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Scientific/Clinical Article

Outcomes and indications for early hand therapy after multiple concomitant elective hand procedures

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ABSTRACT

Study Design: Retrospective comparative study.

Introduction: Trigger finger and carpal tunnel surgery are common, but not without complications including pain and edema, which are treated with hand therapy (HT). There are limited data for the outcomes of multiple trigger finger releases (MTFRs) or combined trigger finger and carpal tunnel surgery and the subsequent need for HT.

Purpose of the Study: Based on our hypothesis that patients with more than 1 procedure may benefit from an early HT visit, we performed this study to compare the frequency of HT orders after single trigger finger releases (STFRs) and MTFRs and determine the reasoning for variation in the rate of HT orders after releases.

Methods: Subjects receiving either an STFR or an MTFR were identified. Patient-reported outcomes were recorded preoperatively and 2 weeks postoperatively.

Results: One hundred fifty-nine eligible subjects were identified; 33 MTFRs and 126 STFRs. MTFR subjects were prescribed postoperation HT at a higher rate compared with STFR subjects (66.7% vs 34.1%; $P < .001$). Of the HT subjects, MTFR subjects received prescriptions for edema management at a significantly higher rate compared with STFR subjects ($P = .02$).

Discussion: Patients with soft tissue dissection, edema, and stiffness would most likely benefit from HT services. It is important to identify these at-risk subpopulations to potentially alter their postoperative trajectories and improve outcomes.

Conclusions: Higher rates of referral to HT occur when there are multiple concomitant hand procedures. This suggests surgeons triage HT services based on need. Policies that disallow postoperative therapy will have a greater impact on patients with these indications.

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Introduction

Elective hand procedures such as carpal tunnel releases (CTRs), single trigger finger releases (STFRs), and multiple trigger finger releases (MTFRs) are common, especially in the comorbid setting of repetitive injuries or metabolic syndromes. The prevalence of trigger finger is roughly 2%, with an increased incidence seen in patients with carpal tunnel syndrome, amyloidosis, de Quervain's

disease, diabetes mellitus, hypothyroidism, and rheumatoid arthritis.¹⁻³

Based on the severity of presentation, initial compressive neuropathies or tenosynovitis can be treated with rest, corticosteroid injection, and splinting. When symptoms remain refractory or functionally limiting, surgical release with transection of the transverse carpal ligament or A1 pulley is typically recommended.⁴ Open trigger digit release is a highly effective procedure, with success rates of 90%-100%.² However, the reported complication rate is not trivial, varying widely up to 43% depending on the definitions used. A recent large series of 795 digits released in 543 patients identified a complication rate of 12%, most commonly pain, stiffness, and swelling.⁵

After surgical release, the expected inflammatory response can induce local edema contributing to stiffness, ongoing pain, or loss of

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function.⁶ However, less is known about the combined effects of MTFR or CTR on the same operative visit with regard to subsequent edema and the resultant need for formal hand therapy (HT). As such, based on the time from surgery to the typical postoperative visit 14 days later, there can be a significant delay in the recognition of pain and edema, which may result in a further delay of initiation of HT and potentially diminished results. It is therefore important to identify referral patterns early to anticipate the postoperative trajectories and intervene proactively for the patients most at risk.

However, to date, no studies have been performed to determine whether MTFRs or concomitant procedures are an independent risk factor for complication or subsequent referral to HT. We have hypothesized that in patients with more than 1 ipsilateral hand procedure, edema is a common finding that often results in a late referral for HT. As such, we undertook this study to evaluate our referral patterns with multiple concomitant elective hand procedures and HT referral schemes, including timing and duration.

Methods

This study was designed to compare the frequency of HT orders after an STFR vs an MTFR and to determine the reasoning for variation in the rate of HT orders for the differing procedures. In this retrospective study, patients receiving a trigger finger release at Beth Israel Deaconess Medical Center (BIDMC) were identified after approval by the institutional review board. A Health Insurance Portability and Accountability Act waiver and waiver of consent were requested and used for this study due to its retrospective nature, and no vulnerable subjects were targeted or included.

Medical records were accessed for patients who had undergone STFR or MTFR from January 2012 to December 2016. Eligible subjects were first identified using the available hospital and orthopedic billing databases by searching for the appropriate *International Classification of Diseases, Ninth Revision/International Classification of Diseases, Tenth Revision* codes matching to the Current Procedural Terminology (CPT) code 26055 for the trigger finger release procedure. In addition, patients were identified using an institutional review board–approved BIDMC Orthopaedic Case Database using the same trigger finger CPT code for subjects within the same time frame. From this list, all patients who met the inclusion criteria, and not the exclusion criteria, were enrolled. Inclusion criteria included male and female patients older than 18 years, a diagnosis of a trigger finger, trigger finger release surgery at BIDMC between January 2012 and December 2016, and a minimum of 2 weeks postoperative follow-up. Subjects were excluded if they had undergone concomitant procedures other than trigger finger release or CTR and/or had additional procedures during the defined postoperative period. To generate a baseline comparison of naive subjects without prior experience to HT or surgery, patients were excluded if they had a prior elective hand procedure.

A total of 419 subjects were screened from the CPT code list generated from both the billing records and BIDMC Orthopaedic Case Database. Of these, 159 meet the inclusion and exclusion criteria and were included in the analysis with 33 in the MTFR group and 126 in the STFR group. The MTFR group consisted of subjects with 2 or more finger releases and/or a concurrent CTR. The STFR group consisted of subjects with only 1 finger release and/or a concurrent CTR.

Medical records were accessed on BIDMC encrypted, and protected devices and information were stored confidentially within a BIDMC-protected REDCap Research Database only accessible by authorized study staff. Data collected from medical records included subjects' medical history; treatment plan; postoperation complications; therapy orders; and the presence or the absence of edema, which was a subjective clinical finding based on visual inspection; and decreased range of motion.

Patient-reported outcomes such as pain level assessments and Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) survey scores were recorded at baseline, before procedures, and 2 weeks postoperatively. QuickDASH assessments administered at clinical appointments included 11 items on a 5-point Likert scale in which patients select the corresponding number that reflects their symptoms and ability to perform common activities. In addition, medical history was used to calculate subjects' Charlson Comorbidity Index (CCI) providing classification of comorbidity conditions that might alter subjects' risk of mortality. As both the QuickDASH and CCI scores increase from 0, there is an increase in disability and mortality, respectively.

Continuous variables are reported as mean \pm standard deviation, and categorical variables are reported as counts (percentage). Group differences were identified using chi-squared or Student *t* test as appropriate. Statistical significance was determined using $\alpha = 0.05$. The final analysis was performed using Microsoft Excel 2010 (Microsoft, Redmond, WA).

Results

A total of 204 trigger fingers were released, 126 digit releases were performed on STFR subjects, whereas 78 digits were released on 33 MTFR subjects. Within the MTFR group, 25 had 2 fingers released at once, 4 had 3 fingers released at once, and 4 had 4 fingers released at once. Overall, subjects undergoing an MTFR at once were prescribed HT for postoperational care at a significantly higher rate compared with STFR subjects ($P < .001$). Of the participants who received MTFR at once ($N = 33$), 66.7% ($N = 22$) were prescribed HT. For the various 2-, 3-, and 4-digit MTFR groups, there was no significant difference in the rate of HT prescriptions ($P = .85$). For subjects who received an STFR ($N = 126$), only 34.1% ($N = 43$) were prescribed HT. When identifying reasons for HT orders, MTFR subjects received prescriptions for edema management at a significantly higher rate compared with STFR subjects ($P = .02$; Fig. 1; Table 1).

Demographics

The demographics of the study population followed previously reported trends for a trigger finger diagnosis (Table 2). Women, in our subject population, tended to report a trigger finger diagnosis at a greater rate, with a nearly 3:1 ratio compared with males (64.2% women for entire subject population). The thumb remained the highest affected digit (34.3%) for all subjects followed by the middle (or long) finger (31.9%), ring finger (24.5%), index finger (8.3%), and small finger (1.0%). In addition, there was no significant difference in HT orders based on subject insurance plans.

When comparing the ages of subjects who received HT orders with those who did not after MTFR, participants prescribed HT

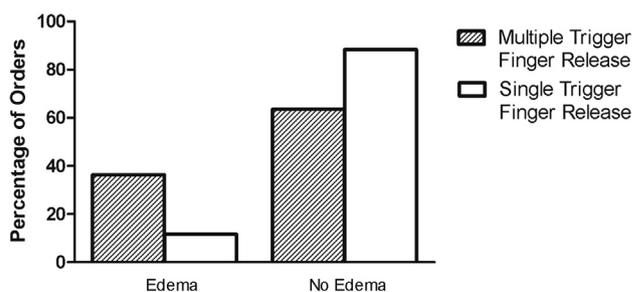


Fig. 1. Number of trigger finger subjects prescribed hand therapy based on edema management. $P = .02$.

Table 1
HT order frequency

Patient groups	HT	Non-HT	P
	N = 65	N = 94	
Overall			<.001 ^a
MTR	22 (33.8)	11 (11.7)	
STFR	43 (66.2)	83 (88.3)	
Based on edema			.02 ^a
MTR	8 (12.3)	14 (14.9)	
STFR	5 (7.69)	38 (40.4)	

HT = hand therapy; MTR = multiple trigger finger release; STFR = single trigger finger release.

^a Statistically significant difference ($P < .05$). Categorical variables are given as count (percentage).

were significantly older with an average age of 63.4 compared with 53.4 years ($P = .02$). Although this same comparison lacked significance for STFR subjects, results showed that HT subjects tended to be older than those without HT (59.2 vs 57.3 years; $P = .40$).

Our subject population was also composed of diverse ethnic populations, including white, black/African American, Asian, Hispanic, American Indian, Alaska Native, and other various groups. Although there was no association between ethnicity and HT and non-HT groups within their respective STFR or MTR groups ($P = .07$ and $P = .14$, respectively), there was an association for ethnicity and HT groups between STFR and MTR groups ($P < .001$).

Comorbidities

Overall, comorbidities (diabetes mellitus, Dupuytren's contracture, de Quervian's tenosynovitis, and thyroid disorders), smoking history, and postoperation complications were similar among all subjects (Table 2). Subjects within the MTR group were more likely to have a diagnosis of diabetes mellitus, as compared with those within the STFR group. In both HT, MTR (MTR-HT) group

and non-HT, MTR (MTR-NOHT) group, 36.4% were diagnosed with diabetes, whereas only 27.9% of those in the HT, STFR (STFR-HT) group and 18.1% of the non-HT, STFR (STFR-NOHT) group were diagnosed with diabetes. A positive smoking history was highest for MTR-HT subjects at 50.0% followed by STFR-NOHT at 43.4% and then STFR-HT and MTR-NOHT at 30.2% and 18.2%, respectively (Table 2).

Postoperative complications

Postoperative complications remained relatively low for all 4 groups. In total, of 159 subjects, 15 acquired infections, 3 experienced dehiscence, 6 experienced persistent scar and palm pain, 1 had a nerve injury, and 8 needed revision procedures.

MTR group

Among the MTR group, patients who received HT had a significantly higher rate of medical comorbidity than those who did not based on the CCI ($P = .03$). HT patients' CCI distribution was 2, 3, 4, and 8 for the respective 25th, 50th, 75th, and 100th quartiles, whereas non-HT patients' distribution was smaller with scores of 0.5, 2, 3, and 3 at each quartile (Fig. 2). In addition, HT patients experienced a significant amount of baseline pain at rest compared with non-HT patients ($P = .04$). Although no significant difference was identified between HT and non-HT patients for baseline pain with activity and baseline QuickDASH scores, those receiving HT tended to have greater average scores. At 2 weeks postoperatively, HT patients had a larger mean QuickDASH score compared with their non-HT counterpart; however, it was not a significant difference (68.0 vs 59.1; $P = .85$; Table 3).

STFR group

Within the STFR group, patients receiving HT after surgery experienced similar pain levels as subjects without HT at baseline and 2 weeks postoperatively. In addition, HT patients waited longer

Table 2
Demographics and treatment characteristics of MTR and STFR subjects

Patient data	MTR		P	STFR		P	Between MTR and STFR-HT groups P
	HT	Non-HT		HT	Non-HT		
	N = 22	N = 11		N = 43	N = 83		
Gender, n (%)			.28			.24	.62
Female	14 (63.6)	9 (81.8)		30 (69.8)	49 (59.0)		
Male	8 (36.4)	2 (18.2)		13 (30.2)	34 (40.9)		
Age (y)	63.4 ± 9.30	53.4 ± 12.9	.02 ^a	59.2 ± 12.8	57.3 ± 11.7	.40	.18
Injections							
Previous injection, n (%)	14 (63.6)	9 (81.8)	.28	33 (39.8)	68 (81.9)	.49	.26
Time from injection to surgery (d)	227.6 ± 122.2	559.4 ± 633.1	.16	355.6 ± 213.4	173.2 ± 161.2	<.001 ^a	.05 ^a
Duration of symptoms before surgery (mo)	14.4 ± 11.3	23.7 ± 21.6	.20	26.8 ± 40.1	18.6 ± 27.5	.18	.18
Comorbidities, n (%)			.42			.74	.96
Diabetes	8 (36.4)	4 (36.4)		12 (27.9)	15 (18.1)		
Dupuytren's contracture	1 (4.5)	0 (0)		1 (2.3)	0 (0)		
De Quervian's	2 (9.1)	2 (18.2)		2 (4.7)	2 (2.4)		
Thyroid disorder	8 (36.4)	1 (9.1)		9 (20.9)	9 (10.8)		
Smoker, n (%)	11 (50.0)	2 (18.2)	.07	13 (30.2)	36 (43.4)	.15	.12
Postoperation complications, n (%)			.36			.14	.34
Infections	2 (9.1)	0 (0)		4 (9.3)	9 (10.8)		
Dehiscence	0 (0)	0 (0)		2 (4.7)	1 (1.2)		
Persistent scar pain	0 (0)	0 (0)		3 (7.0)	0 (0)		
Persistent palm pain	0 (0)	0 (0)		1 (2.3)	2 (2.4)		
Nerve injuries	0 (0)	0 (0)		0 (0)	1 (1.2)		
Revision procedures	2 (9.1)	1 (9.1)		4 (9.3)	1 (1.2)		

MTR = multiple trigger finger release; STFR = single trigger finger release; HT = hand therapy.

^a Statistically significant difference ($P < .05$). Continuous variables are given as mean ± standard deviation, and categorical variables are given as count (percentage).

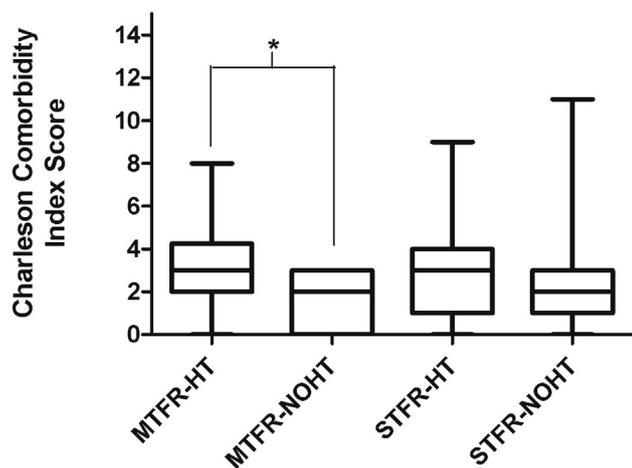


Fig. 2. Quartiles of calculated Charlson Comorbidity Index scores for hand therapy/multiple trigger finger release subjects (MTFR-HT), non-hand therapy/multiple trigger finger subjects (MTFR-NOHT), hand therapy/single trigger finger release subjects (STFR-HT), and non-hand therapy/single trigger finger release subjects (STFR-NOHT). *Statistical significance at $P = .03$.

to undergo surgery after receiving an injection compared with their non-HT counterparts ($P < .001$). HT patients tended to wait longer from their initiation onset of pain and symptoms before having an operation (Table 3).

MTFR and STFR with HT: between groups

Of patients receiving HT, MTFR patients tended to report greater postoperative pain levels compared with STFR patients with near significance at P -values ranging from .07 to .16. As shown in Table 3, MTFR-HT patients experienced more disruption in their ability to use their upper extremity at a significant level when compared with STFR-HT subjects 2 weeks postoperation (QuickDASH, $P = .02$).

In comparison to STFR subjects, MTFR subjects waited for a shorter period after the onset of symptoms before having surgery. For those receiving injections, participants in the MTFR group waited for a shorter period from their last injection to surgical release ($P = .05$).

When stratifying the various MTFR-HT groups into their 2-, 3-, and 4-finger release groups, patients who experienced 3 trigger finger releases at once had a significant amount of increased pain with activity and limitation (ie, QuickDASH) when compared with STFR-HT ($P = .03$ and $P < .001$). In addition, the 3-trigger finger release HT group tended to experience the most pain and

limitations at baseline and 2-week follow-up when compared with their 2- and 4-finger counterparts, although it lacks significance. In relation, the same subjects who underwent a 3-finger trigger finger release waited the shortest amount of time from the onset of pain and date of last injection before operation.

Hand therapy groups: carpal tunnel subset analysis

Overall, subjects who received both a trigger finger(s) and CTR tended to be older when compared with release-only subjects (MTFR: 66.0 vs 63.0 years; STFR: 63.5 vs 57.8 years). Based on CCI, subjects with the additional CTR were significantly sicker when compared with MTFR-only subjects ($P = .03$) and only trended in the same direction for STFR subjects (3.91 vs 2.59; $P = .20$). All 3a subjects receiving both an MTFR and a CTR were prescribed HT, whereas 11 of the 17 patients with an STFR and a CTR were ordered to HT. Although this was not statistically significant relationship ($P = .22$), there is a trend toward patients with these concurrent procedures needing HT.

Discussion

In this retrospective review, we identified that HT patterns after open trigger finger release are associated with multiple or concomitant hand procedures. These findings may be broadly applicable, as our cohort was ethnically diverse and well matched with published reports of patient demographics and outcomes with regard to TFR. Our average QuickDASH scores of 41.9 and 34.4 for our STFR subjects are similar to those previously reported, whereas our MTFR produced greater scores most likely due to the additive nature of the symptoms such as tenderness over the A1 pulley and pain with movement.^{7,8} Our complication rate overall was 20.7%, which is in line with published rates of up to 43% and concordant with 12% rate found in a recent large series of 543 patients.⁵

Ultimately, we found that two-thirds of patients who underwent MTFR, or patients with a combined STFR and CTR, were referred to HT. This is in comparison to only one-third of the patients who underwent STFR. We also identified a statistically significant increase rate of referral in patients who had a higher CCI and baseline pain at rest. This is consistent with appropriate triaging of patients based on needs and clinical presentation. Patients with more soft tissue injury, slower recovery, edema, hypertrophic or hypersensitive scars, and stiffness would be the ones that would most likely benefit from HT services. It is important to identify these at risk subpopulations early to potentially alter their postoperative trajectories and improve outcomes. Blanket policies that refer all patients to HT or that exclude all patients from HT after

Table 3
Outcome and treatment variables

Treatment outcomes	MTFR		P	STFR		P	Between MTFR and STFR-HT groups P
	HT	Non-HT		HT	Non-HT		
CCI	3.23 ± 1.88	1.82 ± 1.33	.03 ^a	2.93 ± 2.28	2.46 ± 2.19	.26	.60
Baseline							
DASH	58.4 ± 18.1	52.9 ± 24.0	.64	41.9 ± 23.7	34.4 ± 17.9	.19	.10
Pain with activity	8.33 ± 1.54	7.75 ± 1.50	.51	6.78 ± 2.69	7.76 ± 2.29	.17	.07
Pain at rest	5.50 ± 2.13	2.75 ± 2.50	.04 ^a	4.07 ± 3.28	4.30 ± 3.20	.81	.16
2-wk follow-up							
DASH	68.0 ± 19.0	59.1 ± 51.5	.85	43.2 ± 21.8	31.2 ± 23.5	.19	.02 ^a
Overall pain	2.45 ± 2.70	0.60 ± 0.89	.06	1.46 ± 2.67	1.82 ± 2.38	.64	.38
Time from last injection to surgery (d)	227.6 ± 122.2	559.4 ± 633.1	.16	355.6 ± 213.4	173.2 ± 161.2	<.001 ^a	.05 ^a

MTFR = multiple trigger finger release; STFR = single trigger finger release; HT = hand therapy; CCI = Charlson Comorbidity Index; DASH = Disabilities of the Arm, Shoulder and Hand.

^a Statistically significant difference ($P < .05$). Continuous variables are given as mean ± standard deviation.

these procedures are overly simplistic and likely to be inefficient in their use of resources or deny care to patients where it would be appropriate.

The MTFR group was most commonly referred for management of edema, which can have a detrimental effect on both the function and esthetic appearance of the hand after surgery.⁹ Rapid control of edema is therefore paramount, and treatment should be initiated early.¹⁰ Exaggerated or persistent edema would be an appropriate indication for HT. Although there is no consensus on the best therapy for management of subacute edema, conventional techniques and functional training can successfully decrease edema, pain with activity, and improve range of motion.^{11–13} Other practices such as transcutaneous electrical nerve stimulation can be a valuable therapeutic tool for upper extremity pain,¹⁴ and work hardening protocols can be designed to promote an early return to productivity. For scar-related disability, pressure therapy can help restore extracellular matrix organization.¹⁵ Ultimately, a close rapport between surgeon, therapist, and patient is important for a successful outcome.¹⁰ Patients who have undergone MTFR, as well as STFR with concomitant CTR, often require a HT referral, and therefore these vulnerable populations may benefit the most from an early preoperative rehabilitation protocol.

This study should be interpreted in light of its limitations. First, this is an observational study, and we cannot determine why some patients required therapy or whether they benefited beyond the natural history of recovery. Second, the determination of edema was a clinical judgment subject to the biases of the examiners. As all patients develop some degree of edema, we cannot offer a specific volumetric threshold at which an early referral to HT should be considered. Third, although we identified subpopulations of TFR at risk for postoperative edema, we cannot say conclusively that application of these criteria as a triage algorithm or that earlier initiation of HT would result in improved outcomes. And finally, the contribution of patient comorbidity to the rate of initial disease progression as well as rate of recovery can be variable and is difficult to discern in a retrospective analysis. For instance, there is a higher rate of stenosing tenosynovitis and peripheral neuropathy in patients with diabetes, with a recent study demonstrating a 2.6% lifetime incidence of flexor tenosynovitis in a healthy population as compared with 16.5% in the diabetic population, and there are additional reports of delayed healing or recovery in this patient population, as well.^{7,16,17}

This retrospective review does, however, provide information that is of value in counseling patients with regard to their likelihood of requiring postoperative HT and points to the need for research that would support evidence-based triage algorithms for referral to HT. Randomized clinical trials that look at large groups of patients where everyone is sent for therapy regardless of need are likely to underestimate the benefit of therapy. The smaller the percentage of patients with specific indications for HT, the more likely that the benefits to HT will be missed in clinical trials or cohort studies. Indeed, this study is a first step toward understanding the needs of the MTFR population with the ultimate goal of streamlining care and improving outcomes by considering indications for HT referrals.¹⁸

Future studies should look at the effectiveness of early HT referrals after elective hand surgery in populations with specific indications, paying particular attention to critical benchmarks such as

QuickDASH and return to work times. There is some early evidence to suggest that even one HT visit focusing on patient education after minor hand surgery such as CTR leads to favorable outcomes, but randomized trials are needed to quantify the benefit.¹⁸

Conclusions

This study suggests that surgical indications and clinical presentation play an important role in who is referred for HT after simple elective hand surgery. Specifically, we have found an increased referral rate to HT after multiple trigger figure releases when compared with a single trigger figure release, most likely due to increased reports of edema and pain. To improve future research, studies that identify patients in need of early HT intervention should supplement simple parallel trials of postoperative therapy, which rarely screen patients for indications before trial inclusion.

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Quiz: # 637

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- # 1. Data were collected
 - a. preoperatively and at 2 months post operatively
 - b. preoperatively and at 2 weeks post operatively
 - c. at 2 weeks post operatively, and at 2 months post operatively
 - d. at 2 days postoperatively, and at 2 weeks post operatively
- # 2. Data were collected through
 - a. physician evaluations
 - b. patient interviews
 - c. videography
 - d. the DASH & pain rating
- # 3. The authors suggest that
 - a. outcomes will not be significantly different regardless of when hand therapy is initiated
 - b. surgeons are trained to wait to observe swelling or pain post operatively before making a decision to refer to hand therapy
 - c. referral to hand therapy after the first post op visit is a delay which may adversely affect outcomes
 - d. best practices should be to refer patients to hand therapy after the first post op visit
- # 4. Risk of comorbidity was assessed using
 - a. an ICC
 - b. the CCI
 - c. the ICU
 - d. a CCC
- # 5. There was an increased rate of referral to hand therapy in the multiple trigger finger group
 - a. true
 - b. false

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