Is platelet-rich plasma or hyaluronic acid better than corticosteroids in treating flexor stenosing tenosynovitis?

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Introduction
The trigger finger is one of the frequent hand conditions. It may not respond to pharmaceutical treatment warranting injection in many cases. Classically, steroids had been used extensively. Recently emerging trends of using hyaluronic acid or platelet-rich plasma in the injection of soft tissue problems had acquired significant popularity despite being significantly more expensive than the steroids.

Aim
The study aims to prove a pragmatic comparison of hyaluronic acid, platelet-rich plasma, and steroids in the treatment of adult trigger fingers.

Patients and methods
Initially 362 patients were evaluated for possible inclusion in the study between August 2018 and January 2024. The condition was classified according to the modified Quinnell classification, and the patients completed the visual analog scale, and Michigan Hand Outcome score at the pre-injection visit, 2 weeks after injection, 6 weeks after injection, and 12 weeks after injection. One hundred ninety-seven patients (67 in the steroid group, 66 in the platelet-rich plasma group, and 64 in the hyaluronic acid group) were available for statistical analysis.

Results
In all groups, the 12 weeks post-injection visual analog score was better than the pre-injection visual analog score (P=0.001). The strongest statistical correlation with the final Michigan Hand Outcome score was with the grade of the inflammation before the injection as classified by Quinnell (P<0.001). Age, sex, whether the dominant hand was affected or not, occupational activity, and diabetic status did not affect the outcome. The duration of symptoms in the hyaluronic acid group had a moderate negative correlation with the outcome (P=0.001). None of the patients in either group suffered complications during the follow-up period.

Conclusion
The results of the current study speak to the safety and efficacy of the three injection materials in the short-term in grades II and III according to Quinnell's. All patients in grades II and III improved significantly in the three groups. The duration of symptoms of less than 15 weeks was associated with better outcomes in the hyaluronic acid group, but the outcomes in the steroid or the platelet-rich plasma group were not affected by the duration of symptoms. Patients with grade IV improved significantly with steroid injection compared to the hyaluronic acid group and the platelet-rich plasma group. Patients with grade V did not improve with any injection. Both hyaluronic acid and platelet-rich plasma are significantly more expensive than steroids, with no added benefit in the short term.

Keywords:
diabetic trigger finger, flexor tenosynovitis, hyaluronic acid, platelet-rich plasma, trigger finger

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Introduction

One of the most frequent causes of hand impairment is the trigger finger, also referred to as stenosing tenosynovitis. Patients under 8 years old and adults in their fifth and sixth decades are the most common populations for trigger finger manifest in a bimodal distribution [1–3]. The lifetime prevalence of trigger fingers in adults is 2–3%, with an annual incidence of 28 per 100 000 people [2,4,5]. Trigger finger is more common in women and typically manifests in the dominant hand's long and ring fingers. Endocrine disorders (such as diabetes mellitus, hypothyroidism, and mucopolysaccharidosis) and various inflammatory

arthropathies are two examples of systemic conditions that predispose patients to a higher incidence and increased severity of the trigger finger [2,6,7].

Individuals with diabetes are more likely to experience more severe and frequent trigger finger. Patients with diabetes have a prevalence that is at least twice as high as the overall population, ranging from 5 to 20% [6,7].

Five ring-shaped and three cross-shaped pulleys hold the double-walled connective tissue cylinder that is the flexor tendon sheath in the finger in place (Fig. 1) [8]. A1 pulley thickening or flexor tendon irritation that impairs flexor tendon gliding at the tendon-A1 pulley interface are the causes of trigger finger [4]. On microscopic examination, there is fibroblastic and chondrogenic degeneration without inflammatory changes despite the commonly used name tenosynovitis [9,10]. Despite being identified since 1850, the precise cause of the ailment is still unknown [3].

Even though certain research has hypothesized that ipsilateral carpal tunnel release may be the cause of trigger finger onset, more recent data contradicts this [8]. A retrospective analysis of 1386 hands that had carpal tunnel release was carried out by Zhang *et al.* [11]. No discernible variation was observed in the onset of new trigger finger before or following carpal tunnel release; trigger finger was observed in 10.6% of patients within a year before carpal tunnel release and 5.8% of patients within a year following carpal tunnel release.

Activity modification, orthotic immobilization, hand therapy exercise regimens, NSAIDs, and steroid injections are examples of conservative treatment modalities for trigger finger [12–14]. It is thought that injecting corticosteroids around the tendon sheath will lessen the tendon-sheath disproportion [15]. The use of corticosteroid injection in primary trigger finger appears to be beneficial in the short term, but the long-term evidence is insufficient, and the efficacy appears to decline with time [16–18].

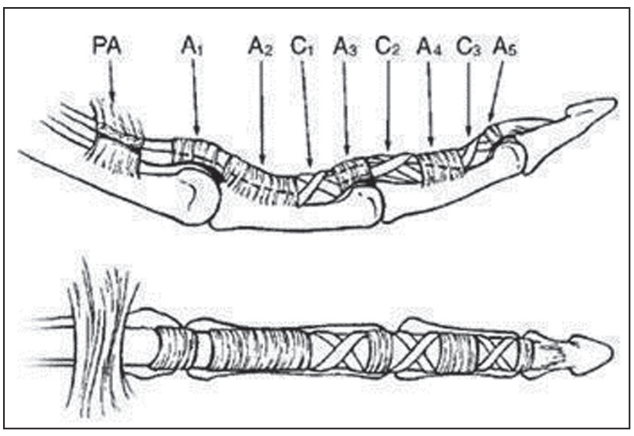
Adverse events such as local infection, tendon rupture, transient elevation of serum glucose in diabetic patients, fat necrosis, dermal atrophy, and hypopigmentation are rarely brought on by cortisone treatment [19–22].

Symptoms reduction in different tendon pathologies with the use of platelet-rich plasma has been shown in different studies [23–25] and seems to be better than cortisone [26–28]. Platelet-rich plasma therapy is safe and feasible [29] however, it has not been shown that the degenerative tendon changes are reversed after platelet-rich plasma despite the fact it contains growth factors [22,30]. However, apart from the cost and the possible withdrawal site discomfort, in a recent literature review, it was reported that platelet-rich plasma may have rare but serious side effects, including blindness (when injected near the globe), inflammation, allergic reactions (when calcium citrate is added), postoperative infections (may be related to not sticking to the strict antiseptic measures during preparation), and the formation of nodules (in dermal injection). Postoperative infections accounted for the majority of reported adverse events [31].

The tendon sheath and synovial fluid contain hyaluronic acid, a glycosaminoglycan. Viscosupplementary, antinociceptive, reduces pro-inflammatory cytokines, and inhibits and modifies fibroblast activity are just a few of its many intriguing qualities [32–37]. Because of these qualities, hyaluronic acid has been researched for the treatment of numerous tendinopathies, such as trigger fingers, de'Quervain's tenosynovitis, rotator cuff disorder, and tennis elbow [38]. Several trials assessing soft tissue indications of hyaluronic acid have been published recently; however, there is disagreement regarding the impact, safety, and relative effectiveness of hyaluronic acid when compared to other injectable soft tissue treatment options [39–43].

This study aimed to compare the short-term effect and safety of the newly suggested more expensive hyaluronic acid and platelet-rich plasma versus the thoroughly extensively researched steroids as the sole injection material for the trigger finger.

Figure 1



The pulley system of the flexor tendons [8].

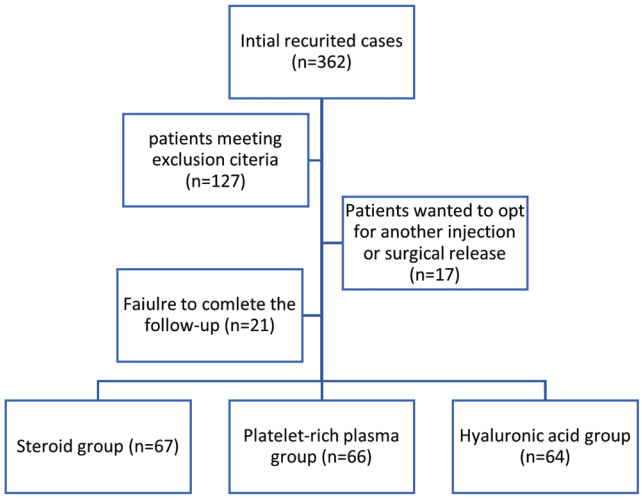
Patients and methods

Exclusion criteria included patients younger than 18 years of age, patients who received previous treatment to the current triggering, whether injection or release, patients with connective tissue disease, history of malignant tumors, patients with ipsilateral hand disease or previous surgery to the same hand, patients with a nearby local skin infection or dermatitis, those with more than one digit affection, and patients who failed to complete the follow-up either due to the need for a second injection, or the patient opting to the surgical release, or the failure to show-up to complete the assessment scores. The study was done after approval by the Ethical Committee of the Faculty of Medicine, at Alexandria University.

The study was carried out between August 2018 and January 2024 at El-Hadra University Hospital. The flowchart of the study is illustrated in Fig. 2.

The diagnosis was based on a clinical assessment of the symptoms, including pain, triggering, and limitations of the daily and/or work-related activities, examination findings of tenderness opposite the metacarpophalangeal joint, and possible demonstration of the clicking by the patient, whether actively or passively corrected. According to the findings, the condition was graded as per Quinnell's classification [44], and the patients completed their self-administered Michigan Hand Outcome score [45,46] and visual analog scale. All patients received initial medical treatment for at least 2 weeks before deciding on injection. Neither the patient nor the assessor was blinded to the used injection material. All diabetic patients were not injected regardless of the injection material used unless the diabetes mellitus was controlled.

Figure 2



Flowchart of the study.

Each patient gave their consent to start treatment after learning about all available options, including possible advantages and disadvantages, as well as the option to withdraw from the study at any time if they desired to receive additional injections or surgical release.

In the steroid group, triamcinolone acetonide ampule 40 mg/ml (Kenacort, Abott, New Cairo, Egypt) was used. In the platelet-rich plasma group, it was prepared in the hospital. After taking 9 ml of whole blood from the patient's antecubital venipuncture, the blood was stored in test tubes with 1 ml of acid citrate dextrose. The collected blood was centrifuged for 10 min at 250 g using a soft spin. A platelet concentrate was obtained by centrifuging the supernatant plasma containing platelets at a higher speed (300 g) for an additional 10 min. Afterward, they were transferred into another sterile tube devoid of anticoagulant. Platelet-poor plasma was extracted and disposed of after a pellet of platelets formed at the tube's bottom. One milliliter of 1.5% hyaluronic acid sodium salt (Hyalubrix, Fidia, Cairo, Egypt) was used in the hyaluronic acid group.

Aseptic conditions were maintained throughout the outpatient procedure. Mepivacaine (0.5% ml) will be injected in the A1 pulley region in combination with either 1 ml of 40 mg of triamcinolone acetonide ampule or 1 ml of concentrated platelet-rich plasma or 1 ml of sodium salt containing 1.5% hyaluronic acid in the steroid, platelet-rich plasma, and hyaluronic acid groups, respectively.

Patients had their wrists supinated on the table while they were seated for the injection. Then, palpation of the first annular pulley and the flexor tendon was done. A slightly oblique angle, oriented distal to proximal, was used to introduce the needle through the skin and into the supra-tendinous space. The absence of resistance during injection validated injection around the tendon sheath so that inadvertent intratendinous injection was avoided. A sterile dressing will be applied at the injection site. Following a 10-min observation period, the patient was discharged.

All patients were given the same post-injection instructions, which consisted of cold compresses, anti-edematous drugs, any type of hand splint for the first 10 days, and paracetamol when needed. All patients were followed up after 2, 6, and 12 weeks post-injection. Patients (three patients in the steroid group, five in the platelet-rich plasma group, and nine in the hyaluronic acid group) who requested a second treatment (a second injection or surgical release) before the end of the follow-up period were excluded from the study. During each follow-up

visit, the patients were requested to complete the self-administered visual analog scale and Michigan Hand Outcome score. Patients (n=21) who failed to complete the follow-up scores were excluded from the study.

Using averages, deviations, and spans, descriptive analysis was performed on numerical data. Testing was done on the results to see if they fell within the expected range. The Shapiro–Wilk test was utilized to ascertain the normality of the distribution. Results that fit into a normal distribution would have been compared using a t test for independent means. As a two-way analysis of variance, the Mann–Whitney U test was used to examine independent factors for data that were not normally distributed. Based on the P value, a significance level below 0.05 was established. SPSS (IBM SPSS Statistics 26; IBM, Chicago, Illinois, USA) was used for the analysis.

Results

The mean age of the patients in the steroid group was 47.5 years old (range, 23–61 years old; SD 7.9), the mean age for the platelet-rich plasma group was 46.1 (range, 23–59 years old; SD 7.4), and the mean age for the hyaluronic acid group was 48.4 years old (range, 22–63 years old; SD 9.2). There was no statistically significant difference in the age distribution between groups using the independent-samples Kruskal–Wallis test (P=0.2).

There were 22 (32.8%) male patients and 45 (67.2%) female patients in the steroid group. There were 27 (40.9%) male patients and 39 (59.1%) female patients in the platelet-rich plasma group. There were 13 (20.3%) male patients and 51 (79.7%) female patients in the hyaluronic acid group. There were statistically significantly more females in the hyaluronic acid group (P=0.04).

There were 34 (50.7%) patients affected in their dominant hand and 33 (49.3%) patients affected in their nondominant hand in the steroid group. There were 27 (40.9%) patients affected in their dominant hand and 39 (59.1%) patients affected in their nondominant hand in the platelet-rich plasma group. In the hyaluronic acid group, 26 (40.6%) of the patients were affected in their dominant hand, and 38 (59.4%) were affected in their nondominant hand. The distribution of affection in the dominant hand was not statistically different between groups (P=0.4).

The ring finger was most frequently affected in the steroid group and the hyaluronic acid group (44.8 and 37.5%, respectively), and the middle finger was the most frequently affected in the platelet-rich plasma group (37.9%).

There were three (4.5%) unemployed patients, 36 (53.7%) patients working at office-based jobs, six (9%) patients manual workers, 20 (29.9%) patients housewives, and two (3%) patients retirees in the steroid group. There were two (3%) unemployed patients, 41 (62.1%) patients working at office-based jobs, seven (10.6%) patients manual workers, and 16 (24.2%) patients housewives in the platelet-rich plasma group. There were one (1.6%) unemployed patient, 32 (50%) patients working at office-based jobs, five (7.8%) patients manual workers, 23 (35.9%) patients housewives, and three (4.7%) patients retirees in the hyaluronic acid group. There was no statistically significant difference between the groups in terms of the distribution of occupational status (P=0.6).

There were 53 (79.1%) diabetic patients in the steroid group, 49 (74.2%) diabetic patients in the platelet-rich plasma, and 46 (71.9%) diabetic patients in the hyaluronic acid. There was no statistically significant difference between groups in the distribution of diabetics (P=0.6).

Overall, the duration of symptoms before injection was 16.4 weeks (range, 4–58 weeks; SD 7.2). In the steroid group, the mean duration of symptoms before injection was 16.4 weeks (range, 4–28 weeks; SD 6.3). In the platelet-rich plasma group, the mean duration of symptoms before injection was 17 weeks (range, 4–29 weeks; SD 6.8 weeks). In the hyaluronic acid group, the mean duration of symptoms before injection was 15.8 weeks (range, 4–58 weeks; SD 8.4 weeks). There was no statistically significant difference between the groups in the duration of symptoms before injection (P=0.3).

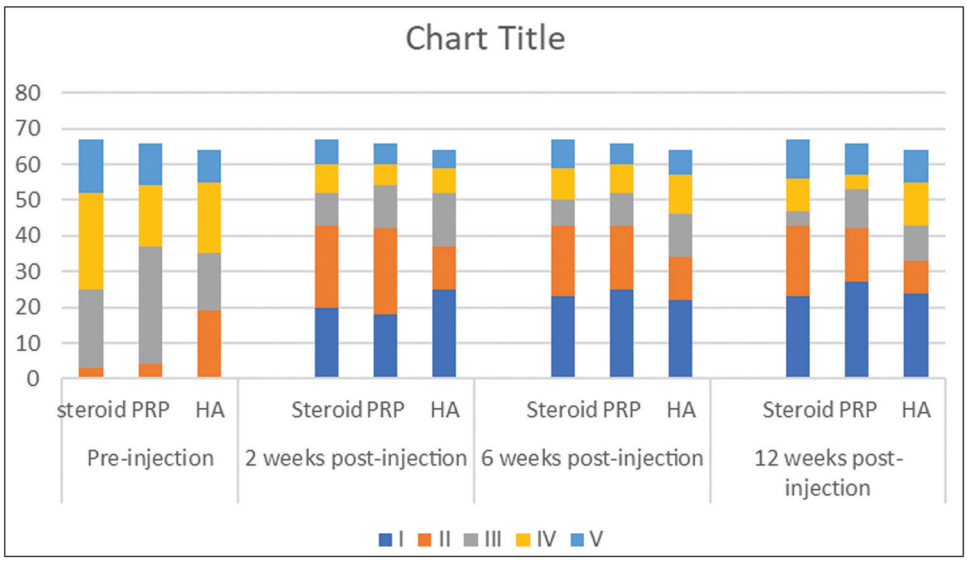
The condition was classified according to the modified Quinnell classification at the pre-injection visit, 2 weeks after injection, 6 weeks after injection, and 12 weeks after injection. The findings are recorded in Table 1 (Fig. 3). The distribution of the patients' grades within the groups was significantly different, with more grade III patients in the platelet-rich plasma group than in the steroid and the hyaluronic acid group, which had more grade IV patients (P=0.001).

The mean scores of the visual analog scale scores and the Michigan hand outcome score for the three groups pre-injection as well as 2, 6, and 12 weeks post-injection are presented in Figs 4 and 5.

Table 1 The distribution of different grades of QuinnellI's classification of the outcome before the injection, 2 weeks post-injection, 6 weeks post-injection, and 12 weeks post-injection

Groups	Quinnell grade	Pre-injection		2 weeks after injection		6 weeks after the injection		12 weeks after the injection	
		n	%	*n*	%	*n*	%	*n*	%
Steroid	I	0	0	20	29.9	23	34.3	23	38.3
	II	3	4.5	23	34.3	20	29.9	20	33.3
	III	22	32.8	9	13.4	7	10.4	4	6.7
	IV	27	40.3	8	11.9	9	13.4	9	15
	V	15	22.4	7	10.4	8	11.9	4	6.7
Platelet-rich plasma	I	0	0	18	27.3	25	37.9	27	45
	II	4	6.1	24	36.4	18	27.3	15	25
	III	33	50	12	18.2	9	13.6	11	18.3
	IV	17	25.8	6	9.1	8	12.1	4	6.7
	V	12	18.2	6	9.1	6	9.1	3	5
Hyaluronic acid	I	0	0	25	39.1	22	34.4	24	40
	II	19	29.7	12	18.8	12	18.8	9	15
	III	16	25	15	23.4	12	18.8	10	16.7
	IV	20	31.3	7	10.9	11	17.2	12	20
	V	9	14.1	5	7.8	7	10.9	5	8.3

Figure 3



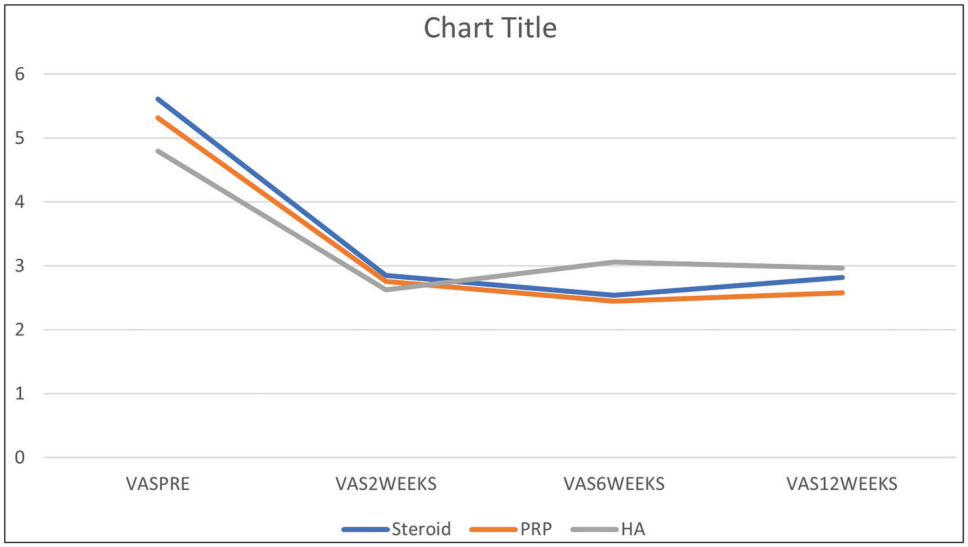
The distribution of grades of the triggering according to the Quinnell grading before injection, 2 weeks post-injection, 6 weeks post-injection, and 12 weeks post-injection.

At the end of the follow-up, patients with grade I were graded excellent, grade II were graded good, III and IV were graded fair, and V was graded poor. Their distribution in the three groups at the end of the follow-up is shown in Fig. 6. Patients with excellent and good grades were considered satisfactory, and patients with fair and poor grades were considered unsatisfactory. Their distribution in the three groups at the end of the follow-up is shown in Fig. 7.

Before injection, there was a statistically significantly higher visual analog score in the steroid group than in the hyaluronic acid group (P=0.005). There was no statistically significant difference between the three groups regarding the visual analog score at 2 weeks post-injection, 6 weeks post-injection, the end of the follow-up (using the independent-samples Kruskal–Wallis test P=0.8, 0.4, and 0.7, respectively) (Fig. 4). In all groups, the 12 weeks post-injection visual analog score was better than the pre-injection visual analog score (P=0.001)

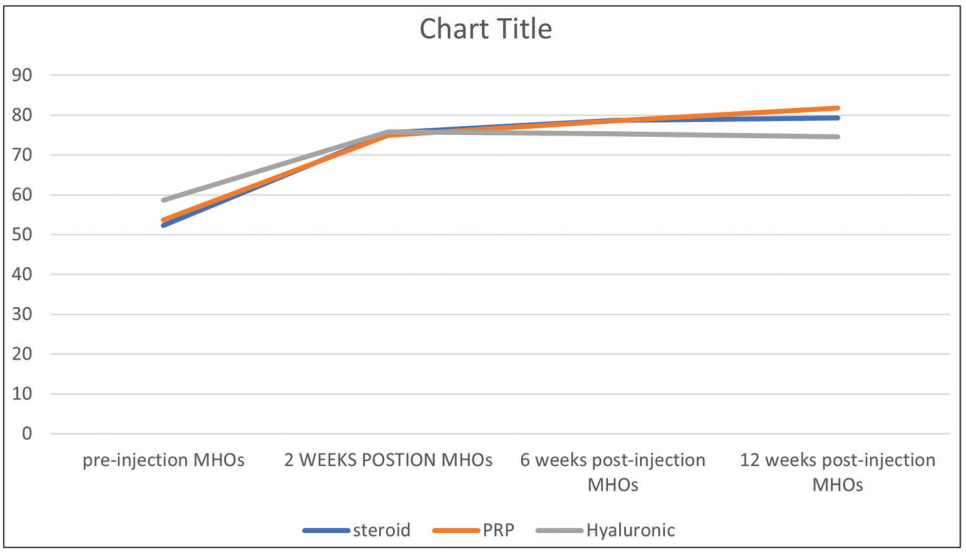
There was no correlation between age and visual analog score at 12 weeks across all groups (Spearman correlation coefficient=0.004, P=0.9). Also, age was not correlated significantly with the visual analog

Figure 4



The mean visual analog score of each group pre-injection, 2 weeks post-injection, 6 weeks post-injection, and 12 weeks post-injection.

Figure 5



The mean Michigan Hand Outcome score before injection, 2 weeks post-injection, 6 weeks post-injection, and 12 weeks post-injection.

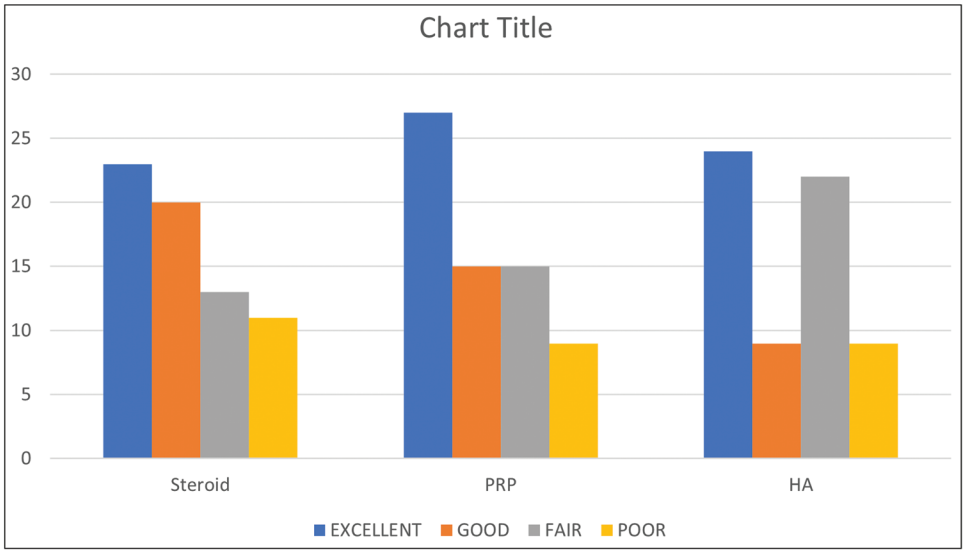
scale at 12 weeks at the steroid, platelet-rich plasma, and the hyaluronic acid groups in individual group analysis (Spearman correlation coefficient −0.07, −0.03, and 0.1, respectively, with *P*=0.6, 0.5, and 0.4, respectively).

Generally, there was no statistically significant correlation between the age of the patient and the final Michigan Hand Outcome score at 12 weeks (correlation coefficient −0.17, *P*=0.7). In a subgroup analysis, there was no statistically significant correlation between the age and the final Michigan Hand Outcome score (*P*=0.8, 0.6, and 0.2 for the steroid group, the platelet-rich plasma group. And the hyaluronic acid group, respectively).

Sex was not statistically correlated with the final grading of the Quinnell (excellent, good, fair, and poor) (*P*=0.3). In the subgroup analysis, sex was not statistically significantly correlated with the final grading of the Quinnell grading in the steroid, the platelet-rich plasma, and the hyaluronic acid groups (*P*=0.7, 0.2, and 0.3, respectively).

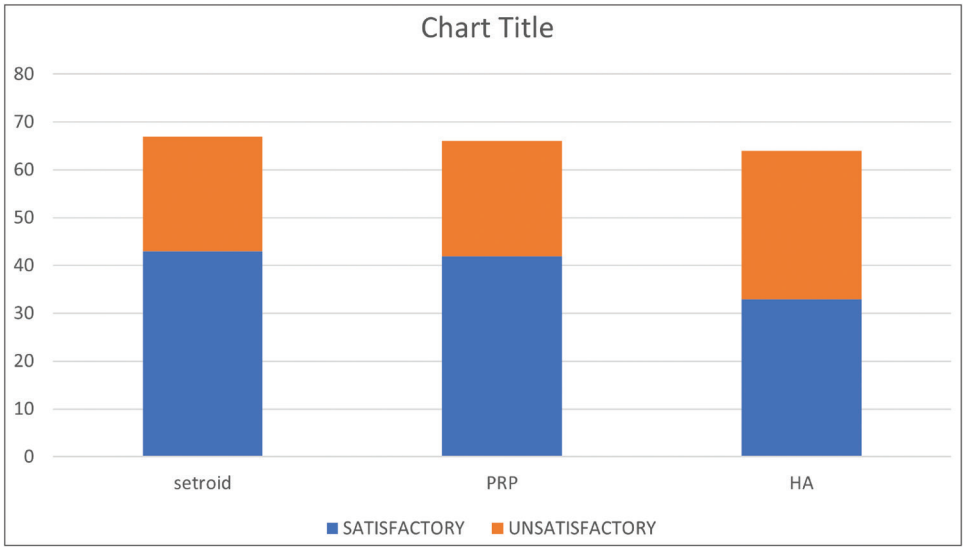
In general, sex was not statistically significantly correlated with the final Michigan Hand Outcome score (*P*=0.07). That was also the case after a separate analysis of each group (*P*=0.6, 0.2, and 0.2 for the steroid, platelet-rich plasma, and hyaluronic acid groups, respectively).

Figure 6



The distribution of the final grading according to Quinnell's classification of the outcome at the end of the follow-up.

Figure 7



The distribution of the satisfactory and the unsatisfactory cases according to the Quinnell grading at the end of the follow-up in the different groups.

There was no statistically significant correlation between the occupational activity and the final grading of the Quinnell score (P=0.4). In the subgroup analysis, the occupational activity was not statistically significantly correlated with the final grading of Quinnell score in the steroid, the platelet-rich plasma, and the hyaluronic acid group (P=0.6, 0.5, and 0.1, respectively).

There was not, in general, a significant statistical correlation between the occupational activity level and the final Michigan Hand Outcome score (P=0.2). In a separate group analysis, the occupational activity did not correlate significantly with the final Michigan Hand Outcome score in the steroid group and the platelet-rich plasma group (P=0.8 and 0.2, respectively). However, the occupational activity type correlated significantly with the Michigan Hand Outcome score in the hyaluronic acid group (P=0.04), with significantly higher scores in both retirees and office-based workers subgroups.

In general, there was no statistically significant correlation between the presence of diabetes mellitus as a comorbidity and the final grade according to Quinnell's classification after the injection across

groups (P=0.3). In the subgroup analysis, diabetes mellitus was not statistically significantly correlated with the final grading of Quinnell score in the steroid, the platelet-rich plasma, and the hyaluronic acid group (P=0.63, 0.56, and 0.59, respectively).

In general, there was no statistically significant correlation between the presence of diabetes mellitus and the final Michigan Hand Outcome score (P=0.3). In a subgroup analysis, that was also the case in the three groups (P=0.3, 0.8, and 0.4 in the steroid group, the platelet-rich plasma group, and the hyaluronic acid group, respectively).

In general, there was no statistically significant correlation between the occurrence of the condition in the dominant hand versus the nondominant hand and the degree of improvement after the injection across groups (P=0.8). In the subgroup analysis, the affection in dominant versus nondominant hands was not statistically significantly correlated with the final grading of Quinnell score in the steroid, the platelet-rich plasma, and the hyaluronic acid groups (P=0.9, 0.6, and 0.1, respectively).

Whether the affection was in the dominant hand or the nondominant hand did not significantly affect the final Michigan Hand Outcome score (P=0.6). In a subgroup analysis, the affection of the dominant hand versus the nondominant hand didn't correlate significantly with the final Michigan Hand Outcome score in the steroid group and the platelet-rich plasma (P=0.9 and 0.2, respectively). However, in the hyaluronic acid group patients affected in the nondominant hand achieved significantly higher final Michigan Hand Outcome scores than those affected in the dominant hand (P=0.04).

In general, there was a weak, negative, statistically significant correlation between the duration of symptoms before injection and the final Michigan Hand Outcome score (correlation coefficient –0.2, P=0.001). In a subgroup analysis, the duration of symptoms before the injection did not correlate significantly with the final Michigan Hand Outcome score in the steroid group, the platelet-rich plasma (P=0.6 and 0.2, respectively). However, in the hyaluronic acid group, patients with a shorter duration of symptoms before the injection (<15 weeks) achieved significantly higher final Michigan Hand Outcome scores than those with a longer duration of symptoms (P=0.001).

In general, there was no statistically significant correlation between the duration of symptoms before injection and the final visual analog score (P=0.2). That was also the case with separate group analysis in which there was no statistically significant correlation between the duration of symptoms before the injection and the final visual analog score (P=0.7 and P=0.1 in the steroid and platelet-rich plasma, respectively). However, there was a moderate negative statistically significant correlation between the duration of symptoms and the final visual analog score in the hyaluronic acid group (P=0.001).

In general analysis and group analysis, the strongest statistical correlation with the final Michigan Hand Outcome score was with the grade of the inflammation before the injection as classified by Quinnell (P<0.001), that is; the lower the grade of the inflammation pre-injection, the better the final Michigan Hand Outcome score.

In a separate analysis of each grade of the condition as per the Quinnell grading, it was found that all groups achieved unsatisfactory results in alleviating the symptoms of those with grade V patients with no advantage of any injection material over the other (P=0.8). There was no statistically significant difference between the groups in treating grade II or grade III (P=0.4 and 0.5, respectively). In patients with pre-injection grade IV, there's a statistically significant improvement in visual analog score in the steroid group over the hyaluronic acid group (P=0.001) and a statistically significantly better visual analog score in the platelet-rich plasma over the hyaluronic acid group (P=0.01), but there was no statistically significant difference between the steroid group and the platelet-rich plasma groups in the visual analog scores (P=0.2).

That was also noticed when the analysis of the final Michigan Hand Outcome score showed no statistically significant difference between groups when used for treating patients with either grade II or III (P=0.9 and 0.5, respectively). The steroid group and the platelet-rich plasma groups outperformed the hyaluronic acid group in the Michigan Hand Outcome score in patients with grade IV pre-injection (P=0.001 and 0.001, respectively), with no statistically significant difference between the steroid group and the hyaluronic acid group in the Michigan Hand Outcome score in patients with grade IV pre-injection (P=0.7).

There were no complications in either of the three groups during the study period.

Discussion

It has been reported in the literature that individuals with diabetes are more likely to experience more severe

and frequent trigger finger. Patients with diabetes have a prevalence that is at least twice as high as the overall population, ranging from 5 to 20% [6]. In the current study, no statistically significant difference existed between groups or across the pre-injection grade, Michigan Hand Outcome score, or visual analog scale score (P>0.05). The presence or absence of the diabetic state did not influence the response to the three tested injection materials except for the hyaluronic acid group's final grading according to Quinnell classification, which was statistically significant for better in that group (P=0.04). This can be explained by the short duration of follow-up in this study and the exclusion of cases that warranted additional treatment, either in the form of a second injection or a surgical release.

Open or percutaneous surgical release of the A1 pulley is part of surgical management. The effectiveness of conservative management and the amount of time it takes for recovery following open release have been linked to the severity of trigger finger [12,47]. In the current study, the most significantly correlated with the degree of improvement regardless of the injectant is the pre-injection grade, that is; the better the grade, the higher the improvement (P=0.001). This can be explained by the lower fibrosis in the A1 pulley with the higher grade, which makes it less likely to reverse after injection.

A broad category of conditions, including "repetitive strain injury" and "cumulative trauma disorder," has been proposed to include trigger fingers since the mid-1980s [8]. According to a study by Trezies *et al.* [48], there may be a correlation between trigger finger and occupation, as indicated by the point prevalence of 14% in 665 workers at a meat packing plant [49]. However, this association could not be verified [48]. In the current study, occupational activity was not statistically significantly related to the degree of the triggering.

Kanchanathepsak and colleagues compared hyaluronic acid and corticosteroids injected via ultrasound guidance in trigger finger management; they reported that in both groups, there was statistically significant improvement in both visual analog score and Disabilities of the Arm, Shoulder, and Hand score with statistically better early results in the steroids group, without statistically significant difference between both groups at 3 months. They also reported that three patients (without specifying which group suffered early local discomfort for the first week post-injection) [50] In the current study, there was no statistically significant difference between the three groups at 2, 6, and 12 weeks post-injection. The difference can be attributed to the fact that they used a lesser molecular weight of hyaluronic acid (1%) (Hylgan). It is reported in the literature that hyaluronic acid has varied lubricating and anti-inflammatory properties depending on its molecular weight [32]. There were also no reported complications in either of the three groups for the study period. This cannot be attributed only to the injection material but maybe also to the post-injection protocol, which was not clarified in their study.

In their study, Callegari and colleagues, compared the sequential injection of steroids, 1 week later, low molecular weight hyaluronic acid (0.8%), versus the surgical release. They reported no complications in the injection group and less recurrence in the surgical group. In the current study, no complications were observed during the follow-up period, which was relatively short to detect the true rate of recurrence.

Liu and colleagues, in their comparative study between the hyaluronic acid and the steroids, reported that there was no statistically significant difference in the number of successful patients (in their definition, no triggering by 3 months post-injection) between both groups, but statistically significant lower visual analog score in the steroid group than the hyaluronic acid group at 3 months post-injection [51]. In the current study, there was no statistically significant difference between groups in the number of satisfied patients nor the mean score of the visual analog scale. This can be attributed to the lower dose of steroid used in the Liu and colleagues study (1 ml of 10 mg/ml triamcinolone acetonide) than in the current study (1 ml of 40 mg of triamcinolone acetonide).

In their review of the role of hyaluronic acid in soft tissue disorders injection, Khan *et al.* [52], reported that hyaluronic acid has no advantage over other injection materials in efficacy in the trigger finger without having serious side effects. This coincides with the findings of the current study.

Hollins *et al.* [53] demonstrated in their retrospective analysis that the longer the duration of the symptoms (more than 2.5 months) before injection, the worse outcome for the steroid injection. In the current study, that was only the case with hyaluronic acid injection, which showed better results if the duration of symptoms before injection was less than 15 weeks. The difference in that aspect can be attributed to the difference in the number of patients tested in each study (297 patients received a steroid injection in the study by Hollins *et al.* [53] and 67 patients received a steroid injection in the current study.

According to a recent literature search, no previous study compared the three injection materials pragmatically till now. Aspinen *et al*. [54] published only their protocol for comparing the long-term efficacy of platelet-rich plasma versus the steroid and a placebo injection.

Limitations of the current study include a lack of automated grip testing, blinding, placebo-control group, and short follow-up duration, so the risk of recurrence was not assessed in this study.

The results of the current study speak to the safety (in all grades according to Quinnell's) and efficacy (in grades II and III according to Quinnell's) of the three injection materials in the short-term, as none of the complications occurred in any patient in any group during the period of follow-up, as well as all patients in grades II and III improved significantly in the three groups. The duration of symptoms of less than 15 weeks was associated with better outcomes in the hyaluronic acid group, but the outcomes in the steroid or the platelet-rich plasma group were not affected by the duration of symptoms. Patients with grade IV improved significantly with steroid injection compared to with the hyaluronic acid group and the platelet-rich plasma group. Patients with grade V did not improve with any injection. Both hyaluronic acid and platelet-rich plasma are significantly more expensive than steroids, with no added benefit in the short term.

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Conflicts of interest
There are no conflicts of interest.

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