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Selective Physical Therapy Modality for Treating Children With Post Traumatic Elbow Stiffness

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ABSTRACT

Background: Elbow stiffness is a common sequel of elbow trauma in children. Restoration of joint range of motion (ROM) and functional activities can be a difficult, time consuming, and costly challenge. The purpose of the study was to investigate the effect of iodine iontophoresis in treating post traumatic elbow stiffness in children **Methods:** 42 patients with posttraumatic elbow stiffness, ranged in age from 6-12 years participated in the study. Patients were randomly assigned into two equal groups. Control group (n=21) and study group (n=21). Patients in the control group received superficial heat, stretching and strengthening exercises for 8 weeks, while patients in the study group received the same program plus application of iodine iontophoresis (2 mA for 15min/session). Patients were evaluated by electrogoniometer for active range of motion of the elbow joint, the disability of arm shoulder and hand (DASH) questionnaire for assessment of functional activities of the arm and the recovery time was calculated. The evaluation was applied at baseline and after last session of corresponding intervention (8weeks) **Results:** There was no significant differences between-groups at baseline in ROM of the elbow joint and DASH scores. At the end of the 8-weeks of intervention, Subjects in the study group experienced significant increase in ROM of the elbow and improvement in elbow function activities with greater reduction of the recovery time than those in the control group ($P < 0.05$). **Conclusion:** The results of this study suggested that iontophoresis application could be an effective and non-invasive modality for decreasing the duration of rehabilitation, improving ROM and functional activities of the elbow joint in children with post traumatic elbow stiffness. Further studies were needed to investigate the mechanism underling the therapeutic action of iodine iontophoresis. **Keywords:** Posttraumatic elbow stiffness, pediatrics, Iodine iontophoresis.

INTRODUCTION

Post traumatic elbow stiffness is a common problem in pediatrics after joint trauma that can cause substantial

impairment of upper limb function ⁽¹⁾. Elbow stiffness has been reported in 3% to 6% of children following a supracondylar fracture of the distal part of the humerus and in 33% to 100% of

children following a fracture of the neck of the radius⁽²⁾. The propensity of the elbow joint to develop stiffness after trauma is recognized by orthopedists, and can occur even after mild trauma. The main factors that expose the elbow joint to this complication are the high degree of congruence, the complexity of the joint surfaces and the high tissue sensitivity to trauma, especially in the joint capsule.⁽³⁾

Elbow contracture in children may be caused by simple elbow dislocations, physeal fractures, complex fracture-dislocations, or extra-articular fractures. The stiffness of the elbow can be classified as extrinsic or intrinsic. An intrinsic contracture is caused by intra-articular adhesions, articular mal alignment, loss of articular cartilage, or a number of other factors. An extrinsic contracture may arise in the joint capsule, collateral ligaments, or muscles surrounding the joint. The stiffness may be caused by myositis ossification which forms around the elbow. The pathogenesis of myositis ossification is unknown, but it frequently leads to severe limitation or total loss of movement^(4,5).

Non-surgical methods for managing post-traumatic elbow stiffness consist of joint immobilization and physiotherapy. Early rehabilitation can make the difference between a functional limb and an extremity with permanent functional loss. The goal of physiotherapy treatment is to restore motion and regain functional activities⁽⁶⁾. Although many narrative reviews

suggest that physiotherapy should be routinely used following elbow fracture, a recent review of the evidence on optimal rehabilitation of post-traumatic elbow stiffness noted the paucity of evidence, a lack of clarity in defining rehabilitation interventions, and a reliance on expert opinions with respect to this topic⁽⁷⁾.

Iontophoresis is the use of electrical current to enhance the transcutaneous administration of pharmacological active substances. Physical therapists use iontophoresis with the objective of delivering a locally higher, therapeutic concentration of an ion or other medication, while minimizing the systemic concentration caused by circulatory removal of the material from the area⁽⁸⁾.

Iodine is a trace element that is naturally present in some foods, added to others, and available as a dietary supplement⁽⁹⁾. Iodine iontophoresis is a non-invasive therapeutic modality was used recently for treating different dermatological and musculoskeletal disorders. It was reported that Iodine ions have sclerolytic effect with high ability of infiltration and penetration through the tissues⁽¹⁰⁾. So it can be used for reducing and breakdown postsurgical scar tissues and post traumatic tendon adhesions. So the current study was conducted to investigate the effect of selective physical therapy modality for

treating post traumatic elbow
stiffness in children.

MATERIAL AND METHODS:

Subjects

Forty two patients of both genders (25 male and 15 female) with post traumatic elbow stiffness aged from 6-12 years were recruited from the outpatient clinic of the Faculty of Physical Therapy, Cairo University. Patients included in this study were diagnosed by an orthopaedist. The main causes of the elbow contracture were supracondylar fracture, radial head fracture, intercondylar fracture, olecranon fracture, medial epicondial fractures and fracture dislocation of the elbow joint. All patients had unilateral involvement, and they were right handed. The aim and methods of the study were explained to all patients and their parents before their informed consent was given.

Inclusion criteria include patient with extension deformity more than 30° and flexion deformity of less than 130°, Radiologically, all the elbows were congruous with an adequate humero-ulnar joint space, the duration of suffering ranged from 6-8 weeks post trauma. Patients were excluded if they had spasticity, burn contractures, associated injury to the head or spinal cord, rheumatoid arthritis or significant heterotopic ossification or elbow arthroplasty or unsuccessful prior physical therapy treatment.

When the patients satisfied the inclusion criteria, they were randomly assigned into two equal groups.

Numbers were given to them⁽¹¹⁾. Control group consisted of the 21 patients with odd numbers, received superficial heat, stretching and strengthening exercises for the elbow musculature for 8 weeks, and study group consisted of 21 patients with even numbers received the same program plus iodine iontophoresis. This study was approved by the ethical committee of the Faculty of Physical Therapy, Cairo University.

Outcome Measures

Patients were assessed at the baseline and at the end of treatment sessions by the same therapist. The main outcomes measures include: active range of motion (AROM) of the elbow joint, functional activities of the arm and the recovery time.

Elbow joint Rang Of Motion

The digital uni-dimensional *elctrogoniometer* was used to measure the active ROM of the elbow joint. While the patient in comfortable lying position, elctrogoniometer was supported by two elastic straps on the lateral aspect of the elbow with the fulcrum on the humero-ulnar joint. The assessment of ROM was in form of flexion arc where the starting of ROM of flexion from extreme active extension point the patient can do it (zero point) to extreme active flexion point (reading measuring). the mean of the three successive reading was obtained.



Fig.1 Assessment of active ROM OF elbow joint

Elbow functional activities

The disability of arm, shoulder and hand (DASH) questionnaire was developed by the American Academy of Orthopedic Surgeons as an outcomes instrument specific to the upper extremity functional activities. It consists of thirty items: twenty-one evaluate difficulty with specific tasks, five evaluate symptoms, and one each evaluates social function, work function, sleep and confidence. The score is scaled between zero and 100 with higher scores indicating worse upper extremity function. The validity and reliability of DASH questionnaire for assessment functional activities of elbow and upper extremity were documented in many studies⁽¹²⁾.

Iodine iontophoresis application

GynmaUniphy N.V. direct current instrument was used for iontophoresis application, Iodine

potassium solution, with concentration of iodine 5% was prepared. The treatment electrode (negative pole) located on the anterior aspect of the elbow in cases of extension limitation and on the posterior aspect of elbow in case of flexion limitation and the dispersive electrode was wetted in tap water and located on the volar surface of the wrist joint from supine position. The direct current was gradually increased to 2mA and held constant for 15minutes. The patient experienced a mild tingling and warmth under both electrodes. After 15 minutes the current was slowly reduced, the electrodes removed, and the underlying skin inspected for irritation. The skin was massaged gently and dusted with talcum powder to soothe the skin and control itching. Iontophoresis was administered for three days/week for eight weeks.



Fig.2 Iodine iontophoresis application

Exercises program

Patients in both groups received gentle passive stretching exercises in flexion or extension or in both directions according to the arc limitation from lying position after the superficial heat application for 15 mints. Contract-relax muscle inhibition technique was used for increase flexion and/or extension. Progressive strengthening exercises were applied by manual and mechanical weights in various positions⁽¹³⁾. Initially use low-intensity resistance with multiple repetitions for muscular endurance, then progress to more intense resistance to strengthen the muscles in preparation for functional demands. The exercise program was conducted every other day for 8 weeks.

Statistical analyses

All data are expressed as mean± SD. The data was analyzed using SPSS for

Windows software, version 18.0 (SPSS, Inc., Chicago, IL). Statistical significance was set at $P = 0.05$. Student *t*-tests were performed to detect any differences between baseline and post-treatment values within groups and between groups.

RESULTS

This study was conducted on 42 patients with post traumatic elbow stiffness (mean age 10.05 ± 1.73) years. Twenty one patients were treated with exercise program and another 21 were treated with the same exercises and iodine iontophoresis for eight weeks. The demographic profile of the patients is shown in Table 1. The results showed that at baseline, there were no statistically significant differences between groups in term of age, weight, height and duration of immobilization ($P > 0.05$).

Table 1. Demographic Data of 42 Patients with post traumatic elbow stiffness

Characteristics	CONTROL Group (n=21) mean \pm SD	STUDUY Group (n=21) mean \pm SD	P- value
Age (year)	10.14 \pm 1.87	9.95 \pm 1.62	0.342
Weight (kg)	58.5 \pm 25.9	60.42 \pm 26.4	0.944
Height (cm)	153 \pm 7.52	155.4 \pm 2.79	0.636
Duration of immobilization (WEEKS)	6.67 \pm 3.13	6.55 \pm 2.21	0.315

***SD: standard deviation, P: probability**

Pre-treatment and post-treatment intra-group analysis revealed that, there was a significant increase in the active range of motion of the elbow joint measured by elecrogouimetr and

significant improvement in the functional activities of the affected arm measured by DASH score with a significant reduction in the time to recovery in favor of iontophoresis (study) group (Table2).

Table 2. Statistical analysis of active ROM of elbow joint, DASH scores and time to recovery between groups.

Variables	Control Group Mean \pm SD	Study Group mean \pm SD	P- Value
Elbow ROM	Pre 58.33 \pm 16.67	55.8 \pm 19.4	0.65
	Post 121.85 \pm 11	130.66 \pm 7.6	0.027
DASH SCORE	Pre 37.31 \pm 11.7	37.58 \pm 10.33	0.93
	Post 4.68 \pm 2.08	3.33 \pm 1.6	0.004
TIME TO RECOVERY	8.14 \pm 2.5	5.61 \pm 2.29	0.002

***SD: standard deviation, P: probability**

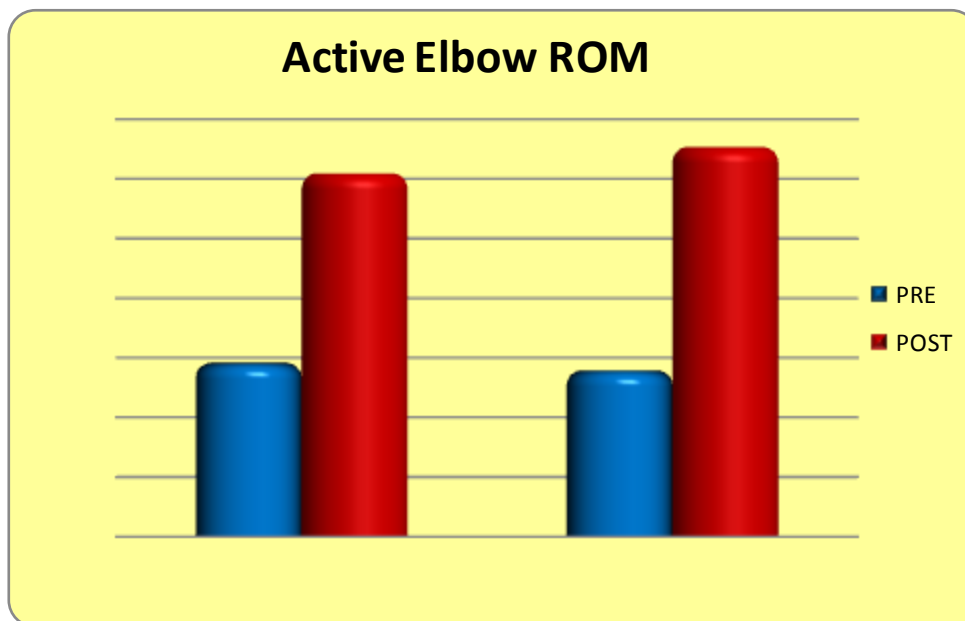


Fig.3 Mean of Active ROM of elbow joints between groups before and after treatment

Figure (3) showed that there is strong inverse person product correlation between the pre treatment active ROM of the elbow joint and pre treatment DASH score between groups

where $r = -0.807$. This means that when the pre treatment ROM decreases the pre treatment DASH score increases

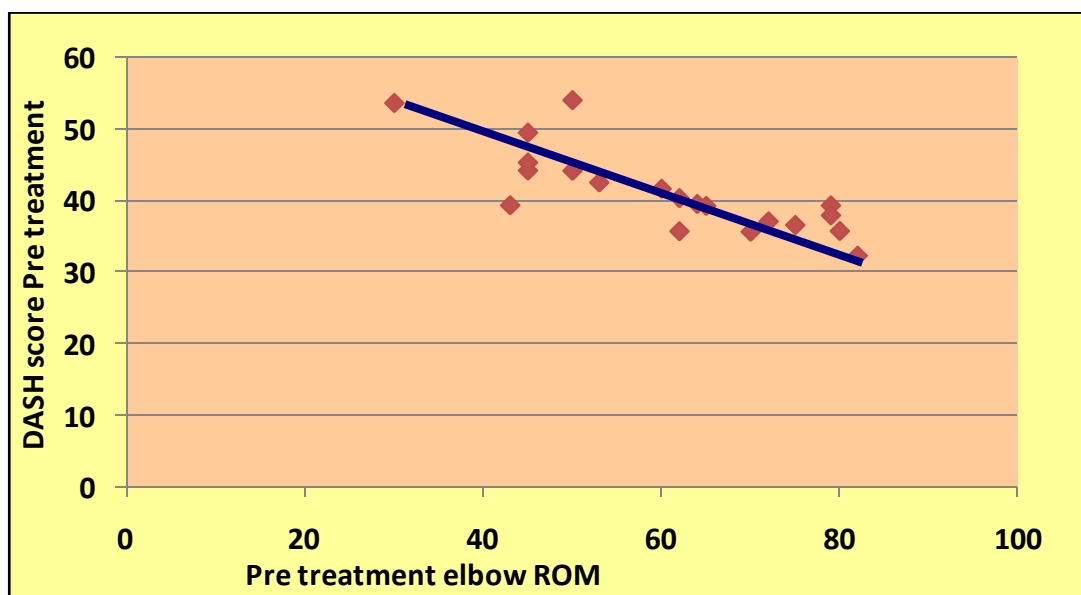


Fig. 4 Correlation between elbow ROM and DASH score pre treatment in both groups

DISCUSSION

Posttraumatic elbow stiffness is recognized as one of the most common complications of trauma of the elbow in adult and children patients. This has been attributed to fibrosis and thickening of the capsule and periarticular soft tissue structures causing different degrees of limitation of motion in the elbow joint⁽¹⁴⁾. When plans orthopedics-surgical treatment was finished and after that limitation of motion in the elbow joint occurred, physical therapy and rehabilitation has the important role in the attaining of the functional improvement and turning out of mobility of the elbow^(15,16).

Although the increasing knowledge and experience regarding the surgical treatment of elbow contractures in adults have suggested that good results can be achieved in most patients^(17,18), Siddharth et al. reported a more pessimistic prognosis for patients with an age of twenty-one years or younger who were managed with various invasive surgical techniques⁽¹⁹⁾.

This study was designed to evaluate the potential effects of iodine iontophoresis in treatment of posttraumatic stiff elbow and its effect on the elbow active ROM, functional activities and the time to recovery. The evaluation was performed by comparing the results gained from control group which received

superficial heat, stretching and strengthening exercises and from study group which receive the same previous program in addition to the iodine iontophoresis. The results revealed more significant increase in active ROM of the elbow, significant improve in functional activities of the affected arm and reduction in the recovery time in the iodine iontophoresis group than in control group.

The relation between active ROM of the elbow joint and the functional disability was investigated in the current study, the results revealed that the greater limitation in ROM the more impairment in the functional activities of the arm that indicates restriction of elbow joint movement may have a major impact on the individual performance in daily activities leading to high level of disability specially in children.

Iontophoresis is a good transporter for materials and medications inside the body for good penetration beside it is painless, sterile and non invasive technique. Iontophoresis mechanism depend on three ways (electromigration, electroporation and electro-osmosis) for introducing ions inside the body so it doesn't affect on implanted metal of the internal fixation and it is save for patients with elbow fracture⁽²⁰⁾.

The clinical studies about using the iodine iontophoresis in treating scar tissues showed that it was effective for

treating superficial scar tissue¹, and gaining normal strength in tendon adhesion⁽²¹⁾. Many studies recommend iodine iontophoresis for treating scar and adhesive tissue because it increases the extensibility of the scar and decrease resistance of scar tissue to the stretching therefore increases the effectiveness of stretching exercises, range of motion exercises and accelerates the rate of regain of functional range of motion⁽²²⁻²³⁾.

Although the mechanism of sclerolytic action of iodine is still not clearly understood, Iodine iontophoresis appears to increase the antioxidative capacity of the tear fluid, which may, in turn, act as a defense mechanism against the development of dry skin in response to environmental oxidative stress. also it can be used as a vasodilator agent, an anti inflammatory agent, and as a sclerolytic agent in cases involving adhesions and calcific deposits of the joints⁽²⁴⁾.

The results of the current study come in contact with Jandric et al. who treated 75 children with posttraumatic elbow contractures. Their average age (9.1±3.2) and the average duration of rehabilitation were 40.1 days. Rehabilitation included procedures of the physical therapy and splints. Outcome of the therapy was the best in the children with supracondylar fracture (34 children from 39 or 87.2% had full range of motion of the elbow at the discharge). The average value of the range of motion of the elbow joint after physical therapy was 124.1°. The duration of rehabilitation was close to the period of achievement of study group but lower than the control group

in children section may be this due to using splints beside the physical therapy⁽²⁵⁾.

CONCLUSION

The results of this study demonstrated that iodine iontophoresis could be considered as non invasive effective therapeutic modality in the rehabilitation program of posttraumatic elbow stiffness and it is safe to use and economical. The adjunct of iodine iontophoresis with passive stretching exercises and strengthening exercises in the management of posttraumatic elbow stiffness allows the maximum clinical improvement and increases the succession rate of the physical therapy and also decreases the needing for using the different types of splints and surgical intervention to increase the ROM of the elbow joint.

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الملخص العربي

طريقه منتقاه في العلاج الطبيعي علاج تيبسما بعد رضوض الكوع عند الاطفال

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يعد تيبس مفصل الكوع من النتائج الحتمية التي تحدث بعد ردود الكوع عند الأطفال والتي يتطلب علاجها وقتاً وجهداً. تهدف هذه الرسالة إلى دراسة مدى تأثير إدخال أيونات اليود كهربائياً في علاج تيبس ما بعد رضوض الكوع عند الأطفال. تكونت العينه من 42 طفل تراوحت اعمارهم من 6-12 سنة يعانون من تيبس مفصل الكوع. ثم تم تقسيم المرضى إلى مجموعتين متساويتين في العدد. المجموعه الاولى (مجموعه ضابطة) تكونت من 21 مريض تلقت البرنامج العلاجي المعتاد في صورته حراره سطحيه (أشعه تحت الحمراء) لمدته 15 دقيقه ومجموعه من تمارينات الأظاله ومدى الحركة والتقويه لمدته 15 دقيقه. المجموعه الثانيه (مجموعه البحث) تكونت من 21 مريض تلقت نفس البرنامج العلاجي المعتاد بجانب إدخال أيونات اليود كهربائياً لمدته 15 دقيقه ثلاث مرات أسبوعياً لمدته شهرين. تم تقييم مدى الحركة لمفصل الكوع والقدرة على اداء الأنشطة الوظيفيه وكذلك قياس مده العلاج لكل مريض قبل وبعد اتمام البرنامج العلاجي. وقد اوضحت النتائج وجود اختلافات ذو دلالة احصائيه بين المجموعتين من حيث مدى الحركة والقدرة على الاداء الوظيفي ومده العلاج في مجموعته البحث بالنسبه للمجموعه الضابطه. وفقاً لهذه النتائج نستنتج أنه يمكن استخدام إدخال أيونات اليود كهربائياً بجانب البرنامج العلاجي التقليدي لتحسين مدى الحركة للكوع وزيادة القوه الوظيفيه وإختصار مده التأهيل اللازمه في علاج تيبس ما بعد رضوض الكوع عند الاطفال. ويوصى بمزيد من الدراسه لبحث اليه العمل اللازمه لتحقيق الهدف العلاجي وراء استخدام ايونات اليود في العلاج.

الكلمات الداله: تيبس ما بعد رضوض الكوع - إدخال أيونات اليود كهربائياً