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RESEARCH ARTICLE

OPEN VERSUS PERCUTANEOUS RELEASE OF A1 PULLEY IN DIABETIC TRIGGER FINGER: A RANDOMIZED CONTROL TRIAL

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ABSTRACT

Stenosing tenosynovitis or trigger finger is a common cause of hand pain and disability.Its prevalence is higher in the diabetic population. The mainstay of treatment consists ofsurgical release of the A1 pulley, either open or percutaneous. The present study attempts to compare the outcomes and complications of conventional open versus percutaneous release, in patients with diabetes mellitus. **Material and Methods**: In total, 69 patients (69 digits) withchronic diabetes mellitus (38 insulin-dependent and 31 non-insulin dependents, with an average age 48 years old) were treated for trigger finger between 2014-2019). The mean duration of symptoms was 6 months. All patients had failed conservative treatment. The digits were graded accordingto severity of symptomsby using the Quinnel classification. There were 22 grade IIfingers(31,9%), 28 grade III fingers (40,6%), and 19grade IV fingers (27,5%) [8 locked in extension and 11 in flexion]. Thirty-seven patients were treated with the open technique and 32 with the percutaneous technique. Postoperatively, the patients received follow-up visits at 2 weeks and 6 months. **Results:** The outcome was assessed using the questionnaire of Gilberts and Wereldsma and documenting the complications and satisfaction rate. The overall complication rate was 16.2% in the open technique group and 15.6% in the percutaneous group, with the most commoncomplications in both groups being postoperative pain on the surgical site. In the open technique group, 21 patients were very satisfied patients after treatment (56.76%), 13 were satisfied (35.14%) and 3 patients (8.1%) were unsatisfied with the surgical result. Inthe percutaneous technique group, there were 19 very satisfied patients (59.37%), 11 satisfied (34.37%), and 2 dissatisfied (6.26%). **Conclusion**: This study highlighted the effectiveness of both techniques; however, the percutaneous technique has the advantages of lower cost and the avoidance of wound complications.

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INTRODUCTION

Trigger finger (also called stenosing tenosynovitis) is one of the most common causes of hand pain and disability in adults, with a reported prevalence of 2.6% in healthy population and up to 10% in diabetics.[1,2] First line treatment consists of splinting, nonsteroidal anti-inflammatory drugs and steroid injections (into the affected tendon sheath) with successful results approximately up to 80% of the patients.[3,4]However, several studies have shown that in the diabetic population success rates are much lower.[5,7]

Operative treatment with open or percutaneous release of A1 pulley is highly successful and is considered as the ultimate treatment for trigger finger. Both techniques presented excellent outcomes in the healthy population, but on the contrary the diabetic population often presents higher rates of complications.[7,8] This population deserves proper attention, due to the fact that complications such as incomplete release, wound healing problems and recurrence, not only affect the outcome of the procedure but also increase the cost of the treatment. Several studies have previously compared both techniques between diabetic and non- diabetic populations .[8,9] However, there is a gap in the literature regarding direct

comparisons of outcomes of percutaneous and open release of A1 pulley in digits, in the diabetic population. The aim of this study is to compare short and midterm outcome of percutaneous and open release in the diabetic population.

METHODS

Study population and processes: A prospectively compiled database of diabetic patients undergoing trigger finger release was examined retrospectively to identify the study cohort at our Institution. The setting was selected due to the clinical capacity and representativeness of the population, since it was estimated to serve the vast majority of the under-study population. At the same time, Crete is an island of more than 633.506 permanent residents, with a relatively homogeneous genetic profile. A convenience sampling approach was followed. Patients were excluded if they had:(1) a history of hand tumor; (2) immunological disease, e.g., rheumatoid arthritis; (3) previous hand trauma or surgery; or (4) a neurologic deficit in the same upper extremity and (5) only one digit affected. Diabetes was defined as type 1 or type 2 according to the American Diabetes Association (ADA) criteria and was treated with diet, oral diabetes medications, or insulin. A total of 69 diabetic patients (69 digits) received trigger finger release over the course of 5 years (2014-019). They were randomly divided in two groups according to the technique that was utilized, the open release group and the percutaneous release group. The Quinnel classification system was used to assess the preoperative severity of each condition. The four grades of this classification system are: grade I pain and tenderness at the A1 pulley, grade II catching of the digit, grade III locking of the digit, passively correctable, and grade IV fixed, locked digit. Patients that were diagnosed trigger finger with Quinnel stage II, III, IV for a mean time of 6 months were included. Characteristics such as age, gender, the involved limb side, and the digit and insulin dependence of the patients were also recorded. All patients were followed-up at 2 weeks and 6 months postoperatively.

Surgical techniques: All procedures were performed by a single surgeon. The percutaneous release was performed according to the technique of Pope and Wolfe and Slesarenko et al.[30,38]Before local anesthesia, surgical landmarks were marked according to the systems of Willhelmi et al..[16]According to the established techniques for percutaneous release, an 18-gauge needle tip was inserted perpendicularly through the skin and through the A1 pulley at the metacarpophalangeal flexion crease of the affected finger.[2,17.18] The bevel of the needle was parallel to the longitudinal axis of the flexor tendon. The surgeon checked the needle tip position by passively flexing and extending the patient's finger. The needle was slightly withdrawn until no paradoxical swing occurred when the finger was moved passively. The pulley was incised longitudinally with a sweeping motion with the needle tip, proximally to distally. A characteristic grating sensation was felt by the surgeon while incising the pulley. Complete release was confirmed by cessation of the grating sensation and full active thumb motion without residual triggering. Regarding the open release technique, a standard transverse incision of approximately 1 cm was made, followed by blunt dissection of the A1 pulley, with the bilateral neurovascular bundles protected with retractors. The surgeon incised the A1 pulley along the direction of the flexor tendon.

Postoperative assessment: Functional outcomes were assessed at 6 months post-operatively by the questionnaire of Gilberts and Wereldsma (2002).[10] The questionnaire consists of the following questions (YES or No answer): Do you have triggering? Do you have pain? Do you have stiffness in the digit? Do you feel numbness of the digit? Do you see a scar? Are you dissatisfied, satisfied, or very satisfied with the results of the treatment? Complications that occurred were also recorded. They were also asked to record their level of satisfaction with their surgery, using a visual analog scale (VAS) of 0 to10, where 0 signified not satisfied and 10 was very satisfied. Patients who defined their level of satisfaction as <5 were categorized as dissatisfied; those with a score of 5-7as satisfied and finally those who defined a level of satisfaction >7 were categorized as very satisfied.

Statistical analysis: The analysis was conducted in the IBM SPSS 24, while all tests were performed at a=0.05. The Kolmogorov-Smirnov and the binomial tests were utilized to test distributions' normality prior further analysis. Descriptive statistics were exported and distributed as N (%) for categorical variables and mean (Standard Deviation-SD) for quantitative variables. Additionally, the chi-square and the Student's t-test were applied to explore any statistical differences between variables, while special focus was given on potential variations between the surgical method (open, percut) and levels of satisfaction (dissatisfied, satisfied and very satisfied).

RESULTS

Table 1 presents patients' characteristics and clinical profile. Sixty-nine diabetic patients, with mean age 48 years (SD 10.90, underwent trigger finger release surgery under local anesthesia. The release was performed using the open technique in 37 patients (53.6%). Percutaneous technique was used in 32 patients (46.4%).

Table 1. Participant's profile (n=69)

Parameter	N	%
Age		
Gender	48a	10.9b
M	27	39.1
F	42	60.9
Finger		
I	12	17.4
L	5	7.2
M	16	23.2
R	13	18.8
T	23	33.3
Method		
Open	37	53.6
Percut	32	46.4
Insulin dependence		
Yes	38	55.1
No	31	44.9
Quinelle class		
GR2	22	31.9
GR3	28	40.6
GR4 extension	8	11.6
GR4 flexion	11	15.9
Complications		
DGI	1	1.4
Pain	6	8.7
Scar Infection	2	1.4
Triggering	2	2.9
Triggering/Pain	1	1.4
Satisfaction		
Dissatisfied	5	7.3
Satisfied	25	36.2
Very Satisfied	39	56.5

Abbreviations: (a: Mean; b: Standard Deviation-SD); M: male; Female: F; GR: Grade; I: Index; M: middle; R:ring; L: little; T: thumb, DGI: digital nerve injury; Percu: percutaneous)

Table 2. Participants' characteristics per method performed

Characteristics	Method N (%)			
	Open	Per cut		
	n=37	n=32		
Agea	51.59 (9.49)	43.84 (11.08)	0.809	0.69
Gender			0.437	0.316
M	17 (45.95)	10 (31.25)		
F	20 (54.05)	22 (68.75)		
Finger				
I	5 (13.5)	7 (21.9)		
L	2 (5.4)	3 (9.4)	0.84	0.783
M	10 (27)	6 (18.8)	0.496	0.184
R	6 (16.2)	7 (21.9)	0.062	0.646
T	14 (37.8)	9 (28.1)	0.723	0.109
Insulin.D			0.256	0.192
IND	21 (56.8)	17 (53.1)		
INND	16 (43.2)	15 (46.9)		
Quinelle Class				
GR2	15 (40.6)	7 (21.9)		
GR3	13 (35.1)	15 (46.9)	0.242	0.8189
GR4	1 (2.7)	-		
GR4 extension	3 (8.1)	5 (15.6)	0.834	0.4312
GR4 flexion	5 (13.5)	5 (15.6)		
Complications			0.071	0.041
DGI	-	1 (3.1)		
Pain	3 (8.1)	3 (9.4)		
Scar Infection	2 (5.4)	-		
Triggering	1 (2.7)	2 (6.3)		
Satisfaction				
Dissatisfied	3(8.1)	2(6.3)		
Satisfied	13 (35.1)	12(37.5)		
Very satisfied	21 (56.8)	18(56.2)		
a Mean (Standard Deviation-SD)				
P value for Open				
P value for Percu				

Thirty-eight of the patients (55.1%) were insulin-dependent. The number of patients within the grades II, III, and IV (IV extension and IV flexion) categories of the Quinnell classification were 22 (31.9%), 28 (40.6%), and 19 (27,5%), respectively. Regarding the patients with grade 4 trigger finger, in 11 patients (15.9%) the digit was fixed in flexion, while in 8 patients (11.6%) the digit was fixed in extension. All patients, regardless intervention techniques presented high levels of satisfaction (very satisfied: 56.5%). In Figure 1 and Table 2, comparisons between open and percutaneous group are illustrated. Satisfaction level per complication is demonstrated in Table 3. Overall, there were 11 documented complications among 69 digits (15.8%). In the open technique group, there were 6 complications (16.2%). The complications involved persistent pain (3 patients, 8.1%) and triggering (1 patient, 2.7%). There were also 2 cases of wound infection (5.4%). In the percutaneous technique group, there were 6 complications (18.8%).

They included persistent pain (3 patients, 9.4%), triggering (2 patients, 6.3%) and digital nerve injury (1 patients, 3.1%). The complication rate was 16.2% in the open technique group and 18.8% in the percutaneous group. In the open technique group, 3 patients (8.1%) were dissatisfied with the procedure result, while there were 13 satisfied (35.1%) and 21 very satisfied patients (56.8%). In the percutaneous technique group, 2 patients (6.3%) were unsatisfied with the result. There were 12 (37.5%) satisfied patients and 18 (56.2) very satisfied. Patients with persistent pain, swelling, or stiffness were treated with observation, therapy, or steroid injections, with eventual resolution of their symptoms. Patients with superficial infections were treated successfully with oral antibiotics. All these cases managed non-operatively regained satisfactory function.

Operative treatment was required in 4 cases of complications (5,7%). In the open group, recurrence of triggering occurred in one patient (2,7%) and was treated with open revision release. In the percutaneous group, recurrence of triggering occurred in 2 patients (6,3%) and was treated with percutaneous revision release. In all aforementioned 3 cases, there was resolution of the symptoms after the second operation. In the percutaneous group, there was one case of digital nerve injury (3,1%), that involved the ulnar digital nerve of the small finger. Neurolysis was performed. Numbness and hypoesthesia resolved completely three months post-operatively. Implementing Fisher exact test for analysis of contingency tables between the two operational methods, we concluded that results of each of two methods performed have no association between them. Based on the results above, we may conclude that the only statistically significant factor for our model is the complications of the operation. Moreover, we observe that open operational methods tend to produce worse results for ring finger than percut method, and the opposite seems to be true for the thumb. Furthermore, after implementing Wilcox test to determine which is the most successful method of the two, we don't have any indication to rule out initial hypothesis of equal shifts; therefore, our methods statistically are equal (p-value=0.918).

DISCUSSION

Stenosing tenosynovitis occurs more frequently in women, on the dominant side,and usually presents in the sixth decade of life.[11] Incidence is higher in the diabetic population.[12,13] Even though trigger finger is a common deficit, there is no uniform algorithm for treatment in diabetics. Furthermore, diabetic patients with trigger finger are more likely to require surgical treatment in comparison to non-diabetic patients.[6]

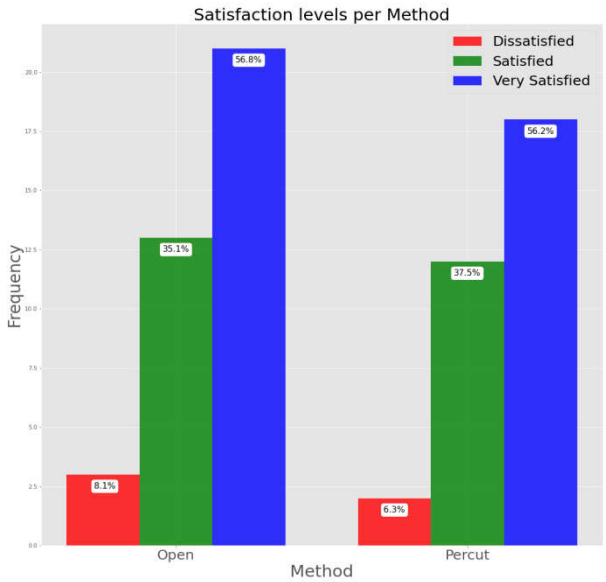

Figure 1. Satisfaction levels based on the method performed

Table 3. Satisfactory level per Complications

Complication	Dissatisfied	Satisfied	Very Satisfied
Scar Infection	2	-	-
Pain	1	5	-
Triggering	1	2	-
DGI	-	-	1

The mainstay of non-operative treatment consists of corticosteroid injections, with success rated being reported between 32% and 66% in diabetics.[20] Corticosteroid injections demonstrate lesser success rates in diabetic patients, and they have significantly less likelihood of avoiding surgery in comparison to non- diabetics.[14,21,22] In addition, Baumgarten et al. reported that patients with diabetic neuropathy or nephropathy were less likely to have symptom relief in comparison to patients without systemic complications.[23] In a more recent study, there was no significant difference in the success of injection in diabetics (57%) and nondiabetics (72%) when examining the long-term follow-up.[24] However, steroid injections are not without adverse effects. Besides the common complications (injection site pain, subcutaneous fat atrophy, cellulites, flexor tendon rupture), they can provoke disturbances of blood glucose levels.[23,25]Transient hyperglycemia has been reported to last for at least 5 days post-injection.[26] Even though corticosteroid injections may decrease the need for subsequent surgery in cases of diabetic trigger finger, immediate surgical release has proven to be the most cost-effective treatment strategy.[27] A recent cost effectiveness analysis revealed that percutaneous release in the office setting is more cost-effective than the open release technique.[28] More specifically, the cost of primary open release was twice that of primary percutaneous release.[28] Additionally, open release has been associated with higher levels of pain in the diabetic population and wound complications.[8,14] Safe and effective percutaneous release technique has been described and performed for decades.[29,30]Despite the initial surgeons' reluctance to perform the percutaneous release technique, as it is blind method that raised concern about neurovascular and flexor tendon injury, multiple studies have demonstrated outcomes and complication rates nearly equivalent to those of open release technique [31,32,33]. Percutaneous release technique has been described using needle, angiocatheter, scalpel blade or other percutaneous custom-made instruments, V-Lance knife.[29,30,31,34,39]Percutaneous trigger finger release is a safe and effective technique, providing that there is demarcation of the longitudinal axis of the tendon and precise anatomic knowledge of the pulleys.[36,40] The additional use of ultrasonography can permit better visualization while maintaining the percutaneous nature of the procedure.[37] However, ultrasonography adds extra expense, whereas with clear understanding of the anatomy no additional imaging is necessary.[36] In the present study, recurrence of triggering occurred in 2patients (6,3%) in the percutaneous release group. Revision was performed utilizing the same percutaneous technique as the initial operation. Recurrence was not observed, following the revision. Digital nerve injury (DGI) is also an important complication of trigger finger surgical treatment.[19] In the percutaneous group, digital nerve injury occurred in 1 patient, while it did not occur in the open group. Satisfaction levels were equally high in both groups. Finally, the one and only patient that has been operated utilizing the percutaneous technique and had a DGI complication, after the successful neurolysis operation, expressed a very satisfied opinion. On the other hand, patients with scar infection were dissatisfied because of the scar. To the best of our knowledge, this is one of the major studies in Cretan population, presenting direct comparison of clinical outcomes between open and percutaneous release of A1 pulley in a diabetic population and assessment of complications and patients' satisfaction. Diagnosis and assessment of patients' clinical profile was performed utilizing reliable clinical evaluation tests. Nevertheless, findings should be interpreted taking into consideration some limitations. These include the self-reported responses of the satisfaction scale and the convenient sampling approach (rather than a power analysis approach). In addition, it should be noted that the selected setting and the hospital that was used for patients' enrollment is considered to be representative for the Cretan population. Therefore, the authors believed that no major effects are expected in the measured correlations.

CONCLUSION

Despite any study limitations, primary findings of this study reflected a satisfying balance of the positive clinical outcomes between open and percutaneous technique, highlighting the effectiveness of both techniques. Still, percutaneous release has a significantly lower cost for the treatment of diabetic trigger finger, and also has the advantage of avoiding wound complications.

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