validated physical tests for diagnosis of gluteal tendinopathy and aimed to exclude hip joint conditions with a plain x-ray and absence of pain on hip flexion-adduction-internal rotation (Clifford

"THE PRIMARY LOCAL SOFT TISSUE PATHOLOGY ASSOCIATED WITH GREATER TROCHANTERIC PAIN HAS BEEN SHOWN TO BE TENDINOPATHY OF THE GLUTEUS MEDIUS AND/OR MINIMUS TENDONS. THERE MAY ALSO BE ACCOMPANYING CHANGES IN THE ADJACENT BURSAE AND THE ILIOTIBIAL BAND, ALTHOUGH THESE ARE RARELY PRESENT IN ISOLATION"

et al 2019). Another recent study included GTPS participants based on a patient-reported history of lateral hip symptoms and pain with two or more of the following activities: lying on the ipsilateral side, sitting, moving from sitting to standing, and / or ascending / descending stairs or slopes (Cowan *et al* 2019). Participants who also reported locking or catching in the joint, range of movement restriction or difficulty manipulating shoes and socks, were excluded. No physical tests or imaging were used to further describe the population. There is no evidence at this point on the diagnostic utility of such a battery of questions. In the LEAP randomised clinical trial (RCT) examining outcomes of intervention for those with gluteal tendinopathy (Mellor *et al* 2018), of 412 potential participants identified, via phone screen (patient responses to questioning), 129 were excluded on physical assessment and a further 43 on imaging. More than 40% of the original group identified through patient questioning was ultimately not considered to have a primary diagnosis of gluteal tendinopathy following physical assessment and imaging.

Use of physical assessment is likely to substantially reduce diagnostic error and ensure there is greater clarity around a test population. The further addition of imaging enhances description of the population but is expensive and is not always feasible. When reading the GTPS literature, it is important to read the inclusion and exclusion criteria to be able to adequately interpret the findings and implications for clinical management.

Diagnostic definitions can influence treatment direction. For a patient diagnosed with GTPS defined as "lateral hip pain of unknown origin", how does a physiotherapist develop an adequate management plan within a clinical reasoning model? There is a trend towards non-specific diagnoses, but does this engender the use of non-specific treatment approaches? Are non-specific treatment approaches equally effective? Without a specific diagnosis or awareness of local pathology, perhaps an impairments-based model may be employed with adequate effect – assess for impairments and address those findings. However, the literature on insertional tendinopathy suggests that an understanding of pathoaetiology and specific tendon loading principles may be important in the development of optimally effective interventions (Cook & Purdam 2012; Grimaldi *et al* 2015).

There is a substantial body of literature available that has identified gluteal tendon pathology as the primary condition associated with greater trochanteric pain (Bird *et al* 2001; Kingzett-Taylor *et al* 1999; Kong *et al* 2007; Long *et al* 2013). Thickening of the bursae and iliotibial band (ITB) (Long *et al* 2013) may also be present but diagnoses such as "trochanteric bursitis" have traditionally given rise to passive treatment approaches such as injections, electrotherapy and surgical removal of the trochanteric bursa. Although there may be other associated soft tissue changes, a diagnosis of "gluteal tendinopathy" is more likely to encourage an active intervention and improved long-term outcomes (Mellor *et al* 2018).

Pathoaetiological mechanisms

While mechanisms underlying the development of pain are complex, science has been able to elucidate mechanobiological mechanisms that influence tendon health, and tendon pathology is considered a risk factor for the development of painful tendinopathy (Docking *et al* 2015).

Compression and combinations of high compressive (transverse) and tensile (longitudinal) load are known to adversely affect tendon health or load capacity (Almekinders *et al* 2003; Cook & Purdam 2012; Docking *et al* 2013). Tendons are naturally exposed to higher compressive load as they wrap around a bone, most commonly at their insertion. The gluteus medius and minimus tendons at insertion absorb high compressive and tensile loads at the greater trochanter. This is amplified by the overlying ITB and further influenced by bony morphology, joint position and muscle factors (Grimaldi *et al* 2015).

One of the factors that most potently alters compressive load is frontal plane joint position. In a neutral hip position, the ITB imparts only four Newtons of compressive load across the greater trochanter and the intervening gluteal

"HIP ADDUCTION POTENTLY INCREASES COMPRESSIVE AND TENSILE LOADS ACROSS THE GLUTEUS MEDIUS AND MINIMUS TENDONS AT THE GREATER TROCHANTER, WITH IMPLICATIONS FOR DIAGNOSIS AND MANAGEMENT OF GLUTEAL TENDINOPATHY"

tendons and bursae (Birnbaum *et al* 2004). With only 10 degrees of adduction, this compressive load increases nine-fold to 36 Newtons and by end of hip adduction range (40 degrees), the compressive load has increased by 26.5 times to 106 Newtons. In an adducted hip position, there is also an increase in tensile load due to the natural stretch applied across the musculotendinous complex. Tensile load in these gluteal tendons will be even greater when the muscles are active and tensioning the tendons. Highest loads may then be applied in a position of hip adduction when the gluteal tendons are both compressed and stretched and particularly when the muscles are active. This information may be used then for inducing provocative loads for diagnostic purposes and for reducing provocative loads for management of painful tendinopathy.

> "THE EVIDENCE SUGGESTS THAT A DIAGNOSTIC TEST BATTERY FOR GLUTEAL TENDINOPATHY SHOULD INCLUDE PALPATION, MOST USEFUL FOR RULING OUT GLUTEAL TENDINOPATHY WHEN NEGATIVE, AND SPECIFIC TESTS THAT APPLY PROVOCATIVE LOADS ACROSS THE GLUTEAL TENDONS (SINGLE LEG STANCE TEST, FADER/R TEST, THE RESISTED EXTERNAL DE-ROTATION TEST, THE ADD/R TEST)"

Diagnosis

Direct compression (palpation) and combinations of compression and tension appear to be most useful for eliciting familiar pain in those with gluteal tendinopathy (Grimaldi *et al* 2017). With regard to diagnosis of GTPS, 84.8% of surveyed UK physiotherapists palpate the greater trochanter, two-thirds consider pain on single leg stance (65.7%) and just over half (55.8%) perform resisted hip abduction in neutral (Stephens *et al* 2019). However, only around a third of surveyed UK physiotherapists are using specific tests that have been developed to combine compressive and tensile loads on the gluteal tendons, such as the FADER/R test (Hip flex/Add/Ext Rot ± Isometric internal rotation) (34%), the ADD/R test (Hip adduction in Obers Position; Hip adduction + Isometric abduction) (27.2%; 34%), or the resisted external de-rotation test (34.6%). These tests have all been shown to have good diagnostic utility for predicting the presence of gluteal tendinopathy on imaging (Grimaldi *et al* 2017; Lequesne *et al* 2008). The relatively low percentage of physiotherapists using these specific tests is similar within those surveyed in Australia, New Zealand and Ireland (French *et al* 2019). The FABER test has also been shown to be useful for differentiating GTPS from hip OA (Fearon *et al* 2013), and yet is used by only about one-quarter of physiotherapists surveyed in both these studies (French *et al* 2019; Stephens *et al* 2019).

Management strategies

Although "load management education and exercise" is now the routine evidence-informed approach for management of gluteal tendinopathy by physiotherapists, the detail regarding what education and exercise is applied may not be consistent with that suggested by the evidence. Load management advice is provided (often or always) by 98.7% of physiotherapists surveyed in the UK and yet only 38.6% (often or always) discuss postural strategies, and 39.9% sometimes, often or always prescribe stretching for the hip abductors (Stephens *et al* 2019). Sustained postures account for a substantial proportion of time exposure to hip adduction in everyday life; sitting with knees crossed, standing in "hip hanging"/adducted postures and side sleeping. Furthermore, stretching for insertional tendinopathies is no longer advised owing to their compressive and, therefore potentially provocative, nature (Cook & Purdam 2012). What exactly, then, is being provided as "load management" advice? Load management does include non-specific advice on reducing activity levels and then gradually reloading as pain allows. Such general advice is important in the overall management of tendinopathy. For those who have developed pain due to a reactive tendon response to a short-term spike in activity, this advice may be sufficient. However, if the situation of tendon overload is underpinned by inherent postural and movement patterns, simply unloading and reloading is unlikely to be an adequate longer-term solution.

> "LOAD MANAGEMENT FOR GLUTEAL TENDINOPATHY ENCOMPASSES MORE THAN SIMPLY REDUCING AND THEN GRADUALLY BUILDING ACTIVITY LEVELS. IDENTIFYING AND REDUCING INDIVIDUAL EXPOSURE TO EXCESSIVE, REPETITIVE, LOADED AND SUSTAINED HIP ADDUCTION IN ACTIVITIES OF DAILY LIVING AND SPORT, IS LIKELY TO BE KEY FOR OPTIMAL MANAGEMENT"

Only 51.4% of surveyed UK physiotherapists always or often provide gait training, with 62% providing functional movement training (Stephens *et al* 2019). In contrast, 98.4% always or

often prescribe strengthening exercises. There is certainly evidence for hip abductor muscle strength deficits in those with gluteal tendinopathy (Allison *et al* 2016a; Ganderton *et al* 2017), but there is also evidence for kinetic and kinematic alterations in gait and other single limb loading tasks (Allison *et al* 2016b). An important component of the successful LEAP RCT protocol was to address kinematic patterns that may contribute to provocative gluteal tendon loading (Mellor *et al* 2018). As all UK physiotherapists (99.7%) reported using functional exercises as a common mode of strengthening (Stephens *et al* 2019), strengthening and neuromotor training goals may well be incorporated into that same exercise programme. Squats, sit-stand, single leg stance and step tasks are commonly prescribed functional exercises and may serve to improve musculotendinous load capacity and kinematic control. Receiving physiotherapist feedback while practising everyday functional tasks may also provide benefit via other mechanisms. Participants that received supervised exercise in the LEAP RCT reported significantly higher levels of pain self-efficacy, i.e. confidence to participate despite their pain, than those in the groups that received a corticosteroid injection or basic advice (Mellor *et al* 2018). Reduced fear and increased confidence associated with practising everyday functional tasks with guidance and assurance from a health professional may contribute to improvements in pain and function.

Gait does not fall within the realm of functional strengthening, but the evidence suggests it should be addressed within a management protocol that aims to optimise functional abductor tendon loading. Allison and colleagues (2016b) demonstrated that individuals with gluteal tendinopathy walked in a manner that increased the loads on the hip abductor tendons, as indicated by external hip adduction moments 9%-33% higher through stance than painfree controls. If we consider that our patients may be taking somewhere between 5,000 and 10,000 steps a day, there is a substantial potential for reducing the daily load imposed on the gluteal tendons through alterations in gait pattern. Why, then, are only 50% of UK physiotherapists addressing gait? Is there a lack of awareness of gait changes in this population or perhaps a lack of confidence in gait analysis and training? Positive changes can be made with visual observation and simple interventions. In gait observation, clinicians can aim to identify overt features such as excessive frontal plane deviations of the pelvis and trunk, excessive stride length, and impact force or inadequate stride width (narrow base of support). In the LEAP RCT (Mellor *et al* 2018), clinicians used simple cues such as "walk a little taller" for those with excessive frontal plane deviations, "walk quietly" for those with excessive stride length and a harsh heel impact, and "walk with your feet slightly wider" for those walking with a midline or cross-midline strike, and therefore excessive hip adduction. Complex cues such as "keep your pelvis level when you walk" or encouraging abnormal muscle holding could serve to worsen altered muscle patterning. Excessive muscle co-contraction has been demonstrated in those with gluteal tendinopathy (Allison *et al* 2018; Ganderton *et al* 2017), therefore it will be important to avoid cues that encourage sustained and inefficient muscle contraction such as "keep your gluteals tight as you walk".

Apart from functional exercises, which can impart both strength and neuromotor benefits, what other exercises are employed to target the hip abductors? Does it matter what and how abductor strengthening is prescribed; isometric, isotonic, weightbearing, non-weightbearing?

Most physiotherapists in the UK appear to use a variety of exercise modes (Stephens *et al* 2019). There is inadequate evidence at this point to direct specific exercise selection. Clifford and colleagues (2019) published a small pilot trial comparing two simple exercises; hip abduction in side lying and in standing provided to patients with GTPS in either an isometric mode group, or an isotonic group (Clifford *et al* 2019). Both groups were also provided with education. After 12 weeks, there was no between-group difference in pain as measured with a numeric rating scale, or disability measured with the VISA-G patient rated outcome measure. With respect to pain, 55% of the isometric group and 48% of the isotonic group had achieved a pain reduction by the minimal clinically important difference (MCID) of at least two points by 12 weeks. Pain scores were, however, still reasonably high, with only one participant in the isometric group and three in the isotonic group falling beneath a pain level of 2/10. Participants in the education and exercise group of the LEAP RCT had an average pain score of 1.5/10 by week eight (Mellor *et al* 2018).

The exercise protocol of the Clifford *et al* (2019) study was necessarily limited to allow testing of one exercise mode against another. The two RCTs that have recently compared education and exercise interventions for gluteal tendinopathy; the LEAP trial (Mellor *et al* 2018) and the GLoBE trial (Ganderton *et al* 2018), both used a variety of exercises that were progressed over the duration of the intervention (table 1). The GLoBE trial compared a gluteal loading programme with a sham exercise

> "THE VALUE OF GAIT TRAINING IN REDUCING PAIN ASSOCIATED WITH GLUTEAL TENDINOPATHY SHOULD NOT BE UNDERVALUED. SIMPLE ADVICE AND CUING TO ADDRESS OVERT FEATURES CAN RETURN RAPID AND MEANINGFUL POSITIVE CHANGE"

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programme and found that both groups improved, with no difference in outcomes between the groups in both the short (three months) and long (12 months) term (Ganderton *et al* 2018). The paper's primary conclusion was that "lack of treatment effect was found with the addition of an exercise programme to comprehensive education on GTPS management". This suggests that the education and not the exercise was the active ingredient for change. The effect of education alone is yet to be established, so the relative effect of the education and exercise components is unknown.

It is difficult to compare outcomes across studies when different outcome measures are used, but both the LEAP and GLoBE trials used the VISA-G patient rated outcome scale, which measures pain and disability in those with gluteal tendinopathy and GTPS. The total score is out of 100, with higher scores indicating less pain and better function. At three months, after the active intervention period of both trials, the LEAP education and exercise group had improved on the VISA-G scale by an average of 19.1 points or 31.7% from the baseline score (60.2/100) (Mellor *et al* 2018). The GLoBE education and exercise group had improved by an average 11.5 points or 18.7% from the baseline score (61.6/100) (Ganderton *et al* 2018). If we consider that both groups received comprehensive education, the difference in progress may have been related to the exercise protocols. Both provided weightbearing exercises with no provocative stretching. However, there were a number of differences between the protocols (table 1), any of which may have influenced outcomes. It is important to note that the VISA-G measure cannot capture all aspects of change, and mediators of change are often complex, variable and difficult to clearly elucidate. Further studies using a standardised core outcome set are required.

> "SUCCESSFUL OUTCOMES HAVE BEEN DEMONSTRATED FOR PATIENTS WITH GLUTEAL TENDINOPATHY WITH EDUCATION AND EXERCISE THAT HAS INCLUDED FUNCTIONAL WEIGHTBEARING EXERCISE AS WELL AS HEAVY SLOW RESISTED WEIGHTBEARING ABDUCTION INTO INNER RANGE. HIGH PATIENT COMPLIANCE AND PHYSIOTHERAPIST SUPERVISION MAY ALSO INFLUENCE OUTCOMES"

LEAP TRIAL EDUCATION & EXERCISE PROTOCOL	GLoBE TRIAL EDUCATION & EXERCISE PROTOCOL
Comprehensive education	**Comprehensive education**
Exercises included: isometric hip abduction supine and standing; squats progressing from double leg to offset to single leg; single leg stance; step ups progressing step height; bridging progressing from double leg to offset to single leg, sidestepping, weightbearing hip abduction against spring and band resistance	**Exercises included: hip hitch/hip hitch with toe tap/ hip hitch with hip swing; double leg wall squat/ single leg wall squat; double leg calf raises/calf raises with toe taps/single leg calf raises; sit to stand/sit to stand with split stance/step up**
Focus on closed chain/weightbearing exercise	**Focus on closed chain/weightbearing exercise**
No stretches	**No stretches**
3 x week heavy loading with external resistance (2 supervised and 1 at home)	***No heavy loading – bodyweight only***
Inner range abduction	***No inner range abduction***
Specific posture, gait & stairclimbing training	***No specific movement training***
90% compliance with exercise programme	***76% compliance with exercise programme***
Number of sessions with physiotherapists: 14	***Number of sessions with physiotherapists: 4***

TABLE 1: Similarities and differences in the LEAP (Mellor *et al* 2018) and GLoBE (Ganderton *et al* 2018) trial protocols. Key differences in protocols indicated by italics

Conclusion

It is clear from recent surveys of physiotherapists, that the general message regarding use of load management education and strengthening exercise for treatment of gluteal tendinopathy and GTPS has been widely translated. However, the use of specific diagnostic tests, tendon-specific education and gait and movement training appears to be less common. Exercise selection and dose (intensity and frequency) is variable. Further research is required to discern the minimal effective dose. This is expected to vary within subgroups, some patients likely to need education with minimal other intervention and others requiring more intensive, supervised training and/or multidisciplinary care. At this stage, there is high quality evidence that a tailored education and exercise protocol is successful for most people and should be first line management for gluteal tendinopathy. Further knowledge translation of the detail underlying successful programmes is required.

About the author

Alison is an Adjunct Senior Research Fellow at the University of Queensland, an Australian sports physiotherapist and Principal of Physiotec Physiotherapy, with more than 25 years of clinical experience and a special interest in hip and pelvic pathologies. Alison was instrumental in the development of the clinical tests and education and exercise intervention for the LEAP multicentre randomised clinical trials (RCT), comparing treatments for gluteal tendinopathy, the findings of

which have recently been published in the *British Medical Journal*. Alison's other publications include 15 peer-reviewed papers on gluteal tendinopathy, 11 on hip-related topics, two editorials and contributions to book chapters in three leading clinical textbooks. Alison has presented widely at national and international physiotherapy and multidisciplinary conferences and has conducted more than 100 clinical workshops across Australia, New Zealand, USA, Canada, the UK, the Republic of Ireland, France, Belgium, Netherlands, Switzerland, Hong Kong, Singapore and Dubai. Visit **www.dralisongrimaldi.com** for further learning resources.

References

Albers S, Zwerver J, Van den Akker-Scheek I. Incidence and prevalence of lower extremity tendinopathy in the general population. *British Journal of Sports Medicine* 2014;48(Suppl 2):A5

Allison K, Salomoni SE, Bennell KL, Wrigley TV, Hug F, Vicenzino B, Grimaldi A, Hodges PW. Hip abductor muscle activity during walking in individuals with gluteal tendinopathy. *Scandinavian Journal of Medicine & Science in Sports* 2018;28(2):686-695

Allison K, Vicenzino B, Wrigley T, Grimaldi A, Hodges P, Bennell K. Hip abductor muscle weakness in individuals with gluteal tendinopathy. *Medicine and Science in Sports and Exercise* 2016a; 48(3):346–352

Allison K, Wrigley T, Vicenzino B, Bennell K, Grimaldi A, Hodges P. Kinematics and kinetics during walking in individuals with gluteal tendinopathy. *Clinical Biomechanics* 2016b;32:56-63

Almekinders LC, Weinhold PS, Maffulli N. Compression etiology in tendinopathy. *Clinics in Sports Medicine* 2003;22:703-710

Bird P, Oakley S, Shnier R, Kirkham B. Prospective evaluation of magnetic resonance imaging and physical examination findings in patients with greater trochanteric pain syndrome. *Arthritis & Rheumatism* 2001;44(9):2138-2145

Birnbaum K, Siebert CH, Pandorf T, Schopphoff E, Prescher A, Niethard FU. Anatomical & biomechanical investigations of the iliotibial tract. *Surgical & Radiological Anatomy* 2004;26:433-446

Clifford C, Paul L, Syme G, Millar N. Isometric versus isotonic exercise for greater trochanteric pain syndrome: a randomised controlled pilot study. *BMJ Open Sport & Exercise Medicine* 2019;5(1): p.e000558

Cook JL, Purdam C. Is compressive load a factor in the development of tendinopathy? *British Journal of Sports Medicine* 2012;46(3):163–168

Cowan R, Semciw A, Pizzari T, Cook J, Rixon M, Gupta G, Plass L, Ganderton C. Muscle Size and Quality of the Gluteal Muscles and Tensor Fasciae Latae in Women with Greater Trochanteric Pain Syndrome. *Clinical Anatomy* 2019; doi: 10.1002/ca.23510 Epub ahead of print

Docking S, Samiric T, Scase E, Purdam C, Cook J. Relationship between compressive loading and ECM changes in tendons. *Muscles, Ligaments & Tendons* 2013;21;3(1):7-11

Docking S, Ooi C, Connell D. Tendinopathy: Is Imaging Telling Us the Entire Story? *Orthopaedic & Sports Physical Therapy* 2015;45(11):842-852

Fearon AM, Cook JL, Scarvell JM, et al. Greater trochanteric pain syndrome negatively affects work, physical activity and quality of life: a case control study. *Arthroplasty* 2014;29(2):383–386

Fearon AM, Scarvell JM, Neeman T, Cook JL, Cormick W, Smith PN. Greater trochanteric pain syndrome: defining the clinical syndrome. *British Journal of Sports Medicine* 2013;47:649-653

French H, Grimaldi A, Woodley S, O'Connor L, Fearon A. An international survey of current physiotherapy practice in diagnosis and knowledge translation of greater trochanteric pain syndrome (GTPS). *Musculoskeletal Science & Practice* 2019;43:122-126

Ganderton C, Pizzari T, Harle T, Cook J, Semciw A. A comparison of gluteus medius, gluteus minimus and tensor facia latae muscle activation during gait in post-menopausal women with and without greater trochanteric pain syndrome. *Electromyography & Kinesiology* 2017;33:39-47

Ganderton C, Semciw A, Cook J, Moreira E, Pizzari T. Gluteal loading versus sham exercises to improve pain and dysfunction in postmenopausal women with greater trochanteric pain syndrome: a randomized controlled trial. *Women's Health* 2018;27(6):815-829

Grimaldi A, Mellor R, Hodges P, Bennell K, Wajswelner H, Vicenzino B. Gluteal tendinopathy: a review of mechanisms, assessment and management. *Sports Medicine* 2015;45:1107-1119

Grimaldi A, Mellor R, Nicolson P, Hodges P, Bennell K, Vicenzino B. Utility of clinical tests to diagnose MRI-confirmed gluteal tendinopathy in patients presenting with lateral hip pain. *British Journal of Sports Medicine* 2017;51(6):519-524

Kingzett-Taylor A, Tirman P, Feller J, McGann W, Prieto V, Wischer T, Cameron J, Cvitanic O, Genant H. Tendinosis and tears of gluteus medius and minimus muscles as a cause of hip pain: MR imaging findings. *American Journal of Roentgenology* 1999;173:1123-1126

Kong A, van der Vliet A, Zadow S. MRI and US of gluteal tendinopathy in greater trochanteric pain syndrome. *European Radiology* 2007;17:1772-1783

Lequesne M, Mathieu P, Vuillemin-Bodaghi V, et al. Gluteal tendinopathy in refractory greater trochanter pain syndrome: diagnostic value of two clinical tests. *Arthritis & Rheumatology* 2008;59:241-246

Long S, Surrey D, Nazarian L. Sonography of greater trochanteric pain syndrome and the rarity of primary bursitis. *American Journal of Roentgenology* 2013;201(5):1083-1086

Mellor R, Bennell K, Grimaldi A, Nicolson P, Kasza J, Hodges P, Wajswelner H, Vicenzino B. Education plus exercise versus corticosteroid injection use versus a wait and see approach on global outcome and pain from gluteal tendinopathy: prospective, single blinded, randomised clinical trial. *British Medical Journal* 2018;52(22):1464-1472

Segal NA, Felson DT, Torner JC, Zhu Y, Curtis JR, Niu J, Nevitt MC. Greater trochanteric pain syndrome: Epidemiology and associated factors. *Archives of Physical Medicine & Rehabilitation* 2007;88:988-992

Stephens G, O'Neill S, French HP, Fearon A, Grimaldi A, O'Connor L, Woodley S, Littlewood C. A survey of physiotherapy practice (2018) in the United Kingdom for patients with greater trochanteric pain syndrome. *Musculoskeletal Science & Practice* 2019;40:10-20