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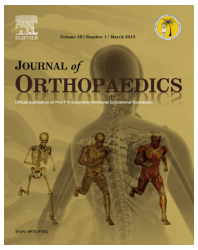

Review Article

The management of greater trochanteric pain syndrome: A systematic literature review☆

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ABSTRACT

Greater trochanteric pain syndrome (GTPS) is a common cause of lateral hip pain. Most cases respond to conservative treatments with a few refractory cases requiring surgical intervention. For many years, this condition was believed to be caused by trochanteric bursitis, with treatments targeting the bursitis. More recently gluteal tendinopathy/tears have been proposed as potential causes. Treatments are consequently developing to target these proposed pathologies. At present there is no defined treatment protocol for GTPS.

The purpose of this systematic literature review is to evaluate the current evidence for the effectiveness of GTPS interventions, both conservative and surgical.

1. Introduction

Localised lateral hip pain with focal point tenderness over the greater trochanter has for many years been clinically diagnosed as trochanteric bursitis.[1,2] The diagnosis of trochanteric bursitis may be inappropriate, given that three of the four cardinal signs of inflammation: rubor, erythema and oedema are uncommon with only pain being a feature.[3,4] Radiological findings for patients with greater trochanteric pain syndrome (GTPS) report variable incidence, with bursitis incidence ranging from 4% to 46% and gluteal tendinopathy ranging from 18% to 50%.[5–7] The preferred clinical term for lateral hip pain is therefore GTPS.[4] GTPS is the term that will be used for this paper.

GTPS encompasses a range of causes including gluteal medius and minimus tendinopathy/tears, trochanteric bursitis and external coxa saltans.[8,9] An exact cause remains unknown.[10] There is often co-existence of both bursitis and tendinopathy.[11] Treatment in the initial stages encompasses a range of conservative interventions including physiotherapy, local corticosteroid injection, PRP injection, shockwave therapy (SWT), activity modification, pain-relief and anti-inflammatory medication and weight reduction. Most cases resolve with conservative measures, with success rates of over 90%.[12,13] GTPS is self limiting for the majority.[14,15] A few cases persist despite treatment and time; these cases are known as refractory cases and may require surgical intervention in the form of bursectomy, iliotibial band (ITB) lengthening techniques or gluteal tendon repair.[2] At present, there is no defined treatment protocol for GTPS.[14,16] The criteria for when surgical intervention for refractory cases of GTPS is indicated are not presently well established.[17] The specific enquiry of this review is to determine the most effective treatment protocol for GTPS.

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1.1. GTPS

GTPS is a clinical diagnosis with typical presentation of chronic intermittent lateral hip/thigh/buttock pain, aggravated with activity and affected side lying position. There is a lack of valid/specific diagnostic criteria for GTPS. The most common examination finding is reproduction of the pain on palpation of the greater trochanter.[18,19]

GTPS affects between 1.8 and 5.6 patients per 1000 per year, more frequent between 40 and 60 years, predominantly female,[4,14] and possibly related to pelvic biomechanics. Females have a larger pelvic width relative to whole body width, with consequent greater prominence of the trochanters and associated increased tension of the ITB over the trochanter.[20] A lower femoral neck shaft angle may also be a predisposing factor, as this increases compression of the gluteus medius tendon on the greater trochanter[21]; increased acetabular anteversion may also be a predisposing factor.[22] The likely cause of GTPS is by repetitive friction between the greater trochanter and ITB, causing repetitive microtrauma of the gluteal tendons that insert into the greater trochanter. This in turn causes local inflammation, degeneration of the tendons and increased tension of the ITB.[23]

Approximately two thirds of individuals with GTPS have co-existing hip joint osteoarthritis or low back pain.[24] Having a higher than normal body mass index is also a likely contributing factor to GTPS.[21]

To determine the most effective management of GTPS, it is essential to have knowledge of the anatomy and proposed pathological processes.

1.2. Anatomy

The greater trochanter is a large quadrangular projection at the junction of the neck of femur with the shaft. It is the main attachment for the strong abductor tendons, which facilitate the complex movement achieved between the abductor mechanism and the bursae. There are approximately 20 bursae in the trochanteric area[25]; some bursae may be acquired due to excessive friction[26] or increased hip offset.[27] Three bursae are consistently present in the majority of individuals. These include the gluteus minimus bursa, located anterosuperiorly to the greater trochanter. The subgluteus medius bursa lies deep to the gluteus medius tendon. The subgluteus maximus bursa is the largest and often described as the 'trochanteric bursa'. This lies lateral to the greater trochanter between the gluteus medius and maximus (Fig. A1).[4,8]

The gluteus medius and minimus form part of the abductor mechanism of the hip joint. They are innervated by the superior gluteal nerve, L5 and S1.[25] The primary function of the posterior part of gluteus medius and gluteus minimus is to stabilise the head of the femur in the acetabulum during movement and gait. The anterior and middle fibres of gluteus medius have a cephalad pull assisting with initiation of abduction. The major hip abductor is tensor fascia lata.[29]

The anterior fibres of the gluteal tendon are under the most force and are consequently seen to separate from the bone first in tears, progressing from anterior to posterior, with the posterior tendon being involved in only the most severe cases.[30] Gluteal tears are present in around 22% of elderly patients.[11] The ITB and tensor fascia lata are another potential cause of GTPS. Together they work as a lateral tension band to resist strains over the greater trochanter.[14]

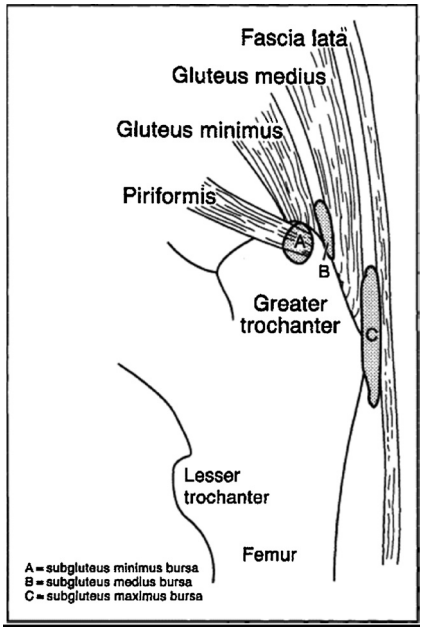

Fig. A1 – Peritrochanteric anatomy.[28]

1.3. Tendinopathy

Gluteal tendinopathy has been identified as a cause of GTPS.[31] Tendinopathy clinically presents as chronic activity related pain and impaired performance of a tendon with or without local tendon swelling.[32] Tendinopathy is characterised by hypercellularity, increased protein synthesis, neovascularisation, disorganisation of the matrix but no inflammation.[33,34] Although recent literature suggests a possible inflammatory component.[35]

The aetiology of tendinopathy is proposed to be multifactorial with both intrinsic and extrinsic components, the exact mechanism is unknown.[32] Repetitive activity is a main factor but tendinopathy can occur in patients without overuse. Different theories of tendinopathy have been suggested, the majority discuss abnormal mechanical loads and altered cellular responses.[36] Other models hypothesis that tendinopathy pathogenesis is related to a 'failed healing' response and is non-inflammatory.[34,37]

Chronic tendinopathies seen on imaging can be asymptomatic, therefore clinical assessment rather than imaging for initial diagnosis and treatment planning of tendinopathy is advocated.[34]

Chronic tendinopathic appearances on imaging show disorganised collagen bundles, neovascularisation and an increase in proteoglycan.[34,38] In tendinopathy there is reduced type 1 collagen and increased type 3 collagen, which has less cross-links and therefore reduces the mechanical strength of the tendon.[34] The chronic pain associated with the pathological changes of tendinopathy may in part be caused by

increased substance P or neural 'sprouting' that often accompanies neovascularisation.[39]

2. Method

2.1. Criteria for studies included and excluded in this review

2.1.1. Inclusion criteria

Types of studies: RCTs and Cohort studies. No restriction on date of the publication. Studies that were available in the English language.

(Case control studies and case series were included for discussion as no RCTs or Cohort studies were found from the search for surgical intervention for GTPS)

Types of participants: Studies where participants:

- are adults (16 and over),
- met the diagnostic criteria for GTPS: lateral hip and thigh pain and focal point tenderness over the greater trochanter.[18,28]
- may have co-morbidities such as low back pain and hip joint osteoarthritis.

Studies including all treatment interventions, conservative and surgical for participants meeting the inclusion criteria.

2.1.2. Exclusion criteria

Studies where participants were:

- post total hip arthroplasty,
- had acute trauma,
- history of significant injury or fracture,
- systemic, inflammatory or infective disease,
- neurological disease or
- neoplasm.

Studies where osteoarthritis of the hip joint or low back pain were the primary diagnosis.

2.2. Outcome measurements

The main treatment aims for patients reporting GTPS are reduction in pain and improvement in function. The evaluation of the effectiveness of an intervention is dependent on having outcome measurements that precisely determine if change has taken place. The outcome tool also should be shown to be valid for the particular patient population/condition studied.[40] As there is no specific outcome measurement tool for GTPS,[41] various different tools have been used in the related literature/studies. The most frequently used outcome is pain measured by visual analogues scale (VAS) or numerical rating scale (NRS). Other outcome tools used in the discussed literature for this review include: SF-36, Oswestry disability index, Likert scale, Western Ontario and McMaster University Osteoarthritis Index (WOMAC), EQ-5D, Harris Hip score (HHS), Roles and Maudsley score, Merle d'Aubergine hip score and JOA disability hip score.

Other outcome measures used included a reduction in the reported use of pain relief medication. Assessment of performance of a single-leg squat has been proposed as a reliable measure to assess hip muscle function[42] and Trendelenburg's sign is proposed as the most sensitive and specific objective finding for the diagnosis of gluteus medius or minimus tears.[43]

2.3. Search strategy for identification of relevant studies

2.3.1. Electronic searches

An electronic search was undertaken, unrestricted by language or date up to the end of June 2015, for studies relating to the treatment of GTPS. The Cochrane Library and TRIP Database were searched. EMBASE, AMED, CINAHL and MEDLINE databases were searched. Search terms used were: trochanteric bursitis, GTPS, lateral hip pain, peritrochanteric, gluteal tendinopathy, treatment, injection, SWT, rehabilitation, exercise, physiotherapy, arthroscopy, bursectomy, dry needling, tendon repair, iliotibial release and lengthening.

The complete search strategies and results for EMBASE, AMED, CINAHL and MEDLINE databases are presented in Appendices A–D. The EMBASE search returned 583 results. The AMED search returned 27 results. CINAHL returned 115 and MEDLINE search returned 406. Duplications from the searches were removed which left 879 studies. There was one Cochrane Library paper which was a protocol for a systematic review for interventions for lateral hip pain (tendinopathy or bursitis).[44] There were no actual Cochrane reviews. The short listing process was undertaken by the author by reading the study titles and abstracts to determine if they met the inclusion criteria. Where there was uncertainty, the entire article was read to make a decision.

This left 27 papers for full text review; 7 were RCTs/Cohort studies. A total of 20 were initially excluded as they were case series or case control studies and therefore of poorer evidence level. However as there were no identified RCTs or Cohort studies for surgical intervention, these level 3 papers were therefore used to form discussion with particular regard to the surgical section. A final search of EMBASE, AMED, CINAHL and MEDLINE databases were re-run, with additional search terms of randomised controlled trial, controlled clinical trial and cohort study (as shown in bold type in Appendices A–D). No additional studies were found.

2.3.2. Searching of other resources

The NICE guidelines were searched for GTPS. There were two interventional procedure guidance papers for refractory GTPS for extracorporeal SWT[45] and for distal tibial band lengthening.[46] Reference lists from the identified systematic reviews and the selected studies were examined manually for other relevant citations. A search of Google scholar was also undertaken. A search for current and unpublished trials in the World Health Organisation Clinical Trials Registry Platform was undertaken (Fig. A2).

2.4. Data collection and assessment of study methodological quality

In this review, the methodological quality of each paper was assessed using the Critical Appraisal Skills Programme (CASP) checklists (Appendix E).

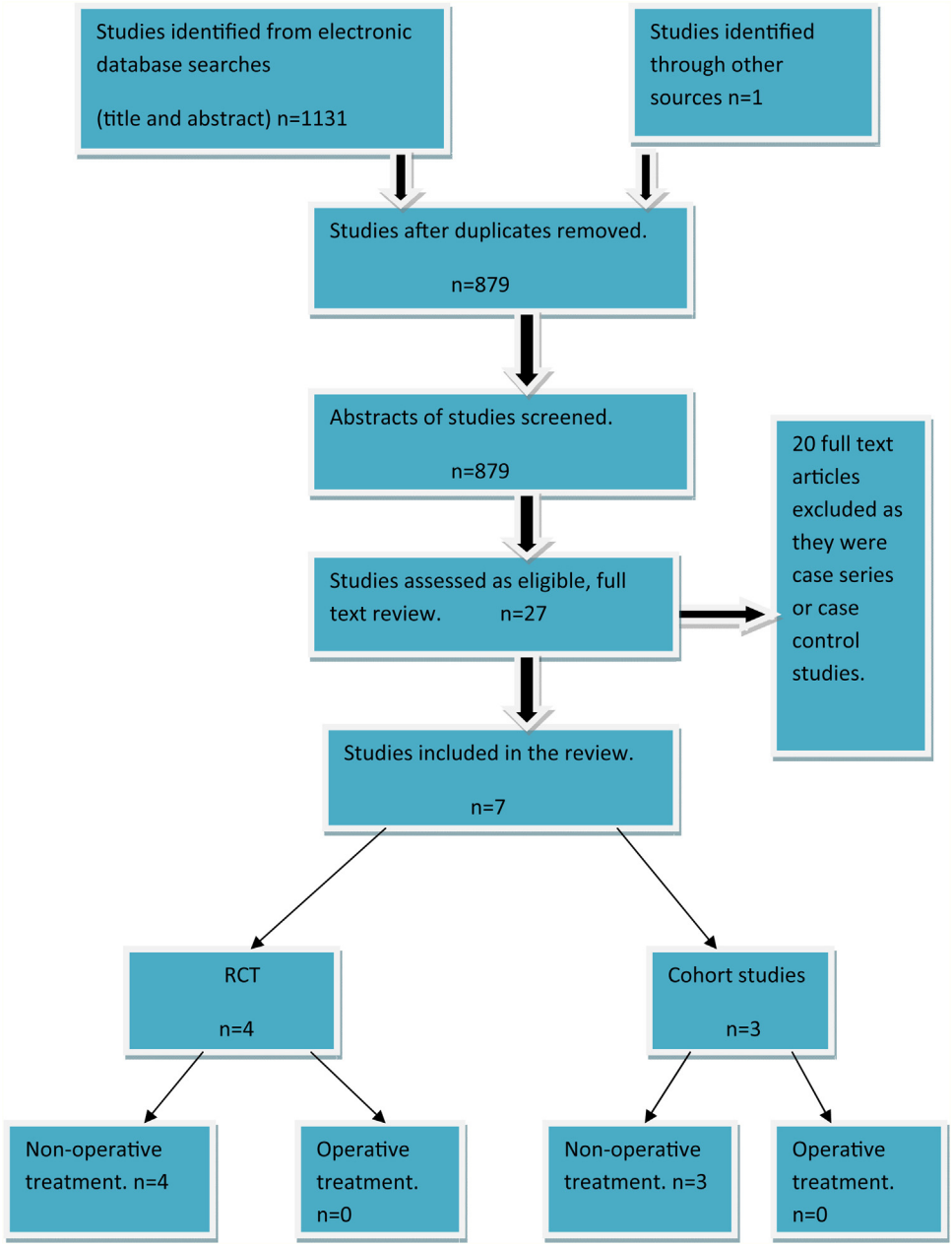

Fig. A2 – Flow diagram showing systematic searching process.

3. Results

3.1. *Conservative interventions – study results*

See Table A1 and Appendix F.

3.2. *Surgical interventions – study results*

See Table A2.

4. Discussion – conservative interventions

There are numerous interventions described for GTPS. Conservative treatments can include any or a combination of the following: pain relief medication, NSAIDs, physiotherapy, SWT and corticosteroid injection(s).[47] Regenerative injection therapy is also a potential treatment option for GTPS. Most patients will have resolution of their symptoms with conservative treatments.[13,32]

Table A1 – Conservative interventions-study results.

Author/ year	Study type/ evidence level	Intervention	Sample size	Mean age (years)	Symptom duration- pre study	Mean length of F/U	Outcome
Rompe et al., 2009[47]	RCT/1	1. Home training vs.	76	46			Group 1: 34% return to activity.
		2. Low energy SWT vs.	78	47	>6 Months	4 Months	Group 2: 64% return to activity.
		3. Single CS inj.	75	50			Group 3: 49% return to activity. Outcomes VAS and Likert
Cohen et al., 2009[48]	RCT/1	Fluoroscopy guided single CS inj. vs. Single blind CS inj.	32 vs. 33	Mid 50s	3.3 Years	3 Months	Guided group:50% +ve perceived effect. Blind inj. group: 53% +ve perceived effect. Outcome: NRS (pain and activity), SF-36, ODI, reduction in drugs
Brinks et al., 2011[49]	RCT/1	1–2 CS inj. vs. 'usual care- analgesics as required. Both groups allowed physio.	60 vs. 60	56	>1 Week	F/U 6 weeks, 3 months, 12 months	3 Months: Inj. group 55% recovered, 'usual care' group 34% 12 Months: inj. group 61% recovered, 'usual care' group 60% Outcomes Likert scale, NRS, EQ-5D, WOMAC
Estrela et al., 2014[50]	RCT/1	Blinded CS inj. vs. Ultrasound guided CS inj.	60	54	32.2 Months	1, 4 and 8 Weeks post inj.	At 8 weeks equal improvement between the groups. USS guided group perceived greater benefits. Outcomes: VAS for pain; Painful palpation; ROM; strength; USS measurement of Glut med and min tendons and trochanteric bursa
Sayegh et al., 2004[51]	Prospective Cohort study/2	Single CS inj. after failed conservative treatment	163	49.6	7.1 Weeks	Up to 4 years	ODI: Baseline = 68.9, 1 month 3.8, 1 year 5.8 4 years 41.6
Ferrari et al., 2012[52]	Cohort study/2	1. Guided local CS inj. vs. 2. Guided local CS inj. and Customised foot orthotics	34 vs. 34	37 ± 11 (SD) vs. 41 ± 11 (SD)	8 ± 3 (SD) weeks vs. 7 ± 3 (SD) weeks	8 Weeks and 4 Months	8/52: Group 1 – 50% recovery, Group 2 – 75% recovery. 4/12: Group 1 – 40% recovery, Group 2 – 90% recovery. Outcomes: ODI and analgesia level
Uliassi 2012[53]	Cohort study/2	1. 1–2 Local CS injs + analgesics as required. vs. 2. 'usual care' (analgesics as required)	60 vs. 60	Range 18–80	>1 Week	3 Months and 12 Months	3/12: Group 1: 55% total/major recovery. Group 2: 34% total/major recovery. 12/12: No difference between the groups for recovery and pain. Outcomes: NRS pain, Likert scale (7), Quality of life/health status
Furia et al., 2009[54]	Case–control study/2	1. Low energy SWT vs.	33 vs.	51	13.7 Months	12 Months	Group 1: 79% 'excellent or good' outcome, 12% 'fair'.
		2. Rest, physio, ice/ heat, U/S, CS inj.	33	50.2	14 Months		Group 2: 36% 'good' outcome, 40% 'fair'. Outcomes: VAS, HHS, R&M score
McEvoy et al., 2013[55]	Retrospective case review/3	CS inj. to greater trochanteric bursa $n = 41$ vs. CS inj. to subgluteus medius bursa $n = 24$	65	Not stated	Not stated	14 Days	Greater improvement with CS inj. to the greater trochanteric bursa

Table A1 (*Continued*)

Author/ year	Study type/ evidence level	Intervention	Sample size	Mean age (years)	Symptom duration- pre study	Mean length of F/U	Outcome
Chowdhury et al., 2012[56]	Case series/3	Guided CS inj.	80	56	>3 Months	7 Days	72% reported significant improvement. Outcome: pain diary
McEvoy et al., 2012[57]	Case series/3	1. Guided CS inj. to greater trochanteric proper bursa (GTPB) vs. 2. Guided CS inj. to subgluteus medius bursa (SGMB)	41 vs. 24	53	Not stated	14 Days	14 days: Group 1: decrease of 3 on VAS, 72% reduction of pain. Group 2: no change on VAS, no % reduction of pain. Outcomes: VAS-pain, %pain reduction
Shbeeb et al., 1996[3]	Case series/3	Single CS inj. comparing different dosages	75	66	Not stated	26 Weeks	79% improved. Outcome: VAS

4.1. *Non-steroidal anti-inflammatory drugs*

Recent literature suggests the process of tendinopathy involves inflammatory components and therefore NSAIDs may have a role in chronic tendinopathy treatment regimens.[35] Sarno et al.[69] concluded from their small number, retrospective case study that at six weeks topical NSAIDs have equal benefit to oral NSAIDs for GTPS.

4.2. *Traditional physiotherapy*

There were no studies found directly relating to physiotherapy treatment for GTPS. Traditional treatments for GTPS are generally aimed at reducing pain and inflammation, rather than altering the tendon structure.[32] There is generally a lack of evidence for modalities such as deep transverse friction massage, therapeutic ultrasound or acupuncture, which are traditionally used as part of physiotherapy treatment for tendinopathies/tendinitis.[34,70]

4.3. *Physiotherapy – eccentric exercise (EE)*

Exercise is the most usual treatment for tendinopathy with EE being superior to a generic exercise regime. EE are specific, impart great load and provide effective resistance exercises. EE reduce pain and may lead to a normal tendon structure.[34] There were no studies identified that directly relate to EE in gluteal tendinopathy. However, studies demonstrate good results with EE in other tendinopathies including patellar tendinopathy[71] and achilles tendinopathy.[72] EE could therefore be considered a potential component of GTPS rehabilitation.

4.4. *Corticosteroid injection*

Local corticosteroid injections are commonly performed for GTPS. The precise mechanism of how CSI effect tendon pain is unclear, because it is likely due to effects on inflammatory and nociceptive pathways.[35] There is strong evidence of a short-term benefit with CSI for GTPS. Studies show significant early improvement of GTPS up to 3 months, with greatest effect at 6 weeks, but often recurrence in the longer term.[48,49] There is limited evidence to guide the selection of medication, dose and frequency of therapeutic CSI(s)[33]; higher doses of local CS provides greater improvement than lower dosages; all dosages produce improvement for trochanteric bursitis.[3] There is no significant difference in outcome between image guided and blind injections.[3,50] Patients receiving USS guided injection did perceive greater benefits[50]; however, fluoroscopic-guided trochanteric bursa injections are not warranted based on outcomes, cost and delay to treatment for GTPS.[48] Greater improvement with CS injection to the greater trochanteric bursa compared to the subglut bursa for patients with GTPS was found in one study at 2-week follow-up. However, not all of the patients had clinical features of bursitis, demonstrating that there is little association between USS diagnosis and pain reduction following CS injection.[55] CSI may be most appropriately used to reduce pain which would enable physiotherapy to be most effective.[32,70] A concern for use of CSI is the possibility for weakening the tendon structure in the long-term.[35] There is a low rate of serious adverse effects after CSI, while minor side effects such as skin depigmentation and post injection pain are common.[33]

4.5. *Low-energy extracorporeal SWT*

SWT has been shown to be effective for tendinopathy[47] and in particular for GTPS.[73] Treatment regimes for SWT vary dependent upon energy density, frequency of shockwaves and number of sessions. The mechanism of how SWT has an effect on GTPS is unclear but it is considered to stimulate healing, possibly by stimulating cellular activity and increasing blood flow.[32] The available evidence for SWT for GTPS is limited but of moderate methodological quality. Low-energy SWT is an effective treatment for chronic GTPS with improvement being maintained at 12 months.[47,54] There is a significant improvement with repetitive low-energy SWT compared to CS injection at 4 months.[47] The studies evaluating effectiveness of SWT show many variables including wave type (focal or radial), intensity per shock wave, frequency of the shock waves, type of SWT generator and the overall treatment protocol. Comparison of results is therefore difficult.

Table A2 – Surgical interventions-study results.

Author/ year	Study type/ evidence level	Intervention	Sample size	Mean age (years)	Symptom duration-pre study	Mean F/U	Outcome
Cardenas-Nylander et al., 2013[58]	Case series/3	Endoscopic gluteal repair	13	54	>3 Months	11 Months	13/13 Had reduction in lat hip pain; 11/13 satisfied with their outcome. Outcomes: WOMAC, HHS
Davies et al., 2013[59]	Case series/3	Open gluteal tendon repairs	23	Not stated	Not stated	100% F/U at 12/12; 83% F/U up to 5 years	23/23 Improved; poorer outcome with largest tears (78% grade 3–4 tears). Outcomes: HHS; LEAS
Makridis et al., 2013[60]	Retrospective case series/3	Gluteal tendon repairs-double row technique	73	Not stated	Not stated	4.6 Years	All satisfactory outcome. Outcomes: VAS for pain; HHS Lequesne Index, Strength, Single leg stability. Radiological review – fatty degen, bone mass index and muscle atrophy
Larose and Guanche, 2012[61]	Case series/3	Arthroscopic bursectomy	38	Not stated	Not stated but failed conservative treatment (3 steroid inj., physio and modified activity)	>2 Years	70% Good functional return. Sustained reduced pain >2 years. Outcomes: VAS, Hip outcome score
Walsh et al., 2011[30]	Case series/3	Glut. tendon repair(s)	72	62	22.4 Months	>12 Months	95% Pain-free/ minimal pain. Outcomes: Merle d'Aubergine Postel score
Voos et al., 2009[62]	Case series/3	Endoscopic Glut. medius repair, bursectomy (1 labral repair, 1 pincer lesion debridement, 1 ITB release, 1 greater trochanter exostectomy, 2 psoas tendon releases, 8 labral debridements)	10	50	>3 Months	25 Months	All complete pain relief. Outcomes: HHS and Hip outcome score
Davies et al, 2009[63]	Case series/3	Glut. medius, minimus repair, bursectomy	16	63	23 Months	12 Months	11/16 Significant reduction of hip symptoms Outcomes: VAS, SF-36, Oxford hip score, Merle D'Aubigne Postel score. Trendelenburg sign
Pretell et al., 2009[13]	Case series/3	Distal fascia lata Z-plasty	13	54.6	22 Months	43 Months	12/13 Very satisfied/ satisfied. 1 unsatisfied. Outcomes: VAS, HHS

Table A2 (*Continued*)

Author/ year	Study type/ evidence level	Intervention	Sample size	Mean age (years)	Symptom duration-pre study	Mean F/U	Outcome
Lequesne et al., 2008[17]	Case series/3	Glut. medius repair, bursectomy (5 glut. minimus repair)	8	71	14.3 Months	29 Months	7/8 Complete resolution of pain, 1/8 partial resolution of pain. Outcomes: VAS, single leg stance, functional status
Baker et al., 2007[64]	Case series/3	Arthroscopic ITB release (longitudinal), debridement, bursectomy.	25	62	>6 Months	26 Months	72% improved. Outcomes: VAS, SF-36, HHS
Craig et al., 2007[27]	Case series/3	Proximal ITB Z-plasty, bursectomy, Glut. tears repaired.	17	60	4.7 Years	47 Months	8/17 complete pain relief, 8/17 good resolution, 1/17 poor. Outcomes: HHS
Chirputkar et al., 2007[65]	Case series/3	Proximal ITB Z-plasty, bursectomy.	16	50	>6 Months	52 Months	93% Improved. Outcome: VAS
Wiese et al., 2004[66]	Case series/3	Endoscopic bursectomy (tractopexie in 4)	45	51	>6 Months	25 Months	44/45 Improved. Outcomes: VAS, JOA disability score
Govaert et al., 2003[67]	Case series/3	Trochanteric osteotomy	12	48	Up to 4 years	23.5 Months	6/12 Very good improvement, 5/12 good, 1/12 fair. Outcome: Merle D'Aubigne Postel score
Kagan 1999[11]	Case series/3	Glut. medius repair (fasciotomy in 4)	7	69	50 Months	42 Months	All complete pain relief, all satisfied
Slawski and Howard, 1997[68]	Case series/3	Longitudinal ITB release, bursectomy	7	40.3	3.8 Years	20 Months	All satisfied. Outcome: HHS

4.6. *Foot orthotics*

Ferrari[52] conducted a pragmatic study with 68 participants to evaluate the effect of customised foot orthotics versus CS injection for 'trochanteric bursitis' of <3 months duration. At 4 months 40% of the injection group compared with 90% of the orthotic group reported recovery, proposing that use of customised orthotics produce a higher rate of improvement than CSI alone for trochanteric bursitis. This study however has significant methodological weakness. No other studies relating to orthotic issue for GTPS were found.

4.7. *Platelet-rich plasma (PRP) or whole blood injections*

PRP or whole blood injections have been used for the treatment of tendinopathies to promote natural healing by providing/manipulating cellular mediators which include growth factors. There are limited studies regarding PRP/blood injection effectiveness for tendinopathies and none directly relating to GTPS, early results however are encouraging and an option prior to consideration of surgical intervention.[32,35]

4.8. *Developments – conservative*

Advances in non-surgical treatments are being developed for the treatment of tendinopathy underpinned by a greater knowledge of the pathological process of tendinopathy. These include: topical glycerol trinitrate therapy, matrix metalloproteinase-inhibitor injection, gene or stem-cell therapy, autologous tenocyte injection and sclerosant injections. Presently, there is limited evidence for use of these interventions in clinical practice; controlled trials are needed to test the efficacy and safety for these treatments of tendinopathies.[32,35,70]

5. Discussion – surgical interventions

Surgical interventions are usually for refractory cases, non-respondent to conservative treatments. Surgery can include bursectomy,[66] ITB release,[44] trochanteric reduction osteotomy[67] or gluteal tendon repair.[30] Often surgery incorporates a combination of these interventions. More recent literature discuss endoscopic rather than open surgical procedures.

All of the studies discussed for GTPS surgical interventions are low methodological quality case series; therefore, a level of caution is needed, when interpreting study findings.

5.1. *Gluteal tendon repair*

Gluteal tendon tears were first reported as incidental findings during open hip procedures such as total hip replacement surgery and trochanteric bursectomy.[11] The lateral part of gluteus medius tendon is the most commonly involved.[11,17]

Tears can be partial, full thickness or intrasubstance. Patients often present with hip abductor weakness ± Trendelenburg sign.[74]

Gluteal tendon repair for refractory cases of GTPS has shown good long-term improvement.[59,60] Kagan[11] reported on seven cases that remained asymptomatic at 45 months mean follow-up. Walsh et al.[30] reported 95% improvement from 72 cases, maintained at 12 months. Endoscopic and open techniques show good outcomes, there was no direct comparison study to evaluate if either technique was superior. Govaert et al.[23] discussed the benefits of a minimally invasive endoscopic versus an open approach being small incision, quicker healing time, less post-operative pain and shorter theatre and hospitalisation time. In some of the reported case series, repair plus other intervention(s) were undertaken including bursectomy.[17,62] Bursectomy alone is a treatment intervention for GTPS and therefore cautious interpretation of these study results is needed. High post-operative complication results were observed in some studies. Walsh et al.[30] reported 6/72 cases of DVT and 2/72 tendon re-tears due to non-adherence to post-op WB restrictions; Davies et al.[63] reported 4/16 cases of re-tears and 1/16 case of infection.

Gluteal tendon repair shows good outcomes in these small number, low methodological quality studies. Further, large number, long-term, randomised controlled studies are needed to determine the best technique of repair.

5.2. *ITB release/lengthening*

ITB is a cause of pain and inflammation secondary to trochanteric impingement and consequent development of trochanteric bursitis. ITB release is therefore important in treatment and prevention of recurrence of GTPS.[23]

ITB lengthening shows good long-term outcomes.[12,13,27] The techniques of ITB lengthening varied between the studies, and all were proximal ITB techniques except one, which was distal.[13] Z-lengthening was undertaken in two studies[27,65]; cross-incision was used in one study[23] and longitudinal release in one study.[68] Trochanteric bursectomy was performed in all the proximal procedures. This alone may provide resolution of GTPS. Post-operative complications were low and included seroma.

These studies are poor in terms of methodological quality but provide interesting results. Further, prospective randomised controlled trials are needed to determine the appropriate site of intervention (distal versus proximal), the appropriate incision type and the value of co-intervention in the form of bursectomy.

5.3. *Trochanteric bursectomy*

Endoscopic/arthroscopic trochanteric bursectomy shows good improvement in outcomes for at least two years following bursectomy.[61,64,66] There were no major post-operative complications, but minor complications included seroma, haematomas and recurrence.

These findings for trochanteric bursectomy are encouraging. The studies however are poor in terms of evidence level hierarchy and therefore need to be interpreted with caution.

5.4. *Trochanteric reduction osteotomy*

Govaert et al.[67] proposed open trochanteric reduction osteotomy as an effective procedure for refractory GTPS. They reported overall improvement at mean follow-up of 23.5 months for 12 hips. This study is poor in terms of evidence level but provides an interesting discussion regarding reduction osteotomy for GTPS. No other studies for osteotomy and GTPS were found.

5.5. *Surgical management of tendinopathy*

The evidence base for operative interventions for tendinopathy is limited. The aim of surgery is to stimulate the tendon environment by modifying the tendon vascularity and cellular-matrix responses. Procedures include multiple tenotomies and/or debridement of abnormal tissue, which may increase local blood flow and thus promote healing. Tenotomy may also indirectly reduce tendon stress load by increasing the overall tendon dimensions.

The surgical outcomes for tendinopathy are uncertain.[34] Future studies to evaluate outcomes following tenotomy and/or debridement for GTPS are needed.

6. Conclusion

6.1. *Implications for practice*

There is currently no evidence-based protocol for the management of GTPS. Conservative treatment is the gold standard for GTPS with over 90% success rate.[13] The diagnosis for GTPS is clinical[27]; examination should exclude other differential diagnoses. Treatment interventions have developed to target the proposed GTPS pathologies. It may therefore be concluded that in order to determine the best treatment protocol for GTPS that the exact pathology of GTPS needs to be defined.

In this systematic review, only four RCTs and three cohort studies met the study inclusion criteria for this review; these were all for conservative treatment of GTPS. There are a low number of high quality studies considering the prevalence of GTPS and the numerous interventions. One study[47] compared corticosteroid injection, SWT and home training. SWT was found to be more effective than CS injection and most effective compared to home training at 4 months post intervention. One study[48] evaluated whether fluoroscopy guided CS injection provided better outcomes than 'landmark' injection for trochanteric bursitis. There was no significant difference in outcomes between the two groups, hypothesising that the CS injection may be treating the peritrochanteric tissues as opposed to the bursa specifically, suggesting evidence of an inflammatory component of either the bursa and/or the tendinopathy. Brinks et al.[49] compared CS injection versus 'usual care'. CS injection had superior outcome at 3 months, but there was no significant difference in outcomes between the groups at 12 months. No studies compared placebo versus CS injection.

There was level 2 evidence that customised orthotics gives long-term improvement for GTPS. However there were shortcomings in this study, such as no randomisation or blinding, potential author bias.[52]

There were no studies found specifically evaluating physiotherapy for GTPS. With regard to tendinopathy, treatment aims are to affect the intracellular processes and/or affect the loading by specific EEs. These exercises have been shown to have good effect in Achilles tendinopathy[72] and patellar tendinopathy.[71] There are no studies specific to EEs for GTPS. EEs may be considered as the most appropriate exercise method for GTPS; studies would be needed to evaluate this.

It can therefore be proposed from the evidence that CS injection can be offered as a low-risk intervention for GTPS for short-term pain relief. This may be most appropriately used to allow physiotherapy/EEs to be most effective during a pain-free period, with the aim of physiotherapy to gain longer-term functional improvement of GTPS.

SWT is not generally readily available as a treatment modality in NHS clinics. However, benefit for GTPS has been shown at 4 months. SWT has many variables including intensity, frequency per shock and type of wave, with no specific protocol presently for GTPS.

With regard to surgical interventions, there were no level one or two studies for any procedure. Evidence was predominantly single surgeon ('expert opinion') case series, retrospective with no control groups, often clinician's proposing their developed specific techniques for GTPS treatment.

6.2. *Implications for research*

There are large gaps in the literature with regard to GTPS interventions, both conservative and surgical. RCTs should be undertaken to assess the effectiveness of ITB lengthening techniques, bursectomy, gluteal tendon repairs and trochanteric osteotomy – endoscopic and open techniques – as all have been reported by case series to be effective. There are no specified criteria as to when one technique would be preferred over another.

Studies are also needed to determine the best exercise regime for GTPS, assessing duration and compliance of the eccentric programmes; the psychological aspects of chronic pain of refractory cases; effects with orthotic issue and the developing tendinopathy treatments.

Large number, long follow-up, high quality, prospective, randomised controlled studies with valid outcome measures need to be undertaken to determine the most appropriate management protocol for GTPS.

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Appendix A. EMBASE Database search results

Line	Search term	Results
1	(trochanteric AND bursitis).ti,ab	224
2	(greater AND trochanteric AND pain AND syndrome).ti,ab	79
3	(lateral AND hip AND pain).ti,ab	828
4	peritrochanteric.ti,ab	156
5	(gluteal AND tendinopathy).ti,ab	16
6	1 or 2 or 3 or 4 or 5	1192
7	treatment.ti,ab	3,354,533
8	Injection.ti,ab	402,556
9	(shockwave AND therapy).ti,ab	482
10	rehabilitation.ti,ab	123,093
11	exercise.ti,ab	195,999
12	physiotherapy.ti,ab	15,267
13	arthroscopy.ti,ab	11,505
14	bursectomy.ti,ab	302
15	(dry AND needling).ti,ab	151
16	(tendon AND repair).ti,ab	5727
17	(iliotibial AND release).ti,ab	74
18	(iliotibial AND lengthening).ti,ab	32
19	7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18	3,903,286
20	6 and 19	583
21	**(randomised AND controlled AND trial).ti,ab**	**23,350**
22	**(controlled AND clinical AND trial).ti,ab**	**52,034**
23	**20 AND 21**	**4**
24	**20 AND 22**	**11**
25	**(cohort AND study).ti,ab**	**210,153**
26	**20 AND 25**	**25**

Appendix B. AMED Database search results

Line	Search term	Results
1	(trochanteric AND bursitis).ti,ab	11
2	(greater AND trochanteric AND pain AND syndrome).ti,ab	3
3	(lateral AND hip AND pain).ti,ab	48
4	peritrochanteric.ti,ab	0
5	(gluteal AND tendinopathy).ti,ab	1
6	1 or 2 or 3 or 4 or 5	58
7	treatment.ti,ab	36,833
8	Injection.ti,ab	1509
9	(shockwave AND therapy).ti,ab	22
10	rehabilitation.ti,ab	21,274
11	exercise.ti,ab	12,215
12	physiotherapy.ti,ab	3882
13	arthroscopy.ti,ab	244
14	bursectomy.ti,ab	4
15	(dry AND needling).ti,ab	35
16	(tendon AND repair).ti,ab	359
17	(iliotibial AND release).ti,ab	6
18	(iliotibial AND lengthening).ti,ab	3
19	7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18	66,163
20	6 and 19	27
21	**(randomised AND controlled AND trial).ti,ab**	**728**
22	**(controlled AND clinical AND trial).ti,ab**	**1226**
23	**20 AND 21**	**0**
24	**20 AND 22**	**2**
25	**(cohort AND study).ti,ab**	**2515**
26	**20 AND 25**	**27**

Appendix C. CINAHL Database search results

Line	Search term	Results
1	(trochanteric AND bursitis).ti,ab	30
2	(greater AND trochanteric AND pain AND syndrome).ti,ab	21
3	(lateral AND hip AND pain).ti,ab	156
4	peritrochanteric.ti,ab	16
5	(gluteal AND tendinopathy).ti,ab	4
6	1 or 2 or 3 or 4 or 5	217
7	treatment.ti,ab	233,821
8	Injection.ti,ab	11,956
9	(shockwave AND therapy).ti,ab	45
10	rehabilitation.ti,ab	41,703
11	exercise.ti,ab	38,793
12	physiotherapy.ti,ab	6628
13	arthroscopy.ti,ab	1228
14	bursectomy.ti,ab	13
15	(dry AND needling).ti,ab	87
16	(tendon AND repair).ti,ab	847
17	(iliotibial AND release).ti,ab	13
18	(iliotibial AND lengthening).ti,ab	3
19	7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18	310,050
20	6 and 19	115
21	**(randomised AND controlled AND trial).ti,ab**	**7338**
22	**(controlled AND clinical AND trial).ti,ab**	**7482**
23	**20 AND 21**	**0**
24	**20 AND 22**	**4**
25	**(cohort AND study).ti,ab**	**30,285**
26	**20 AND 25**	**6**

Appendix D. MEDLINE Database search results

Line	Search term	Results
1	(trochanteric AND bursitis).ti,ab	167
2	(greater AND trochanteric AND pain AND syndrome).ti,ab	56
3	(lateral AND hip AND pain).ti,ab	606
4	peritrochanteric.ti,ab	122
5	(gluteal AND tendinopathy).ti,ab	10
6	1 or 2 or 3 or 4 or 5	883
7	treatment.ti,ab	2,656,086
8	Injection.ti,ab	346,757
9	(shockwave AND therapy).ti,ab	379
10	rehabilitation.ti,ab	91,699
11	exercise.ti,ab	158,965
12	physiotherapy.ti,ab	10,150
13	arthroscopy.ti,ab	8763
14	bursectomy.ti,ab	328
15	(dry AND needling).ti,ab	101
16	(tendon AND repair).ti,ab	5062
17	(iliotibial AND release).ti,ab	59
18	(iliotibial AND lengthening).ti,ab	26
19	7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18	3,122,052
20	6 and 19	406
21	**(randomised AND controlled AND trial).ti,ab**	**17,744**
22	**(controlled AND clinical AND trial).ti,ab**	**40,211**
23	**20 AND 21**	**2**
24	**20 AND 22**	**10**
25	**(cohort AND study).ti,ab**	**149,746**
26	**20 AND 25**	**17**

Appendix E. CASP RCT checklist (Solutions for Public Health, 2012)

CRITICAL APPRAISAL SKILLS PROGRAMME

11 questions to help you make sense of a trial

These questions consider the following:

Are the results of the trial valid? (SECTION A)

What are the results? (SECTION B)

Will the results help locally? (SECTION C)

A/ Are the results of the trial valid?

Screening Questions

1 Did the trial address a clearly focused issue? Yes ☐ Can't tell ☐ No ☐

An issue can be 'focused' in terms of
- the population studied
- the intervention given
- the comparator given
- the outcomes considered

2 Was the assignment of patients to treatments randomized? Yes ☐ Can't tell ☐ No ☐

3 Were all of the patients who entered the trial properly accounted for at its conclusion Yes ☐ Can't tell ☐ No ☐

- was follow up complete?
- were patients analysed in the groups to which they were randomised?

Detailed Questions

4 Were patients, health workers and study personnel 'blind' to treatment? Yes ☐ Can't tell ☐ No ☐
- were the patients
- were the health workers
- were the study personnel

5 Were the groups similar at the start of the trial? Yes ☐ Can't tell ☐ No ☐
In terms of other factors that might effect the outcome such as age, sex, social class

6 Aside from the experimental intervention, were the groups treated equally? Yes ☐ Can't tell ☐ No ☐

B/ What are the results?

7 How large was the treatment effect?
What outcomes are measured?

8 How precise was the estimate of the treatment effect?
What are its confidence limits?

C/ Will the results help locally?

9 Can the results be applied to the local population? Yes ☐ Can't tell ☐ No ☐
Do you think that the patients covered by the trial are similar enough to your population?

10 Were all clinically important outcomes considered? Yes ☐ No ☐
If not, does this affect the decision?

11 Are the benefits worth the harms and costs? Yes ☐ No ☐
This is unlikely to be addressed by the trial. But what do you think?

CASP

Appendix F. Hierarchy of study design (Khan et al., pp.17, 2004)

Study design	Level given to the evidence based on the reliability of the design
Experimental study • Randomised controlled trial (RCT) with concealed randomisation	1
Experimental study • Experimental study without randomisation **Observational study with control group** • Cohort study • Case–control studies	2
Observational study without control group • Cross-sectional study • Case series • Before and after study	3
Case reports **Expert opinion/consensus**	4

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