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Injection Treatment of Trigger Finger in Patients with Previous Injection Resistant Trigger Finger

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By

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Abstract

HYPOTHESIS:

The purpose of this retrospective chart review was to quantify the effectiveness of steroid injections have in treating new trigger fingers in patients with a history of injection resistant trigger finger.

METHODS:

Forty-three study subjects were defined as those patients who presented with trigger finger, underwent at least one steroid injection followed by surgical release of the A1 pulley, and subsequently represented with another trigger finger in a distinct digit and compared to a group of 40 control subjects presenting with first trigger fingers. Demographic data, PMH, and treatments for trigger finger were recorded. Subjects were surveyed to assess any residual symptoms and level of satisfaction with injection treatment. The control and study groups were then compared by student's T test for any statistically significant differences in measured outcomes. Decision Tree Analysis of cost for treatment of repeat trigger finger was employed using Precision Tree Software.

RESULTS:

The study group had higher proportion of injection resistant trigger finger than control group with 49% (21/43) of patients and 38% (35/91) of digits proceeding to surgery vs 23% (9/31) of patients and 22% (11/38) of digits in the control group (p values 0.01 and 0.05 respectively). There were no significant differences in number of injections before surgery or resolution of symptoms, the duration of symptoms before

first injection or before surgery, patient satisfaction with injection treatment, or patient willingness for future injection treatment. 87% (26/30) study group digits had complete resolution of symptoms on survey vs 57% (16/39) digits in the control group (p value 0.011) with the most common side effect being stiffness.

There were no significant differences in gender, age, and medical comorbidites between the two groups including diabetes. The study group had statistically significant higher incidence of carpal tunnel syndrome (p value 0.0001), Dupuytren's disease (p value 0.026) and occupational exposure (p value 0.012).The distribution of affected fingers differed with trigger thumbs being more prevalent in the control group (p value 0.0044). Precision Tree Software revealed that injection treatment was a cost efficient method of treating trigger digits in patients with previous injection resistant trigger finger.

SUMMARY POINTS:

Patients returning for with a new trigger finger after having required surgery for another finger can still respond to non operative treatment, specifically a steroid injection. It is our clinical recommendation that steroid injection treatment should be considered for initial or repeat presentation of trigger finger.

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Contents

Background:

Trigger finger, or stenosing tenosynovitis, is a condition where the normal smooth gliding of the flexor tendons through the fibrous tendon sheath of the digit is altered. Inflammation where the flexor tendon enters the sheath leads to either thickening of the fibrous pulley and/or inflammation or nodular enlargement of the tendon. This enlargement of the tendon results in locking and clicking symptoms of the affected finger where the patient is unable to fully extend of flex the finger without the area of tendon enlargement becoming trapped within the tendon sheath.

Anatomy and Pathobiology of Tenosynovitis

Normal finger flexion is a finely coordinated movement initiated by the flexor digitorum superficialis and profundus that reside in the palm of the hand. The muscle belly is connected to the phalanges by a flexor tendon that is guided by a tendon sheath and complex pulley system composed of eight focal thickenings of the flexor tendon sheaths. These flexor tendon sheath thickenings are referred to as the five annular pulleys (A1 thru A5) and the three cruciate pulleys (C1 thru C3) (Figure 1). These retinacular structures serve two functions: first they maintain the flexor tendon position relative to the bones and second, they provide a fulcrum to generate increased power of flexion to prevent bowstringing of the flexor tendon.

The tendon sheath has a membranous, synovial component. The synovial sheath is a double walled hallow tube containing synovial fluid through which the flexor tendon

travels that extends proximally to the carpal tunnel in digits I and V, and to the MP joint in digits II, III, and IV (1).

Some controversy exists in the literature regarding the precise histology of the normal A1 pulleys and the histology of trigger finger affected pulleys (2) (3) (4) (5). Sbernardori and Bandiera compared sections of the central portion of 40 A1 pulleys from adult patients with symptoms of trigger finger from sections from 10 healthy volunteers were subjected to light and electron microscopy to study the histology and ultrastructural make up of the samples (6). They showed differences in the connective tissue structure of the normal A1 pulleys vs pathologic ones. Normal pulleys consist of two distinct connective tissue layers, an inner layer of organized collagen bundles with occasional fibrocytes and scant extracellular matrix, and an outer layer of loosely organized collagen (shown in Figure 2).

They found in the pulleys of triggering digits, there were three distinct histologic layers. There was an additional inner layer (labeled c in figure 3) that was not present in the normal samples consisting of irregularly organized collagen with more extracellular matrix, with round cells organized lacunae and islands of chondroid metaplasia. The other two layers were as described for the normal pulleys. The underlying flexor tendons exhibit a nodular or fusiform swelling and with granulation tissue—both believed to be secondary to stenosis caused by the thickened tendon sheath.

Chondroid metaplasia, is the formation of cartilage-like cells in tissues where they are not normally found. Beyond trigger fingers, this finding has also been described as part of a degenerative process that takes place in the rotator cuff supraspinatus tendon (7)

and in the ACL (8). Several cell lines are capable of differentiating into chondroid–like structures including fibrocytes (9), tenocytes (10), and synoviocytes (11).

Several studies have characterized stimuli that are associated with chondroid metaplasia in tendons. Giori et al found that the level of compressive and hydrostatic forces on tendons correlated with the degree of fibrocartilaginous metaplasia (12). The tissue-level mechanical stimuli associated with forces where tendons and ligaments had to cross bony or fibrous pulleys appeared to regulate cartilaginous and fibrous matrix composition of connective tissues.

The presence of chondroid metaplasia and its association with abnormal mechanical stimuli could indicate that the pulley thickening associated with trigger finger is related to an increase of pressure in the A1 pulley as a result of abnormal frictional forces developed during digital flexion. These forces could precipitate differentiation of fibrocytes or other stem cells located in the visceral layer of the pulley towards chondrocyte like cells and fibrocartilaginous metaplasia. Based on its anatomic location, the A1 pulley, may be particularly stressed during digital motion.

Clinical Presentation and Evaluation

The classic clinical history of flexor tendon entrapment usually refers to a slow onset of pain symptoms that occur more frequently over time. During this “pretrigger” phase, pain is worsened by exercise or hand-use intensive labor. Stage II, the “active stage”, refers to objective presence of clicking of the symptomatic finger which the patient is able to overcome by actively extending the finger. This stage progresses to stage III or the “passive” stage during which the patient cannot actively overcome the discrepancy

between tendon and flexor sheath diameter. As a result, the patient must manually extend the finger by forcing it to straighten with the asymptomatic hand (stage IIIA) or the patient is unable flex the finger (stage IIIB). The final stage IV, is the presence of rigidity of the finger in a flexion posture (13). These findings are confirmed on physical examination (Table 1).

Treatment Options

Treatments for trigger finger in order of invasiveness include splinting, NSAIDs, physical therapy, corticosteroid injections, and surgical release of the tendon sheath. There are no level 1 or level 2 studies that assess the effectiveness of exercise, physical therapy, splinting, or treatment with non-steroidal anti-inflammatory medication in the orthopaedic literature.

Physical Therapy, Exercise, and Splinting

There are no trials assessing exercise, stretching, mobilization, and hot or cold modalities. However there are some studies that assess splinting as a modality for the treatment of trigger fingers. The goal of splinting is to alter flexor tendon biomechanics to minimize force over the affected joint while maximizing tendon glide (14). At this point there is no agreement in the literature as to which joint to include in the splint and the degree of joint positioning. There have been no trials comparing different joint splint strategies and there are no standardized protocols for splinting.

Colbourn et al. evaluated the efficacy of custom thermoplastic splinting in 28 patients (14). Patients wore a low-profile custom thermoplastic MCP blocking (ring) splint for

six weeks and pre and post outcomes measured. After the use of a splint, there were statistically significant improvements in the stenosing tenosynovitis grade, numeric pain rating scale, the number of triggering events in ten active fists, and in the participant perceived improvement in symptoms. Grip strength did not significantly change. However, it is impossible to gage the significance of these effects without a control group.

Another prospective study in 21 manual workers assessed splinting of the DIP joint (15). Splinting was the primary intervention, and a single corticosteroid injection was offered if triggering was stage 4 or greater. After mean follow up of one year, 81% of digits (50% of patients) were treated successfully. This study also lacked a control group.

A third study of 50 patients assessed splinting of the MCP joint at 10-15 degrees of flexion for an average of 6 weeks (range 3-9 weeks) (16). In this protocol, the DIP and PIP joints were free to move. Outcomes of the splinted subjects were compared to another 50 patients who received a corticosteroid injection. Treatment was successful in 66% of splint treated patients as compared to 84% of injection treated patients.

Non-Steroidal Anti-Inflammatory Medication

Non-steroidal anti-inflammatory medications can be used in the treatment of trigger finger for pain control (17). There are no trials in the English literature showing the effectiveness of non-steroidal anti-inflammatory medications in the treatment of trigger finger symptoms such as triggering or locking.

Steroid Injections

Injections with corticosteroids are the most commonly used treatment for trigger finger (18) and were described as early as 1953 (19). The goal is to place the medication directly into the flexor tendon sheath, though injection in proximity of the sheath has also been shown to be effective (20) (21). Common medication combinations used include 0.5 ml of the steroid dexamethasone (4 mg/ml) combined with 0.5 ml of 1% plain lidocaine or .5 ml of triamcinolone with 0.5 ml lidocaine mixed in a 3 cc syringe, utilizing a 5/8 no 27 needle (22) or 1.0 mL betamethasone, 0.5 mL of 1% plain lidocaine and 0.5 mL of 0.5% bupivicane.

Injection treatment for trigger finger has been shown to be effective in 67% (23) to 93% (24) for anywhere from 1-4 injections per finger. A recent double blind randomized placebo controlled trial comparing saline placebo injection with 1 mL triamcinolonacetonide (TCA) in a total of 50 patient (25 in each group) showed that patients in the TCA group had a higher rate of immediate symptom improvement than in the control group 16/25 vs 5/25 (p value 0.001) and improvement in triggering 13/24 vs 5/22 (p value 0.053) (25). While this is the first randomized controlled study comparing corticosteroid treatment to placebo, it suffers from low subject enrollment.

There are two approaches to injection treatment for trigger finger. The conventional technique involves direct injections into the flexor tendon over the metacarpal head. This technique is associated with significant pain. In 1984, Carlson and Curtis described an alternative, midaxial technique that reportedly might minimize patient discomfort (26). In this technique the needle is pushed to the bone at the proximal phalange level

and then adjusted so that the head of the needle enters the flexor tendon sheath. The surgeon will know that they have successfully entered the tendon sheath as the medication should be easily injected. Two studies have compared the conventional technique (CI) and midaxial technique (MAI). In an abstract presented at the ASSH by Bernstein RA, MAI and CI were compared in an RCT in 115 subjects where success rates in resolving triggering symptoms were 72% and 73% for CI and MAI respectively (p value > 0.05, non-significant) (27). Patients also quantified their pain using a Visual Analog Pain scale and there was no statistically significant difference on whether one approach was more painful.

A second study comparing the two techniques quantified pain by Visual Analog Pain Scores (VAS) and found scores of 40.19 ± 23.3 and 48.39 ± 26.5 for the MAI and CI technique groups, respectively (28). These scores were not statistically significant by students T-test. The authors also conducted a Pearson's chi squared assay. The authors categorized patients into groups with pain scores ≥50 and pain scores <50. The chi squared test was statistically significant (p value < 0.05), however, it is unclear whether these categories are clinically significant, especially given the large spread of data (approximated by the standard deviations), non-significance of the student's T test, and arbitrariness of the category distinction given that the VAS score is a continuous variable.

Traditionally, physicians attempt to inject steroid medication within the synovial sheath, the goal being to provide the highest concentration of medication possible to the area of pathology. Intrasheath injections however do come with additional risk of damage to the flexor tendon. The effectiveness of intrasynovial vs extrasynovial injection was first

assayed by Taras et al assessed the injection location with radiopaque dye (20). In a prospective trial, Taras et al found those subjects who had intrasheath injections had a 47% resolution of triggering, those who received medication both in the subcutaneous tissues and intrasheath (due to leak as tracked with the radiopaque dye) had 50% resolution of symptoms, and those who had subcutaneous injection had 70% resolution of symptoms. The authors concluded that there was no benefit to intrasheath injection compared to subcutaneous injection.

The relative benefit of intrasheath injections was revisted by Kazuki et al in a prospective cohort of 100 patients with triggering symptoms graded into three classes of severity (grades I-III in order of increasing severity). There was no control or placebo group. They found that pain was relieved in 98% of the cases and triggering relieved in 74% of cases (21).

The most common side effects of steroid injection for trigger finger are steroid pain flare and skin blanching at the site of injection. The steroid pain flare is an increase in pain after the initial injection and is thought to be caused by the crystallization of steroid crystals leading to a transient increase in pain that resolves over time (29). Other side effects include infection and a transient increase in blood sugar in patients with diabetes. The increase in blood sugar in diabetics can be marked, especially the first morning after injection where one study showed an average increase in blood sugar of 73% above average preinjection levels. The increase in blood sugar can last at least five days, with an average increase in blood sugar of 26% above preinjection levels at day five (30). A review of the literature reveals case reports of rarer side effects such as necrotizing fasciitis (31), multiple pulley rupture (32), delayed flexor digitorum

superficialis and profundus tendon rupture (33), and shower emboli with associated digital necrosis (34) can be associated with trigger finger steroid injection.

Rozental et al prospectively followed a cohort of 130 patients with primary presenting trigger fingers to quantify prognostic factors associated with symptom recurrence including patient demographics, comorbidities, and aspects of their symptom presentation (35). They found that insulin dependent diabetes mellitus was a strong predictor of symptom recurrence ($p < 0.01$). Independent predictors of surgical release included younger age ($p < 0.01$), multiple symptomatic digits upon initial presentation ($p < 0.01$), and history of other upper extremity tendinopathies ($p = 0.02$). Interestingly duration and severity of symptoms were not for predictors surgical release. This group also performed Kaplan-Meir analysis to follow the symptom-free duration following injection treatment. Ultimately 56% of the digits followed in their cohort had a recurrence of symptoms within one year following injection treatment.

Injection resistance in patients with diabetes was studied in a prospective, double blinded RCT where cohorts of thirty diabetic patients and twenty nine control patients were randomized to receive either placebo or corticosteroid injections; success was defined as resolution of symptoms such that surgical intervention was not required (36). Consistent with the Roznetal study, diabetic patients were found to have a lower success rate than non diabetic patients (p value 0.03). Interestingly, within the diabetic group, corticosteroids did not decrease the surgery rate significantly over placebo, however, as there were only 30 patients in the diabetes group, this study may have been underpowered to show non-significance.

Associated Hand Co-morbidities of Trigger Finger

Both trigger finger and carpal tunnel syndrome are associated with medical conditions such as diabetes mellitus, rheumatoid arthritis, and hypothyroidism. Kumar and Chakrabarti prospectively followed a group of 551 patients who did not have diabetes, RA, or hypothyroidism to determine if there was any independent association of carpal tunnel syndrome with trigger finger (37). Kumar and Chakrabarti found that 43% of patients with trigger finger also had carpal tunnel syndrome, and 21% of the patients with carpal tunnel syndrome also had trigger finger. This study was repeated by Rottgers et al who found a similar association between trigger finger and carpal tunnel syndrome (38). Rottgers et al also concluded that because of the high rate of comorbidity between the two conditions, patients that present with trigger finger should also be evaluated for carpal tunnel syndrome and vice versa.

Economic Considerations and Cost Effectiveness

Two studies have looked the costs associated with trigger finger treatment. In a study from the UK, Webb and Stothard (39) conducted a prospective, cost-minimization study on patients who presented with common hand conditions such as trigger finger, Dupuytren's disease, and hand ganglions. Each patient who presented to their clinic with injection resistant trigger finger was offered percutaneous release. Only those who failed two attempts at percutaneous release were then offered open surgical release; there were no exclusion criteria. All variable costs associated with the procedures including operating room and out-patient room time, basic consumables, nursing and anesthesia staffing. Medical personnel staff costs were considered fixed costs and were

excluded from analysis. Over the six month time period, 52 patients presented with trigger fingers, of which 44/52 (85%) were successfully treated as an outpatient with percutaneous procedure, and the remaining 8/52 (15%) were treated surgically. Cost savings for trigger finger treated in the outpatient setting vs in the operating room was 609£ (15£ outpatient vs 624£ surgical) resulting in 609£ greater net income for the provider based on a national tariff income of 1322£ for trigger finger (Figure 4).

Cost effectiveness of trigger finger treatment has also been studied in the American healthcare system (40). Kerrigan and Stanwix examined five strategies for treating trigger fingers including different combinations of injection, surgery, and percutaneous release seeking to identify the least costly algorithm.

Using decision tree analysis (DATA, TreeAge Software Inc), the five strategies were used to construct a five branched decision tree. Success in the decision tree was defined at no need for additional treatment within 8.0 weeks to 8.5 years (depending on the study), whereas failure was defined as necessitating additional intervention or lack of relief of symptoms. Success rates for the decision tree were calculated from existing literature, using the median success rate from all published trials for a given intervention. The treatment strategies assayed were 1) 1 steroid injection followed by surgical release for failures (steroid option 1), 2) 1 steroid injection followed by a second injection for failures followed by definitive surgery if needed (steroid option 2), 3) same as 2) with a third steroid injections before definitive surgery for failures (steroid option 3), 4) surgical release, and 5) percutaneous release with definitive surgery for failures. The decision tree is shown in Figure 5.

The authors found that Steroid option #2 (one steroid injection followed by a second injection for failures followed by definitive surgery if needed) was the most cost effective option for treatment of trigger finger. On average, surgery cost payers (such as private insurance companies and Medicare) between 248% and 340% more than the steroid option #2. This option represents the least costly of acceptable treatment algorithms for the treatment of trigger finger.

Statement of Purpose & Hypothesis:

The goal of this study is to quantify the level of effectiveness steroid injections have in treating new trigger fingers in patients with a history of injection resistant trigger fingers. Thus the hypothesis is: If steroid injections are as effective in treating trigger finger symptoms in patients with previous injection resistant trigger finger as they are in primary fingers, then symptom recurrence rates should be equal in a sample of patients with primary trigger fingers as in a sample of patients with second trigger fingers who needed surgery for previous symptoms.

Clinical Significance:

There are currently no studies that address the efficacy of steroid injection treatments in those patients who have previously failed trigger finger injection treatment. As outlined in Kerrigan and Stanwix, there are multiple treatment algorithms for treatment of trigger fingers ranging from proceeding directly to surgery to up to three injections before considering surgery (40). There are no best practice guidelines published as of the date of this review. Given the potential heterogeneity of treatment algorithms of primary trigger fingers, one might assume there is also heterogeneity in the treatment of those patients presenting with secondary trigger fingers, especially in those patients who have previously had injection resistant fingers. Some orthopaedic surgeons might opt to proceed directly to surgical treatment given that the patient has in the past not responded to injections, the injections are painful (28), the patient may have a relapse of triggering symptoms (35), and surgery is relatively safe and the definitive treatment. However, the surgery is not without risks.

A recent chart review documented the rates of both major and minor complications in a cohort of 43 patients who underwent 78 open releases of A1 pulleys for trigger finger (41). The found a major complication rate (i.e. complications that required further surgery) of 3% (2/78) and a minor complication rate (i.e. complications that resolved with non-operative treatment or did not reduce function) of 31% (24/78). The major complications included a synovial fistula that required excision and proximal interphalangeal joint arthofibrosis which caused pain. Minor complications included decreased range of motion, scar tenderness, pain, and wound erythema. The authors noted that the rate of minor complications was surprisingly high.

The ultimate goal is to provide the patients with effective treatment for their trigger finger condition while minimizing risk. Given the potential for both major and minor complications during open pulley release for trigger finger, our study hypothesis sought to determine whether trial of injection treatment should be attempted in a population of patient who had previously failed injection treatment. Steroid injection is a less invasive procedure than open release of the A1 pulley and carries a lower rate of complications. At the same time, if injections were ineffective in a population of those patients who have previously failed injection treatment and required surgery, then patient suffering would be prolonged if they were subjected to a trial of steroid injections.

Methods:

Trigger Finger Sample

One hundred sixty three patients who presented to the study sponsor's practice between the years of 1999 and 2008 were identified as potential candidates for the chart review by CPT code search for code 26055 - Tendon Sheath Incision (eg, for trigger finger)). Of these 143 original patients, a subset of 43 patients with a history of at least one episode of injection resistant trigger finger treated surgically that subsequently developed a second trigger finger treated was identified. Exclusion criteria were presence of rheumatologic disease or previous treatment with steroid injection. Participants ranged in age from 40 to 84 years at the time of presentation of their index case trigger finger (average age at index case presentation 58.8 years). The gender distribution between males and females was biased towards females who made up 70% of the sample (30 females, 13 males).

Additional descriptive data collected included past medical history of diabetes, hypothyroidism, or OA, non-injection and non-surgical treatment of trigger finger, BMI, history of other upper extremity orthopedic conditions, and treatment for upper extremity orthopedic conditions.

Control Sample

The comparison sample consisted of 56 consecutive patients presenting with primary trigger fingers treated with injection between the dates of 3/1/08 and 6/1/08. Exclusion criteria were presence of rheumatologic disease, previous treatment with steroid injection or surgery for trigger finger. Of the 56 consecutive patients, 40 met eligibility

requirements for the study. These participants ranged in age from 44 to 81 years of age (average 65 years at time of presentation of index case trigger finger). The gender distribution between males and females was biased towards females who made up 65% of the sample (26 females, 14 males). Additional descriptive data was collected as described for the study group.

Procedure

The charts of the 83 adults (43 study patients and 40 controls) were reviewed and data obtained regarding their past medical history relevant to trigger finger (presence of diabetes, insulin treatment for diabetes, hypothyroidism, or gout), demographics (age at presentation, BMI, sex, and occupational exposure), as well as the presence of any other upper extremity pathology and associated treatment for the upper extremity pathology. The subjects were then consented as described in Yale HIC # 0912006039 and surveyed by phone using form 1 shown in the Appendix.

The control and study groups were compared on all metrics including demographic information trigger finger characteristics, incidence of treatments including injection and surgery, and survey data. A student's T-test was used to assay the significance of differences between the two groups. A P-value of less than or equal to 0.05 was considered statistically significant. Success of the corticosteroid injection was defined as the absence of triggering symptoms at 12 month followup.

Results:

Demographics and Trigger Finger Characteristics

There were no differences in gender distribution and BMI between the two groups (p values of 0.65 and 0.46 respectively). However, there was increased incidence of occupational exposure in the study group where the control group subjects had 15% (6/40) prevalence of occupation exposure (as reported by the patient as either workman's compensation or hand-intensive occupation or hobby) and while the study group had 40% (17/43) prevalence (p value 0.01). There were no differences in the prevalence of other medical comorbidities including diabetes (p value 0.95), diabetes treated with insulin (p value 0.96), hypothyroidism (p value 0.59), and gout (p value 0.96). There was no difference between the two groups in the incidence of hand osteoarthritis, as diagnosed radiographically (p value 0.36).

Factors characterizing the trigger finger were tracked. The forty patients in the control ultimately presented with forty-nine affected fingers (average 1.23 fingers per patients, range 1 to 3 fingers). The forty-three patients in the study group presented with ninety-one fingers (average 2.12 fingers per patient, range 1 to 6). Right hands were affected 73% (28/49 fingers) of the time in the control group and 54% (49/91 fingers) of the time in the study group (p value 0.11). Dominant hands were affected nearly twice as often in the control group than the study group 73% vs 42% though with the numbers available this was not statistically significant (p value 0.08).

The distribution of fingers affected also differed between the control group and the study group. Trigger thumbs were more prevalent in the control group with 41% (20/49) of digits affected as opposed to 19% (14/91) in the study group (p value 0.0044). There

was a statistically significant higher prevalence of index fingers in the study group as well with 15% (14/91) fingers affected as opposed to 4% (2/49) in the control group (p value 0.045). Overall, the distribution of trigger digits was more even in the study group as opposed to the control group where the majority of digits affected were thumbs, third, and fourth digits.

Hand Co-morbidities

As described previously, several hand conditions have been associated with trigger finger. Seven of the most common upper extremity conditions were tracked for comparison. Statistically significant differences between the study and control groups were found in the prevalence of carpal tunnel syndrome and Dupuytren's disease (p values 0.0001 and 0.026 respectively). Prevalence levels of other hand conditions such as the presence of cysts, Dequervain's tenosynovitis, RSI, shoulder impingement, and epicondylitis were not statistically different (p values ranging from 0.59 to 1.00).

Levels of treatment for other hand morbidities ranged from non-operative interventions such as splints, physical therapy, injections, and NSAIDs, as well as surgical procedures were not statistically different between the control and study groups (p values ranging from 0.1 to 0.64).

Survey Data

Patients were surveyed by telephone to 1) determine if patients had any treatments for trigger finger besides those documented in the patient's charts and 2) to quantify the

residual symptoms and relative satisfaction the patient had with injection treatment for trigger finger. Eighty percent (32/40) of control group patients were available for followup vs only 56% (24/43) of study group patients (p value 0.019). This was likely due to the fact that many study patients were several years out from their last visit for trigger finger and their contact information was not updated. No patients in either the control group or the study group had either injection treatment or surgery for trigger finger at any facility outside of RAB's practice.

Patients were also surveyed regarding any residual symptoms after either injection treatment or surgery. Final followup was defined as the time elapsed from the last injection treatment to the date of survey and was 44.75 months (range 3.53-112.73) for the study group and final follow-up 16.3 months (range 5.0-21.3) for the control group. The most common symptom after injection treatment was stiffness in 32% (9/28) control subjects and 0% (0/24) study subjects (p value 0.011). Pain was the second most common symptom in 11% (3/28) control group subjects and 10% (3/30) in the study group. No patients in either group who had injection treatment were experiencing any clicking or locking at followup. 91% (21/23) of patients in the control group were satisfied with injection treatment for trigger finger vs 83% (10/11) in the study group (p value 0.5). Ninety one percent (21/23) of patients in the control group would be willing to undergo injection treatment for trigger finger again vs 83% (10/11) in the study group (p value 0.5).

Injection Efficacy and Surgery Rates

We assayed whether longer duration of trigger finger symptoms before injection treatment with increased nonoperative treatment failure rates. Tables 6a, 6b, and 6c compare the duration of symptoms before first injection and duration of symptoms before surgery to see if there was any difference. Table 6a compares patients in the control group who either required to surgery or those who did not. The average time between onset of triggering symptoms before first injection was 15.45 weeks in those who had surgery for trigger finger vs. 16.08 weeks for those control group patients who did not need surgery for their symptoms (p value 0.94). Time till surgery was 58.06 weeks for the control + surgery group.

Table 6b illustrates the same analysis for the study group. In patients in the study group who went onto have surgery for their triggering symptoms there was 15.20 week duration before first injection vs. 12.93 weeks for those study group patient who did not need surgery (p value 0.56). Time from onset of symptoms to surgery was 101.74 weeks for the study group.

Table 6c compares the control group with the study group. Among those patients who had surgery, the control group averaged 15.45 weeks and the study group averaged 15.20 weeks before first injection (p value 0.97). The control group averaged 58.06 weeks of symptoms before surgery vs. 101.74 weeks for the study group (p value 0.073). Among those who did not need surgery for their triggering symptoms, the study group had on average 16.08 weeks symptoms before first injection and the study group averaged 12.93 weeks (p value 0.55).

The absolute prevalence of surgical treatment in the control and study groups was compared. There were 23% (9/40) control group patients who needed surgery for their symptoms vs. 49% (21/43) of patients in the study group (p value 0.01). Among digits, 22% (11/49) of digits in the control group needed surgery vs. 38% (35/91) in the study group (p value 0.05).

Effect of Diabetes

In Rozental et al, diabetes was found to be independently correlated with inferior outcomes of corticosteroid injection treatment (35). Table 9 shows the surgery rates for the diabetic and non-diabetic patients in both the control and study groups. In our sample groups, 25% (10/40) control group and 26% (11/43) study group had diabetes with 2.5% (1/40) insulin dependent diabetics in the control group and 2.3% (1/43) insulin dependent diabetics in the study group. There were no significant differences in the rates of surgery when comparing diabetic to non-diabetic patients, and when comparing control and study groups (p values ranging 0.30-0.94).

Multiple Presenting Fingers vs. Single Presenting Fingers

In Rozental et al, patients who presented with multiple trigger fingers had higher rates of corticosteroid injection treatment failure than those patients who presented with a single symptomatic finger (35). Table 10 shows the surgery rates for those who presented with multiple and single digits in both the control and study groups. Contrary to Rozental's study, there were no significant differences in the rates of surgery when

comparing multiple finger presenting and single finger presenting patients, and when comparing control and study groups (p values ranging 0.15-0.96).

Decision Tree Analysis

A decision tree analysis using Precision Tree Software© (Palisade Decision Tools) was performed using reimbursement values from Medicare obtained from Kerrigan et al of $171 for corticosteroid injection and $1227 for open release of flexor tendon for trigger finger (40). These direct costs included professional fees (those fees paid to the orthopaedic surgeon and anesthesiologist) and technical fees (incidental hospital costs, medications, supplies, nursing costs and equipment). Indirect costs were not considered (opportunity cost of time, QALY, etc). There were four treatment arms in our analysis for patients with previous injection resistant trigger finger requiring surgery representing with a new and distinct trigger finger: 1) Default directly to surgery, 2) One injection, if failure then surgery, 3) Two injections, if failure then surgery, 4) Three injections, if failure then surgery. Probabilities for the success of each arm were taken from the chart review data in this study. The decision tree was constructed and we found that with a success rate of 36.67% in our data set, three corticosteroid injections followed by surgery had the least economic impact at an average cost of $678.43. Three branch decision analysis shown in Figure 9 analyzes the economic impact of 1) Default directly to surgery, 2) One injection, if failure then surgery, 3) Two injections, if failure then surgery. The total value of the decision was $791.12 with the injection strategy of 2 injections followed by surgery being the decision with the least economic impact.

Discussion:

Stenosing tenosynovitis is a disease where there is gradual growth of a fibrous tissue over the flexor tendon of a finger or thumb that eventually leads to a relative narrowing of the flexor tendon sheath. This leads to friction between the thickened flexor tendon nodule and the connective tissue pulleys leading to pain, restricted movement, and the characteristic triggering or "popping" symptoms associated with trigger finger. A commonly accepted treatment protocol for primary presenting trigger finger is a trial of up to two corticosteroid injections into the tendon sheath followed by surgical release of the restrictive pulley if non-operative treatment is not successful. At this point, there are no studies addressing treatment protocols for those patients with a history of injection resistant trigger finger who present with new, distinct trigger. The hypothesis for this study originated when patients asked the study's sponsor, "because surgery was needed for another finger, will cortisone work for the new finger?"

The primary goal of the study was to determine the relative success rate of corticosteroid injections in our study population as compared to a control population of patient presenting with primary trigger fingers. As shown in Table 7, there was a statistically significant difference in the surgery rates where 49% (21/43) of study patients, 38% (35/91) of study digits had surgery (and thus failed non-operative, steroid injection therapy). This is compared with control group surgery rates of 23% (9/40) patients and 22% (11/49) digits (p values of 0.01 and 0.05 respectively). Patients in the study group had higher rates of surgery than those patients in the control group who were presenting with their first or primary finger. This result is significant for counseling patients who return with multiple trigger fingers in distinct digits after

having surgery for previous trigger finger as in this cohort, 51% of patients avoided surgery by using the less invasive injection treatment.

Long term follow up by telephone survey of those patients who underwent successful injection treatment found that the vast majority of both control group and study group patients were satisfied with injection treatment and would have the treatment again if needed. No patients underwent trigger finger treatment outside the study practice. The average follow up for the control group was significantly less than for the study group (average 16.03 months, range 5.0-21.3 for the control group vs 44.75 months, range 3.53-112.73 for the study group). The reason for this discrepancy was because the study group was gleamed from the entire duration of the sponsor's practice while the control group was obtained from a group of 50 consecutive patients who presented during a randomly chosen period of 3/2008-6/2008.

There was a statistically significant higher incidence of stiffness as a residual symptom after corticosteroid injection in the control group than in the study group in the telephone survey. Patients with 9/39 digits surveyed in the control group reported symptoms of stiffness vs. patients with 0/55 digits surveyed in the study group (p value 0.0005). This may be because all patients in the study group had surgery and injection treatments as well as a higher prevalence of hand pathology in general and thus have a different baseline for stiffness than the control group. Study group patients may be less likely to report mild symptoms of stiffness due to their higher baseline of pathology.

A secondary goal of the study was to determine characteristics of the study group that were distinct from a group of patients presenting with first trigger fingers (the control

group). Demographics analysis revealed that age, gender ratio, BMI, past medical history (including diabetes, hypothyroidism, and gout) were not significantly different between the control and study groups. Occupational exposure including hobbies was significantly higher in the study group than the control group (40% study group vs 15% control group, p value 0.0012). In addition to higher rates of occupational exposure, there were higher rates of carpal tunnel syndrome and dupuytren's contracture (p values 0.0001 and 0.026 respectively). The study group had a 44% incidence of carpal tunnel syndrome which when compared to the general population incidence of carpal tunnel syndrome is 0.1-0.3% per year with prevalence of approximately 0.5% (42). The high rates of carpal tunnel syndrome in our study group, consistent with previous studies (37) (38), underscores the need for patients with trigger finger to be concomitantly evaluated for carpal tunnel syndrome. The higher incidence of occupational exposure may the study group had a higher incidence of more diffuse hand pathology than the control group.

Interestingly, the distribution of triggering digits differed in the control and study groups. The dominant hand was more often affected in the control group (73% of the digits affected were from the dominant hand) while there was a more even distribution of triggering digits in the study group (only 42% of the digits affected were from the dominant hand); however this trend only approached significance with a p value of 0.083). The thumb was most often affected in the control group (41% of the time), while there was a more even distribution of affected digits in the study group. Together with the higher incidence of diffuse hand pathology, the distribution of affected digits

may indicate that there is an underlying predisposition to hand pathology rather than distinct overuse of a particular digit such as the thumb.

Rozental et al showed that insulin dependent diabetes mellitus and presentation with multiple fingers were independent predictors of non-operative management failure (35). On the contrary, our sample did not show any association with of comorbidity with diabetes or multiple fingers at first presentation with surgery rates. This could be due to sampling error as our samples were smaller than the cohort in the Rozental study. Consistent with the Rozental study, our samples did not show an association of duration of symptoms to first corticosteroid injection with surgical intervention.

The economic viability of treatment protocol options was explored in the framework of Kerrigan et al's study (40). Two decision tree analyses were performed, one including all data including those patients who against medical advice received opted to receive three corticosteroid injections in a single finger, and a second decision tree which only analyzed those patients that received either one or two injections, or surgery. Both decision trees showed that it was cost effective to proceed with three or two (respectively) injections rather than proceeding directly to surgery in those patients who had previously failed non-operative treatment for trigger finger. Sensitivity analysis revealed that the reimbursement rate of trigger finger surgery would have to fall below $678.43 in the case of three injections or below $791.12 in the case of two injections in order to favor surgery earlier in the treatment protocol.

There only a handful of studies as reported in Kerrigan et al have ever reported success rates of three corticosteroid injections for trigger finger, and there are no reports of the

success rates in patients with previous injection resistant trigger finger. Based on the limited data associated with three rounds of steroid injection for trigger finger, it is safest to follow the conventional trigger finger treatment protocol of a trial of up to two steroid injections followed by surgery if non-operative treatment fails for patients with a history of injection resistant trigger finger who present with new and distinct trigger digit(s).

Study Shortcomings and Future Directions:

The basic design of this study was a retrospective chart review that is considered a level 3 study. While the results of this study provide the first evidence to support the use of corticosteroid injections in patients who have had previous injection resistant trigger finger, it cannot be the basis on which clinical recommendations are made. Clinical recommendations are made based prospective, level 1 and level 2 clinical trials and cohort studies.

One reason a retrospective chart review was chosen as an initial study was as an initial assay of the efficacy of steroid injections in patients with previous injection resistant trigger finger was because of the relative rarity of the condition and clinical scenario. As outlined in the results of this study, of the many patients who presented to RAB's practice with primary trigger fingers over 10 years, only 143 patients needed open surgical intervention for their triggering symptoms after steroid injection treatment. Of those 143 patients who had surgery, only 43 patients returned after their surgeries with another distinct trigger digit. A prospective trial recruiting patients presenting with first

primary trigger digits would likely need to enroll 1000 patients in order to get a sufficient number of patient who proceed to surgery for their triggering symptoms, and then enough patients to return from surgery with another distinct finger to conduct a sufficiently powered analysis of the efficacy of steroid injections. A prospective trial of corticosteroid injections conducted in this fashion, or another similar prospective study would be necessary to establish firm clinical guidelines or recommendation for the use of steroid injections in these patients.

One potential shortcoming of the chart review conducted in this thesis was the lack of use of a standardized outcome measure to provide a validated meaure of the patient's subjective impression of the level of function and disability associated with their trigger digit(s) after injection treatment. The use of the DASH inventory was considered during the initial study design but was included not as the DASH has questions pertaining to the entire upper extremity and may not be sensitive enough to show subtle changes in the function of a single finger. The minimum difference in DASH inventory score necessary to show a clinically significant difference in outcome is 10 points and there may not be enough questions that pertain to finger specific function to be detected by the DASH. Another possible inventory that could be considered would be the Michigan Hand Outcomes Questionnaire. Given the low rates of finger complications and disability associated with injection, the phone survey was optimized to minimize confusion and focus on general satisfaction with treatment, our definition of "success" of injection treatment (+/- triggering), and rate of surgery. Should there be a prospective study looking at success rates of injections in this population with in-office visits, then an outcomes assessment should be used.

Finally, the cost analysis done in this study took into only took into account the direct costs associated with the treatment of trigger finger. In the pay-for-service model of healthcare that is present in the US, the direct costs to the third party payers such as insurance companies associated with trigger finger treatment can be approximated by the reimbursement rate for the CPT codes for injection into tendon or sheath and the code for open release of pulley for trigger finger. Ideally, a thorough costs analysis study would include other, indirect costs associated with treatment such as post operative care (revision surgery, rehabilitation, palliative and/or pharmacologic pain relief), the opportunity costs of the patient's time that might be spent more productively at work and the impact the condition and/or the treatment have on the patient's life. The latter, the impact the condition and/or treatment have on the patient's life can be approximated by the Quality Adjusted Life Year (QALY) which is a measure of disease burden and can be used as an outcomes measure.

Currently there are no models for QALY or accepted rates of complication associated with corticosteroid injections for trigger finger and only one retrospective chart review characterizing the complication rates of open surgical release for trigger finger (41). Given the lack of evidence characterizing complication rates and the subjective nature of determining QALYs for conditions such as trigger finger, the decision tree analysis in this study was limited to direct costs, approximated by the Medicare reimbursement rates published in Kerrigan and Stanwix (40).

Conclusions:

There are no published studies examining the responsiveness of trigger finger in patients with previous injection-resistant tenosynovitis in the English literature. Our study demonstrates that corticosteroid injections are effective in relieving the symptoms of triggering in 51% of patients and 62% of digits in our sample with previous injection resistant trigger finger presenting with symptoms in a distinct finger. Patients with injection resitant trigger finger have a higher rate of comorbidity with carpal tunnel syndrome and Dupuytren's contracture. Additionally, it is cost effective to follow a treatment strategy of a trial of two corticosteroid injections followed by surgery as opposed to proceeding directly to surgery. It is our clinical recommendation that a trial of up to two corticosteroid injections should considered for patients with a history of injection resistant trigger finger presenting with new and distict idiopathic tenosynovitis of the thumb and finger.

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Figure 1: Anatomy of flexor tendon showing the intricate pulley system that guides finger flexion. The pulley most often affected in trigger finger and subsequently released during open release for trigger figner is the A1 pulley.

Medscape. Flexor Tendon Anatomy: eMedicine Clinical Procedures. [Online] January 4, 2010. [Cited: January 4, 2010.] http://emedicine.medscape.com/article/1245236-overview. (43)

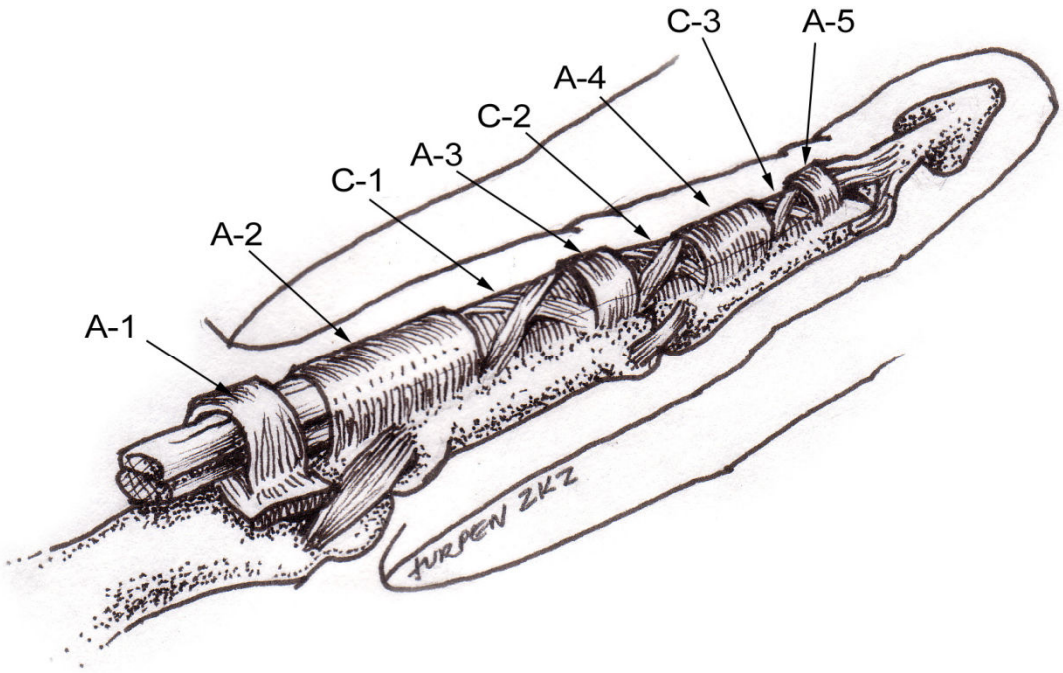

Figure 2: Normal and Pathologic Pathology of the A1 Pulley in Trigger Finger

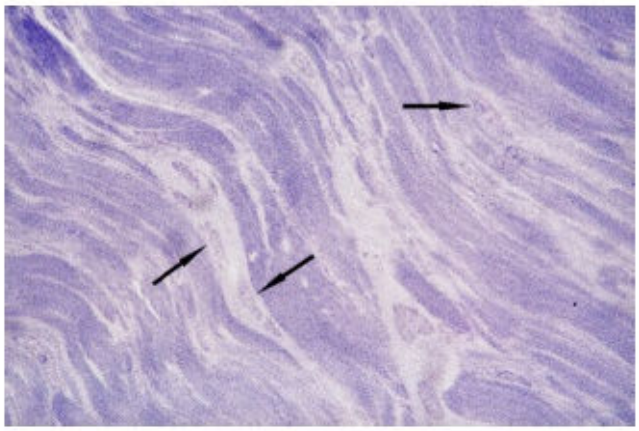

Fig 2 Specimen from a normal pulley. Among the fibres are seen spindle-shaped fibrocytes (arrows). (Semi-thin section. Toluidine Blue stain. Original Magnification × 250.)

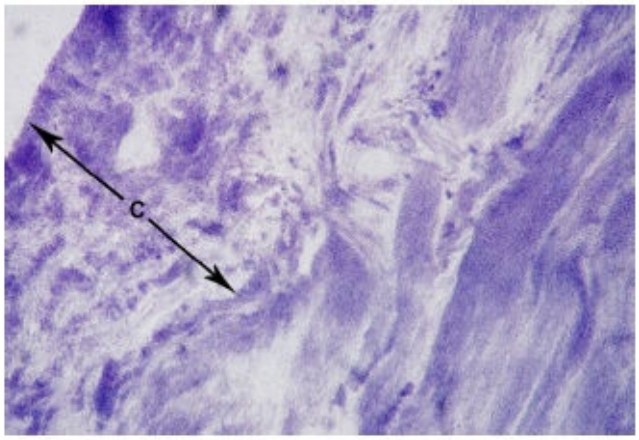

Fig 3 Specimen from a pathological pulley. The inner layer (C) is formed by a thin sheet of irregular connective tissue which faces the flexor tendons. (Semi-thin section. Toluidine Blue stain. Original Magnification × 250.)

Figure 2: Normal vs. pathological A1 pulley showing two normal layers of connective tissue in the top panel and three layers in the pathologic pulley. The inner layer, marked c, is postulated to be pathologic tissue.

Histopathology of the A1 pulley in adult trigger fingers. **Sbernardori MC, Bandiera P.** 2007, J Hand Surg Eur , pp. 32(5):556-9. Epub 2007 Aug 7. (6)

Figure 3: Chondroid Metaplasia in Trigger Finger

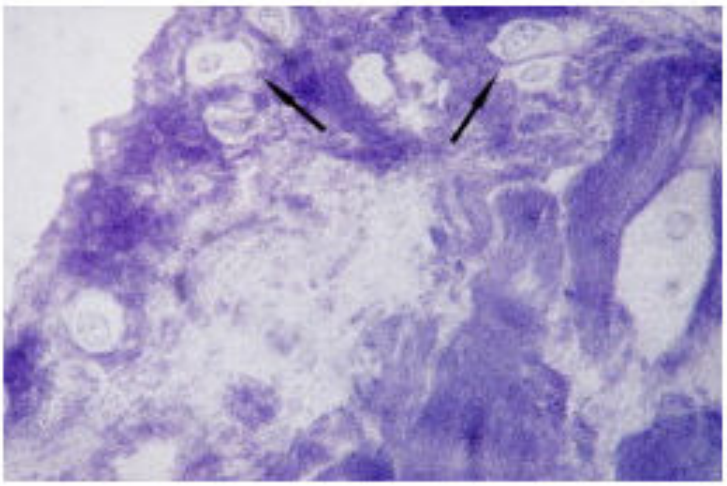

Fig 4. Specimen from a pathological pulley showing chondroid metaplasia (arrows) with cells which look like cartilaginous cells organised in "nests". (Semi-thin section. Toluidine Blue stain. Original Magnification×250.)

Figure 3: Chondroid Metaplasia in the pathologic A1 pulley (shown by arrows)

Histopathology of the A1 pulley in adult trigger fingers. **Sbernardori MC, Bandiera P.** 2007, J Hand Surg Eur , pp. 32(5):556-9. Epub 2007 Aug 7. (6)

Figure 4: Costs Associated with Trigger Finger Treatment

Table 2 **National tariff income and theatre/out-patient costings and net income for the treatment of Dupuytren's disease, ganglia and trigger digits in the study centre**

	Dupuytren's disease	Trigger digit	Ganglia
National tariff income (£)	1714	1322	
Cost in theatre (£)	624[a]	624[a]	624[a]
Cost in out-patients (£)	15[b]	15[b]	15[b]
Net income if performed in theatre (£)	1090	698	437
Net income if performed in out-patients (£)	1699	1307	1046

[a]£1872/3; [b]£185/12.

Figure 4: Costs associated with outpatient and surgical treatment in the UK. These are direct costs including both professional and technical fees including supplies.

Cost minimisation using clinic-based treatment for common hand conditions--a prospective economic analysis. **Webb JA, Stothard J.** 2009 Mar, Ann R Coll Surg Engl, pp. 91(2):135-9. (39)

Figure 5:

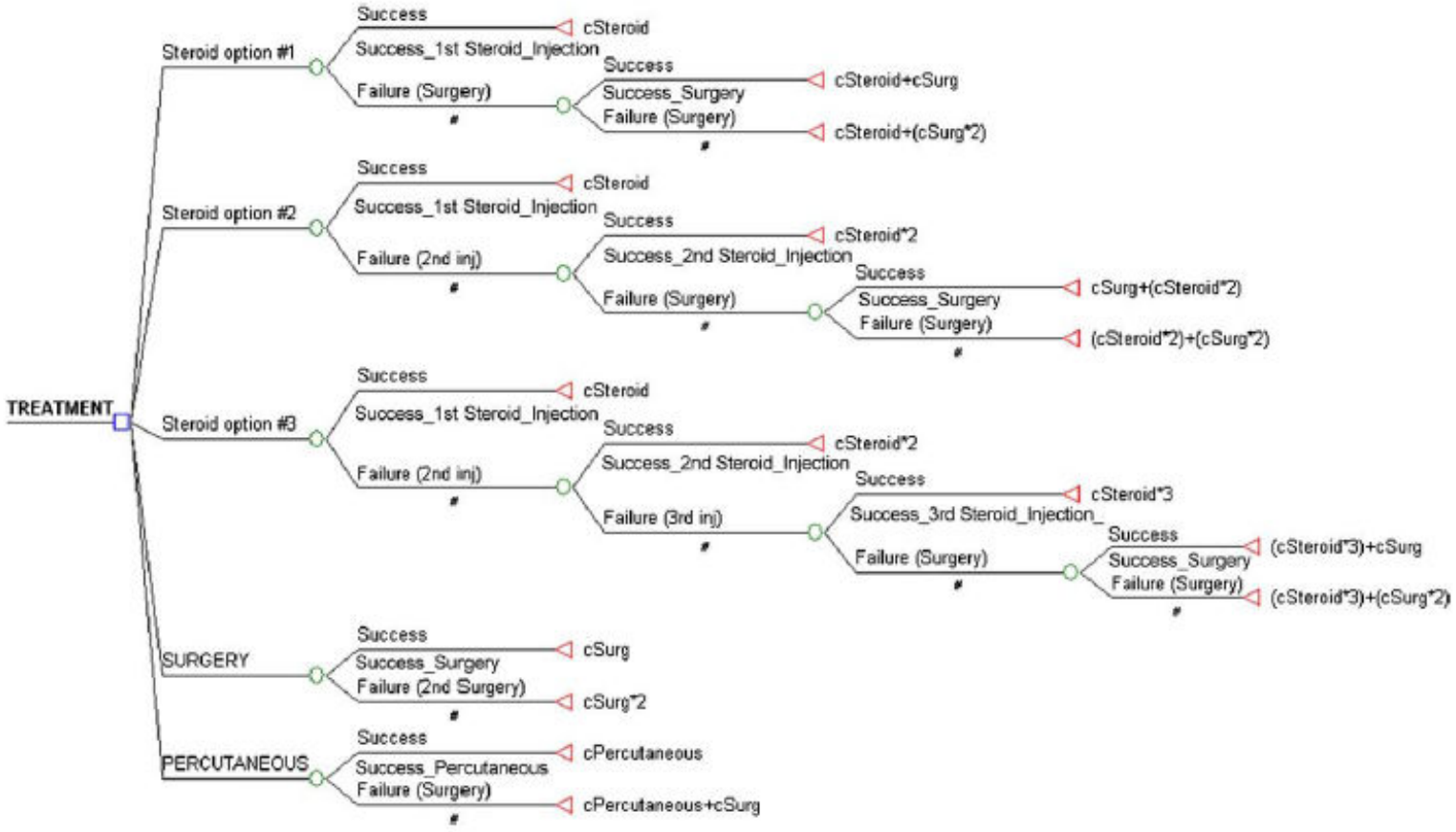

Figure 5: Decision Tree analysis for cost of trigger finger treatment strategies from Kerrigan et al. Five treatment arms are examined. *Using evidence to minimize the cost of trigger finger care.* **Kerrigan CL, Stanwix MG.** 2009, J Hand Surg Am. , pp. 34(6):997-1005. (40).

Figure 6a: Outcomes of Study Group

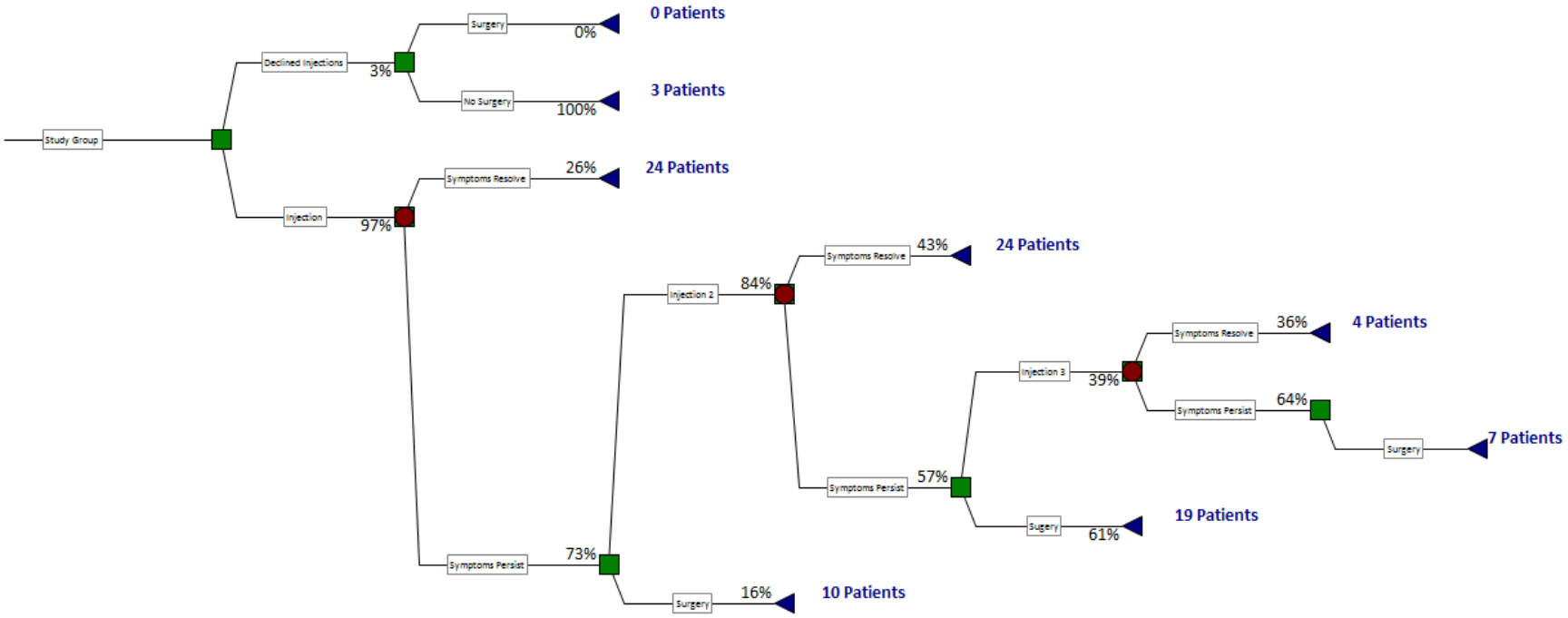

Figure 6a: Summary of outcomes in study group. A total of 91 digits were initially enrolled and had outcomes as shown in the figure above.

Figure 6b: Decision Tree Analysis using all treatment algorthims.

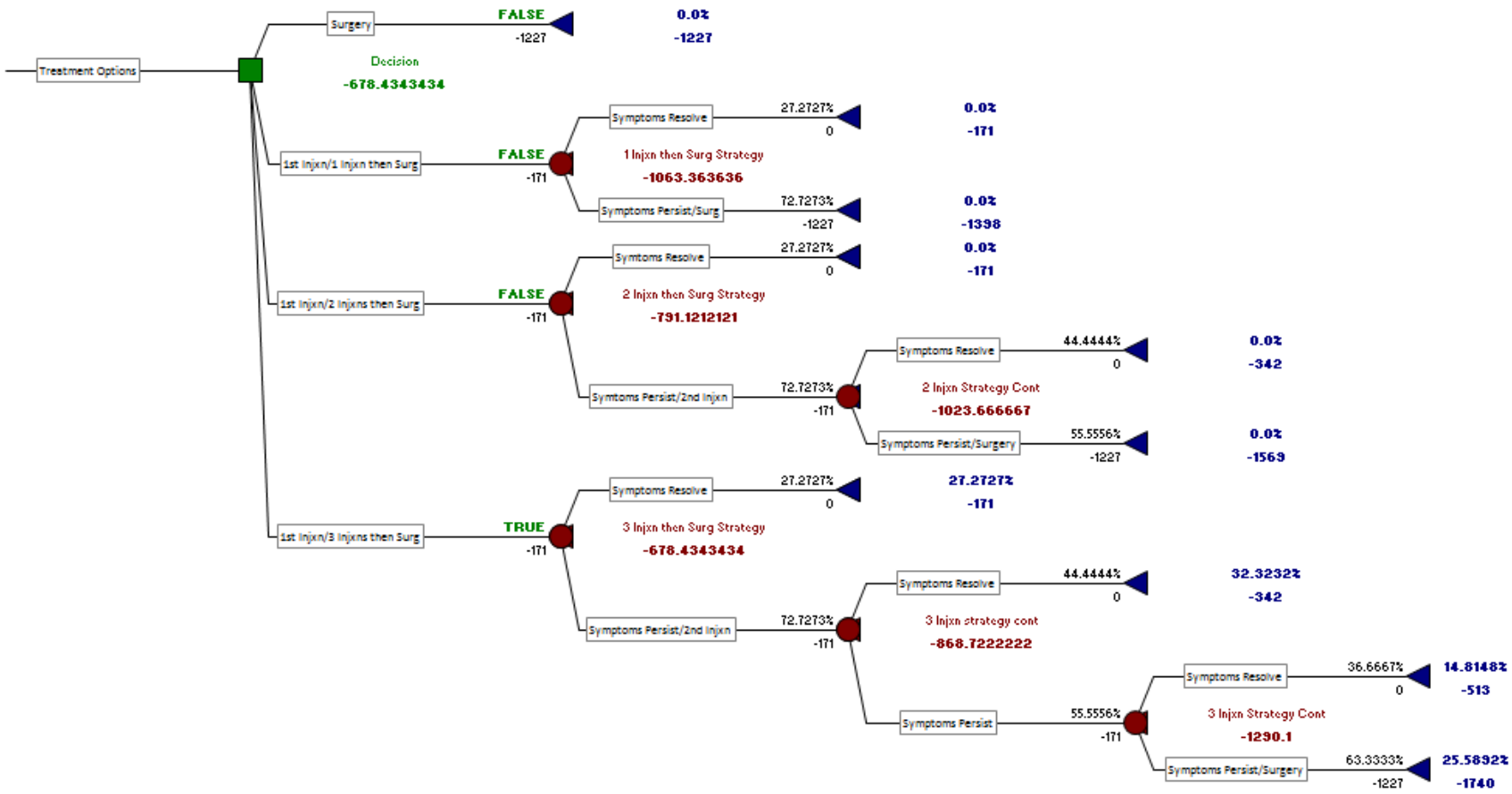

Figure 6b: Decision Tree Analysis for Patients with History of Injection Resistant Trigger Finger Presenting with New Trigger Digit with Four Decision Branches. The dominant branch (i.e. the branch with the lower average costs) is marked as TRUE and probability of each outcome marked in each branch end point (shown as a blue triangle).

Figure 7: Chart of Outcome Probabilities

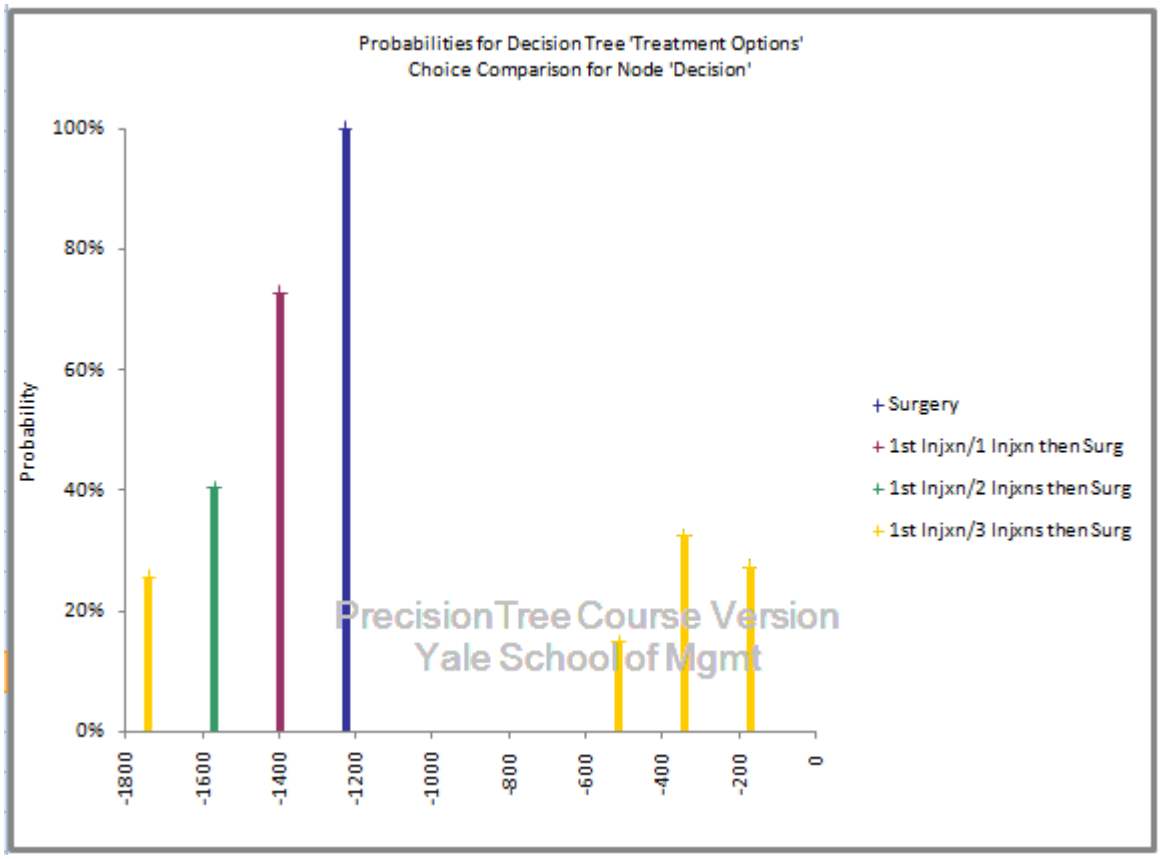

Chart Data

	Surgery		1st Injxn/1 Injxn then Surg		1st Injxn/2 Injxns then Surg		1st Injxn/3 Injxns then Surg	
	Value	Probability	Value	Probability	Value	Probability	Value	Probability
#1	-1227	100.0000%	-1398	72.7273%	-1569	40.4040%	-1740	25.5892%
#2			-171	27.2727%	-342	32.3232%	-513	14.8148%
#3					-171	27.2727%	-342	32.3232%
#4							-171	27.2727%

Figure 7: The bar chart shows the probability and value of each outcome in the decision tree shown in Figure 6b.

Figure 8: Sensitivity Analysis of Cost of Surgery for Decision Tree Analysis.

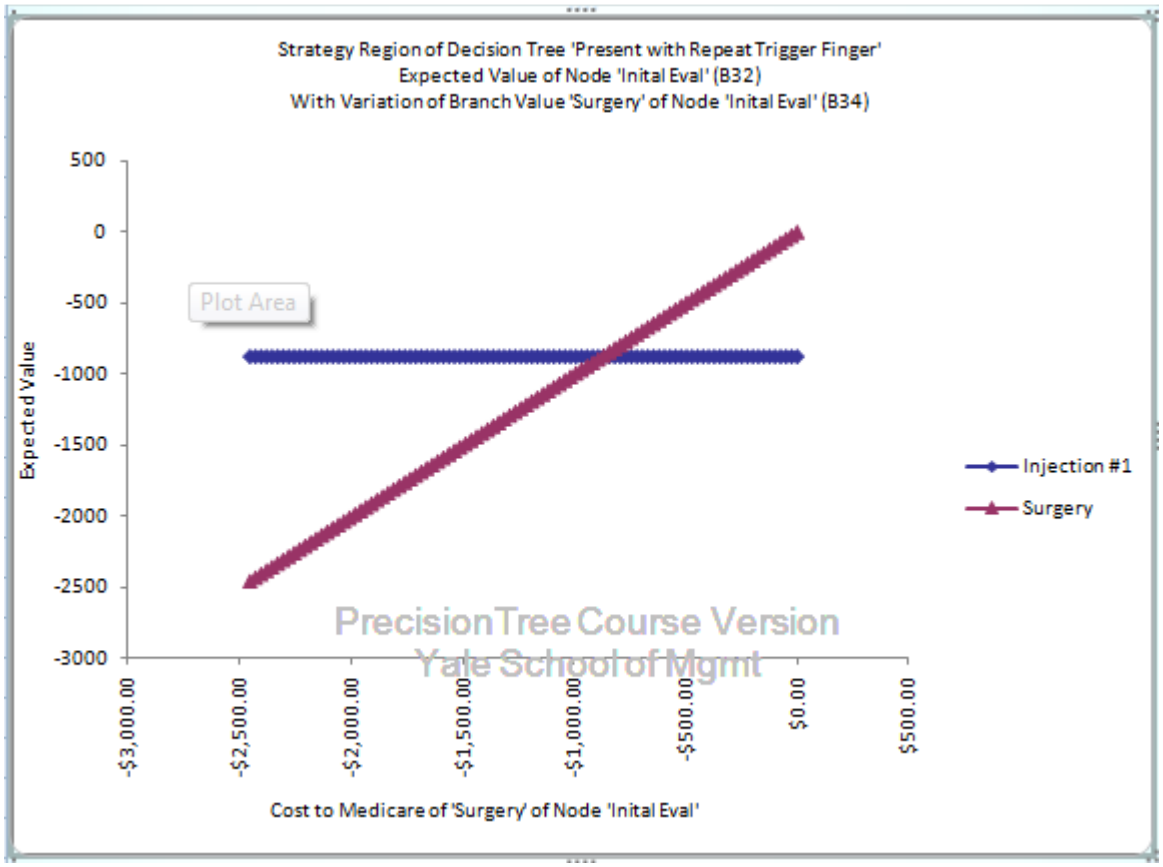

Figure 8: The sensitivity analysis varies the cost of surgery against the cost of injection. The point of intersection represents the cost of surgery at which surgery becomes more cost effective than injection treatment.

Figure 9: Decision Tree Analysis with Three Decision Nodes.

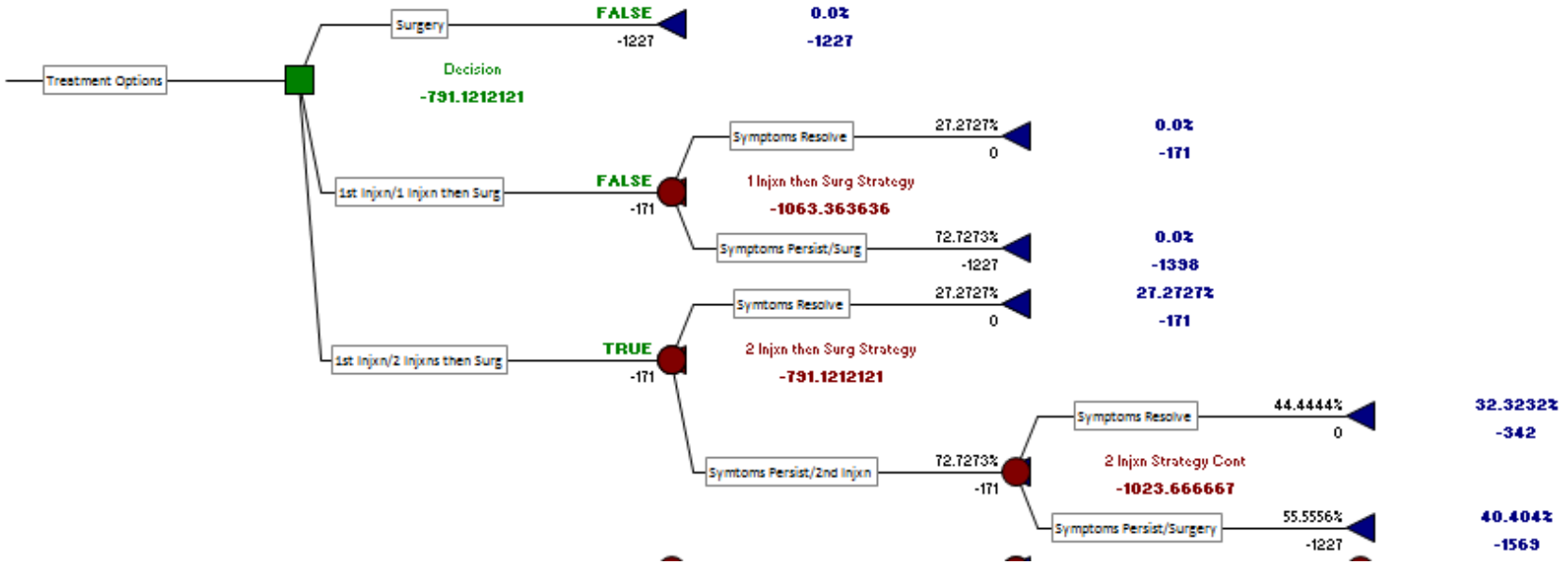

Figure 9: As no other studies have established success rates for treatment protocols using three steroid injections, a separate decision tree analysis was performed for treatment protocols using up to two steroid injections. In this decision tree, the dominant strategy was to us up to two steroid injections as initial treatment followed by open surgery in the case of non-operative treatment failure.

Table 1: Classification of Trigger Fingers as in **Wolfe SW. Tenosynovitis. In: Green DP, Hotchkiss RN, Pederson WC, eds.** *Green's operative hand surgery, 4th ed.* New York: : Churchill Livingstone, , 1999:2022–2044. (13).

TABLE 1. CLASSIFICATION OF TRIGGER FINGERS	
Grade	**Characteristics**
I (pretrigger)	Pain; positive sign of trigger finger not evaluated during the objective medical examination; increased sensibility toward pain in correspondence with the first annular pulley.
II (active)	Objective presence of trigger finger; the patient is able to extend the finger actively.
III A (passive)	Objective presence of trigger finger. Extension is only possible passively with the help of an applied external force
III B	Objective presence of trigger finger. The patient is unable to actively flex the finger.
IV (rigidity) in a flexion posture.	Objective presence of trigger finger; the proximal interphalanx is stuck

Table 2: Table of Demographics of Study and Control groups showing statistically significant differences in occupational exposure.

DEMOGRAPHICS - CONTROL GROUP			DEMOGRAPHICS - STUDY GROUP			P value
Summary Statistics	Number	Percentage	Summary Statistics	Number	Percentage	
Number of Patients	40		Number of Patients	43		
Male Patients	14	35%	Male Patients	13	30%	0.65
Female Patients	26	65%	Female Patients	30	70%	
Average BMI	29	N/A	Average BMI	29	N/A	0.46
Occupational Exposure	6	15%	Occupational Exposure	17	40%	**0.012**

Table 3: Past Medical History

PAST MEDICAL HISTORY - CONTROL GROUP			PAST MEDICAL HISTORY - STUDY GROUP			P value
PMH	Number	Percentage	PMH	Number	Percentage	
Diabetes	10	25%	Diabetes	11	26%	0.95
Diabetes with Insulin	1	3%	Diabetes with Insulin	1	2%	0.96
Hypothyroidism	6	15%	Hypothyroidism	4	9%	0.59
Gout	1	3%	Gout	1	2%	0.96
None of the above	26	65%	None of the above	24	56%	0.97

Table 3b: Radiographic Data for Presence of Osteoarthritis of the Hand

RADIOGRAPHIC FINDINGS - CONTROL GROUP			RADIOGRAPHIC FINDINGS STUDY GROUP			P value
Xray Findings	Number	Percentage	Xray Findings	Number	Percentage	
OA	16	40%	OA	13	30%	0.36
Normal	22	55%	Normal	22	51%	0.73
Other	2	5%	Other	1	2%	0.52

Table 4: Index case of trigger finger, average number of injections, time till injections, percentage that have surgery, dominant hand affection, finger affected

TRIGGER FINGER CHARACTERISTICS - CONTROL GROUP			TRIGGER FINGER CHARACTERISTICS - STUDY GROUP			
Trigger Finger Characteristics	Number	Percentage	Trigger Finger Characteristics	Number	Percentage	P value
Number of Trigger Fingers	49		Number of Trigger Fingers	91		n/a
Number of Patients	40		Number of Patients	43		n/a
Right Hand Fingers Affected	28	73%	Right Hand Fingers Affected	49	54%	0.11
Left Hand Fingers Affected	21	53%	Left Hand Fingers Affected	42	46%	n/a
Dominant Hand Fingers Affected	28	73%	Dominant Hand Fingers Affected	38	42%	0.083
	Number	Percentage		Number	Percentage	
Thumb Affected	20	41%	Thumb Affected	17	19%	**0.0044**
Index Affected	2	4%	Index Affected	14	15%	**0.045**
Long Affected	13	27%	Long Affected	31	34%	0.36
Ring Affected	12	24%	Ring Affected	21	23%	0.85
Small Affected	2	4%	Small Affected	8	9%	0.31

Table 5: Other upper extremity conditions, treatment for other upper extremity conditions

OTHER HAND COMORBIDITIES - CONTROL GROUP			OTHER HAND COMORBIDITIES - STUDY GROUP			P value
Other Hand Dx	Number	Percentage	Other Hand Dx	Number	Percentage	
Carpal Tunnel Syndrome	6	15%	Carpal Tunnel Syndrome	19	44%	**0.0034**
Bilateral Carpal Tunnel Syndrome	3	8%	Bilateral Carpal Tunnel Syndrome	8	19%	0.14
Total Carpal Tunnel Syndrome	9	23%	Total Carpal Tunnel Syndrome	27	63%	**0.0001**
Cyst	3	8%	Cyst	2	5%	0.59
Dequervains	4	10%	Dequervain’s	5	12%	0.81
RSI	0	0%	RSI	0	0%	1.00
Impingement	7	18%	Impingement	7	16%	0.88
Epicondylitis	3	8%	Epicondylitis	4	9%	0.77
Dupuytren's	0	0%	Dupuytren's	4	9%	**0.026**
Other	7	18%	Other	7	16%	0.88
PAST HAND TREATMENT - CONTROL GROUP			PAST HAND TREATMENT - STUDY GROUP			
Treatment for Other Hand Dx	Number	Percentage	Treatment for Other Hand Dx	Number	Percentage	
Splints	6	15%	Splints	13	30%	0.1
Therapy	13	33%	Therapy	11	26%	0.49
Injections	9	23%	Injections	15	35%	0.22
NSAIDS	3	8%	NSAIDS	5	12%	0.53
Surgery	12	30%	Surgery	15	35%	0.64

Table 6a: Duration of Symptoms before first injection and before surgery for the control group

CONTROL				
All Patients	Weeks			
Time from Onset of Symptoms to First Injection	16.06			
Time from Onset of Symptoms to Surgery	N/A			
Patients that had Surgery	Weeks	Patients that did not have Surgery	Weeks	P value
Time from Onset of Symptoms to First Injection	15.45	Time from Onset of Symptoms to First Injection	16.08	0.94
Time from Onset of Symptoms to Surgery	58.06	Time from Onset of Symptoms to Surgery	N/A	

Table 6b: Duration of Symptoms before first injection and before surgery for the study group

STUDY GROUP				
All Patients	Weeks			
Time from Onset of Symptoms to First Injection	14.11			
Time from Onset of Symptoms to Surgery	N/A			
Patients that had Surgery	Weeks	Patients that did not have Surgery	Weeks	P value
Time from Onset of Symptoms to First Injection	15.20	Time from Onset of Symptoms to First Injection	12.93	0.56
Time from Onset of Symptoms to Surgery	101.74	Time from Onset of Symptoms to Surgery	N/A	

Table 6c: Duration of Symptoms before first injection and before surgery of study vs control group

CONTROL		STUDY GROUP		P Value
All Patients	Weeks	All Patients	Weeks	
Time from Onset of Symptoms to First Injection	15.91	Time from Onset of Symptoms to First Injection	14.11	0.64
Time from Onset of Symptoms to Surgery	N/A	Time from Onset of Symptoms to Surgery	N/A	
Patients that had Surgery	Weeks	Patients that had Surgery	Weeks	
Time from Onset of Symptoms to First Injection	15.45	Time from Onset of Symptoms to First Injection	15.2	0.97
Time from Onset of Symptoms to Surgery	58.06	Time from Onset of Symptoms to Surgery	101.74	0.073
Patients that did not have Surgery	Weeks	Patients that did not have Surgery	Weeks	
Time from Onset of Symptoms to First Injection	16.08	Time from Onset of Symptoms to First Injection	12.93	0.55
Time from Onset of Symptoms to Surgery	N/A	Time from Onset of Symptoms to Surgery	N/A	

Table 7: Surgery prevalence among the control and study groups

	Control	Percentage	Study	Percentage	P value
Total Patients	40		43		
Number of Patients + Surgery	9	23%	21	49%	**0.01**
Number of Patients - Surgery	31	78%	22	51%	-
Total Digits	49		91		
Number of Digits + Surgery	11	22%	35	38%	**0.05**
Number of Digits - Surgery	38	78%	56	62%	

Table 8: Survey Data

Control Group	Number	Percent	Study Group	Number	Percent	P value
Number of Patients	40		Number of Patients	43		
Number Surveyed	32	80%	Number Surveyed	24	56%	**0.019**
Total Digits	49		Total Digits	91		
Digits Surveyed	39	80%	Digits Surveyed	55	60%	**0.0004**
Patients Surveyed Who Had Surgery	9	28%	Patients Surveyed Who Had Surgery	12	50%	0.098
Patients Surveyed Who Did Not Have Surgery	23	72%	Patients Surveyed Who Did Not Have Surgery	12	50%	0.098
Digits Surveyed That Had Surgery	11	22%	Digits Surveyed That Had Surgery	25	45%	0.13
Digits Surveyed That Did Not Have Surgery	28	78%	Digits Surveyed That Did Not Have Surgery	30	55%	0.13
Of Digits That Did Not have Surgery (28 Digits in 23 Patients)			Of Digits That Did Not have Surgery (30 Digits in 11 Patients)			
Number With No Symptoms	16	57%	Number With No Symptoms	26	87%	**0.011**
Number With Pain	3	9.6%	Number With Pain	3	10%	0.93
Number With Stiffness	9	32%	Number With Stiffness	0	0%	**0.0005**
Number With Clicking/Locking	0	0%	Number With Clicking/Locking	0	0%	1
Number Satisfied With Injection Treatment	22	79%	Digits Satisfied With Injection Treatment	29	97%	**0.035**
Number Who Would have Injection Treatment Again	24	86%	Digits Who Would have Injection Treatment Again	29	97%	0.14
Patients Satisfied With Injection Treatment	21	91%	Patients Satisfied With Injection Treatment	10	83%	0.5
Patients Who Would have Injection Treatment Again	21	91%	Patients Who Would have Injection Treatment Again	10	83%	0.5

Table 9: Diabetes

	Surgery	No Surgery	Percentage	P value
Control Diabetes +	1	7	13%	0.3
Control Diabetes -	8	24	25%	
Study Group Diabetes +	5	6	54%	0.94
Study Group Diabetes -	16	17	48%	
P value	0.44	0.63		

Table 10: Multiple Presenting Fingers vs Single Presenting Fingers:

	Surgery	No Surgery	Percentage	P value
Cont Multiple Finger Presentation	0	3	0%	0.34
Cont Single Finger Presentation	9	28	24%	
Study Multiple Finger Presentation	2	2	50%	0.96
Study Single Finger Presentation	19	20	49%	
P value	0.36	0.15		

Form 1: Consent Script and Survey Data Collection Sheet

Hello this is _____. I am contacting you because you are a potential volunteer in a study being conducted by Dr. Bernstein's office at The Orthopaedics Group, LLC. We are conducting a survey on your experience with injection treatment for trigger finger studying how effective injections were in treating your symptoms. This study takes about 10 minutes and you are under no obligation to participate. If you have any questions at anytime during this survey, do not hesitate to ask. Your participation in this survey will in no way affect your relationship with The Orthopaedics Group, LLC. The information obtained in this survey such as your name and symptoms and treatment for trigger finger will be used in conjunction with your information from you medical records like your past medical history relevant to trigger finger and symptoms and treatment of trigger finger and later de-indentified. This information will be protected by securely storing the information in password protected documents on password protected computers, with monthly security reviews. Do you consent to participate in this survey and for the use of your protected health information as described for this study?

Subject Name:_____Date of Survey:_____

Consent Given:_____Date of Consent:_____

Consent Obtained by:_____

Hand Affected: Right Left Finger Affected: T I L R S

Are you having pain in the previously injected finger? Yes No

If yes then rate pain: 0 1 2 3 4 5 6 7 8 9 10 (10=max, intolerable)

Are you experiencing any stiffness in the previously injected finger? Significant Mild None

Are you experiencing any clicking/locking in the finger? None Rare Constant

Have you received treatment anywhere else for the previously injected finger? Yes No

If yes What was done? Surgery Therapy Injection Other_____

Did you have surgery on the trigger finger?

If no to the surgery question

Were you satisfied with the injection treatment for the trigger finger? Yes No

Would you have the injection treatment again if needed? Yes No