



The Effectiveness of Dry Needling on Total Elbow Arthroplasty to Improve Range of Motion, Upper Extremity Dexterity and Performance: Case Report

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Abstract

Background: Complications during elbow joint (EJ) injuries might indicate further surgeries such as Total Elbow Arthroplasty (TEA), which is rarely performed from an expert surgeons. Furthermore, there are many complications occur after TEA such as infection, implant loosening, instability, fracture, and component failure in the form of bushing wear. Additionally, the triceps complications occur after the surgery. Also, the Range of Motion (ROM) of the elbow extension will be limited. Yet, there is no evidence proof the effectiveness of DN on TEA.

Objective: The current study aimed to investigate the effectiveness of DN for post TEA to Improve Range of Motion (ROM), Upper Extremity Dexterity and Functions.

Case Description: This case is a male patient, 32-years old, post TEA, 6 months post operation. He had motor vehicle accident (MVA), fixed externally 6 years ago. Multiple irrigation and debridement were performed after the accident. Finally, the physician decided to perform TEA for him, referred to physiotherapy after the operation to start the rehabilitation program which included strengthening exercises and ROM exercises. Visited our clinic to continue the rehabilitation program. During the examination, the ROM was limited and the muscles, especially the triceps, were weak.

Intervention: Patient continued the same rehabilitation program (ROM and muscles strengthening), DN was added to the intervention. He was seen for 3 times per week, for 8 weeks. DN was applied once per week.

Results: There was a significant improvement in Box and Blocks (BBT) and Disabilities of the Arm, Shoulder, and Hand (DASH), but there was no significant difference in ROM.

Conclusion: Applying DN on post TEA demonstrate a significant improvement in dexterity and performance of EJ. Patient must continue rehabilitation program daily and the DN should be applied around the scar and on the TrPs for at least once every 2 weeks to observe the improvement.

Keywords: Total Elbow Arthroplasty; TEA; Dry Needling; Elbow; Rehabilitation

Introduction

The elbow joint (EJ) is one of the important joints of the upper extremities for performing normal daily activities. However, it is common that EJ exposed to many degenerative problems such as

trauma or fractures which leads to arthritis or complications. The functions of EJ are flexion and extension using the humeroulnar and humeroradial joints; supination and pronation using the radi-

oulnar and humeroradial joints. Therefore, it is difficult to replace or bypass those functions [1].

EJ injuries that occur due to trauma may lead to complications to EJ such as inflammatory arthritis, acute fractures, trauma sequelae and miscellaneous indications. Hence, these conditions indicate surgeons to perform total elbow arthroplasty (TEA) [2].

TEA in before was used mainly in patients with inflammatory arthritis, but the indications were expanded to other conditions. TEA presents some unique features as elbow joint is smaller than knee and hip joints. Wherefore, the arthroplasty is smaller and the stability of the joint depends on the stability of the ligaments [3]. The main purpose of the surgery to be performed is to restore the stability of the humeroulnar and humeroradial joints and lateral collateral ligament reconstruction, to facilitate early elbow mobility and to reduce the chance of stiffness and disability [4].

There are two techniques to perform TEA, triceps on and triceps off. The triceps-on approach is performed by making a window medial to the distal triceps tendon. Another triceps sparing approach is to perform a chevron osteotomy and to reattach the osseous insertion of the triceps afterwards. Triceps off approaches use sub-periosteal dissection of the triceps insertion and refixation using tension band wiring [1].

Compared to total knee arthroplasty (TKA) and total hip arthroplasty (THA), TEA performed lesser. In England, in 2017, only 600 TEA were performed while approximately 100,000 TKR and THR were performed [5]. Furthermore, the number of TEA is increasing in United States of America with rate of 248% from 1993 to 2007 [6].

Regardless of purpose of the surgery, there are many complications occur after the operation such as infection, implant loosening, instability, fracture, and component failure in the form of bushing wear [7]. Additionally, the triceps complications occurs after the surgery, the range of Motion (ROM) of the elbow extension will be limited [8]. The study [1] concluded that the rate of the complications due to TEA still high and recommended to perform the operation in specialized centers.

Postoperative rehabilitation starts immediately at 1st day after the operation. According the previous studies, the rehabilitation program were vary. [1] suggested that EJ should be compressed, and the dressing should be applied for 24 to 72 hours. They focused

on the ROM to prevent the contractures or limitations, the continuous passive motion was suggested to enhance ROM; adding the pain killer should be used during the acute stage post operatively.

The study [9] mentioned that EJ should be immobilized for 1 to 2 weeks after TEA. The strengthening exercise will start gradually after that with ROM exercise. The patients will follow the rehabilitation program for 12 months. While the study [10] summarized the rehabilitation program as following: immobilization of EJ in extension position for 1 week using the anterior plaster cast, if the triceps-off approach was applied, EJ will be immobilized for 6 weeks. Finally, the life-long load-bearing limitation of 5 kg.

The study [11] explained the rehabilitation into 3 phases: PHASE I: the inflammatory or protective phase, including immobilization and splinting; PHASE II: fibroplasia, which include passive and active ROM; PHASE III: scar maturation and remodeling to enhance ROM with painfree by continuing the ROM exercises and strengthening exercise.

Regarding rehabilitation, dry needling (DN) is drug-free intervention used to reduce pain and lead to effective treatment compared with other alternative therapies for post operative cases [12]. DN showed a significant different in ROM reached 15-degree difference in the 1st week for post anterior cruciate ligament reconstruction (ACLR) [13]. In contrast, applying DN for post shoulder stabilization repair showed no significant differences compared with standard rehabilitation [14]. Yet, from our knowledge, there is no evidence proves the effectiveness of DN on TEA. Therefore, this study aimed to investigate the effectiveness of DN for post TEA to Improve ROM, Upper Extremity Dexterity and Functions.

Materials and Method

- **Study Design:** Case Report
- **Setting:** National Guard Hospital (NGH) at Jeddah.

Materials

- **The disabilities of the arm, shoulder, and hand (DASH) questionnaire:** A 30-item questionnaire that looks at the ability of a patient to perform certain upper extremity activities [15]. The scores for the items in the questionnaire are used to compute a scale score range from 0 (no disability) to 100 (most severe disability). A 10-point difference in mean score may be considered as a minimal important change [16]. It is valid and reliable outcome measure intended for

any person with one or more upper extremity musculoskeletal disorders [15].

- **Box and blocks test (BBT) tool:** It measures unilateral gross manual dexterity. Characterized as a quick, simple, and inexpensive test. It can be used with a wide range of populations. This test composed of a wooden box divided in two compartments with a partition in the middle and 150 blocks. The BBT administration consists of asking the patient to move, one by one, the maximum number of blocks from one compartment of a box to another of equal size, within 1 minute. Higher scores indicate better gross manual dexterity. It is a valid and reliable outcome measure according to [17].
- **Dry needles:** The size of the dry needles used for the patient is 0.3 × 500 mm.
- Goniometer to measure the ROM.

Case Description

This is a case of male patient, from Taif, he is 32 years old, he is a soldier working at National Guard, referred to Physiotherapy as a post TEA 6 months ago. He has a history of post motor vehicle accident (MVA), external fixation of the left elbow 6 years ago. He had multiple irrigation and debridement. Past medical history that he is heavy smoker who was instructed to stop smoking, left-handed.

The operation performed was left total elbow arthroplasty replacement using Nexel Zimmer system with humerus size 4 × 115 mm, and the articulation kit size number 4. He had rehabilitation program including ROM and strengthening exercises, 2 weeks post operation. Patient visited our clinic 4 months after the operation. The ROM of the left elbow was 40° to 120°, which means that the patient has limited ROM in flexion with 20° and limited ROM in extension with 10°. Additionally, the ROM is 80° in supination, which considered limited ROM, and 90° in pronation, which considered normal ROM. The muscles of the left elbow were weak, especially the left triceps muscles. He complains of pain in the left elbow with functions such as driving, eating, turning the key to open the door, and reaching.

Rehabilitation program

The rehabilitation program included the following

- Dry needles around the scar and on the trigger points (TrP) every 2 weeks on the left EJ. (Figure 1) and (Figure 2) demonstrate the location of the DN on the patient's EJ.
- ROM exercise for EJ (flexion, extension, supination, and pronation). The exercise was performed passively and actively.

- Strengthening exercises for the triceps muscle using the TheraBand and dumbbells (2kg). The exercises were performed daily in different position of the left upper extremity and different postures (patient was asked to lie in supine position and the left upper extremity was flexed in 90°. He was asked to extend his left elbow and performed the exercise for 30 repetition; another exercise was performed in sitting position and asked to fully flex his left shoulder to be fixed in that position then extend his left elbow while holding the dumbbell and continue the same exercise for several times to reach 30 repetition; the last exercise performed was from standing position and the TheraBand was tied in fixed object in front of the patient, the patient was asked to fix his left upper extremity beside his trunk with 90° left elbow flexion, after preparing the patient for the posture, he was asked to extend his left elbow then return back to the 90° to start over



Figure 1: Dry Needles (DN) around the scar.



Figure 2: Dry needles (DN) on the trigger points (TrP).

Data collection

ROM using the goniometer, Disabilities of the Arm, Shoulder, and Hand (DASH) and Boxand Blocks Test (BBT) were taken at the baseline, 4 weeks after the intervention, and after 8 weeks of the intervention (Figure 3) demonstrate the use of BBT. The scores of DASH and BBT were collected and retrieved in tables to visualize the improvements. The score of DASH will be calculated using the following equation

$[(\text{sum of } n \text{ responses}/n)-1] \times 25$, where the n is the number of completed responses.

Furthermore, the score of the BBT will be calculated based on the number of transferred blocks from one compartment to another, each hand will be scored separately.

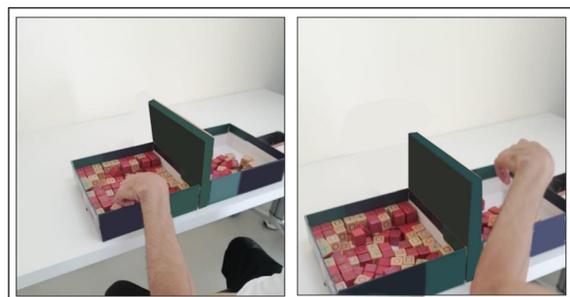


Figure 3: Participant performing the Box and Blocks Test (BBT).

Data analysis

The collected data were described in table to demonstrate an overview of the outcomes before and after the intervention.

Administrative and ethical considerations

Ethical approval was obtained by institutional review board (IRB) at King Abdullah International Medical Research Center (KAIMRC) with reference number: JED-21-427780-154688. A written consent form was taken from the participant.

Results

Range of motion

The ROM of the left elbow was 40° to 120°. Unfortunately, the ROM did not increase after the intervention. Also, the ROM in supi-

nation did not increase. (Figure 4) demonstrate the ROM of the left elbow after 8 weeks of applying DN on EJ.



Figure 4: Left elbow flexion and extension after 8 weeks of applying the intervention.

Dexterity

The dexterity was tested with the BBT. Patient performed the test 3 times, at the baseline, after 4 weeks of the intervention, and finally after 8 weeks of the intervention. As shown in (Figure3) patient performed the test. He was asked to take the blocks from the right side to the left side for 1 minute and after that he was asked to perform the same test for the left upper extremity. This score was calculated by counting the amount of the blocks that transferred from the right side to the left side and vice versa. (Table 1) summarize the results of BBT scores.

Performance

Performance was tested and measured with DASH. Patient performed the test at the sametime with the dexterity, at the baseline, after 4 weeks, and after 8 weeks of the intervention. Patient was asked to answer all of the 30 items in the questionnaire. The sum items were calculated according to the equation mentioned in the method section. (Table 2) demonstrate the results of DASH scores.

Score		
	Right side	Left side
Baseline	56 blocks	47 blocks
After 4 weeks	57 blocks	49 blocks
After 8 weeks	61 blocks	56 blocks
There was a significant improvement in the dexterity based on the results shown in the table		

Table 1: BBT scores results.

Scores	
Baseline	34.2
After 4 weeks	26.7
After 8 weeks	19.2
There was a significant improvement in performance based on the results shown in the table	

Table 2: DASH scores results.

Discussion

We hypothesized that DN is effective in improving ROM, Upper Extremity Dexterity, and performance. The DN was applied around the scars and on the TrPs in addition to the rehabilitation program that include strengthening exercises and ROM exercise.

This rehabilitation program was applied on this patient as he is a complicated case, due to the multiple trauma and the multiple surgeries he had been through. Additionally, he was hopeless about his left upper extremity. Therefore, he was informed that he needs valid and reliable outcome measures to understand the improvement he reached. DASH and BBT were valid and reliable outcome measures to evaluate the upper extremity performance [15] and dexterity [17].

Regardless the intervention applied to the patient, yet he still has complications and functional limitations. After reviewing DASH, patient still unable to perform activities that need reaching above his head such as change a lightbulb overhead (item no.12 in the questionnaire). He also reported that he still complains of weakness on the left upper extremity (item no. 27) even after applying the DN and the therapeutic exercises [10]. Reported that the rehabilitation program included life-long load-bearing limitation of 5 kg after TEA. In which, the muscles will still be weak even if the patient continued the strengthening exercises for the triceps muscles.

As the patient is left-handed, the focus on the left upper extremity was needed to improve the dexterity and performance. Though, the left upper extremity still less in dexterity than the right upper extremity as shown in the results of BBT (Table 1). The study [18] reported that the functions of the upper extremity after TEA might be restricted, which explains the functions of the left upper extremity still less in functions such as dexterity than the right upper extremity.

Including the International Classification of Functioning, Disability and Health (ICF) in this case may demonstrate better description of patient’s needs and improvements. After reviewing DASH, item No. 30: I feel less capable, less confident, or less useful because of my arm, shoulder, or hand problem, he answered with (STRONGLY DISAGREE). Regardless, during attending events, his family members were always asking him about the improvement in his EJ ROM (Participation in ICF framework). The study [19] reported that ICF can easily identify the content coverage and content comparison between measures, and also can be used as a standard when selecting the most appropriate outcome measure.

The results in the current study demonstrate no significant differences in ROM, which correspond with the results of the study (Halle, *et al.* 2020) who applied DN for post shoulder stabilization repair. They found that there is no improvement in ROM after applying the DN. Therefore, we suggest that the aim of using DN for cases such as TEA is to improve the dexterity and performance rather than using it to increase ROM. However, our study is case report, another study design may demonstrate better results in ROM such as quasi studies or RCTs.

Our study has several limitations as it is case study, a risk of bias may occur with only one participant. Also, the participant always report that his skin became softer, and the ROM increased, we assume that he was convincing himself that his ROM increased because the skin was rigid and become softer so the ROM increased, which a possibility of placebo effect may occur.

Another limitation can be found in our study that the size of the arm was not taken, taking the size of the arm may indicate other results such as increasing the power of triceps muscles. Those limitations may affect on the results of the current study. Furthermore, the intervention maybe not effective on other elbow surgeries such as hemi elbow arthroplasty or revision TEA.

Further studies are recommended to conduct a research including the missed parts in our study. additionally, conducting a research in form of RCT or at least case series may demonstrate better results by applying the same interventions. Also, further investigations needed to prove the effectiveness of DN on the TEA and other elbow surgeries.

Conclusion

The findings of our study showed that applying DN on post TEA demonstrate a significant improvement in dexterity and perfor-

mance of EJ. Patient must continue rehabilitation program daily and the DN should be applied around the scar and on the TrP for at least once every 2 weeks to observe the improvement. Furthermore, there was no improvement in the ROM after applying the DN and after 8 weeks of a given rehabilitation program. However, the intervention was applied on a complicated case who had multiple trauma and multiple surgeries. Applying the same intervention on other surgeries such as hemi elbow arthroplasty or revision TEA may not show the same results. Using valid and reliable outcome measure is necessary to follow the improvement that the patient reached.

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