Original Article

The Effect of Shock Wave Therapy on Improving the Symptoms and Function of Patients with Dupuytren's Contracture

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Abstract

Introduction: We aimed to evaluate the effect of shock wave therapy on the improvement of symptoms and function of patients with Dupuytren's contracture. **Materials and Methods:** This research is a pre-post intervention study, conducted among patients referred to the physical medicine clinics of Isfahan during 2019–2020. In this study, subjects experienced shock wave therapy for 6 sessions, each in a week, and improvement of symptoms and function were assessed and compared after the period of study and follow-up (before treatment, 6 weeks after treatment, and 14 weeks after treatment). The pain visual analog scale and disabilities of the arm shoulder and hand questionnaire were completed for all patients at the mentioned time, and the finger contraction angle was also measured by a goniometer over these intervals. **Results:** Twenty patients, 11 (55%) men and 9 (45%) women participated in the study. The mean and standard deviation of their age was 66.6 ± 7.11 years. The trend of pain severity of patients was continuously and significantly decreasing up to 14 weeks, which implies the effectiveness of the intervention ($P < 0.05$). Moreover, the patients' functional status improved due to the continuation of the intervention, and its trend was decreasing up to 14 weeks ($P < 0.05$). As for the contraction angle, there was a continuous and significant decreasing trend until week 14, and the intervention was also effective on the contraction angle ($P < 0.05$). **Conclusion:** It can be concluded that shock wave therapy can be effective in improving the symptoms and function of patients with Dupuytren's Contracture.

Keywords: *Contracture, Dupuytren's contracture, shock wave therapy*

Introduction

Dupuytren's disease is a fibrosing disorder, which leads to progressive thickening and shorting of the palmar fascia. The debilitating contracture of the fingers occurs particularly in the metacarpophalangeal (MCP) and proximal interphalangeal (PIP) joints. Dupuytren's disease categorizes in the group of fibromatosis disorders, which include Plantar fibromatosis (Ledderhose disease), Penile fibromatosis (Peyronie's disease), and fibromatosis of dorsal PIP joints (Garrod nodes or knuckle pads).[1]

Dupuytren's most often occurs among people of Northern European descent, and totally, affects 4%–6% of Caucasians worldwide.[2] The study conducted in the United States has reported the prevalence of the disease between 0.5% and 11%, and its incidence was three per 10,000 people annually.[3] Forty-five percent of people experience bilateral disease. In unilateral cases, the right side is more affected. The ring finger is most commonly involved, followed by the little and middle fingers are most commonly affected.[4] Although the etiology of this disease is unknown, there is often a positive family history. The disease is diagnosed in patients over the age of 60 years[5] and most often occurs in males three times more than females, and also males are more likely to experience higher disease severity,[6,7] which may be related to the expression of androgen receptors in Dupuytren's fascia.[8] Other potential risk factors include manual labor with vibration exposure, prior hand trauma, alcoholism, smoking, diabetes mellitus, hyperlipidemia, Peyronie's disease, and Complex Regional Pain Syndrome.[9] Rheumatoid arthritis appears to protect against Dupuytren's disease.

Deformity of the fingers and hands, in many patients, limit their daily activities and affect negatively the quality of their life.[10] Dupuytren's disease occurs in the

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following three phases: Proliferative phase, involutional phase, and residual phase. The proliferative phase is the phase myofibroblasts proliferate and a nodule develops. In early phases, some patients may report tenderness, and the pain appears to be due to nerve fibers embedded in the fibrous tissue or compression of local nerves.[11] In the involutional phase, the disease spreads along the fascia and into the fingers resulting in the development of a cord. In the residual phase, the cord tightens creating a contracture. The nodular tissue disappears as doing the myofibroblasts and acellular tissue with thick bands of collagen remain. However, Dupuytren's disease is not always progressive. A prospective study with follow-up at intervals of 3–6 months found that in up to 75% of patients, the disease stabilizes or even regresses.[12]

In terms of severity, the Dupuytren's disease is divided into three following grades. Grade 1 is accompanied by a thickened nodule and band in the palmar aponeurosis that may be associated with skin abnormalities. Grade 2 comes with pretendinous and digital cords with the limitation of finger extension. Grade 3 also includes flexion contracture.[13]

Treatment options for the disease include pharmacological and surgical therapy, which include opening the affected fascia, percutaneous needle fasciotomy, and steroids or collagenase injection.[14,15] Contracture more than 30° in MCP joints, and more than 15° in PIP joints, is a definite indication for surgery.[16] These treatments are associated with neurovascular damage, and its recurrence rate, depending on the chosen treatment, and the disease severity has been between 8% and 66%.[14] Surgical complications include delayed wound healing, hematoma, infection, swelling at the surgical site, and inability to bend the fingers.[17]

In a study, collagenase *Clostridium histolyticum* (CCH) injection into the joints of patients with advanced Dupuytren showed reduced contracture and improved range of motion.[18] Recently, the use of radiotherapy in the early stages of the disease,[19] and transforming growth factor-β such as N-acetylcysteine, and angiotensin-converting enzyme inhibitors have been suggested to limit disease progression, however advanced studies in this regard is not available.[20]

Shock wave therapy, in the last 10–15 years, has become a treatment option for many orthopedic problems, such as plantar fasciitis, lateral epicondylitis, shoulder calcific tendonitis, and delayed union fracture. Shock wave therapy has also recently been used in the treatment of achilles tendinopathy, patellar tendinopathy, and avascular necrosis of the femoral head.[21] The effectiveness of shock wave therapy has been demonstrated in a large number of published studies, including clinical trials and cohort studies.[22-24] However, there are few studies, if any, that have reported less effectiveness of treatment comparing the placebo.[25,26] Shock wave therapy is a new noninvasive procedure, which is associated with effectiveness, comfort, and safety. This treatment, also, could potentially be used in many orthopedic disorders, instead of surgical procedures and does not pose surgical risks. Dissatisfactions on treatment with this method are few and ignorable. Although there is no exact mechanism of shock wave therapy in the treatment of orthopedic disorders, most performed studies have reported the positive effect of this treatment and have introduced it as an appropriate treatment.[21]

Considering the search for data sources, so far no study has been conducted in Iran on the effect of shock wave therapy on improving Dupuytren. Moreover, due to the significance of treating this disorder, and the less complication of this treatment method, compared to surgery, and citing the fact that shock wave therapy has been effective in two studies[8,18] to treat Dupuytren, doing a new study to confirm this effectiveness seems necessary. Therefore, the present study, as a clinical intervention study, conducted with the aim of analyzing the therapeutic effect of shock wave therapy on the rate of symptoms and upper extremity functional status in patients with Dupuytren's Contracture.

Materials and Methods

This research is a pre-post intervention study (self-control clinical trial), conducted and followed up as a pilot study on patients with Dupuytren's Contracture referred to the physical medicine and rheumatology clinics of Isfahan University of Medical Sciences during 2019–2020. Due to the low prevalence of Dupuytren's disease, the sample size included 20 patients who were included in the study using the easy sampling method by census method.

The study's Inclusion criteria are Dupuytren's disease, grade one or two (mild-to-moderate severity), involvement of at least one finger, age ≥18 years, flexion contracture of ≤15° in the PIP joint, flexion contracture of ≤30° in the MCP joint, and willingness and consent of patients to participate in the study after an in-person explanation of the project objectives. Exclusion criteria also included pregnancy, coagulation disorders, osteoporosis, use of pharmacological or physical modalities in 3 past months, the patient's refusal to follow-up or complete the questionnaire within the prescribed time, worsening the patient's symptoms so that he/she requires other treatment or surgery, and the patient's unwillingness to continue treatment.

The pain visual analog scale (VAS) and disabilities of the arm shoulder and hand (DASH) Questionnaire were completed before the onset of treatment for all patients. The contraction angle was also measured using a Goniometer in all patients before treatment. Then shock wave applied on the nodule(s) of patients within 6 shock wave sessions per week (each session on a day of the week and the next session in the following week, on the same day) (using Storz Duolith SD1 device, high-energy focused

of 1.24 mJ/mm^2, with 2000 shocks and frequency of 3 Hz per session).[25] Following the use of gel, the probe is placed vertically on the hand. Patients did not receive any medication during treatment.

Six weeks after the onset of treatment, the pain VAS and DASH Questionnaire were completed for all participants. Then, again 14 weeks after the onset of treatment, the pain VAS and DASH Questionnaire were for all. Contracture angle was also measured 6 and 14 weeks after the onset of treatment using a goniometer. The results of each one were collected, analyzed, and compared with each other. Patients were informed of the results of evaluations and improvements.

This study, with ethics code NO.IR.MUI.MED.REC.1398.529, was approved at Isfahan University of Medical Sciences. After approval, it was approved at the Clinical Trial Center, No. IRCT20200607047676N1.

Disabilities of the arm shoulder and hand questionnaire

This questionnaire measures the prevalence of musculoskeletal disorders of the upper extremities and examines the ability to perform activities and symptoms over the past week. The DASH questionnaire consists of 30 questions (the score of each question is 1–5) that measure upper extremity functional status. There is included, in this questionnaire, questions to measure the patient's level of difficulty in performing daily tasks (21 questions), pain intensity while sleep and activity, joint weakness and stiffness (5 questions), and the effect of the upper extremity on social and occupational activities (4 questions). To use the results of the questionnaire, at least 27 questions must be answered. The score of this questionnaire is calculated from 100, and to calculate the final score, after adding the score of all the questions and averaging, the resulted figure is subtracted from one, and then multiplied by 25. The closer this number is to 100, the greater the disability.[26] Mousavi *et al*. localized the Persian version of the DASH Questionnaire and determined its validity and reproducibility.[27]

The pain visual analog scale

This scale is a 10 cm graduated line, the figures of which are graded from zero (no pain) to 10 (most severe pain possible). The scoring criterion on this scale is the figure at the patient draws a line around it. This scale has been widely used in pain-related research, and its validity and reliability have been confirmed.[28]

The normality of the scores' distribution was assessed using the Kolmogorov–Smirnov test. Quantitative data were reported as mean ± standard deviation and median interquartile range and qualitative data as N (%). To compare the variables before and after treatment, the repeated measure test and, if necessary, its nonparametric equivalent was used. $P < 0.05$ was considered as the minimum value for statistical significance, and all calculations were performed in IBM SPSS Statistics, Version 25.

Results

Twenty patients participated in this study and were treated [Figure 1]. Twenty patients, 11 men (55%) and 9 women (45%) participated in the study. The mean and standard deviation of their age was 66.6 ± 7.11 years. Among 20 patients, 12 patients (60%) were experienced pain in both hands, and 8 patients (40%) were experienced it on the one hand. Other demographic variables including occupation, underlying illness, history of smoking, and drinking alcohol were examined. The results are reported in Table 1.

With regards to the objectives of this study, pain intensity, functional status, and MCP contracture angle were evaluated in three intervals before the intervention, 6 and 14 weeks after the onset of the intervention. The results are reported in Table 2 and Figure 2.

Considering the results, the trend of pain severity of patients was continuously and significantly decreasing up to 14 weeks, which implies the effectiveness of the intervention ($P < 0.001$). Moreover, the patients' functional status improved due to the continuation of the intervention, and its trend was decreasing up to 14 weeks ($P < 0.001$).

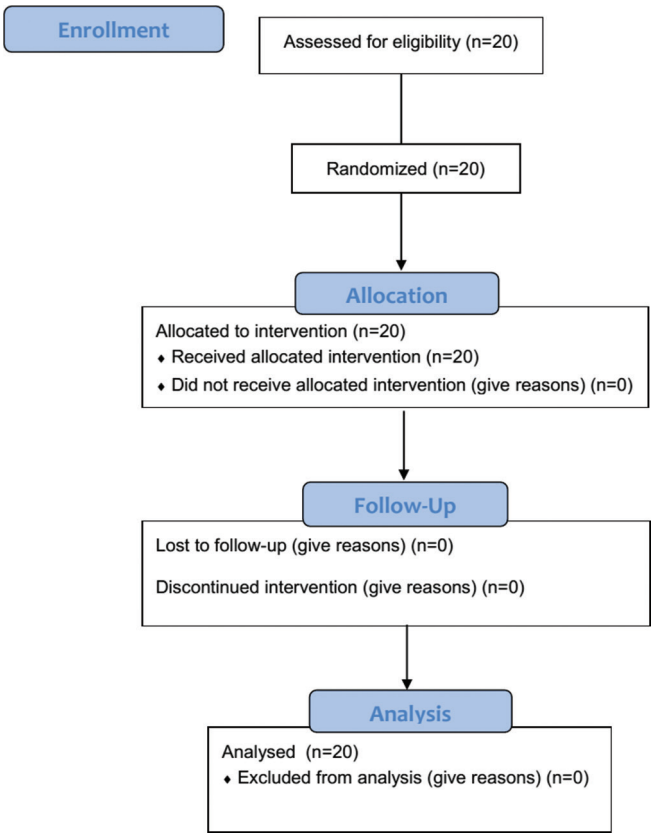

Figure 1: CONSORT diagram

In the case of the MCP contraction angle, there was a continuous and significant decreasing trend until week 14, and the intervention was also effective on the MCP contraction angle ($P < 0.001$).

Table 1: Demographic information of patients

Variables	Frequency (%)
Job	
Unemployed	3 (15)
Freelance	8 (40)
Housekeeper	6 (30)
Governmental	3 (15)
Underlying diseases	8 (40)
Smoking	4 (20)
Alcohol consumption	0
Hand number	
Both side	12 (60)
One side	8 (40)

In this study, the side effects observed during the study were a slight increase in pain 1–2 days after each shock wave therapy session, which was relieved by the use of an analgesic such as acetaminophen.

Discussion

The purpose of this study was to evaluate the effect of shock wave therapy on the improvement of symptoms and function of patients with Dupuytren's Contracture. The research results showed that the trend of pain severity of patients was continuously and significantly decreasing up to 14 weeks, which implies the effectiveness of the intervention. Moreover, the patients' functional status improved due to the continuation of the intervention, and its trend was decreasing up to 14 weeks. In the case of the contraction angle, there was a continuous and significant decreasing trend until week 14, and the intervention was also effective on the contraction angle.

Table 2: Visual analog scale, disabilities of the arm shoulder and hand, and contraction angle information

Variables	Before	After 6 weeks	After 14 weeks	First measurement *P* value*	Second measurement *P* value**	Intercept *P* value
VAS	5.4±1.63	5.05±1.27	4.85±1.22	0.069	0.214	<0.001
DASH	60.35±14.6	52.95±12.75	47.1±11.21	<0.001	<0.001	<0.001
MCP contraction angle	24.1±3.8	21.75±4.07	19.7±3.64	<0.001	0.001	<0.001

DASH: Disabilities of the arm shoulder, MCP: Metacarpophalangeal, VAS: Visual analog scale

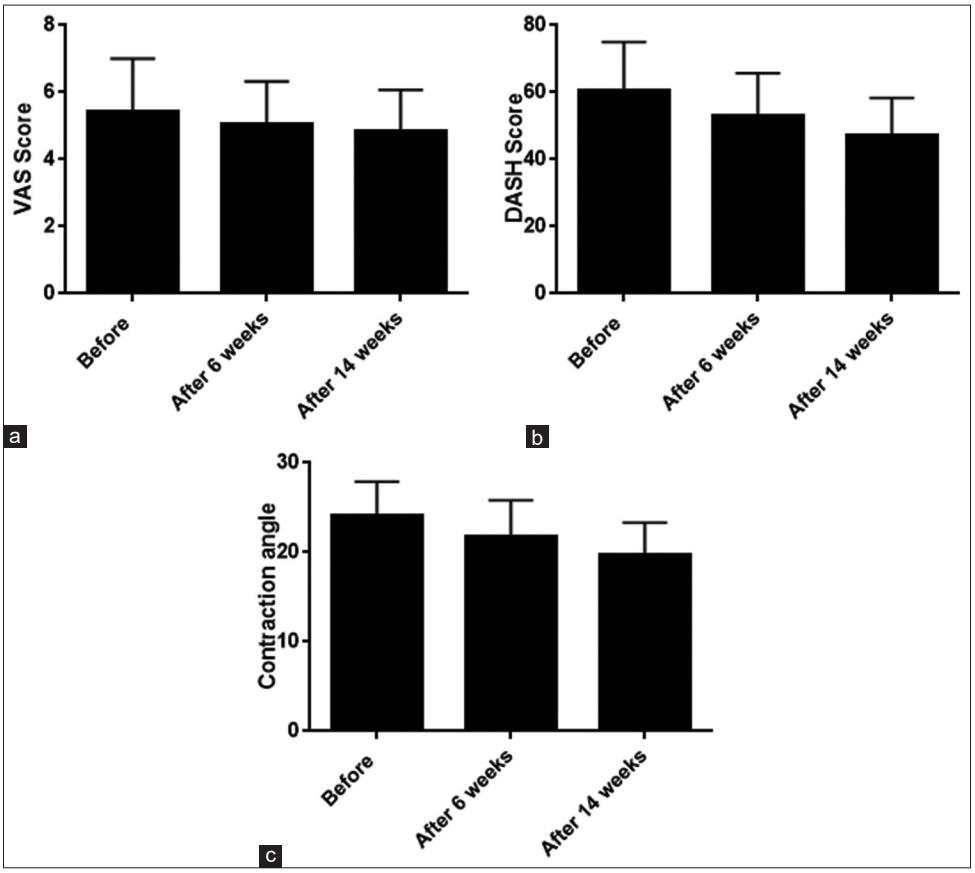

Figure 2: Visual analog scale (VAS), (a) disabilities of the arm shoulder and hand (DASH), (b) and contraction angle information (c)

Surgical and noninvasive methods are used to treat the Dupuytren's disease. Noninvasive or nonsurgical methods have been studied in several studies. In a 2016 review, Ball *et al*. reviewed these methods. According to the results of a study by Ball *et al*., nonsurgical methods for treating the Dupuytren's disease include pharmacological therapy (including steroids, Vitamin E, furazolidone injection, aminosyn, and hyperbaric oxygen), physical therapy (including ultrasound, splinting, frictional massage, and heat treatment with joint stretching), and radiotherapy.[29] But to date, no specific treatment protocol has been developed for the treatment of Dupuytren's disease, and it is usually managed and treated with advanced injections and surgical interventions. In this study, we used Extracorporeal Shockwave Therapy (ESWT) to significantly improve performance in the treatment of disease. According to studies, the prevalence of Dupuytren was higher in our male population.[30,31]

Gold Standard to treat Dupuytren's disease is removing injured tissue and correcting finger contractions if any.[32] The results of a systematic review study by Werker *et al*. showed that the success rate of contraction correction varied between 15 and 96%, which fluctuated widely. In the same study, the recurrence rate after surgery was reported to be between 12 and 100 at different phases of the disease.[33] In another systematic study by Chen *et al*.[34] the recurrence rate was reported 12%–39% in a follow-up period of 1.5–7.3 years after partial open fasciotomy, 50%–58% in a follow-up period of 3–5 years followed by needle aponeurotomy and 31–10 in a follow-up period of 3 months to 4 years, after treatment with CCH injection.

To date, few studies have been performed with the aim of examining the effect of shock wave therapy on the improvement of symptoms and function of patients with Dupuytren's disease. According to the research results, the pain severity of patients was continuously and significantly decreasing up to 14 weeks, which implies the effectiveness of the intervention (P = 0.005). In this regard, the study of Aykut *et al*., the pain was significantly reduced at the start of the intervention and in the first stage of follow-up; however, it increased again in the second follow-up. Moreover, the DASH score of this study was evaluated, and its score was continuously and significantly decreasing up to 14 weeks, which implies the effectiveness of the intervention (P = 0.040). The trend of this criterion in the study of Aykut *et al*. initially was significantly decreasing; however, it has been increased after the second follow-up.[35] In order to justify this difference, the different conditions of the intervention, and the difference in the follow-up time of patients can be considered.

The nonreferral of patients for follow-up was one of the limitations of this study, which could be solved by sufficient explanation to patients and appropriate and regular follow-up. Another limitation of this study was the lack of funding, which it tried to overcome by reducing costs as much as possible. In addition, we tried to reduce the design costs, as much as possible, in order to collect the least sample size and to achieve proper internal and external validity.

Conclusion

According to the research results, it can be concluded that shock wave therapy can be effective to improve the symptoms and function of patients with Dupuytren's contracture. More comprehensive studies with larger sample sizes and long-term follow-up are recommended in future studies.

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Conflicts of interest

There are no conflicts of interest.

References

1. Warwick D. Dupuytren's disease: My personal view. J Hand Surg Eur Vol 2017;42:665-72.
2. Hurst LC, Badalamente MA, Hentz VR, Hotchkiss RN, Kaplan FT, Meals RA, *et al.* Injectable collagenase *Clostridium histolyticum* for Dupuytren's contracture. N Engl J Med 2009;361:968-79.
3. DiBenedetti DB, Nguyen D, Zografos L, Ziemiecki R, Zhou X. Prevalence, incidence, and treatments of Dupuytren's disease in the United States: Results from a population-based study. Hand (N Y) 2011;6:149-58.
4. Zarezadeh A, Layeghi A, Jamaloddini SM. Evaluation of the effects of fasciectomy on finger contracture in patients with Dupuytren's disease. J Isfahan Med Sch 2017;35:285-90.
5. Anderson ER, Burmester JK, Caldwell MD. Evaluation of a mitochondrial DNA mutation in maternally inherited and sporadic cases of Dupuytren's disease. Clin Med Res 2012;10:122-6.
6. Geoghegan J, Forbes J, Clark D, Smith C, Hubbard R. Dupuytren's disease risk factors. J Hand Surg 2004;29:423-6.
7. Anthony SG, Lozano-Calderon SA, Simmons BP, Jupiter JB. Gender ratio of Dupuytren's disease in the modern U.S. population. Hand (N Y) 2008;3:87-90.
8. Al-Qattan MM. Factors in the pathogenesis of Dupuytren's contracture. J Hand Surg Am 2006;31:1527-34.
9. Hindocha S, McGrouther DA, Bayat A. Epidemiological evaluation of Dupuytren's disease incidence and prevalence rates in relation to etiology. Hand (N Y) 2009;4:256-69.
10. Salari N, Heydari M, Hassanabadi M, Kazeminia M, Farshchian N, Niaparast M, *et al.* The worldwide prevalence of the Dupuytren disease: A comprehensive systematic review and meta-analysis. J Orthop Surg Res 2020;15:495.
11. Johnson JD, Pavano C, Rodner C. Dupuytren's disease. In: Essentials of Hand Surgery. 2018 Feb 28:57.
12. Lanting R, van den Heuvel ER, Werker PM. Clusters in short-term disease course in participants with primary Dupuytren disease. J Hand Surg Am 2016;41:354-61.
13. Bogdanov I, Rowland Payne C. Dupuytren contracture as a sign of systemic disease. Clin Dermatol 2019;37:675-8.

14. Kaplan FTD, Crosby NE. Treatment of recurrent Dupuytren disease. Hand Clin 2018;34:403-15.
15. Binhammer P. Comparative outcomes of Dupuytren disease treatment. Hand Clin 2018;34:377-86.
16. Rayan GM. Nonoperative treatment of Dupuytren's disease. J Hand Surg Am 2008;33:1208-10.
17. Eberlin KR, Mudgal CS. Complications of treatment for Dupuytren disease. Hand Clin 2018;34:387-94.
18. Zhang D, Earp BE, Benavent KA, Blazar P. Collagenase treatment of Dupuytren's disease with minimum 5-year follow-up: Recurrence, reintervention, and satisfaction. Plast Reconstr Surg 2020;146:1071-9.
19. Betz N, Ott OJ, Adamietz B, Sauer R, Fietkau R, Keilholz L. Radiotherapy in early-stage Dupuytren's contracture. Long-term results after 13 years. Strahlenther Onkol 2010;186:82-90.
20. Knobloch K, Kuehn M, Vogt PM. Focused extracorporeal shockwave therapy in Dupuytren's disease – A hypothesis. Med Hypotheses 2011;76:635-7.
21. Aykut S, Aydın C, Öztürk K, Arslanoğlu F, Kılınç CY. Extracorporeal shock wave therapy in Dupuytren's disease. Sisli Etfal Hastan Tip Bul 2018;52:124-8.
22. Yum JK, Ahn SJ. Extracorporeal shock wave therapy in musculoskeletal disorders. J Korean Orthop Assoc 2018;53:400-6.
23. Moya D, Ramón S, Schaden W, Wang CJ, Guiloff L, Cheng JH. The role of extracorporeal shockwave treatment in musculoskeletal disorders. J Bone Joint Surg Am 2018;100:251-63.
24. Stasinopoulos D. Can extracorporeal shock-wave therapy be used for the management of lateral elbow tendinopathy? World J Methodol 2018;8:37-9.
25. Abdulsalam AJ, Shehab D, Elhady AA, Abraham M. High-energy focused extracorporeal shockwave therapy relieved pain in Dupuytren's disease: A series of seven hands. Eur J Phys Rehabil Med 2019;55:862-4.
26. Taghizadeh S, Haghighat F, Piroozi S, Karimi A, Nejad DK. The survey and comparison of musculoskeletal disorders of shoulder, arm and hand in taxi and bus drivers in the city of Shiraz in 2016. Arch Rehabil 2018;19:64-75.
27. Mousavi SJ, Parnianpour M, Abedi M, Askary-Ashtiani A, Karimi A, Khorsandi A, *et al.* Cultural adaptation and validation of the persian version of the disabilities of the arm, shoulder and hand (DASH) outcome measure. Clin Rehabil 2008;22:749-57.
28. Zahednezhad S, Salehi R, Tajali S, Borji A. correlation between pain intensity and disability level with some of the impairments in patients with nonspecific low back pain. J Ilam Univ Med Sci 2013;21:10-20.
29. Ball C, Izadi D, Verjee LS, Chan J, Nanchahal J. Systematic review of non-surgical treatments for early Dupuytren's disease. BMC Musculoskelet Disord 2016;17:1-7.
30. Dominguez-Malagon HR, Alfeiran-Ruiz A, Chavarria-Xicotencatl P, Duran-Hernandez MS. Clinical and cellular effects of colchicine in fibromatosis. Cancer 1992;69:2478-83.
31. Luck JV. Dupuytren's contracture; a new concept of the pathogenesis correlated with surgical management. J Bone Joint Surg Am 1959;41-A: 635-64.
32. Badalamente MA, Hurst LC. Enzyme injection as nonsurgical treatment of Dupuytren's disease. J Hand Surg Am 2000;25:629-36.
33. Werker PM, Pess GM, van Rijssen AL, Denkler K. Correction of contracture and recurrence rates of Dupuytren contracture following invasive treatment: The importance of clear definitions. J Hand Surg Am 2012;37:2095-105.e7.
34. Chen NC, Srinivasan RC, Shauver MJ, Chung KC. A systematic review of outcomes of fasciotomy, aponeurotomy, and collagenase treatments for Dupuytren's contracture. Hand (N Y) 2011;6:250-5.
35. Aykut S, Aydın C, Öztürk K, Arslanoğlu F, Kılınç CY. Extracorporeal shock wave therapy in Dupuytren's disease. Sisli Etfal Hastan Tip Bul 2018;52:124-8.