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Efficacy of Extracorporeal Shockwave Therapy in the Treatment of Patients with Trigger Finger

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Abstract:-

- ***Background and Need:-*** **Trigger finger being one of the common causes of pain and disability in the hand, is thought to be caused by inflammation and narrowing of the A1 pulley. Extracorporeal Shockwave Therapy (ESWT) which is commonly used to treat varied orthopaedic conditions, works by correcting the mechanical insufficiency related to trigger finger. This article aims to give an overview of ESWT in reducing pain, stiffness and improving range of motion in patients with trigger finger.**
- ***Methods:-*** **570 articles were retrieved from databases viz. PubMed, Science Direct and Google Scholar. Considering the inclusion and exclusion criteria, five studies were found eligible for this review that consisted of interventional and cohort studies.**
- ***Results:-*** **Two randomised controlled trials found significant reduction in pain intensity and severity of triggering, but did not show any significant differences in functional impact of triggering. Alternately, two non-randomised trials and one retrospective cohort study showed reduced pain levels and increased general functional capacity, grip strength, pinch strength and range of motion.**
- ***Conclusion:-*** **ESWT can be consider as a safe and effective treatment in alleviating pain and general function in patients with trigger finger. However, these findings need to be confirmed by future trials and establish the short- and long-term effects of ESWT on pain, range of motion, strength and function in the management of trigger finger.**

Keywords:- *ESWT, Extracorporeal Shockwave Therapy, Trigger Finger, Trigger Finger Disorder.*

I. INTRODUCTION

A trigger finger is a common finger ailment, thought to be caused by inflammation and narrowing of the A1 pulley and is associated with clinical signs like pain, clicking, catching, and loss of motion of the affected digit.[1] The triggering occurs at the level of the metacarpophalangeal joints and is one of the most frequent causes of pain and disability in the hand.[2,3] The gliding of the flexor tendons causes changes that lead to stenosis of the A1 pulley and the friction caused in the flexor tendons when passing through the stenotic pulley can change the fibers, forming an intratendinous lump.[3] The flexor tendons which are surrounded by the flexor sheath from the metacarpal neck to the volar plate of the distal interphalangeal joint, are attached longitudinally to the underlying bony structures. This sheath is thick over the bones and thin in areas overlying the joints which permits digital flexion.[4]

The dominant hand is more commonly affected and occurs in the middle fifth to sixth decades of life where women are affected more than men and the lifetime risk of trigger finger development is between 2 to 3 percent but increases to up to 10 percent in persons with diabetes.[1,5] The ring finger is most commonly affected, followed by the thumb, long, index, and small fingers in patients with multiple trigger digits. Patients with diabetes mellitus, carpal tunnel syndrome, Dupuytren's disease, rheumatoid arthritis, amyloidosis, hypothyroidism, mucopolysaccharide storage disorders, and congestive heart failure are often affected with trigger finger.[6] The patient presents with pain in the palm during movement of the involved digits and the flexor tendon causes a painful click when the patient flexes and extends the digit. The patient may present with a digit locked in a flexion position.[4] Signs and symptoms of patients with trigger fingers include pain, catching or snapping as the patient flexes and extends, lump in the digit, and swelling.[3]

Triggering of the flexor mechanism of a digit can be cured by surgery, but it is not always successful in relieving the patient's symptoms and at worst, the phenomenon of triggering may be replaced by discomfort from a painful scar.[2] Other conservative methods such as splinting prevents the friction caused by flexor tendon movement through the affected A1 pulley until the inflammation resolves. Besides, corticosteroid injections reduce the risk of tendon damage. Extracorporeal Shockwave therapy (ESWT) for the treatment of musculoskeletal diseases is a field that is developing rapidly and attracting increasing attention.[7] Extracorporeal shockwaves are defined as pressure waves, that propagate in three dimensions and typically induce a

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clear increase in pressure within a few nanoseconds.[8] There are three main techniques through which shockwaves are generated, these are electrohydraulic, electromagnetic, and piezoelectric principles, each of which represents a different technique for generating shockwaves.[9]

Researchers have found that ESWT in the management of trigger finger leads to a reduction in severity of pain and triggering, and functional impact of triggering, and this reduction persisted until the 18th week after intervention. It is recommended to use ESWT in terms of a non-invasive intervention with no significant complications for patients with trigger finger.[10] This article aims to give an overview of ESWT and its uses in trigger finger patients to reduce pain and stiffness and increase the range of motion of the affected digit. As there is a dearth of evidence concerning ESWT in trigger finger this study will help summarise its effects.

II. METHODOLOGY

➢ *Search Strategy*

Databases used for this review were PubMed, Science Direct and Google Scholar. The following keywords were used: 'ESWT', 'extracorporeal shock wave therapy', 'focused extracorporeal shock wave therapy', 'radial extracorporeal shock wave therapy', 'trigger finger' and 'trigger finger disorder'.

➢ *Study Selection*

Studies were considered for inclusion if they met the following criteria: (a) articles in English language (b) articles that include radial extracorporeal shock wave therapy and/or focused extracorporeal shock wave therapy (c) articles published from 2010 to 2022 and (d) studies done on human subjects. Studies were considered for exclusion if they met the following criteria: (a) articles whose full text was not available (b) articles published before 2010 (c) articles that used ESWT for conditions other than trigger finger.

➢ *Examined Variables*

The variables examined in the study were: (a) frequency of triggering, (b) severity of triggering, (c) pain, (d) general functional capacity, (e) ROM, (f) grip strength and (g) pinch strength.

➢ *Search of Literature*

The literature search through the database showed 1865 articles, out of which 1295 duplicates were ruled out. After initial screening, 540 were excluded and 30 papers remained for abstract review. A total of 25 articles that did not meet the remaining inclusion criteria were excluded, after which only 5 studies that met all the inclusion criteria were considered for further review. (Figure 1)

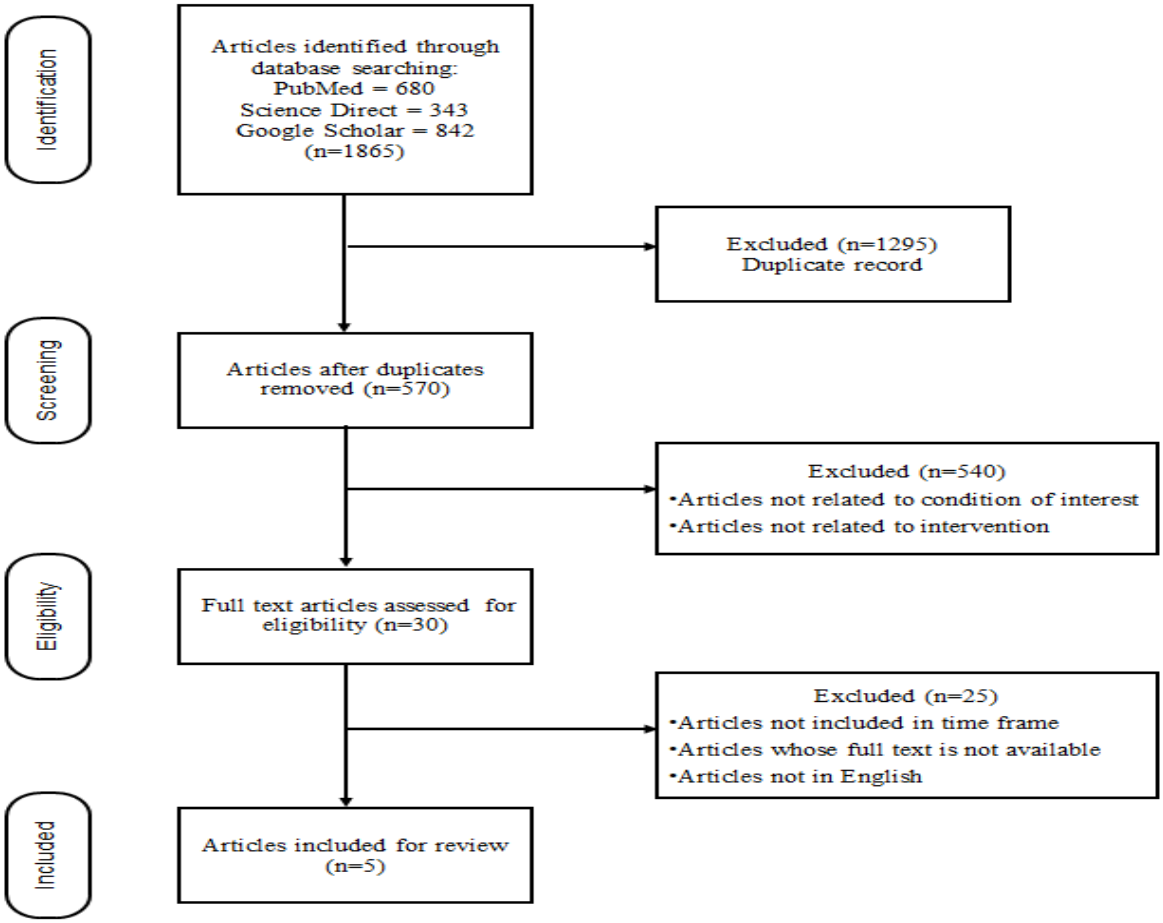

Fig 1 The Prisma Flow Diagram, Illustrating Each Step in the Process to Identify the Final Selection of Studies to be Reviewed.

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III. RESULTS

➢ *Sample*

The study samples consisted of adults suffering from trigger finger. Most studies included individuals with Grade II trigger finger that was classified according to the Quinnel classification.

➢ *Methodological Quality of Trials*

In accordance with the selection and rejection criteria, only 4 studies were finally accepted for the present study (Figure 1). Since the study done by Chen et al.[11] and Yildirim et al.[14] adopted the design of a randomised controlled trial (Level 2), the PEDro scale was used to assess the quality of these trials, which was 9/10 and 8/10 respectively. The studies conducted by Vahdatpour et al. [10] and Dogru et al.[12] were a non-randomised clinical trials whereas the study by Malliaropoulos et al.[13] adopted the design of a retrospective cohort study (Level 3).

➢ *Interventions*

The intensity and type of ESWT differed in the studies. Chen et al. compared the effects of a high and low energy ESWT, wherein the patients in the high energy ESWT group and low energy ESWT group received 1500 impulses of focused shockwaves at a density of 0.01 mJ/mm^2 and 0.006 mJ/mm^2 respectively. Yildirim et al. compared the effect of the ESWT of a frequency of 15 Hz with a local corticosteroid injection. Other types of ESWT such as Radial extracorporeal shockwave therapy (rESWT) and Focussed extracorporeal shockwave therapy (fESWT) were also tested. rESWT, a type of ESWT adopts a rocket mechanism to stimulate pressure waves on the peripheral tissues of the nodule whereas fESWT was administered directly on the nodule and site of maximum tenderness. All interventions were given for an average of 12-18 weeks (Table 1).

Table 1 Brief Description of Included Studies

No	Author & Year	Sample size	Intervention/Device	Duration, Frequency, Intensity of Intervention	Dependent variables	Evaluation/ re-assessment	Results
1	Chen YP et al.[11] (2021)	N=60 HS group=20 LS group=20 Sham group=20	Wide-focused ESWT device (LM-IASO)	Once per week for 4weeks HS group (energy flux density of 0.01mJ/mm^2, 5.8 bar, 1500 impulses) LS group (energy flux density of 0.006mJ/mm^2, 3 bar, 1500 impulses) Sham group (1500 impulses of energy free vibration)	Pain score, frequency of triggering, severity of triggering, functional impact of triggering, general functional capacity	Baseline, one, three and six months after intervention	All groups showed significant improvement; HS group demonstrated higher magnitude of improvement; no effect on functional impact of triggering
2	Yildirim P et al.[14] (2016)	N=40 ESWT group=20 Injection group=20	Vibrolith Ortho ESWT	Three sessions (one week interval between each session) ESWT group (energy flux density of 15Hz, 2.1 bar, 1000 impulses) Injection group (local corticosteroid)	Cure rate, pain score, frequency of triggering, severity of triggering, functional impact of triggering, general functional capacity	Baseline, one, three and six months after intervention	Both groups demonstrated statistically significant improvements in all outcome measures; no between group differences for cure rates, pain and functional status at follow up

3	Vahdatpour B et al.[10] (2020)	N=19	DUOLITH SD1 Tower (rESWT + fESWT)	Three sessions (one week interval between each session) eESWT (energy flux density of 15Hz, 2.1 bar, 1000 impulses)	Pain score, severity of triggering, trigger finger score, general functional capacity	Baseline, immediately after, six and eighteen weeks after intervention	Except for severity of triggering, there were statistically significant outcomes in all variables post intervention
4	Dogru et al.12 (2020)	N=18	Swiss Dolorclast rESWT	Ten sessions, twice a week for 5 weeks rESWT (energy flux density of 10Hz, 2 bar, 2000 impulses)	Pain score, general functional capacity, range of motion, grip strength, pinch strength	Baseline, immediately after and three months after intervention	Statistically significant outcomes in all variables post intervention
5	Malliaropoulos N et al.13 (2016)	N=44	Storz Medical Masterplus MP200 rESWT device	Weekly until symptoms subsided (based on individual response) rESWT (energy flux density of 5-6Hz, 1-3 bars, 2000 impulses)	Pain score, functional outcome	Baseline, one, three and twelve months after intervention	Significant reductions in pain scores and functional improvement were found between baseline and all follow-up assessments

N: Sample Size; ESWT: Extracorporeal Shockwave Therapy; HS:High-energy ESWT; LS:Low-energy ESWT; rESWT:radial Extracorporeal Shockwave Therapy; fESWT:focused Extracorporeal Shockwave Therapy

IV. DISCUSSION

Patients with trigger finger disorder present with pain, reduced ROM, carpal tunnel syndrome, uneven finger movements and locked digit. It has been suggested that ESWT helps in correcting the trigger finger disorder by reducing pain, severity of triggering and functional impact of triggering. The interventional studies and cohort studies which were selected for the review showed that ESWT reduces pain severity, increases general functional capacity, grip strength, pinch strength and ROM. Some of the studies demonstrated positive effects of ESWT in trigger finger patients whereas some of the articles showed no difference following ESWT in some parameters which were reflected in the results.

Chen YP et al.[11] who used the wide-focused ESWT device found that participants experienced a significant improvement in all clinical parameters such as pain, frequency and severity of triggering. However, the functional impact of triggering did not improve. It was noteworthy that even the sham group demonstrated these improvements with time, implying that the patients's expectations and use of NSAIDs may lead to the development of this placebo effect. Also, this trial only included patients with Grade II trigger finger, where symptoms are caused due to inflammation and not due to mechanical locking. Hence, this could be the reason behind all groups displaying similar results as all participants were allowed to consume NSAIDs and take adequate rest. Comparing to a fixed energy density, this study noted that ESWT with a maximum tolerable energy could be more effective in relieving pain and function. This study also did not exclude participants with associated comorbidities such as diabetes mellitus and carpal tunnel syndrome. The effect of ESWT was compared with that of a corticosteroid injection by Yildirim et al.[14] where both groups demonstrated statistically significant improvements in cure rates, pain and functional status after 6 months of treatment. These findings emphasise that ESWT can be a recommended alternative for patients who are allergic to local anaesthesia, have needle phobia or those who fear the complications of corticosteroid injections in general. Besides recruiting individuals only with Grade II trigger finger, this study lacked a control group and the pain experienced during either treatment was not documented.

Similarly, Vahdatpour B et al.[10] who administered fESWT found that it lead to reduction in pain and severity of triggering immediately after intervention but did not yield a statistically significant difference compared to before intervention. On the other hand, the effect of the treatment on reducing pain severity, severity of triggering, and functional impact of triggering in the 6 weeks after

intervention did not yield a statistically significant difference compared to the 18 weeks after intervention. Dogru M et al[12] and Malliaropoulos N et al[13] showed rESWT is an effective method in patients with trigger finger disorder by decreasing pain levels and increasing general functional capacity, grip strength, pinch grip and range of motion of the affected digit. All outcome measures showed statistically significant improvements immediately after and three months post treatment but, these studies did not include a control group. The number of rESWT sessions significantly correlated with pretreatment symptom duration.

Overall, all the above findings indicate that ESWT can be a safe alternative to medications and also play a major role in the conservative management of patients with trigger finger. It is postulated that the action of ESWT is to stimulate biological activity in cells leading to the development of mechanosensitive biofeedback between the sound waves and the cells. Researchers show that an increase in the angiotensin factor by ESWT results in neovascularization and appropriate vascular support of the injured tendon leading to its repair. Moreover, ESWT stimulates the synthesis of nitric oxide which suppresses inflammation.[15-18] Nevertheless, the effectiveness of ESWT depends on several factors including the location of pressure application, the energy flux density, overall energy, adherence to the principles of shockwave production, and the device itself.[19]

The current review observed certain limitations. Only limited articles could be included since many others used ESWT along with other procedures. The review could not maintain homogeneity in the type of study, such that only few randomized controlled trials were included. It was also difficult to compare the quality among the chosen studies as some had no control groups. The studies had smaller sample sizes which could potentially affect the reliability of the results, leading to higher variability and bias. Though the devices used for intervention were not of the same make, the studies were comparable in terms of treatment intensity and duration.

V. CONCLUSION

The findings of this review suggest that physical therapists can safely consider the use of ESWT as an adjunct to the conventional protocol of treating trigger finger effectively. The use of ESWT not only warrants reduction in pain levels, but also can accelerate functional performance and recovery in patients with trigger finger. Future research is needed to include studies with improved research protocols, with larger study populations and that are specific of the type and dosage of ESWT to be used. These will further strengthen the evidence towards the use of ESWT in clinical practice. Therefore, taking into account the limitations of this literature review, the researchers warrant a future scope with new experimental protocols with better methodological quality to confirm the efficacy of ESWT in the management of trigger finger.

➢ *Declaration of Conflicting Interests*

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