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"COMPARISON OF ULTRASOUND AND SHOCKWAVE THERAPY IN TENDINOPATHY- AN EVIDENCE BASED STUDY"

Physiotherapy

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ABSTRACT

Background: Tendinopathy is a failed healing response of the tendon, with haphazard proliferation of tenocytes, intracellular abnormalities in tenocytes, disruption of collagen fibres, and a subsequent increase in non-collagenous matrix. There is always remains controversy regarding effectiveness of different treatment techniques for tendinopathy and aim of present study is to find and justify better treatment modality for management of tendinopathy. **Purpose:** To study the evidences regarding effect of Shock wave therapy versus Ultrasound therapy in tendinopathies. **Methodology:** This Evidence based study was conducted from June 2017 to June 2022. Search engines used to find appropriate articles were: PubMed, Google Scholar, PEDro, ResearchGate, ScienceDirect and Embase. Key words used were: Ultrasound, Shock wave Therapy and Tendinopathy. Articles were assessed via 2 scales: Centre for Evidence-Based Medicine's (CEBM's) Levels of Evidence and PEDro scale. **Results:** Total 156 articles were found, out of which 12 articles were relevant and from those 6 articles were included in this evidence-based study. From 6 studies, 1 Meta-analysis (Level of evidence 1a), 2 Randomized controlled trails (Level of evidence 1b) and 3 Comparative studies (Level of evidence 2b). **Conclusion:** There are moderate to strong evidences suggests the Shock wave therapy has more effect on Achilles, Gluteal, Rotator cuff and Lateral Elbow tendinopathies when compared to ultrasound.

KEYWORDS

Ultrasound, Shock wave Therapy and Tendinopathy

INTRODUCTION

Tendinopathy is a degenerative tendon disorder associated with chronic pain, swelling, and impaired physical function. Tendons are susceptible to injury as they undergo high forces during loading activities, receive little vascular blood supply, have low elasticity and decreased metabolism. Tendinopathy is thought to be caused by repetitive tendon microtrauma and subsequent failed healing responses, characterized by neovascularization, incidence of calcium deposits or calcification and increased tendon thickness or swelling.[1]

Histologically, tendinopathy is characterized by the absence of inflammatory cells, poor healing, non-inflammatory intratendinous collagen degeneration, collagen fiber disorientation and thinning, hypercellularity with high concentrations of glycosaminoglycans and proteoglycans, and neovascularization. [2][3]Although inflammatory cells are typically present in tendinopathy, tendon cell degeneration rather than inflammation is considered the pathological hallmark of the disorder, leading to the adoption of the term tendinopathy rather than the previously used diagnosis of tendinitis.

A variety of therapeutic techniques have been proposed for the appropriate management of patients with tendinopathy including exercise, orthotics, manual therapy, passive modalities, acupuncture or a combination of them. However, the effectiveness of each treatment option remains debatable.

Extracorporeal shockwave therapy is a popular method in the management of common tendinopathies and has been proposed as an effective supplement to other noninvasive therapies. The ultrasound is a commonly used modality for tendinosis. It Improves microcirculation, migration and synthesis of collagen fibers to the tendon [4]. There is growing evidence from in vitro and animal-based models that low intensity pulsed ultrasound (LIPUS) may also have beneficial effects on non-mineralized tissues, such as ligaments and tendons. For instance, using these models low intensity pulsed ultrasound (LIPUS) has been found to accelerate knee medial collateral ligament healing [5][6][7], augment tendon repair [8] and modulate tendon cell activity. Alexander et al showed that higher doses of ultrasound energy improved pain in individuals with shoulder calcific tendinitis. In contrast, Warden et al. found that lower doses of ultrasound was no better than placebo for the treatment of individuals with patellar tendinopathy.

So, there is always remains controversy regarding effectiveness of different treatment techniques for tendinopathy and aim of present study is to find and justify better treatment modality for management of tendinopathy.

METHODOLOGY

Study Design: This is an Evidence Based Study, which was conducted according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) guidelines. (Figure 1).

Literature Search:
A specified literature search was performed from June 2017 to June 2022 (Last 5 years). Literature was searched using following search engines: Google Scholar, PEDro, PubMed, ResearchGate, ScienceDirect, Embase

Key Words Used For The Search Were:
Ultrasound, Shock wave Therapy and Tendinopathy

METHOD OF SELECTION OF ARTICLES:

Inclusion Criteria:
(1) Studies involving any type of Tendinopathy from June 2017 to June 2022 (Last 5 years), (2) Studies which compared Ultrasound or Shockwave Therapy in any type of Tendinopathy, (3) Articles on tendinopathy having study design of Systematic reviews, Meta-analysis and RCTs, (4) Articles published in English, (5) Studies done on Human participants.

Exclusion Criteria:
(1) Articles on tendinopathy having study design of Case Control and Cohort (2) Studies done on animals.

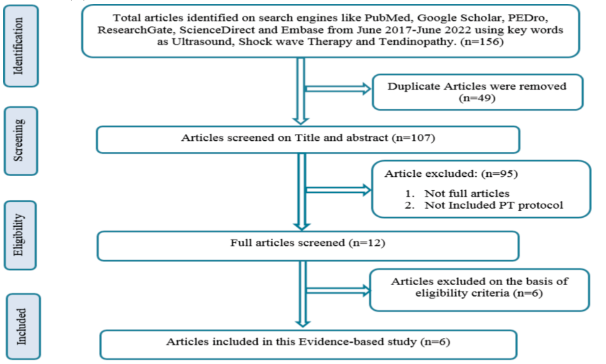

Figure 1: Preferred Reporting Items for systematic reviews and Meta-analysis (PRISMA)

Table 1: Characteristics of Included Studies

SR NO.	TITLE	Study design & Duration	Articles Or Sample Size	Outcome Measures	Pedro And Level Of Evidence
1	Analgesic Effect of Extracorporeal Shock-Wave Therapy in Individuals with Lateral Epicondylitis: A Randomized Controlled Trial [9]	A Randomized Controlled Trial (5 sessions)	40	VAS, Taiwan Version of DASH and Dynamometer	8/10 1b
2	Achilles tendinopathy: Comparison between shockwave and ultrasound therapy [10]	A comparative study (4 weeks)	130	The University of Peloponnese Pain, Functionality and Quality of life Questionnaire - the UoP-PFQ'	4/10 2b
3	Comparison of Radial Extracorporeal Shock Wave Therapy and Traditional Physiotherapy in Rotator Cuff Calcific Tendinitis Treatment [11]	A comparative study (4 weeks)	80	Age, height, Weight, BMI, VAS, Goniometer (Internal and external rotation ROM) and QuickDASH	4/10 2b
4	Comparison of Radial Extracorporeal Shockwave Therapy versus Ultrasound Therapy in the Treatment of Rotator Cuff Tendinopathy [12]	A comparative study (4 weeks)	115	The University of Peloponnese Pain, Functionality and Quality of life Questionnaire - the UoP-PFQ'	4/10 2b
5	Focused extracorporeal shock wave therapy for greater trochanteric pain syndrome with gluteal tendinopathy: a randomized controlled trial [13]	A randomized controlled trial (3 weeks)	50	NPRS, LEFS	7/10 1b
6	A comparative study of the efficacy of ultrasonics and extracorporeal shock wave in the treatment of tennis elbow: a meta-analysis of randomized controlled trials [14]	A meta-analysis	5 articles involving 117 participants	-	- 1a

Assessment of Methodological Quality:
Data was assessed using 2 parameters: (1) Centre for Evidence-Based Medicine's (CEBM's) Levels of Evidence and (2) PEDro scale (Appendix 1 & 2)

RESULTS
Evidences were reviewed and analysis was done on the basis of PEDro score and CEBM's Level of Evidence Scale. Risk of bias is also assessed.

Total 156 articles were found, out of which 12 articles were relevant and from those 6 articles were included in this evidence-based study and other articles were excluded as per Inclusion and Exclusion criteria.

From total 6 studies, there is 1 meta-analysis on efficacy of ultrasonics and extracorporeal shock wave in the treatment of tennis elbow and their result shown that Extracorporeal shock wave Therapy is a superior adjuvant therapy for tennis elbow compared to Ultrasound. Its level of evidence was 1a. 5 out of 6 studies (2 Randomized controlled trials and 3 Comparative studies) were shown that Shock wave (Either Extracorporeal or Radial) was effective treatment for reducing pain and improving disability in subjects with Achilles, Lateral elbow, Gluteal, Rotator cuff tendinopathies when compared to Ultrasound. Their Level of evidence was 1b and 2b.

DISCUSSION
Total 6 studies (1 Meta-analysis, 2 Randomized controlled trials and 3 comparative study) were included in this evidence-based study. The methodological qualities of included studies were moderate to high. The sample size varied from 40-117 subjects.

There are 1 strong evidence (Meta-analysis) which suggest that shock wave therapy is an effective treatment for reducing pain and disability in patients with Lateral elbow tendinopathy when compared to Ultrasound.

There are 2 moderates to high quality of evidences (2 Randomized Controlled Trials) which suggest that shock wave therapy alone or can be adjunct to other conventional treatment provide significant benefits in reducing pain and dysfunctions in patients with Lateral elbow and Gluteal tendinopathies. Total study duration varied from 3 to 5 weeks.

Furthermore, there are 3 low to moderate quality of evidences (3 Comparative Studies) having small to large sample size which compares Ultrasound with Shockwave therapy and their results confirms that Shock wave therapy effectively reduces pain and promotes healing in Rotator cuff and Achillies Tendinopathy. Total Study duration was 4 weeks.

Haupt proposed four possible phase mechanisms of ESWT effects on tissue: physical, physicochemical, chemical and biological. In the physical phase, shockwave pressures cause absorption, refection, refraction and transmission of energy into cells. These tensile forces induce cavitation, increasing cell membrane permeability and activating cell signaling pathways. These include mechano-transduction pathways and those that regulate a variety of gene expressions. In the physicochemical phase, cells release molecules such as adenosine triphosphate (ATP), activating cell signaling pathways. In the chemical phase, ion channels in cell membranes are altered allowing cell calcium mobilization. The biological phase plays host to a plethora of identified biological responses due to tissue and cell stimulation.

Tissue-healing responses are mediated by release of vascular endothelial growth factor (VEGF), endothelial progenitor cells, endothelial nitric oxide synthase (eNOS), insulin-like growth factor (IGF1) proliferating cell nuclear antigen (PCNA) and various other functional proteins.

Cellular modulation is activated by upregulation and downregulation of proteins which promotes processes such as neovascularization, anti-inflammation, anti-apoptosis, chondroprotective effects angiogenesis and regeneration of bone and tendon tissue. [15]

It should be noted that there were no any adverse effects reported from Shockwave Therapy from included articles.

CONCLUSION
From this Evidence based study, it can be concluded that there are moderate to strong evidences suggests the Shock wave therapy has more effect on Achilles, Gluteal, Rotator cuff and Lateral Elbow tendinopathies when compared to ultrasound.

Conflict Of Interest : There is no conflict of interest.

Abbreviations
RCTs: Randomized controlled Trials, VAS: Visual Analogue Scale, VAS-FA: VAS foot and ankle, eNOS: Endothelial Nitric Oxide Synthase, VEGF: Vascular Endothelial Growth Fact, PCNA: Proliferating Cell Antinuclear Antigen, ESWT: Extracorporeal Shockwave Therapy, F-SWT: Focused Shockwave Therapy, R-SWT: Radial Shockwave Therapy, LIPUS: Low Intensity Pulsed Ultrasound, TUS: Therapeutic Ultrasound. PEDro: Physiotherapy Evidence Database, CINAHL: Cumulative Index of Nursing and Allied Health Literature, CEBM: Center of Evidence Based Medicine, PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-analysis, DASH: Disability of Arm, Shoulder and Hand, ROM: Range of Motion, BMI: Body Mass Index, NPRS: Numerical Pain Rating Scale, LEFS: Lower Extremity Functional Scale, GTPS: Greater Trochanteric Pain Syndrome, ATP: Adenosine Triphosphate, OVID: Offshore Vessel Inspection Database, EMBASE: Excerpta Medica Database, IGF1: Insulin-Like Growth Factor1

Ethical Approval
Ethical approval was not required.

Appendix 1- CEBM's Level of Evidence
It assesses quality based on study design, which categorize the studies

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in a scale ranging from 1 to 5 with further subdivision for 5each.

Level	Definition
1a	Systematic reviews of randomized controlled trials
1b	Individual randomized controlled trials
1c	All-or-none studies
2b	Systematic reviews of cohort studies
2b	Individual cohort studies or low-quality randomized controlled trials
2c	Outcome research
3a	Systematic reviews of case-control studies
3b	Individual case-control studies
4	Case series, poorly designed cohort or case-control studies
5	Animal and bench research, expert opinion

Appendix 2-PEDro Scale

It assesses methodological quality and consists of a checklist of 11 criteria, 10 of which are scored. For each criterion the study met, 1 point was awarded. The points were tallied and presented as a score out of 10. The scale applies only to experimental studies. For this review, investigations with PEDro scores of 6 to 10 were considered high quality, of 4 to 5 were considered moderate quality, and of 0 to 3 were considered low quality.

No.	Description	Yes/No
1	Eligibility criteria were specified (No points awarded)	
2	Subjects were randomly allocated to groups	
3	Allocation was concealed	
4	The groups were similar at baseline regarding the most important prognostic indicators	
5	There was blinding of all subjects	
6	There was blinding of all therapists who administered the therapy	
7	There was blinding of all assessors who measured at least one key outcome	
8	Measure of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups	
9	All subjects for whom outcome measures were available received the treatment or control condition as allocated	
10	The result of between group comparisons are reported for at least one key outcome	
11	The study provides both point measures and measures of variability for at least one key outcome	

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