EDITOR'S CHOICE

Factors Influencing the Successful Treatment of Recurrent Trigger Finger With Repeated Corticosteroid Injections: A Prospective Cohort Study

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Purpose The aim of this study was to determine the success rate, duration of disease control, and predictive factors of success of repeated corticosteroid injections for recurrent trigger finger.

Methods This prospective cohort study involved patients who had recurrent trigger finger and a history of corticosteroid injections. A total 114 patients were treated with repeated corticosteroid injections and followed for 12 months. Data on demographic characteristics, comorbid conditions, and possible predictive factors for successful treatment from medical chart reviews and direct patient interviews were compared. Patients were classified into success or failure groups at one, three, six, and 12 months after the initial injection. The relationship between hypothesized predictors and success or failure after repeated corticosteroid injection was analyzed with multivariable logistic regression.

Results The overall success rates from repeated cortisone injections after one, three, six, and 12 months were 97.4%, 84.2%, 68.4%, and 49.1%, respectively. Multivariable logistic regression modeling revealed that a high grade of disease (grade III or IV based on the Quinnell system), a body mass index (BMI) $\geq$ 25 kg/m^2, and a short symptom-free period ($<$ six months) after a previous injection were strong predictors of symptom recurrence (odds ratio = 3.6 [95% CI 1.5−8.4], odds ratio = 2.5 [95% CI 1.1−5.9], and odds ratio = 1.8 [95% CI 1.1−3.0], respectively). The average success rates for patients at 1-year according to the number of risk factors were as follows: none of the three risk factors, 73.3%; one risk factor, 54.2% to 63.6% (54.2% for grade III−IV triggering, 63.6% for BMI $\geq$ 25 kg/m^2 and 63.6% for $<$ 6-month symptom-free period); two risk factors, 30% to 75% (30% for a combination of grade III−IV and BMI $\geq$ 25 kg/m^2, 45.5% with grade II−IV and $<$ 6-month period, and 75% with a combination of $<$ 6-month period and BMI $\geq$ 25 kg/m^2); and all three risk factors, 11.8%.

Conclusions Repeated corticosteroid injections for recurrent trigger finger should be considered in patients who prefer nonsurgical treatment, especially in those without factors predictive of failure. *(J Hand Surg Am. 2024;49(3):253−259. Copyright © 2024 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Prognostic II.

Key words Corticosteroid, factor, injection, recurrent, repeated, trigger finger.

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Trigger digits are one of the common causes of pain and disability in the hand. For the first episode of the disease, corticosteroid (CS) injection at the A1 pulley is the common treatment. However, 49% to 55% of patients who receive a CS injection may experience recurrence and require further treatment, including repeated injections or surgery.[1,2] The time between initial treatment and recurrence can vary from 0.5 months to 13.1 months and has been reported to depend on multiple factors, including symptom duration, nodule type, location or number of fingers involved, sex, age, and associated comorbid conditions, such as other upper extremity tendinopathies, the presence of osteoarthritis in the fingers, and diabetes.[2−11]

The probability of long-term success following the second and third injections for trigger finger is unclear. Chances of symptomatic improvement are estimated to range from 23% to 79% for second injections and from 6% to 74% for third injections.[1,4,7,9,12] The risk of requiring further treatments, including repeated injections or surgery, after the second and third injection are 63% and 70%, respectively.[2] Based on the current literature, physicians are unable to precisely inform patients about the risk of symptom recurrence following a repeated corticosteroid injection. In addition, the factors influencing the outcome of repeated corticosteroid injections in trigger finger as well as the pattern of symptom recurrence are not fully understood. The objectives of this study were to determine the success rates and duration of symptom control after repeated CS injections for recurrent trigger finger and to identify the predictive factors for the failure of treatment with repeated CS injections.

MATERIALS AND METHODS

This prospective single-center cohort study was approved by the institutional review board of the Faculty of Medicine, Chulalongkorn University. The inclusion criteria were patients who were diagnosed with recurrent symptoms in the treated digit (finger or thumb); had a history of CS injections in the treated digit, from the authors or other referring physicians; and agreed to undergo steroid injections to treat a single digit that had been treated with at least one previous CS injection. For patients who presented with multiple trigger digits, only patients who chose to receive injections for a single digit were enrolled. The exclusion criteria were patients who had surgical treatment in the affected digit, had inflammatory arthritis, received an injection within the six weeks prior to the study visit, had planned surgical treatment for trigger digits, and chose to receive multiple CS injections for multiple trigger digits at the same time.

The flexor tendon sheath was injected with 10 mg (1 mL) of triamcinolone acetonide and 1.0 mL of 1% lidocaine through the A1 pulley using a 27-gauge needle pointed at 45° from the proximal to distal direction. All subjects were treated by hand surgeons at a single tertiary hospital between March 2021 and March 2022.

Demographic data were recorded, including age, sex, hand dominance, body mass index (BMI), the number of digits involved at the time of presentation, and the duration and grading of the trigger digit for which an injection would be provided during the visit. The Quinnell grading system was used to classify the severity of the trigger digit.[13] Grading was categorized as follows: grade I, pain but no catching; grade II, catching but can actively extend the digit; grade III, catching requiring passive extension or inability to actively flex; and grade IV, catching with a fixed flexion contracture of the proximal interphalangeal (PIP) joint. Patient comorbid conditions, such as noninsulin-dependent diabetes, insulin-dependent diabetes, hypothyroidism, hyperthyroidism, and associated hand disorders, such as carpal tunnel syndrome and inflammatory tendinopathies of the upper extremity, were recorded. Multiple digit involvement was defined as symptoms involving more than one digit at the time of presentation. If a patient had a history of multiple trigger digits but presented with a single trigger digit during the current episode, the patient was classified as having single digit involvement. Data on the duration of the symptom-free period after the last injection were collected from the patients' medical charts if the prior injection was performed in our hospital and through patient interviews if the prior injection was given outside of our hospital. The duration of the symptom-free period was defined as the interval from the prior injection to the first day of recurrent symptom onset.

Patients were followed up at one, three, six, and 12 months after injection to determine whether their symptoms had improved. Patients were classified as having a successful treatment with CS injections if they had pain reduction of 50% or more on the visual analog scale (VAS) or VAS pain ≤ 3 and if there was no additional injection or switch to surgery after the initial treatment. Patients were classified as having treatment failure if pain did not decrease or decreased less than 50% on the VAS or they received repeated CS injections or surgery during the follow-up period.[8,9,14] All data were collected from medical

records or direct patient interviews at the outpatient clinic or by phone calls.

Statistical Analysis

Descriptive analyses produced frequencies and percentages for categorical variables (sex, affected digits, grading, and comorbidities). Mean and standard deviation (SD) were used for continuous variables (age, body weight, duration of symptoms, and symptom-free period). To determine the factors predictive of successful treatment at the 1-year follow-up, bivariate analyses using the $\chi 2$ test for categorical variables and independent samples *t* test for continuous variables were used.

The relationship between success or failure of treatment with repeated CS injections and the hypothesized predictors of failure was analyzed using multivariable logistic regression, considering other patient variables. The binary outcome variable in this model was treatment failure at one year of follow-up. The factors that approached significance in bivariate analysis were included in the multivariable logistic regression model to determine associations with the dependent outcome of treatment failure at the 1-year follow-up period.

RESULTS

A total of 150 patients with recurrent symptoms after CS injection were included. Thirty-six patients were excluded based on the selection of surgical treatment (28 patients), refusal to undergo repeated injections (six patients), and the presentation of multiple digit involvement and the preference to receive multiple digit injections at the time of presentation (two patients). A total of 114 patients were enrolled in this study with a 100% 1-year follow-up rate.

All patients received a single CS injection in one digit that had previously received at least one steroid injection. No patients who received multiple digit injections at the same time were included in this study (only one digit per patient was enrolled, even if the patient presented with multiple trigger digits). Of the 114 patients, 102 (89.5%) had one previous steroid injection, eleven patients (9.6%) had two injections, and one patient (0.9%) had three injections before this study. The average age of the patients in this study was 63.0 ± 10.1 years. Ninety-one patients (79.8%) were female, and 23 patients (20.2%) were male. Sixty patients (52.6%) presented with multiple trigger digits at the time of injection. The severity of the symptoms of the injected trigger digits were classified based on the Quinnell system as follows: grade I (two patients, 1.8%), grade II (39 patients, 34.2%), grade III (64 patients, 56.1%), and grade IV (nine patients, 7.9%). Patients' comorbid conditions included diabetes (28.0%), associated tendinopathy of the upper extremities (15.8 %), and obesity with a BMI ≥ 25 kg/m^2 (63.2%). Details of demographic data in this study are shown in Table 1.

TABLE 1. Demographic Data of the 114 Patients Included in This Study

Variables	Number of Patients (%)
Age	
18–39 years	1 (0.8)
40–59 years	41 (36.0)
60–79 years	62 (54.4)
>80 years	10 (8.8)
Sex (Female:Male)	91 (79.8):23 (10.2)
Affected digit (%)	
Thumb	22 (19.3)
Index	27 (23.7)
Middle	35 (30.7)
Ring	22 (19.3)
Small	8 (7.0)
Number of steroid injections (%)	
Second injection	102 (89.5)
Third injection	11 (9.6)
Fourth injection	1 (0.9)
Multiple trigger-digit involvement	60 (52.6)
Grading by Quinnell system	
1	2 (1.8)
2	39 (34.2)
3	64 (56.1)
4	9 (7.9)
Comorbidity	
Diabetes status*	
None	82 (71.9)
Well controlled	16 (14.0)
Poorly controlled	16 (14.0)
Upper extremity tendinopathy (CTS, DQ)	18 (15.79)
Body mass index	
≥25 kg/m^2	72 (63.2)
<25 kg/m^2	42 (36.8)

CTS, carpal tunnel syndrome; DQ, De Quervain tenosynovitis.
*Diabetes status: Well-controlled HbA1c level ≤ 6.5 mg%, poorly controlled HbA1c level > 6.5 mg%.

The success rates of repeated CS injections after one, three, six, and 12 months were 97.4%, 84.2%,

TABLE 2. Patient Characteristics and Bivariate Contrasts Between Treatment Success and Failure at 12 Months (n = 114)

Variables		Success (n = 56) Number of Patients	Failure (n = 58) Number of Patients	*P* Value
Age (year)	18–39	0	1	.79
	40–59	21	20	
	60–79	30	32	
	>80	5	5	
Sex	Female	45	46	.54
	Male	11	12	
Affected finger	Thumb	9	13	.07
	Index	17	10	
	Middle	19	16	
	Ring	7	15	
	Little	4	4	
Grading	1–2	28	13	<.05*
	3–4	28	45	
Number of digits involved	Multiple fingers	30	30	.06
	Single finger	26	28	
Duration of this presentation	<3 months	39	41	.35
	3–6 month	13	16	
	6–12 month	4	1	
	>12 months	0	0	
Number of steroid injections	Second injection	53	49	.18
	Third injection	3	8	
	Fourth injection	0	1	
Symptom-free period following previous injection	<3 months	1	6	<.05*
	3–6 month	21	26	
	6–12 month	22	22	
	>12 months	12	4	
Diabetes status	None	42	40	.47
	Diabetes	14	18	
Body mass index	<25 kg/m^2	41	31	<.05*
	≥25 kg/m^2	15	27	

*Statistically significant (*P* value < .05).

68.4%, and 49.1%, respectively. No adverse effect of cortisone injections was observed throughout the 1-year follow-up period. At the 1-year follow-up period, "success" after repeated steroid injections was found in 49.1% (56/114) of patients, and "failure" was found in 50.9% (58/114). In the success group, the mean values of VAS pain before repeated CS injection and at the 1-year follow-up were 4.1 ± 0.7 and 1.2 ± 0.6, respectively. In the failure group, the mean values of VAS pain before repeated CS injection and at the last follow-up were 4.7 ± 1.0 and 3.1 ± 0.4. There were three factors that showed statistically significant differences ($P < .05$) between the groups with successful and failed treatments after repeated injections at 1-year after the enrollment injection: Quinell grade of the trigger digit at the time of injection ($P < .05$), BMI ($P < .05$), and the symptom-free period after the previous injection ($P < .05$). The other factors, including age, sex, the digits affected, the number of previous injections, multiple digit involvement, the duration of symptoms before presentation, and diabetes status, showed no statistically significant differences between the groups (Table 2).

Regarding the grading of the trigger digit, 68.3% (28/41 patients) of grade I–II patients were successfully treated compared with only 38.4% (28/73 patients) of grade III–IV patients. Regarding BMI, patients who had BMI ≥ 25 kg/m^2 had a treatment failure rate of 64.3% (27/42 patients) compared with 43.1% (31/72

TABLE 3. Multiple Logistic Regression Analysis of Factors Associated With Treatment Failure at 12 Months

Variables	Odds Ratio	95% Confidence Interval
High-grade disease (Grade III or IV)	3.6	1.5−8.4
Body mass index ($\geq$ 25 kg/m^2)	2.5	1.1−5.9
Short symptom-free period (< 6 months) after previous injection	1.8	1.1−3.0

patients) in patients with BMI < 25 kg/m^2. Regarding the symptom-free period after the previous injection, comparing the treatment success and failure groups, the number of the patients who had a symptom-free period of greater than 12 months, six to 12 months, three to six months, and less than three months were 75% (12/16) versus 25% (4/16 patients), 50% (22/44) versus 50% (22/44 patients), 44.7% (21/47) versus 55.3% (26/47 patients), and 14.3% (1/7) versus 85.7% (1/7 patients), respectively. The 6-month symptom-free period after the previous injection was chosen to calculate the multivariable logistic regression model for associations with treatment failure. In our practice, a 6-month period is considered clinically significant given that most of our patients and physicians accept this period as the control-duration period after steroid injection; additionally, the 6-month period is considered to be the problematic period regarding whether to repeat the injection.

Multivariable logistic regression modeling revealed that a higher grade of disease (grade III or IV), BMI $\geq$ 25 kg/m^2, and a short symptom-free period (< 6 months) after the previous injection were strong predictors of symptom recurrence within one year after repeated injections (odds ratio = 3.6 [95% CI 1.5−8.4], odds ratio = 2.5 [95% CI 1.1−5.9] and odds ratio = 1.8 [95% CI 1.1−3.0], respectively) (Table 3).

Survival analysis of the success of repeated steroid injections in recurrent trigger finger was constructed by comparing time to treatment failure for the patients with different types of these three prognostic factors (Fig. 1). We found that each factor did not equally affect the result of repeated CS injections. The factor with the greatest effect on the result of repeated injections was high-grade disease (grades III, IV), followed by BMI $\geq$ 25 kg/m^2, and a symptom-free period < 6 months after the previous injection.

Stratified by these three risk factors, the success rate at 6-months in patients who had one risk factor differed for each factor as follows: 66.7% success rate with one factor of grade III−IV triggering, 100% with BMI $\geq$ 25 kg/m^2, and 100% with < 6-month symptom-free period. For patients presenting with two risk factors, success rates of 50% were found for the combination of grade III−IV and BMI $\geq$ 25 kg/m^2, 63.6% for the combination of grade III−IV and < 6-month symptom-free period, and 100% for the combination of < 6-month symptom-free period and BMI $\geq$ 25 kg/m^2. For the patients who had three risk factors, the success rate was 11.8%.

The success rate at 12 months in patients with one risk factor was as follows: 54.2% success rate with one factor of grade III−IV triggering, 63.6% with BMI $\geq$ 25 kg/m^2, and 63.6% with <6-month symptom-free period. For two risk factors, success rates of 30% were found for the combination of grade III−IV and BMI $\geq$ 25, 45.5% for the combination of grade III−IV and <6-month symptom-free period, and 75% for the combination of <6-month symptom-free period and BMI $\geq$ 25 kg/m^2. Furthermore, the success rate in patients with all three risk factors was 11.8%.

Overall, our study showed that patients who had zero, one, two or three of these risk factors had the average success rates of 100%, 82.6%, 63.9 %, and 11.8%, respectively, at six months after repeated injection and 73.3%, 58.7%, 44.4%, and 11.8%, respectively, at 12 months. However, each prognostic factor had a different effect on the treatment outcome as noted above (Fig. 1 and Table 3).

DISCUSSION

CS injections are effective for most primary trigger fingers with success rate of 72% to 92% and minimal side effects.[5,15] Nonetheless, the success rate of treatment with repeated CS injections varies. According to Dala-Ali et al,[7] the overall efficacy of steroid injections was 66%. The success rate of the first injection was 34%, and the rate increased to 63% and 66% for the second and third injections, respectively, after one year of follow-up. According to Sobel et al,[2] the percentage of patients who did not need to seek further treatment within the 2-year follow-up period after the first, second, and third injections were 51%, 37% and 30%, respectively. Dardas et al[8] reported that 39% of patients with trigger finger who received a first or second unsuccessful CS injection responded to a subsequent steroid injection with a median time to recurrence of 371 days. In our study, the success rates for patients with recurrent trigger finger who received repeated CS

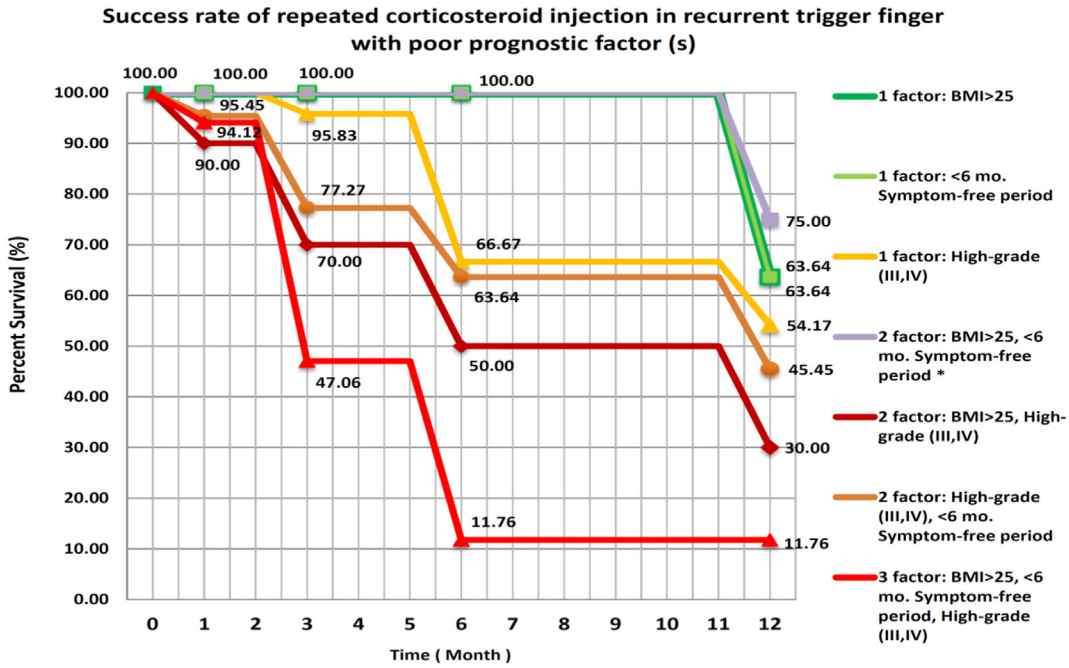

FIGURE 1: Success rates of repeated corticosteroid injections after one, three, six, and 12 months in patients with one of the three prognostic factors, those with two factors, and those with all three risk factors. *The rate of success in this group (2 factors: BMI > 25 kg/m^2 with a < 6-month symptom-free period) must be interpreted with caution due to the low number of patients included in this group ($n = 4$).

injections were 97.4%, 84.2%, 68.4%, and 49.1% at one, three, six, and 12 months, respectively.

The difference between the treatment success and failure rates in each study might be attributed to variations in the definition used to define treatment success and failure. An example of the definition of failure could vary from less than 50% improvement in the VAS pain score to the need for further treatment, including injections or surgical release, or recurrent symptoms.[2,4,7–9,16] A definition of success that would be less ambiguous is the complete resolution of symptoms, including pain and triggering. However, in our study, we defined treatment success as satisfactory pain reduction $\geq$50% on the VAS or a VAS pain score $\leq$3 and no further injections or surgery after treatment. We did not use the improvement of the triggering symptom because most of our patients continue to do well with the triggering sensation if they had minimal pain symptoms.

Many investigators have confirmed the additional benefit of repeated steroid injections for trigger finger despite a wide range of follow-up durations and number of injections.[7–11] However, most of these studies did not clarify the different factors that may affect those results, such as the patient-level characteristics, the preparation of CS usage, or past medical history of the previous treatment, including the symptom-free duration or the outcome after the previous injection. Previous research showed that the severity of trigger finger can affect the result after steroid injection. Specifically, high-grade triggering doubled the failure rate compared with low-grade triggering at 1-month after treatment.[17]

According to Rhoades et al,[5] the number of digits involved and a duration of the presenting symptom of greater than four months were associated with unsatisfactory results. Newport et al[4] similarly reported that a single trigger finger with symptoms for less than six months had more favorable outcomes. Other authors have found no association between the duration of symptoms and the effectiveness of an injection.[16]

Being overweight is also associated with ineffective treatment outcomes; according to our study, most treatment failure patients were overweight. Current hypotheses of tendon injury in obese patients focus on two mechanisms: the increased tension on the load-bearing tendons and the biochemical changes attributable to systemic bioactive substances. Obesity and diabetes have comparable pathogenic pathways marked by increased cross-linking between collagen fibrils driven by advanced glycation end-products and low-grade inflammation, which exacerbate the deleterious effect of tendon overuse.[18] Obesity has a negative effect on treatment results, according to Kang et al,[19] who identified obesity as a risk factor for the decision to operate.

Another key risk factor for poor treatment outcomes is the duration of symptom control following

the previous injection. In our study, we found that a short symptom-free period after previous injection (<6 months) could increase the rate of treatment failure after repeated CS injections.

Several limitations are inherent to this study's design. First, the previous CS injections in this study were performed by several physicians, including the authors and referring physicians outside of our hospital, so we did not have accurate details about symptom severity, grading, the agent that was injected or the dosage of the previous injection for all patients. All of these factors could have differed among the patients. Second, data on the duration of symptom relief in the patients who received previous CS injections outside of our hospital were collected from patient interviews, which may confer a risk of inaccuracy and recall bias. Third, there are no follow-up data on clinical outcomes beyond 12 months. Nonetheless, an improvement in objective results and pain scores could be anticipated. In contrast, it is possible that several individuals whose symptoms recurred had surgery after the research period. Fourth, there are various definitions of treatment success and failure that may differ between studies. In this study, we focused exclusively on pain reduction and the need for repeated CS injections or surgery during the follow-up period, not trigger symptoms. Comparisons of the results of treatments between this study and any other studies should be made with caution. Fifth, patients may have responded differently to the enrollment injection, as the patients had a variable number of injections prior to enrollment. Many studies have shown decreasing improvement in symptoms as more injections are given. Depending on the mechanism of follow-up, it may also be prudent to include that the scheduled follow-ups themselves may contribute to the selection of repeated procedures (injections or surgery) simply given that the patients were more actively involved in their follow-up care.

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