ORİJİNAL ARAŞTIRMA ORIGINAL RESEARCH

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The Effectiveness of Ultrasound Guided Local Corticosteroid Injection Combined with Orthosis in the Treatment of Trigger Digit: A Randomized Controlled Study

Tetik Parmak Tedavisinde Ortezle Kombine Edilen Ultrason Rehberliğinde Lokal Kortikosteroid Enjeksiyonu Etkinliği: Randomize Kontrollü Çalışma

Cemile Sevgi POLAT[a], Şule ŞAHİN ONAT[a], Fazıl KULAKLI[b], Ender ERDEN[a], Meltem Güneş AKINCI[a]

[a]Clinic of Physical Medicine and Rehabilitation, Ankara Physical Therapy and Rehabilitation Training and Research Hospital, Ankara, Türkiye
[b]Department of Physical Therapy and Rehabilitation, Giresun University Faculty of Medicine, Giresun, Türkiye

ABSTRACT Objective: The aim of this study was to investigate the effectiveness of ultrasound guided local corticosteroid injection in the treatment of trigger digit. **Material and Methods:** Forty three patients over 18 years with a Wolfe Grade 2 and/or 3 trigger digit were enrolled in this prospective randomized controlled clinical study. All patients were right handed. Patients were randomly assigned to orthosis group or combined treatment group (corticosteroid injection+orthosis use). The first group patients were treated by using an orthosis of the metacarpophalangeal, proximal interphalangeal and distal interphalangeal joint at 0 degrees of extension. Second group patients were treated by ultrasound guided corticosteroid injection in addition to the orthosis use. Evaluation was done at baseline and at 6 weeks posttreatments. Pain level and triggering level were assessed by visual analogue scale (VAS). Dexterity was assessed by the Nine Hole Peg Test, hand grip strength was assessed by the hydraulic hand dynamometer, upper extremity activities and functionality were assessed by the Disabilities of the Arm Shoulder and Hand (DASH) Questionnaire. **Results:** Combined treatment group showed significant improvements in all clinical variables, but orthosis group showed significant improvements only in terms of VAS pain, VAS triggering and DASH scores. The reduction in VAS pain, VAS triggering and DASH scores was significantly greater in combined treatment group. **Conclusion:** Combining corticosteroid injection to orthosis use seems to be more effective in trigger digit compared to orthosis use alone.

Keywords: Ultrasound guided; corticosteroid injection; trigger digit; orthosis

ÖZET Amaç: Bu çalışmanın amacı, tetik parmak tedavisinde ultrason rehberliğinde lokal kortikosteroid enjeksiyonu etkinliğini araştırmaktır. **Gereç ve Yöntemler:** Prospektif randomize kontrollü klinik bu çalışmaya Wolfe evrelemesine göre Evre 2 ve/veya Evre 3 tetik parmağı olan 18 yaş üstü 43 hasta dâhil edildi. Bütün hastalar sağ el dominanttı. Hastalar randomize olarak ortez grubuna ve ya kombine tedavi grubuna (kortikosteroid enjeksiyonu+ortez) ayrıldı. Birinci grup hastalar metakarpofalangeal, proksimal interfalangeal ve distal interfalangeal eklemleri 0 derece ekstansiyonda tutan ortez kullanımı ile tedavi edildiler. İkinci grup hastalar ortez kullanımına ilave ultrason rehberli kortikosteroid enjeksiyonu ile tedavi edildiler. Değerlendirmeler tedavi öncesi ve tedaviden 6 hafta sonra yapıldı. Ağrı seviyesi ve tetiklenme seviyesi görsel analog skala [visual analogue scale (VAS)] ile değerlendirildi. El becerisi Nine Hole Peg Test ile el kavrama gücü hidrolik el dinamometresi ile üst ekstremite aktiviteleri ve fonksiyonelliği Kol, Omuz ve El sorunları Anketi [Disabilities of the Arm, Shoulder and Hand (DASH)] ile değerlendirildi. **Bulgular:** Kombine tedavi grubunda bütün klinik değişkenlerde istatistiksel olarak anlamlı iyileşme izlenirken, ortez grubunda sadece VAS (ağrı ve tetiklenme) ve DASH skorlarında istatistiksel olarak anlamlı değişiklik saptandı. Her iki grup karşılaştırıldığında kombine tedavi grubundaki VAS (ağrı ve tetiklenme) ve DASH skorlarındaki iyileşme daha fazla idi. **Sonuç:** Tetik parmak tedavisinde ortez kullanımı ile kortikosteroid enjeksiyonunun kombine edilmesi tek başına ortez kullanımından daha etkili görünüyor.

Anahtar Kelimeler: Ultrason rehberli; kortikosteroid enjeksiyonu; tetik parmak; ortez

Correspondence: Cemile Sevgi POLAT
Clinic of Physical Medicine and Rehabilitation, Ankara Physical Therapy and Rehabilitation Training and Research Hospital, Ankara, Türkiye
E-mail: drsevgipolat@hotmail.com

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Trigger digit (TD) is one of the most common pathologies of the hand, occurring in 2%-3% of the general population and up to 10% in patients with diabetes mellitus (DM).[1] It is a tenosynovitis in the flexor sheaths of the digits as a result of repetitive use.[2] Inflammation and hypertrophy of the flexor sheath progressively restricts the motion of the flexor tendon.[3] Patients present with pain, catching, triggering, and locking of the digit.[4] TD causes functional limitations that include limited grip strength and decreased ability to hold objects with handles.[5] TD affects women six times more frequently than men and the onset is usually in the middle fifth to sixth decades of life.[6] Although all digits can be affected, the ring and thumb are most often involved.[4] TD is associated with disorders including rheumatoid arthritis, gout, amyloidosis, thyroid disease, and DM.[2] Other disorders such as de Quervain's tenosynovitis, carpal tunnel syndrome and Dupuytren's contracture, often coexist with TD.[7] The diagnosis of TD is made clinically based on the patient's presenting symptoms and physical examination.[6] Ultrasound can be obtained in assessing the diagnosis.[2]

Several treatment options have been described for the management of TD including orthosis use, streoid injection, and surgery.[1,2,6,7] Indication depends on the clinical form of TD.[6] First-line treatment is conservative with orthosis use and corticosteroid injections.[1,2] An orthosis that immobilized the digit in an extended position can help rest the tendon and let the inflamed sheath heal.[8] Steroid injections directly into the inflamed tendon sheath is often successful and is well supported in the litetarure.[2] Although previous studies specifically examined the efficacy of corticosteroid injection alone, and orthosis use alone as a primary treatment modality, to the best knowledge of the authors, there was only one study in the literature comparing the effect of steroid injection with orthosis use and there are no studies combining corticosteroid injection to orthosis use.[3-5,8-14] We hypothesized that combining corticosteroid injection to orthosis use would yield superior clinical results compared to orthosis use alone. Therefore, in this study, we aimed to evaluate the efficacy of combining corticosteroid injection to orthosis use and to compare the efficacy of orthosis use alone on symptom severity (pain and triggering), functional status, grip strength and dexterity.

MATERIAL AND METHODS

Patients over 18 years with a Wolfe Grade 2 and/or Grade 3 TD were enrolled in this prospective randomized clinical trial. Clinical severity of TD was graded using the Wolfe grading system.[15] All patients were right handed. Exclusion criteria included patients with more than one TD per hand, TD with a flexion contracture, previous steroid injection or orthosis use in the affected digit. A total of 58 patients with TD were evaluated and considered the exclusion criteria, only 50 patients were eligible for the study. The patients were randomized into two groups by a coin toss method. The first group patients were treated by using an orthosis of the the metacarpophalangeal (MCP), proximal interphalangeal (PIP), and distal interphalangeal (DIP) joint at 0 degrees of extension. Second group patients were treated by ultrasound guided corticosteroid injection in addition to orthosis use. Patients were instructed to wear the orthosis day and night for six weeks as supported in the literature.[8,12,14] Evaluation was done at baseline before treatment and at 6 weeks posttreatments. All patients completed the visual analogue scale (VAS) for pain and triggering and the Disabilities of the Arm Shoulder and Hand (DASH) Questionnaire. Dexterity was evaluated using the Nine Hole Peg (NHP) Test and hand grip strength was evaluated using a hydraulic hand dynamometer (Jamar Hydraulic Hand Dynamometer, White Plains, NY, USA). During the 6 week follow-up, 4 patients from orthosis group and 3 patients from combined treatment group (corticosteroid injection+orthosis use) had to remove from the study because they did not complete the collection of results. At last 26 patients in combined treatment group and 17 patients in orthosis group completed the collection of results and were included in the final analysis (Figure 1).

The demographic and clinical data of the patients were recorded. A written informed consent was obtained from each patient. The study was approved by the Clinical Research Ethics Committee of Giresun University (date: November 12, 2019, no: 90139838-000-E.61579) and was performed according to the principles outlined in the Declaration of Helsinki.

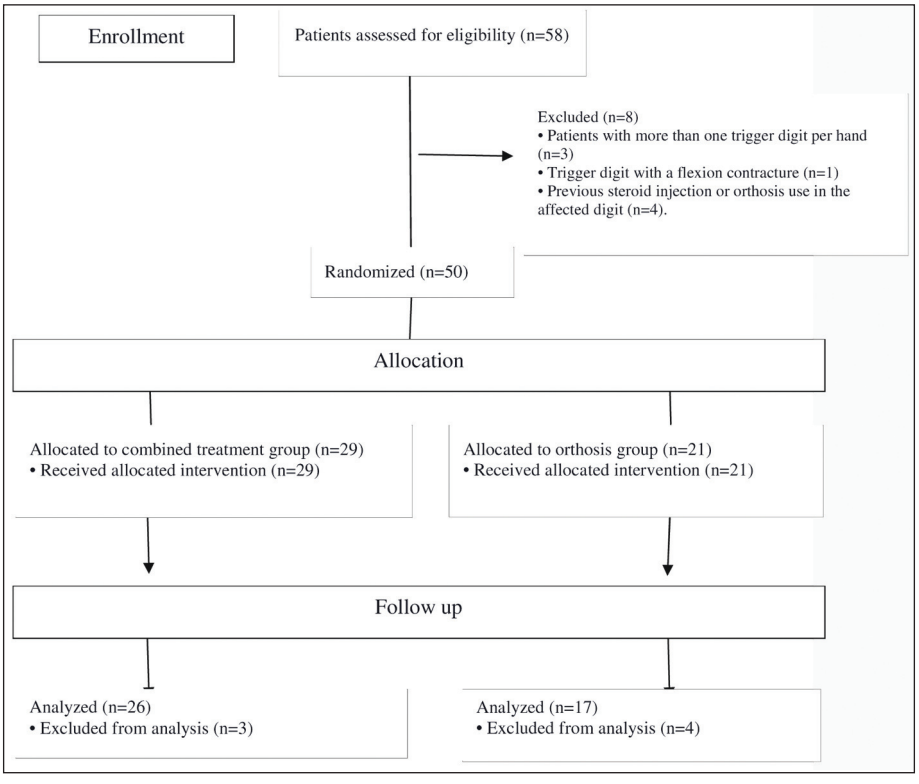

FIGURE 1: Flow diagram for randomized subject enrollment in this study.

ULTRASONOGRAPHIC EVALUATIONS

A 5-12 MHz linear array probe (Logiq P5, General Electric, Wisconsin, USA) was used for the ultrasound. With the examinee seated on a chair, we positioned patients' forearm on a table, supinated with the wrist in a neutral position. The MCP and PIP joints were fully extended on the table, and an adequate amount of ultrasound gel was dispensed onto the examinee's hand on the palmar side, in the area between the distal palmar crease and the PIP joints. The transducer was positioned perpendicular to the palm of the examinee's hand with minimal pressure. All patients were injected by the same physiatrist under aseptic conditions, using 0.2 mL (8 mg) triamcinolone acetonide and 0.8 mL prilocaine. The needle (26-gauge) enters the skin at the side of the probe in the in-plane approach. The solution directly into the flexor sheath immediately proximal to the A1 pulley and expansion of the sheath were confirmed to ensure accurate injection into the tendon sheath.

THE WOLFE GRADING SYSTEM

The Wolfe grading system is used to assess clinical severity of TD. According to this classification, TD is rated as follows: Grade 1: Uneven movements, no locking, Grade 2: Clicking, no locking, Grade 3: Locking, actively or passively correctable locking of the digit, Grade 4: Locked, can not be unlocked.[15]

VAS

The VAS was used to assess the severity of pain and triggering. It consists of a 10 cm line, with the left extreme indicating zero (no pain or no triggering) and the right extreme indicating 10 (unbearable pain or triggering).[16]

NHP TEST

The NHP Test is commonly used by occupational therapists as a simple, quick assessment for finger dexterity.[17] On this test, we wanted patients to pick up the pegs one at a time, using one hand only, and put them into the holes as quickly as they can in any

order until all the holes are filled. Then, without pausing, remove the pegs one at a time and return them to the container as quickly as they can. Time was measured by stopwatch

THE HYDRAULIC HAND DYNAMOMETER

The hydraulic hand dynamometer was designed to measure gross power fist grip and is considered to be the most accurate test for this skill. The American Society of Hand Therapists recommended the use of this tool for the assessment of grip strength.[18] Grip strength was performed at the standard position which is recommended by American Society of Hand Therapists. Patients were seated with their shoulders adducted and neutrally rotated, elbow flexed at 90°, forearm in neutral position and wrist between 0 and 30° of flexion and between 0 and 15° of ulnar deviation. After patients were positioned appropriately and were instructed to squeeze the dynamometer, three successive measurements were taken and the mean of the three trials was used for data analysis.[19]

DASH QUESTIONNAIRE

The DASH was developed in order to describe the disability experienced by people with upper limb disorders and also to monitor changes in symptoms and function over time. The questionnaire consists of 30 questions related to physical function, social function, and different symptoms. Each item has five response options. The scores for all items are then used to calculate a scale score ranging from 0 (no disability) to 100 (most severe disability). There are two additional parts with four questions that are relevant for people that engage in sports, music, and work.[20] These parts were not included in the present study.

STATISTICAL ANALYSIS

All statistical calculations were done by using the SPSS 16.00 program (SPSS Inc., Chicago, Illinois). The Kolmogorov-Smirnov test was utilized to assess the normality of distribution. Chi-square test was used to compare the distribution of categoric variables. We used “paired sample t-test” for analyzing pre and post treatment outcomes for each within group and “independent sample t-test” for analyzing between groups. Significance level was set at $p \leq 0.05$ with a 95% confidence interval.

SAMPLE SIZE

The power analysis using Power and Sample Size Software (PASS; NCSS, Utah, USA) showed that at least 14 patients were required in each group when the alpha value was 0.05, the confidence limit was 95%, the power of the study was 80%, and the ratio of the experiment to the control group was set at 1:1.

RESULTS

In total, 43 patients (12 male, 31 female) were included in this study. Distribution of affected digits is presented in Figure 2. The most common finger involved is the thumb in the right hand. The ring and the thumb are the most frequent TDs in the left hand.

The comparison of baseline characteristics of the groups are given in Table 1 and clinical parameters of the groups are given in Table 2. There were no significant differences between the groups in any of these parameters ($p>0.05$). The majority of the patients were females and the most common etiological factor was overuse in both groups. Thyroid disorder was the most common concomitant disease followed by DM in both groups. Carpal tunnel syndrome coexists with TD in 10 patients. The comparison of the results within groups is summarized in Table 3. As a result, in comparison to baseline, significant improvements were observed in all clinical variables (NHP Test, JD and DASH scores, VAS pain, VAS triggering) in combined treatment group ($p<0.05$), but significant improvements were observed only in VAS pain, VAS triggering and DASH scores in orthosis group. According to baseline val-

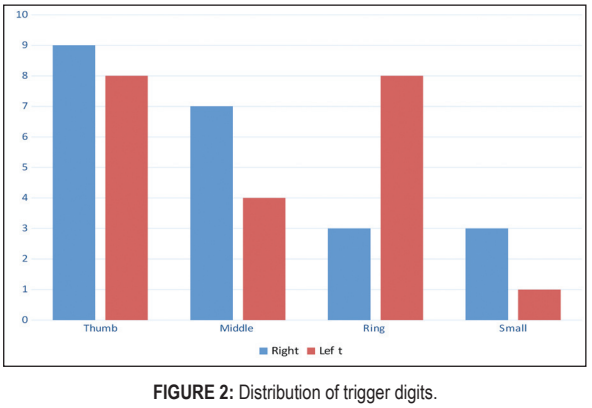

FIGURE 2: Distribution of trigger digits.

TABLE 1: The comparison of baseline characteristics and clinical parameters of the groups.

	Combined treatment group (n=26)	Orthosis group (n=17)	p value
Age (years), X̄±SD	54.3±12.4	54.1±6.9	0.960
Sex, n (%)			0.679
Male	8 (30.7)	4 (23.5)	
Female	18 (69.2)	13 (76.4)	
Marital status, n (%)			0.178
Married	23 (88.4)	14 (82.3)	
Widowed	3 (11.5)	3 (17.6)	
Work status, n (%)			0.662
Working	22 (84.6)	2 (11.7)	
Not active working	4 (15.3)	15 (88.2)	
Duration, X̄±SD	6.1±4.7	8.4±13.9	0.445
Concominant disease, n (%)			
Diabetes mellitus	6 (23.0)	5 (29.4)	0.642
Thyroid disorder	10 (38.4)	7 (41.1)	0.859
Concomitant disorder, n (%)			0.167
DeQuervain's tenosynovitis	0 (0)	2 (11.7)	
Carpal tunnel syndrome	7 (26.9)	3 (17.6)	
Dupuytren's disease	0 (0)	1 (5.8)	
Etiology, n (%)			0.144
Overuse	13 (50)	12 (70.5)	
Idiopathic	8 (30.7)	1 (5.8)	
Occupational	5 (19.2)	4 (23.5)	

Data are given as as ratio or X̄±SD; SD: Standard deviation.

TABLE 2: The comparison of clinical parameters of the groups.

	Combined treatment group (n=26)	Orthosis group (n=17)	p value
NHP Test right	28.4±6.1	26.9±5.05	0.416
NHP Test left	30.2±5.6	29.3±7.9	0.660
JD right	56.5±27.5	49.8±22.7	0.412
JD left	46.1±22	48.6±14.8	0.686
DASH	37.8±18.7	28.5±11.8	0.075

Data are given as X̄±SD; NHP: Nine Hole Peg; JD: Jamar Hydraulic Hand Dynamometer; DASH: Disabilities of the Arm Shoulder and Hand; SD: Standard deviation.

ues, the changes in outcome scores with treatment are demonstrated in Table 4. Significant differences in changes were found in VAS pain, VAS triggering and DASH scores between the groups ($p<0.05$). There were no statistically significant differences in changes by means of the NHP Test and JD scores between the groups ($p>0.05$).

DISCUSSION

The primary purpose of this study was to evaluate the efficacy of combined treatment (corticosteroid injection+orthosis use) and to compare to orthosis use alone in the treatment of TD. The efficacy of corticosteroid injection alone and orthosis use alone was shown in the literature.[3-5,8-13] This study revealed that orthosis use alone and combining corticosteroid injection to orthosis use were effective treatments for TD and combined treatment was more effective in TD for improving pain, triggering, and disability compared to orthosis use alone.

Although nonsurgical treatments are typically the initial treatment for TD, no standard protocol ex-

TABLE 3: The comparison of baseline and post treatment (6th week) results within groups.

	Combined treatment group (n=26)			Orthosis group (n=17)		
	Baseline	6th week	p value	Baseline	6th week	p value
NHP Test right	28.4±6.1	25.5±6.1	**0.004**	26.9±5	24.5±3.2	0.006
NHP Test left	30.2±5.6	26.7±5.3	**0.0001**	29.3±7.9	26.1±3	0.098
JD right	56.5±27.5	60.9±29.2	**0.015**	49.8±22.7	53.8±24.2	0.058
JD left	46.1±22	55.3±27	**0.003**	48.6±14.8	51.4±20.1	0.166
DASH	37.8±18.7	13.7±17.2	**0.0001**	28.5±11.8	18.9±9	**0.0001**
VAS pain	6.3±1.5	1.0±1.5	**0.0001**	5.1±1.4	2.6±1.9	**0.0001**
VAS triggering	7.3±1.5	1.0±1.6	**0.0001**	6.1±1.5	3.8±1.9	**0.001**

Data are given as X±SD; NHP: Nine Hole Peg; JD: Jamar Hydraulic Hand Dynamometer; DASH: Disabilities of the Arm Shoulder and Hand; VAS: Visual Analog Scale; SD: Standard deviation.

TABLE 4: The comparison of treatment changes (Δ) of the clinical parameters according to baseline values.

	Combined treatment group (n=26)	Orthosis group (n=17)	p value
ΔNHP Test right	3.8±3.5	2.7±2.4	0.263
ΔNHP Test left	3.7±3.1	4±7	0.883
ΔJD right	6.7±3.8	5.2±2.02	0.420
ΔJD left	10.7±6.7	6.4±3.5	0.193
ΔDASH	23.2±12.3	9.6±6.3	**0.0001***
ΔVAS pain	5.3±1.7	2.6±1.5	**0.0001***
ΔVAS triggering	6.3±1.8	2.2±1.3	**0.0001***

Δ; The changes of parameters (6th week vs. baseline);*Statistically significance is caused by this value; Data are given as X±SD; NHP: Nine Hole Peg; JD: Jamar Hydraulic Hand Dynamometer; DASH: Disabilities of the Arm Shoulder and Hand; VAS: Visual Analog Scale; SD: Standard deviation.

ists. A 2018 Cochrane review was unable to recommended one treatment over the others.[21] There is weak evidence to support the use of orthosis and there is moderate evidence to suggest local corticosteroid injection in the systematic review of Amirfeyz et al.[22] Previous studies have demonstrated good outcomes with orthosis use alone or corticosteroid injection alone for treatment of TD.[3-5,8-13] The results of this study indicated that both groups reported significant improvements in VAS pain, VAS triggering, and DASH scores. The reduction in VAS pain, VAS triggering, and DASH scores in combined treatment group was significantly greater than in orthosis group. Although there were significant improvements in finger dexterity and hand grip strength in both groups, no superiorities were found in the combined treatment group compared to the orthosis group.

Orthosis use is a noninvasive treatment option for TD.[11] In the literature, all therapists reported using orthosis to treat TD.[23] Previous studies examined orthosis use alone as a primary treatment modality but authors diverged the type of orthosis.[5,8,11-13] Many studies indicated the use of the MCP joint blocking orthosis.[8,11,12] However, other studies advocated for solely using a DIP orthosis or PIP orthosis.[5,13] For orthosis use, no evidence for effectiveness was found in the multidisciplinary treatment guideline for managing TD.[24] No consensus could be achieved on the optimal type of orthosis and on the duration of wearing the orthosis in this mentioned guideline. The suggested duration of wearing the orthosis varies in the literature, from 3 to 12 weeks with the average being 6 weeks.[5,8,13,14] Lunsford et al. suggested a single joint orthosis (MCP, PIP or DIP joint) and they reported that symptom reduction was noted by using an orthosis for 6-10 weeks continually in their systematic review.[25] We used an orthosis immobilizing MCP, PIP, and DIP joint in full extension for 6 weeks continually in this study. Patients reported that they wore their orthosis at all times with removal for hygiene

purposes. After the use of the orthosis, significant improvements were observed in pain, triggering and disability scores but dexterity and grip strength did not significantly change in this study. The use of an orthosis for TD is a viable and inexpensive option for patients who are unwilling and unable to receive corticosteroid injections.[25]

Corticosteroid injection is a frequently used treatment for TD with cure rates around 50% in randomised controlled trials.[26] Corticosteroid injections were found to be effective for the first 1 to 4 weeks but did not remain effective in the mid term or long term in the review of Lunsford et al., Wojahn et al. evaluated the long-term efficacy of corticosteroid injection for TD and showed that patients had symptom relief two years after injection.[25,27] We showed the effectiveness of corticosteroid injections at 6 weeks post injection in this study. Further research with long period of follow can be done to determine the long-term effectiveness of corticosteroid injection.

Choudhury and Tay compared the combination therapy (topical non-steroidal anti-inflammatory drugs, occupational therapy, and orthosis use) and corticosteroid injections and found that combination therapy was more effective than corticosteroid injection in lower grades of TD.[28] Unlike to the mentioned study, we evaluated different combination therapy and the results showed that combining corticosteroid injection to orthosis use provides better reduction in VAS pain, VAS triggering, and DASH scores compared to orthosis group. We consider that the use of ultrasound guided injection of corticosteroid may be associated with superior clinical benefits. Ma et al. investigated the efficacy of corticosteroid injection for TD by performing a meta-analysis of randomized controlled trials and revealed the efficacy of corticosteroid injection was superior to other non-surgical treatments.[29] A study that compared the effectiveness of physiotherapy and corticosteroid injection reported that corticosteroid injection has a better outcome compared to physiotherapy in the treatment of TDs.[30] In the present study, we showed the efficacy of combined treatment was superior to orthosis use alone.

There are several limitations of this study. The main limitation of this study was the lack of long-term follow-up. We evaluated the patients at 6 weeks posttreatments. We don't know the long-term functional outcomes of patients. Another limitation of this study was the lack of data about ultrasonographic evaluation before and after treatment. Although we showed significant improvements in all clinical variables, we didn't report the ultrasonographic changes of patients after treatment. Also no control group was used to exclude placebo effects of orthosis and corticosteroid injection. Further research using a larger sample size with control group and long period of follow is suggested.

CONCLUSION

We conclude that combining corticosteroid injection with orthosis use is more effective in pain, triggering, and disability than orthosis use alone in grade 2-3 TD.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

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