Focused Shock wave Therapy for Dupuytren's Disease: A Literature Review

Tratamento com ondas de choque focais na doença de Dupuytren – uma revisão da literatura

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Resumo

A Doença de Dupuytren é uma patologia fibroproliferativa progressiva da fáscia palmar, levando a contraturas digitais e comprometimento funcional. O tratamento com ondas de choque focais tem surgido como uma abordagem não invasiva para essa condição. Com esta revisão pretendemos sumariar a evidência atual sobre a utilização da terapêutica com ondas de choque focais na Doença de *Dupuytren*, nomeadamente nos parâmetros utilizados, redução de dor, qualidade de vida e impacto funcional, amplitudes articulares e efeitos adversos.

Os estudos disponíveis sugerem que a aplicação terapêutica de ondas de choque focais na Doença de *Dupuytren* parece ser uma alternativa promissora e não invasiva, nomeadamente no controlo álgico e melhoria da funcionalidade da mão, com efeitos adversos mínimos. No entanto, a ausência de padronização nos protocolos limita conclusões robustas. Estudos futuros devem incluir um seguimento a longo prazo, bem como a uniformização dos parâmetros de tratamento aplicados para definirmos o papel das ondas de choque focais na abordagem da Doença de *Dupuytren*.

Abstract

Dupuytren's Disease is a progressive fibroproliferative condition of the palmar fascia, leading to digital contractures and functional impairment. Focused shock wave therapy has emerged as a non-invasive approach for managing this condition. This review aims to summarize the current evidence on the use of focal shock wave therapy in Dupuytren's Disease, particularly regarding treatment parameters, pain reduction, quality of life and functional impact, joint range of motion and adverse effects.

Available studies suggest that focused shock wave therapy in Dupuytren's Disease appears to be a promising and non-invasive alternative, particularly for pain management and hand functionality improvement, with minimal adverse effects. However, the lack of standardized treatment protocols limits robust conclusions. Future research should include long-term follow-up and standardization of treatment parameters to better define the role of focal shock wave therapy in the management of Dupuytren's Disease.

Keywords: *Dupuytren's Disease; Extracorporeal shock wave therapy*

Introduction

Dupuytren's disease is a benign condition characterized by progressive fibrosis of the palmar fascia, leading to flexion contractures of the fingers. It typically begins with the appearance of fibrous nodules in the palm, which may or may not be painful. These nodules gradually progress to form longitudinal cords that cross the metacarpophalangeal (MCP)

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and proximal interphalangeal (PIP) joints, eventually resulting in flexion contractures, most commonly affecting the fourth and fifth fingers. It may be associated with other fibroproliferative disorders in different locations, including the soles of the feet (Ledderhose's disease or plantar fibromatosis), the dorsal aspect of the PIP joints (Garrod's nodules or knuckle pads), and the penis (Peyronie's disease).[1, 2]

Although Dupuytren's disease is considered a benign condition, the flexion deformity leads to reduced function of the affected hand and fingers, with patients commonly reporting difficulties with hygiene, grasping objects, writing, shaking hands, and performing work-related and leisure activities. The resulting disability can negatively impact the patients' quality of life across various domains, including social and emotional aspects, self-esteem, and daily living Activities.[3]

The global prevalence of Dupuytren's disease is approximately 8%, with a higher incidence in males, individuals over 50 years old, and Caucasians. It is frequently associated with diabetes and excessive alcohol consumption.[4] Other risk factors include a positive family history, epilepsy, liver disease, smoking, and occupational exposure, particularly in manual laborers.[2, 5]

Several staging systems are used to assess the severity of Dupuytren's disease, based on the presence of palmar nodules, cords, and the degree of finger contracture. The Tubiana classification includes five stages based on the total flexion deformity of the fingers[6]:

- Stage N: Palmar or digital nodule, without flexion contracture.
- Stage I: Total flexion deformity between 0-45º.
- Stage II: Total flexion deformity between 46-90º.
- Stage III: Total flexion deformity between 91-135º.
- Stage IV: Total flexion deformity >135º.

Diagnosis is primarily clinical, based on the presence of characteristic nodules and cords in the palm and fingers. Imaging studies are rarely required.

Therapeutic options for Dupuytren's disease may be either conservative or surgical. When flexion deformities result in functional limitation of the hand, surgery remains the cornerstone of treatment.[6, 7] However, surgical treatment is invasive, carries the risk of complications, particularly neurovascular injuries, and is associated with recurrence rates ranging from 18-33%, depending on the surgical approach and disease severity[7]. Consequently, there has been increasing interest in exploring alternative treatment options.

Collagenase injections have proven effective in reducing flexion contractures and improving range of motion in patients with Dupuytren's disease,[8] although the five-year recurrence rate remains high.[9] In early stages, radiotherapy seems to limit disease progression.[10]

Focused shock wave therapy (FSWT) has emerged as a promising approach for Dupuytren's disease. The hypothesis for its use in Dupuytren's disease was first proposed by Knobloch et al.[11] based on the benefits of shock wave therapy in other fibroproliferative conditions with similar pathophysiology, such as Ledderhose's disease and Peyronie's disease. FSWT appears to regulate stem cell differentiation, thus contributing to tissue regeneration and reducing fibrosis.[12, 13] FSWT is a non-invasive procedure involving the application of high- energy acoustic waves to the target area, promoting regenerative processes through neovascularization, reduced inflammation, and tissue remodeling.

The aim of this review was to summarize the current evidence on the use of focused shock wave therapy in Dupuytren's disease, specifically regarding treatment parameters (intensity, number of pulses, and frequency), pain reduction, quality of life and functional impact, joint range of motion, and adverse effects.

Methods

A literature review was conducted in the PubMed, CENTRAL, Scopus, and SciELO databases using the following terms: ("extracorporeal shockwave therapy" or "ESWT" or "shock wave therapy") AND ("Dupuytren's disease" or "Dupuytren contracture" or "fibromatosis palmaris"). Inclusion criteria were case series, observational studies, and clinical trials evaluating the effect of focused shock wave therapy on Dupuytren's disease, published up to May 2024, in either Portuguese or English. After applying the inclusion criteria, five articles were included.[14-18]

Results

- Parameters used

  There is variability in the parameters of focused shock wave therapy (FSWT) application, including intensity, frequency, and number of pulses across different studies. As shown in Table 1, intensity ranged from 0.03 to 1.24 mJ/mm², frequency from 3 to 8 Hz, and the number of pulses from 1,000 to 2,000. The number of sessions varied from 3 to 6, administered every 5 to 7 days.

- Pain

  All studies included an assessment of pain using the Visual Analog Scale (VAS) for pain before and after the intervention, except for Abdulsalam et al.,[16] who

evaluated pain through section IV of the Michigan Hand Outcome Questionnaire (MHOQ).

All studies reported a reduction in pain in the short-to-medium term, as shown in Table 1. Knobloch et al.[15] observed a reduction in pain of at least 1.7 points on the VAS, which persisted for at least 18 months.

- Functionality

  Hand functionality, quantified using the DASH (Disabilities of the Arm, Shoulder, and Hand) scale, was assessed following treatment with focused shock wave therapy (FSWT) in several studies. Notarnicola et al.[17] and Taheri et al.[18] reported significant improvement in functionality for activities of daily living, with a significant improvement in the DASH score that persisted for at least 3 months after treatment. This positive trend in functionality was also reported by Aykut et al.[14] and Knobloch et al.,[15] although without statistical significance at 18 months post- intervention.

- Joint Range of Motion

  Notarnicola et al.[17] and Taheri et al.[18] evaluated the impact of FSWT on joint range of motion. Notarnicola et al. included patients with Dupuytren's disease at any stage, while Taheri et al. only included patients with early-stage Dupuytren's disease (flexion contracture ≤15º at the PIP joint and ≤30º at the MCP joint). Both studies found a reduction in the extension deficit of the fingers.

- Adverse Effects

  Focused shock wave therapy for Dupuytren's disease appears to be a safe treatment, with no significant adverse effects reported. In fact, only Taheri et al.[18] reported mild adverse effects, such as increased pain in the first 2 days post-treatment, which resolved with acetaminophen.

Table 1 - Summary table of study characteristics included in the review, including author, year, study type, intervention and key results

Author, year of publication, type of study	Sample	Frequency (Hz)	Intensity (mJ/mm2)	Number of pulses	Number of sessions	Pain (**)		Functional limitation (DASH)		Extension deficit (º)		Reported adverse effects
						Before Mean (Median)	After Mean (Median)	Before Mean (Median)	After Mean (Median)	Before Mean (Median)	After Mean (Median)	
Notarnicola et al. (2017) Randomize Clinical Trial	N=45 FSWT = 15 High-energy laser = 15 Stretching = 15	4	0,03	1000	3 (every 5 days)	3,9±1,0 (4,0)	2,7±1,0 (3,0) (3 months after treatment)	37,0±11,3 (40,0)	28,8±16,5 (30,0) (3 months after treatment)	51,7±29,1 (50,0)	30,7±29,0 (20,0) (3 months after treatment)	No adverse effects reported.
Aykut et al. (2018) Case Series	N=23	6-8	0,18	1700	6 (1 per week)	2,8±3,2 (2,0)	2,4±2,5 (2,0)*	24,6±26,3 (15,0)	23,0±24,9 (11,4)*	-	-	-
Abdulsalam et al. (2019) Case Series	N=7	3	1,24	2000	5 (1 per week)	8,75±0,5	2,0±0,9 (8 weeks after the start of treatment)	-	-	-	-	No adverse effects reported.
Knobloch et al. (2022) Randomized Clinical Trial	N=52 FSWT=27 Placebo=25	3	0,35	2000	3 (1 per week)	3,6±1,8	1,9±0,8 (18 months after treatment)	12±18	10±9 (18 months after treatment)*	-	-	No adverse effects reported.
Taheri et al., 2022 Case series	N=20	3	1,24	2000	6 (1 per week)	5,4±1,63	4,85±1,22 (14 weeks after treatment)	60,35±14,6	47,1±11,21 (14 weeks after treatment)	24,1±3,8	19,7±3,64 (14 weeks after treatment)	Mild exacerbation of pain complaints 1-2 days after treatment, resolved with acetaminophen.

*No statistically significant. ** Pain was assessed using Visual analog scale (VAS), except for Abdulsalam et al., who evaluated pain using section IV of the MHOQ questionnaire

Discussion

This review highlights the role of focused shock wave therapy as a non-invasive approach in the treatment of Dupuytren's disease. It appears to be a particularly promising option for patients with early-stage Dupuytren's disease or those with contraindications to surgical procedures. The evidence suggests that focused shock wave therapy is an effective and safe treatment for Dupuytren's disease, particularly in pain management and improving hand functionality.

Indeed, Notarnicola et al.[17] and Taheri et al.[18] found that treatment with FSWT is associated with an improvement in hand functionality, even in more advanced stages. Knobloch et al.[15] demonstrated that the application of 2000 high-energy pulses over 3 sessions is associated with significant pain relief, which persists for at least 18 months. These results are particularly relevant considering that Dupuytren's Disease is a chronic condition, and conventional treatments, such as surgery, have recurrence rates between 18-33% and an increased risk of complications.[7] However, the high variability in the parameters used hinders the establishment of a standardized treatment protocol.

The effect of focused shock wave therapy on the progression of finger flexion contracture has been evaluated in two studies.[17, 18] Both studies demonstrated that this approach is associated with a reduction in finger flexion contracture. This finding is particularly noteworthy, as flexion contracture of the MCP and PIP joints are among the primary causes of functional impairment in patients with Dupuytren's disease.[3]

Finally, regarding the treatment parameters, the considerable variability observed across the analyzed studies limits the generalizability of the results. Indeed, differences in intensity levels, frequency, and number of sessions may influence both the efficacy and safety of the treatment, underscoring the importance of establishing standardized application protocols.

Study Limitations

Despite the promising results, this literature review is subject to certain limitations, primarily the small number of studies and limited sample sizes, which compromise the statistical robustness of the results and constrain their extrapolation to larger populations.

Another limitation is the high variability in the application parameters of focused shock wave therapy, such as the number of sessions, applied intensity and frequency, and intervals between sessions. This variability hinders the comparison of results across studies and limits the development of a standardized protocol to optimize outcomes.

Most studies evaluate short- or medium-term effects, with a lack of long-term data. This gap prevents assessment of the long-term impact on disease progression or the potential need for future interventions. In fact, only Knobloch et al.[15] included an evaluation at 18 months post-treatment.

Additionally, most studies are observational and lack control groups, limiting the ability to distinguish the specific effects of focal shock wave therapy from placebo effects. The absence of studies directly comparing focal shock wave therapy with more established therapeutic approaches, such as surgery or collagenase injections, also limits the scope for comparative analysis.

Conclusion

The therapeutic application of focused shock waves in Dupuytren's disease appears to be a promising and non-invasive alternative, particularly in pain control and improving hand functionality, with minimal adverse effects. However, its limitations, including the small number of available studies, most of which lack a well-established control group, as well as the lack of long-term data and, to our knowledge, the absence of comparative studies with other more established therapeutic approaches, such as surgery or collagenase injection, warrant caution in the interpretation of the results. Therefore, further studies with long-term follow-up, larger sample sizes, and the standardization of treatment parameters are needed to define the role of focused shock waves in the management of Dupuytren's disease.

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