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Comparative study between ultrasound-guided local injection of corticosteroid and shockwave in treatment of greater trochanteric pain

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Abstract
Background: Greater trochanteric pain syndrome (GTPS) is a medical disorder marked by pain and tenderness in the immediate area of the trochanteric region.
Objectives: Comparing the effect of ultrasound guided injection of corticosteroid and extracorporeal shock wave therapy for refractory GTPS.
Methods: This prospective randomized study was conducted on 30 adult patients of both sexes, diagnosed with chronic GTPS. Patients were subdivided into two equal groups:
Group I: Treated by twice injections of 1 ml methyl prednisolone combined with 4ml of lidocaine 2 weeks apart under ultrasound guidance.
Group II: Treated by extracorporeal shock wave therapy. 4 sessions one week apart of radial shock wave, 2000 pulses, energy level (2.0-3.0 bar), frequency 12Hz.
Results: There was a notable disparity in pain relief, as measured by the Visual Analogue Scale (VAS) and the Lower Extremity Functional Scale (LEFS), between the two groups after 4 weeks and 3 months. Only the Numerical Rating Scale (NRS) and Roles and Maudsley Score (RMS) shown results at the 3-month mark. The evaluation of pain using VAS, NRS, and LEFS revealed a significant disparity in group 1 and 2 at three different time points: before and after 4 weeks, before and after 3 months, and between 4 weeks and 3 months. The root mean square (RMS) analysis revealed a notable disparity in group 1 when comparing the periods of (Pre and 4 weeks), (Pre and 3 months), and (4 weeks and 3 months). Similarly, in group 2, there was a substantial difference seen between the periods of (Pre and 4 weeks) and (Pre and 3 months).
Conclusions: In the treatment of GTPS, corticosteroid and extracorporeal shock wave therapy effectively alleviate pain and improve function. These methods are particularly useful when conventional physical therapy has failed.

Keywords: Ultrasound, corticosteroid, shockwave; greater trochanteric pain

1. Introduction
Greater trochanteric pain syndrome (GTPS) is a medical condition characterized by pain and discomfort in the specific location of the trochanteric region [1, 2].
Enthesopathy, tendinopathy, snapping iliotibial band may be the source of pain [3].
GTPS syndrome mainly affect female. The male to female ratio is 1:4 [4].
GTPs is diagnosed via clinical assessment, which involves identifying the presence of tenderness and pain in the trochanteric region [1, 5].
Modifying activity, giving non-steroidal anti-inflammatory drugs, and injecting corticosteroids locally (With or without anesthesia) are all examples of conservative techniques that make up the treatment.
If problems persist and pain continues, surgical procedures such as bursectomy to release the iliotibial band, hip cuff repair, and trochanteric reduction osteotomy may be necessary [6].
The successful use of radial shock wave therapy for planter fasciitis, Achilles tendinitis, and lateral epicondylitis led to the development of extracorporeal shock wave therapy as a therapeutic alternative for GTPs [1, 7, 8].
This study set out to determine whether or not extracorporeal shock wave therapy and ultrasound-guided corticosteroid injection were effective in alleviating pain in the greater trochanteric area that had not responded to previous treatments.

Materials and Methods

The researchers used a prospective randomized strategy and conducted their study at a single center. The examples were chosen from the Tanta University Hospitals Rheumatology and Rehabilitation Department's Outpatient Clinic.

Thirty adult patients of both sexes, diagnosed with chronic Greater trochanteric pain, pain on palpation of lateral region of the hip, tenderness on palpation of greater trochanter and the complaint persists for at least 3 months instead of medical treatment.

Cases with chronic greater trochanteric pain were subdivided into two equal subgroups according to line of treatment: Group I: treated by twice injections of 1ml methyl prednisolone combined with 4 ml of lidocaine 2 weeks apart under ultrasound guidance and Group II: treated by extracorporeal shock wave therapy. 4 sessions one week apart of radial shock wave, 2000 pulses, energy level (2.0-3.0 bar), frequency 12Hz.

Exclusion criteria

Hip arthrosis, lumbar radiculopathy, neuropathy in the lower limbs, a full rupture of the gluteal tendon, and a history of steroid injections in the hip region within the last month are all potential complications.

Clinical Assessment

Demographic data were collected, general examination and lateral region of hip was examined [Inspection: the overlying skin, muscle wasting, and swelling and palpation: pain and tenderness of greater trochanter].

Pain assessment was done by VAS for pain (VAS) [9] and Numeric rating scale [10].

Roles and Maudsley score (RMS) [10]: The 4-point patient evaluation is a subjective measure of pain and activity limits. A score of 1 indicates an exceptional outcome with no symptoms after therapy, while a score of 2 indicates considerable improvement from before treatment. A score of 3 suggests that the patient is moderately better, and a score of 4 indicates that the symptoms are same or worse than before treatment.

Trendelenburg Test, 30-second single-leg stance test, Resisted external derotation test and FABER test [11] were assessed in all patients.

Functional assessment

Lower extremity functional scale [11]: The LEFS is a tool that may be used to assess the functional disability of a patient who has a condition affecting either one or both of their lower limbs. It may be used for long-term patient monitoring and to assess the efficacy of an intervention. To get the final score, add up the values of the columns on the scale according to the scoring guidelines. The impairment increases as the score decreases. The lowest detectable change and the minimal clinically relevant difference are both 9 scale points. The percentage of maximum function may be calculated by dividing the LEFS score by 80 and multiplying the result by 100.

Group I: Local corticosteroid injection

The patient was positioned in the lateral decubitus posture, with the affected hip elevated and the hips and knees extended in a comfortable position. The skin was sterilized with betadine followed by a 70% alcohol-based solution (Ethanol) used with a single-use swab or cotton ball, by wiping the injection site. Using live ultrasound imaging, a 22-gauge needle of 3.5 inches (9 cm) in length was inserted in a direction parallel to the ultrasound probe, starting from the back and moving towards the front. The needle was accurately positioned inside the soft tissues surrounding the greater trochanter. The injection is administered either into the larger trochanteric bursa or the subgluteus medius bursa. An ultrasound-guided injection was performed using a solution consisting of -1ml of methyl prednisolone mixed with 4ml of lidocaine.

It is advised to place a sterile bandage over the injection site and instruct the patient to delicately mobilize the region to disperse the fluid. Recommendations on post-injection rest. It is advised to completely refrain from any physical activity for a period of 24-48 hours, and to only engage in restricted activity for 2-4 weeks. Non-steroidal anti-inflammatory medicines (NSAIDs) may be suggested as a treatment option if there was a corticosteroid flare in response to cold packs.

Group II: Shock wave therapy

Extracorporeal shock wave therapy (DUOLITH SD1 Tower) was applied on the greater trochanter with the following parameters: 4 sessions one week apart of radial shock wave, 2000 pulses, energy level (2.0-3.0 bar). After the session, simple analgesia and icing may be required to control the pain. Anti-inflammatory medication is contraindicated. Rest for 2-3 days from aggressive activities after treatment, then restriction of activities for 2–4 weeks is recommended.

Ethical Approval

The research received approval from the Ethics Board of Tanta University, and the patients were provided with comprehensive information on the experiment. Every individual included in the study submitted a duly signed and informed consent document.

Statistical analysis

Software developed by IBM Inc. of Chicago, Illinois, USA, known as SPSS v26, was used to do the statistical study. For the quantitative variables, we used an unpaired Student's t-test to present the means and standard deviations (SD) and compare them between the two groups. We used Chi-square or Fisher's exact test to look at the qualitative variables, which were presented as percentages and frequencies, respectively. Statistical significance was determined by a two-tailed P value that was less than 0.05.

Results

There was a negligible differential between the two examined groups in terms of demographic data, those on the side with increased trochanteric discomfort, and the length of the complaint. Table 1

Table 1: Statistical analysis of the two groups based on demographic variables, location of the most painful trochanteric area, and length of time of complaint

		Group 1 (Corticosteroid injections) (n = 15)	Group 2 (Shock wave therapy) (n = 15)	Test	P
Age (yrs.)		53.87±5.66	56.53±4.34	T: 1.449	0.159
Sex	Male	3 (20%)	2 (13.3%)	X^2: 0.240	0.624
	Female	12 (80%)	13 (86.7%)		
Occupation	Housewife	10 (66.7%)	11 (73.3%)	X^2: 0.159	0.690
	Worker	5 (33.3%)	4 (26.7%)		
Duration (ms)		5.53±2.13	6.53±2.67	T: 1.133	0.267
Side	Right (%)	6 (40%)	8 (53.3%)	X^2: 0.536	0.464
	Left (%)	9 (60%)	7 (46.7%)		

Regarding assessment of pain by VAS NRS, LEFS, there was significant difference in group 1 and 2 between (Pre and 4 weeks) and (Pre and 3 months) and (4 weeks and 3 months). Assessment of pain by RMS showed a significant difference in group 1 between (Pre and 4 weeks) and (Pre and 3 months) and (4 weeks and 3 months), while in group 2 showed a significant difference in group 2 between (Pre and 4 weeks) and (Pre and 3 months). Table 2

Table 2: Assessment of pain by VAS, NRS, LEFS and RMS in group1 and 2 before treatment, 4 weeks and 3 months later

	Pre	4 weeks	3 months	F. test	P
VAS					
Group 1	7.60±2.13	5.20±1.21	2.40±1.40	38.237	0.001*
	P1=0.001*, p2=0.001*, P3=0.001*				
Group 2	7.87±1.06	6.40±1.45	5.93±1.58	7.988	0.001*
	P1=0.006*, p2=0.001*, P3=0.361				
NRS					
Group 1	7.60±2.13	4.60±0.51	2.40±1.24	48.338	0.001*
	P1=0.001*, p2=0.001*, P3=0.001*				
Group 2	7.07±1.10	4.40±1.80	4.07±1.28	19.930	0.001*
	P1=0.006*, p2=0.001*, P3=0.526				
LEFS					
Group 1	19.40±13.62	34.80±13.13	47.60±11.72	18.115	0.001*
	P1=0.001*, p2=0.002*, P3=0.009*				
Group 2	19.60±8.48	22.00±5.13	27.07±4.27	5.621	0.007*
	P1=0.297, p2=0.002*, P3=0.031*				
RMS (Group 1)					
Excellent	0(0.0%)	0(0.0%)	6(40.0%)	X^2: 45.101	0.001*
Good	0(0.0%)	9(60.0%)	9(60.0%)		
Acceptable	6(40.0%)	6(40.0%)	0(0.0%)		
Poor	9(60.0%)	0(0.0%)	0(0.0%)		
	P1=0.001*, p2=0.001*, P3=0.002*				
RMS (Group 2)					
Excellent	0(0.0%)	0(0.0%)	0(0.0%)	X^2: 33.118	0.001*
Good	0(0.0%)	4(26.7%)	4(26.7%)		
Acceptable	3(20.0%)	11(73.3%)	11(73.3%)		
Poor	12(80.0%)	0(0.0%)	0(0.0%)		
	P1=0.001*, p2=0.001*, P3=1.0				

There was a notable disparity in pain alleviation, as measured by the Visual Analog Scale (VAS), between the two groups after 4 weeks and 3 months. There was a significant difference in pain relief, as measured by the Numeric Rating Scale (NRS) and the Root Mean Square (RMS), between the two groups after 3 months. There was a notable disparity in the level of pain alleviation, as measured by the LEFS, between the two groups after 4 weeks and 3 months. Table 3

Table 3: Comparison of change in improvement of pain (VAS, NRS, LEFS and RMS) between the two studied groups before treatment, 4 weeks and 3 months later

	Group 1 (corticosteroid injections) (n = 15)	Group 2 (Shock wave therapy) (n = 15)	t. test	p.
VAS				
Pre	7.60±2.13	7.87±1.06	0.434	0.668
4 weeks	5.20±1.21	6.40±1.45	2.459	0.020*
3 months	2.40±1.40	5.93±1.58	6.475	0.001*
NRS				
Pre	7.60±2.13	7.07±1.10	0.861	0.396
4 weeks	4.60±0.51	4.40±1.80	0.413	0.683
3 months	2.40±1.24	4.07±1.28	3.619	0.001*
LEFS				
Pre	19.40±13.62	19.60±8.48	0.048	0.962

4 weeks		34.80±13.13	22.00±5.13	3.516	0.002*
3 months		47.60±11.72	27.07±4.27	6.375	0.001*
RMS					
Pre	Acceptable	6(40.0%)	3(20.0%)	1.429	0.232
	Poor	9(60.0%)	12(80.0%)		
4 weeks	Good	9(60.0%)	4(26.7%)	3.394	0.065
	Acceptable	6(40.0%)	11(73.3%)		
3 months	Excellent	6(40.0%)	0(0.0%)	18.923	0.001*
	Good	9(60.0%)	4(26.7%)		
	Acceptable	0(0.0%)	11(73.3%)		
		P1=0.001*, p2=0.001*, P3=0.002*	P1=0.001*, p2=0.001*, P3=1.0		
		X^2:45.101, P1=0.001*	X^2:33.118, P1=0.001*		

There was significant difference between two groups in percent of improvement of pain during Trendelenburg test at 3 months. Table 4

Table 4: Comparison of changes in percent of improvement of pain between the two studied groups at 3 months

	Group 1 (Corticosteroid injections) (n = 15)	Group 2 (Shock wave therapy) (n = 15)	X^2 test	P
Without pain	12(80.0%)	6(40.0%)	5.001	0.025*
With pain	3(20.0%)	9(60.0%)		

Discussion

GTPS is diagnosed clinically based on the characteristic symptoms of persistent, intermittent pain in the lateral hip, thigh, and buttock. This pain is worsened by physical activity and while reclining on the effected side [15]. GTPS has an incidence rate of 1.8 to 5.6 cases per 1000 individuals per year, with a higher occurrence in the age range of 40 to 60 years. It mostly affects females [16].

In the present study, in group I and II: VAS score significantly reduced after both 4 weeks and 3 months of treatment compared to its pretreatment value. VAS score was significantly lower after 3 months compared to its value after 4 weeks. Our results came in line with Begkas *et al*. [17] documented that methylprednisolone group showed significant improvement regarding VAS score at 4 and 12 weeks compared to its level at baseline. Also, Ramon *et al*. [18] demonstrated that f-ESWT is a secure and efficacious therapy, resulting in a significant enhancement in pain ratings after 2 months and an increase in functional and quality of life scores after 6 months.

Corticosteroids are often used to treat musculoskeletal (MSK) diseases by inhibiting the production of arachidonic acid from membrane phospholipids. This effect helps control inflammation that is mediated by prostaglandins [19]. By reducing the generation of vasoactive kinins and inhibiting the formation of leukocytes and macrophages, the anti-inflammatory activity of the medication reduces pain. It reduces prostaglandin synthesis, which is associated with inflammation and may cause pain and mechanical dysfunction, and it blocks the release of damaging enzymes that target injured tissue [20]. Similar to our findings, Rompe *et al*. [7] It was observed that one month after the baseline, the outcomes after corticosteroid injection (with a success rate of 75% and a pain rating of 2.2 points) were considerably superior than those following home training (with a success rate of 7% and a pain rating of 5.9 points) or shock wave treatment (with a success rate of 13% and a pain rating of 5.6 points). Contrary to our discoveries, Heaver *et al*. [16] reported that after 3 months of patients monitoring there was insignificant difference in VAS score between ESWT group and corticosteroid injection group while after 12 months of follow up, the ESWT showed significantly lower VAS score than injection group. The deviation from our findings may be attributed to different factors as sample size and technique (Injected mixture, dosage and time interval) may be a suitable reason for this difference.

A total of 80 mg of Depo-Medrone (Methylprednisolone) was mixed with 3.5 ml of 0.5% bupivacaine and 3.5 ml of 1% lignocaine in a single syringe. However, Saber *et al*. [21] reported non-significant difference between extracorporeal shockwave therapy group and local steroid group after treatment in mayo clinic scoring system.

In group I NRS was significantly reduced after both 4 weeks and 3 months of treatment compared to its pretreatment value. NRS was significantly lower after 3 months compared to its value after 4 weeks. Similar to our findings, Brinks *et al*. [22] stated that corticosteroid injections in GTPS showed significant reduction in NRS score for pain at 3 months of follow-up. Our results are supported by Cohen *et al*. [23] reported that injections of corticosteroid into the trochanteric bursa resulted in significant reduction of NRS score for pain from baseline to 1 and 3 months.

In group II NRS was significantly reduced after both 4 weeks and 3 months of treatment compared to its pretreatment value. While there was an insignificant difference in NRS after 4 weeks and after 3 months of treatment. Similarly, Rompe *et al*. [7] stated that radial shock wave therapy showed significant reduction in pain score after one month from baseline.

Hyperstimulation analgesia refers to excessive stimulation of the treated area, which results in reduced transmission of signals to the brain stem. This stimulation blocks the gate-control mechanism and affects the transmission of pain by acting on substance P and calcitonin gene-related peptide expression in the dorsal root ganglion, as well as on neurovascular sprouting [24].

Shock wave treatment also has anti-inflammatory benefits by inducing the production of nitric oxide, which possesses analgesic, angiogenic, and anti-inflammatory properties [24].

Lastly, the biochemical signals are generated by the mechanical effects of ESWT treatment, which stimulate protein synthesis and tissue regeneration by loading the cytoskeleton mechanically. Through the release of growth factor, ESWT has been shown to stimulate anabolic response in ligament and tendon tissues and improve vascularization at the bone-tendon interface [24].

In our study, NRS was significantly lower in group I than group II after 3 months of treatment ($p< 0.05$). Also, Brinks *et al*. [22]. Reported that at the 3-month follow-up visit, the recovery rate was 34% among patients in the standard care group, whereas it was 55% among patients in the injection group. The intensity of pain, as assessed by the NRS score during rest and physical activity, reduced in both groups. However, the drop was more pronounced in the group receiving the injection.

In contrast to our findings, Rompe *et al*. [7] According to the findings, radial shock wave therapy had considerably superior outcomes (68%; 3.1 points) compared to home training (41%; 5.2 points) and corticosteroid injection (51%; 4.5 points) in terms of treatment success after 4 months. After a period of fifteen months, radial shock wave treatment (with a success rate of 74% and an improvement of 2.4 points) and home training (with a success rate of 80% and an improvement of 2.7 points) were shown to be substantially more effective than corticosteroid injection (With a success rate of 48% and an improvement of 5.3 points).

In the current study, in group I LEFS significantly increased after both 4 weeks and 3 months of treatment compared to its pretreatment value. LEFS was significantly higher after 3 months compared to its value after 4 weeks. In agreement with our findings, Wang *et al*. [25] conducted a systematic review and meta-analysis of randomized controlled trials evaluating the effect of corticosteroid injection in the treatment of greater trochanter pain syndrome. CSI showed significant improvement in function at different follow up intervals compared to baseline readings.

In the present study, in group II LEFS significantly increased after both 4 weeks and 3 months of treatment compared to its pretreatment value. While there was an insignificant difference in LEFS after 4 weeks and after 3 months of treatment. Like our findings, Seo *et al*. [10] It was observed that the function scores showed improvement both in the short and long term after ESWT. Approximately 55.6% of patients reported favorable or outstanding outcomes, on average 27 months after the intervention. However, Carlisi *et al*. [26] reported that f-ESWT failed to show a significant improvement in functional scores at 2 and 6 months of the follow up.

In this study, LEFS was significantly higher in group I than group II after 4 weeks and after 3 months of treatment.

However, its effect to inhibit fibroblast proliferation and expression of ground substance proteins may play a big role in early functional improvement [27]. Like our findings, Wang *et al*. [25] It was revealed that CSI outperformed ESWT in terms of functional improvement throughout short and medium-term follow-up.However, Heaver *et al*. [16] documented that HHS was significantly higher in ESWT group compared to steroid injection group at 12 weeks of follow up.

In group I, there was a notable decrease in RMS values after 3 weeks and 3 months, as compared to the values seen before treatment. Also, Saber *et al*. [21] evaluated ultrasound guided local steroid injection versus extracorporeal shockwave therapy in the treatment of plantar fasciitis.

In group II, there was significant reduction in RMS after 3weeks and 3 months when compared with before treatment while there was an insignificant difference in RMS after 4 weeks compared to after 3 months of treatment. Our results are in harmony with El Molla *et al*. [28] revealed that ESWT resulted in significant improvement in RMS after 4 sessions. Corticosteroids have a quick start but have a limited duration of impact, in contrast to shock wave treatment which has more long-lasting benefits. This finding supports previous research that have shown enhanced healing of tendinous structures after shock wave therapy [29].

Due to the limited sample size, this study has several limitations. The research was place in only one location. There was a lack of extensive patient follow-up for a brief time.

Conclusions

Corticosteroid and extracorporeal shock wave therapy are effective in relieving pain and improving function in the treatment of GTPS and they give good results especially after failure of traditional physical therapy.

Declarations

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Consent for publication

I attest that all authors have agreed to submit the work.

Availability of data and material

Available.

Competing interests

None.

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Conflicts of interest

No conflicts of interest.

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