Physical Therapy Approach after Plastic Surgery in Crushed Hand

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ABSTRACT

The main purpose of this study was to assess the available physical therapy approach after plastic surgery in crushed hand. Sixty five hand surgeons and 60 physiotherapists from different Hospitals filled out a handed in questionnaire which included two check lists were utilized. The results of the study revealed that the majority of selected hospitals lack specialized hand therapists, both therapeutic and measuring equipment for hand among team members. Additionally, the study showed the most common modalities and techniques for associated problems of crushed hand in participated hospitals. The study concluded that an emphasis should be given to the earliness of physiotherapy intervention through a well experienced hand therapist and well equipped departments.

Key words: *(Physical therapy approach, crushed hand, plastic surgery)*

INTRODUCTION

Crushed hand injuries are most common in the work place[1]. The care of these patients requires an accurate assessment, carefully planned executed surgical procedures and a long period of rehabilitation[2]. Good hand therapy programs that are executed by a well experienced hand therapist with close co–operation between the rehabilitation team works should be cost effective and successfully return patients with complex and extensive hand injuries to either their regular jobs or modified ones[3].

It is observed that the presence of modalities and techniques and their use were varied among therapists working at different hospitals. There was no therapist who uses all modalities and techniques that included in the checklist. Because of the complexity of such injuries, the physical therapy program was designed on the principles of problem solving approach system. This approval specifies the validity of different treatment modalities according to the associated problems that may be varied from case to another. With respect to the wound care of the injured part of the hand.

It is reported that the therapist's treatment goals with wounds should promote wound closure with minimal scar formation, restore full active and passive range of movement to the affected hand and maintain a

full range of movement in the uninvolved joints of the upper limb[4].

it is stated that tissue extensibility can be increased by raising its temperature enough to cause dissolution of the cross links within and between protein molecules. High protein tissues preferentially absorb ultrasound at faster rate in skin, scar tissue and fascia than loose connective tissues as muscle and fat[5].

Thirty one therapists stated that deep friction massage may be used in combination with ultrasound. They added that this is a simple manual method that may be used for scar management. On the other hand, the remaining therapists reported that they do not apply this modality for fear from injuring the newly healed skin. Therefore, the study recommends the necessary training of manual therapy among physiotherapists. Another reason as it is a manually applicable modality that consumes much time, especially in those hospitals that receive great number of patients[6].

It is stated that reduction of edema should be a high priority. Most commonly recommended methods for edema reduction include elevation, retrograde massage, various forms of external intermittent and continuous compression, including pressure sleeves and gloves, bandaging, Coban elastic wrapping techniques and early introduction of activity[7].

This study was an attempt to determine the defects in the application of physical therapy management of patients with crushed hand injuries and to clarify causes of these defects. Therefore, optimum results could be achieved in the shortest period of time that might help the patient to return to his work as early as possible with the least possible disability.

Materials and procedures

Sixty-five hand surgeons who perform surgical management of crushed hand patients and 60 physiotherapists, who provide physical therapy approach for surgically managed crushed hand, participated in this study. All were selected from different hospitals that represent different categories of health care organizations. Seventeen Public Hospitals, 16 Health Insurance Hospitals, 11 Private Hospitals, 8 Military Hospitals, and 8 University Hospitals were selected randomly in Cairo City. In order to achieve the purposes of the study: Two different questionnaires were designed to elicit the appropriate information from both hand surgeons and physiotherapists. A Checklist was constructed to assess the actually applied physical therapy program for crushed hand patients in different hospitals. Another one was to assess the available therapeutic and measuring equipment and tools that are commonly used for hand physical rehabilitation. Prior to conducting the study, three experts were asked to review the items of the questionnaires for clarity and relevance to the stated purposes of this study.

PROCEDURES

The data was collected by direct distribution of questionnaires to 65 hand surgeons and 60 physiotherapists. The purpose of the study and all questions were explained before gathering responses. Each subject was given enough time for answering questions and each questionnaire was collected at the

same day of each visit. The check list of the responses of therapists towards modalities and techniques used in the management of crushed hand injuries was collected by interviewing a senior physiotherapist while the check list of both therapeutic and measuring equipment and tools was collected by personal observation of the researcher after taking permission from the hospital manager.

RESULTS

Table (1) summarizes the responses that were gathered under 3 common problems that face the application of physical therapy program given for crushed hand patients. These common problems were collected according to surgeon's point of view. The table shows that hand surgeons recorded that all sixty five hand surgeons recorded that the main problem is the lack of specialized hand therapist as well as interested physiotherapist in hand therapy. While 62 hand surgeons recorded lack of proper communication among team work of rehabilitation. In addition, 48 surgeons recorded lack of patient's compliance as a common problem that may face the application of physical therapy program for such patients.

Table (1): Problems facing the application of physical therapy program from surgeon's point of view

Common Responses	Frequency	percentage	Total
Lack of specialized hand therapist as well as physical therapist interest	65	100%	65
Lack of proper communication among team work	62	95.3%	65
Lack of patient's compliance	48	73.8%	65

The responses were summarized into 4 common problems that face the application of physical therapy program given for crushed hand patients. These common problems were collected according to therapist's point of view. Table (2) shows that there were 50 therapists recorded lack of communication among team work forty three therapists recorded lack of equipment and tools specially that used in hand physical rehabilitation, forty six therapists recorded lack of patient's compliance, while forty five therapists recorded the high number of refereed patients to physical therapy department with other disorders.

Table (2): The problems facing the application of physical therapy program from physical therapist's point of view

Common Responses	Frequency	percentage	Total
Lack of communication among team work	50	83%	60
Lack of equipment and tools especially that used in hand rehabilitation.	43	71.6%	60
Lack of patient's compliance.	46	76.6%	60
The high number of referred patient to physical therapy department with other disorders.	45	75%	60

Presentation of physiotherapist's responses to different modalities and techniques

The collected data from the checklist concerning the responses of sixty physiotherapists about the frequency of application of different modalities and techniques that are commonly used in the treatment of associated problems of crushed hand injuries.

Regarding wound care of the injured part of the hand in figure (1), out of 60 therapists, 8 therapists use whirlpool while 9 of them use dressings. It is noticed that 5 therapists mentioned they apply both whirlpool and dressings as common methods of wound care for the surgically managed crushed hand injuries.

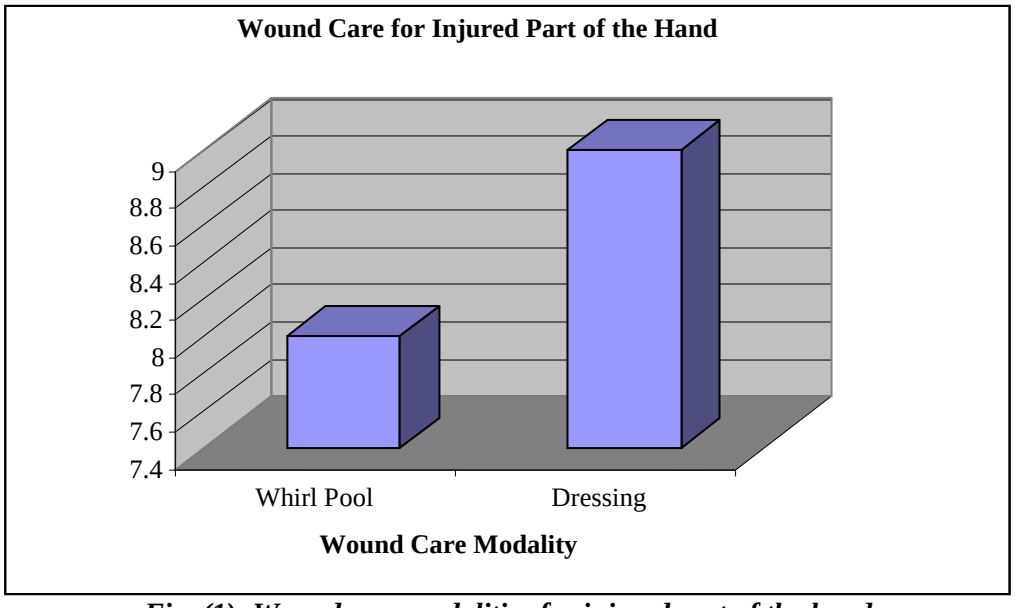

Fig. (1): Wound care modalities for injured part of the hand.

Regarding superficial scar management in figure (2), all 60 therapists among all visited hospitals and clinics use ultrasound therapy as a common modality to treat superficial scars after wound healing. Thirty one mentioned that they use deep friction massage in addition to ultrasound therapy, while one therapist uses a specialized vibrator in addition to ultrasound and deep friction massage. On the other hand, no response was recorded about using pressure garments in controlling superficial scar.

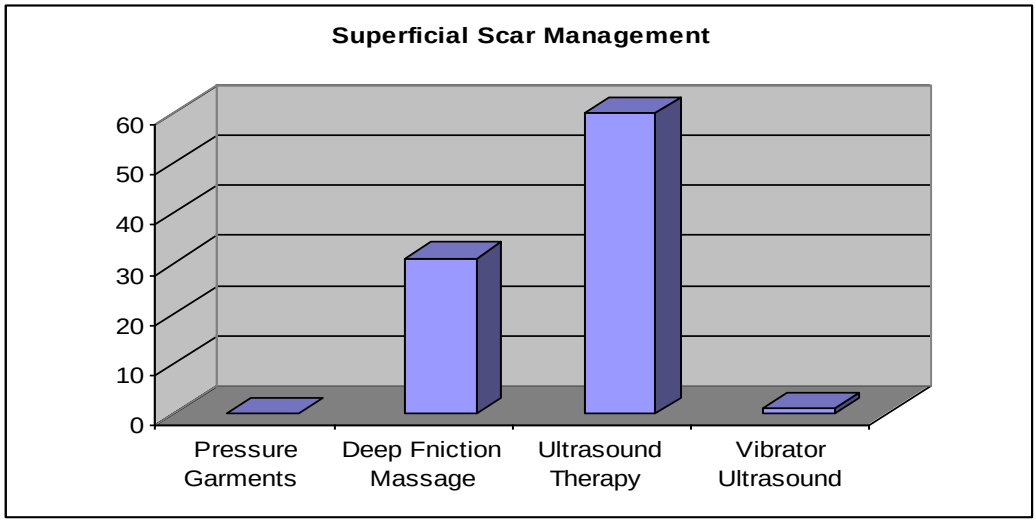

Fig. (2): Superficial scar management modalities

With respect to edema reduction techniques, the collected data in figure(3) show also that all therapists treat hand edema mainly by positioning of injured hand in elevation, while 54 therapists provide active free movement exercises for non injured parts of the hand as an effective and simple method of edema reduction techniques. Retrograde massage is applied by 29 therapists while high voltage pulsed current is applied by 25 therapists. Additionally there are 20 therapists use cold application either in the physical therapy department or as a home care program.

Six therapists mentioned that they use (IPC) device as it is available in their physical therapy departments while only 2 therapists stated that they use (CET). Additionally one therapist applies elasticized gloves to reduce edema of the injured hand. The study also showed that out of 60 therapists, There are 25 therapists provided four different modalities in combination that are (elevation, retrograde massage, active free movement exercises and high voltage pulsed current) while 17 therapists provide another four modalities that are (elevation, retrograde massage, active free movement exercises and cold application). It was also shown that there are 15 therapists use five different modalities (elevation, retrograde massage, and active free movement exercises high voltage pulsed current and cold application). Only one therapist uses all eight modalities that are mentioned in the check list as a condensed treatment to reduce edema.

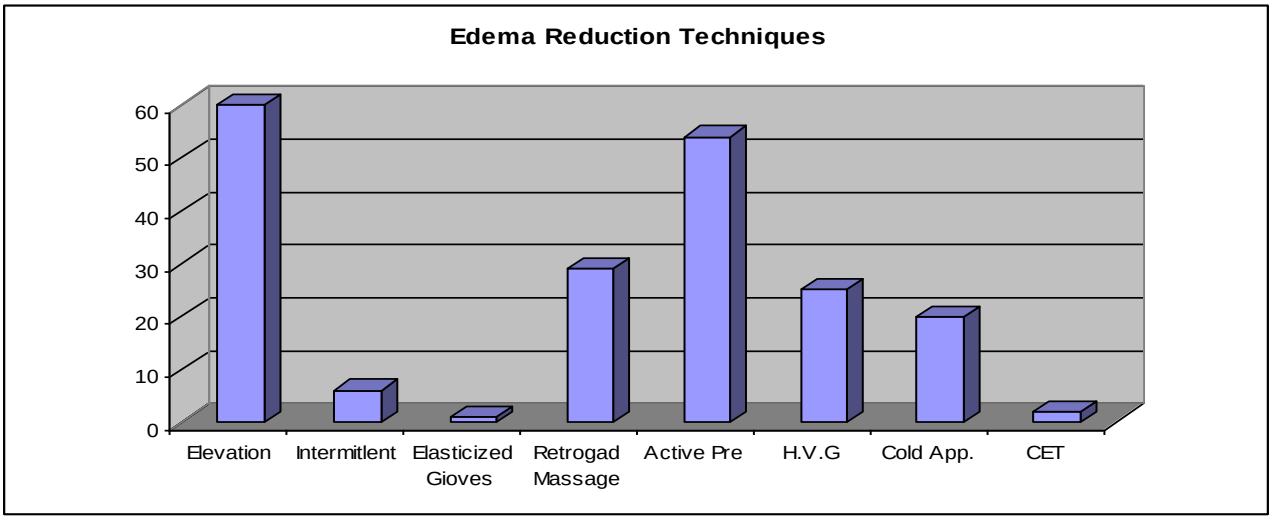

Fig. (3): Edema reduction techniques

Regarding passive range of motion exercises in figure (4), the majority of therapists (54 therapists) mentioned that they use gentle passive stretching exercises while 42 therapists indicate the use of mobilizing exercises. Continuous passive motion device (CPM) is used by only 5 therapists. On the other hand, five therapists use the three modalities in combination with each other as different types of passive range of motion exercises.

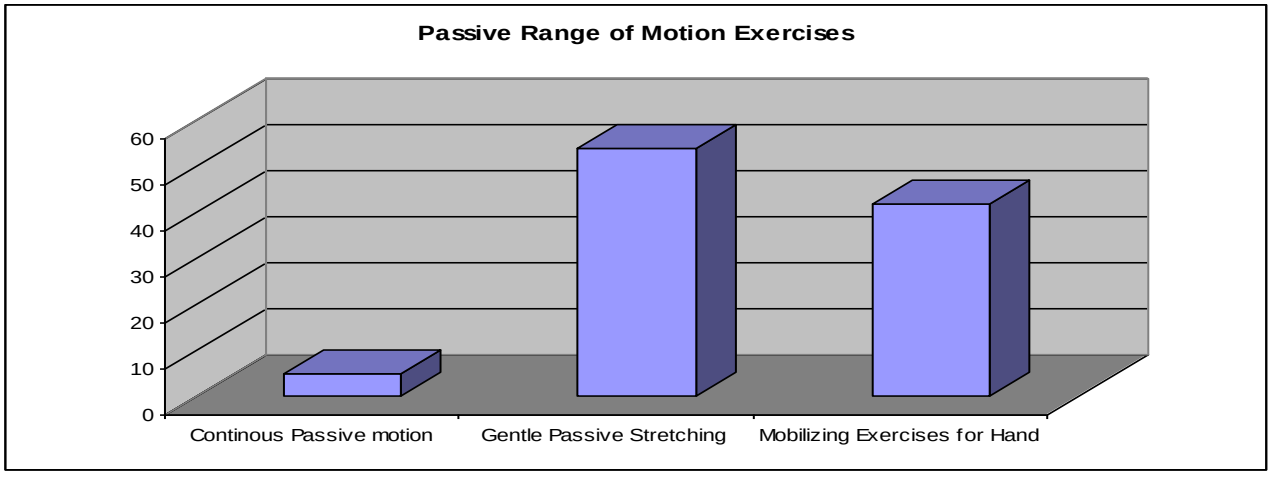

Fig. (4): Passive range of motion exercises.

For the active range of motion exercises presented in figure (5), the majority of physiotherapists (55 therapists) stated that they use gliding exercises while there are 30 therapists use blocking exercises in addition to gliding exercises.

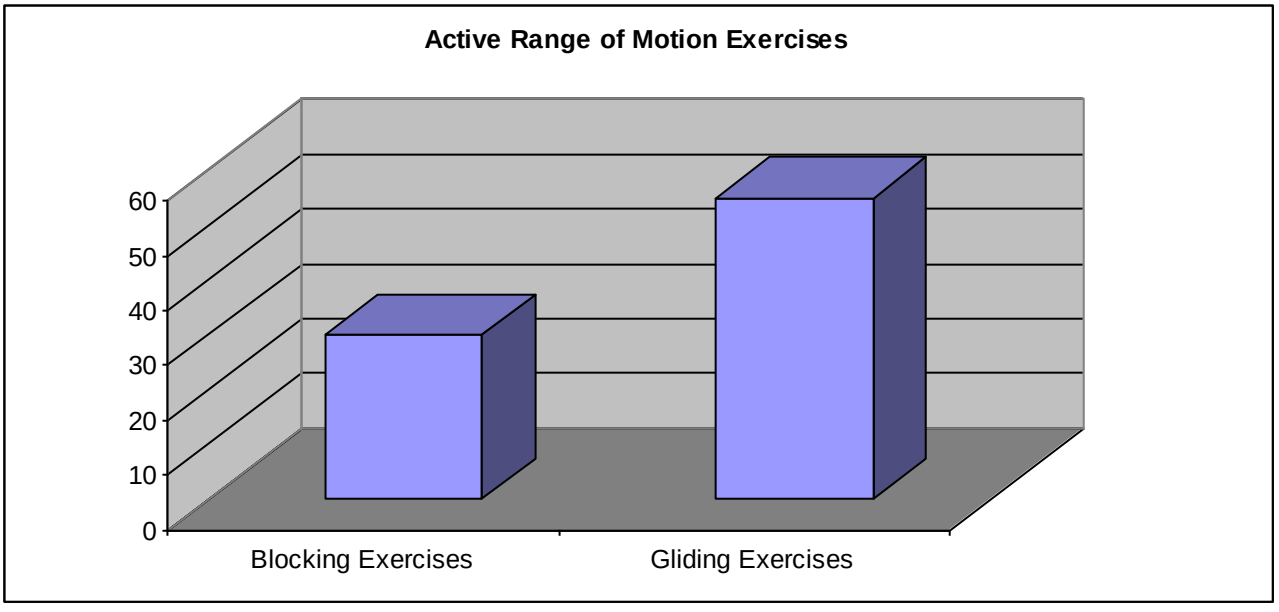

Fig. (5): Active range of motion exercises.

For strengthening exercises of muscles of the injured hand, the data in figure (6) shows that the majority of therapists (54 therapists) mentioned that they use manual resistive exercises, while there are 45 therapists use electrical stimulation; additionally, two therapists mentioned that they use hand grip dynamometer as a tool for strengthening exercises, while only one therapist use pulley materials. It is also observed that 44 therapists usually use two combined modalities as manual resistive exercises and electrical stimulation. While one therapist mentioned that he uses three combined modalities as manual resistive exercises, electrical stimulation and dynamometer. Only one therapist uses the four mentioned modalities in the checklist.

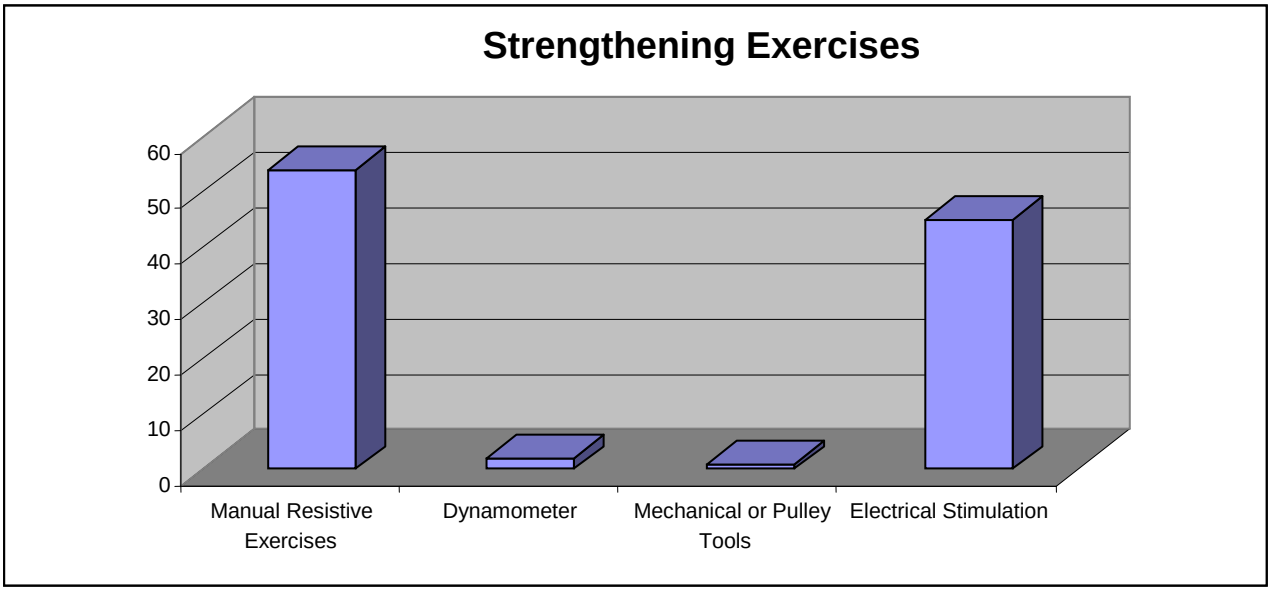

Fig. (6): Strengthening exercises of the hand muscles

Availability of therapeutic and measuring equipment and tools

Table (3) presents the collected data about the therapeutic equipment and tools that are commonly used in hand physical therapy in different hospital categories.

For wound care, whirlpool was present in (18.3 %) and dressings facilities in (15%) among all hospitals. Ultrasound device was (100%) available in all hospitals for scar management. However, any other tools (pressure garments, elastomer or silicone gel sheeting) were not provided at any hospital. For edema management, high voltage pulsed current, cold packs, intermittent compression device, closed environmental therapy device and elastic compressive gloves all are equipment and tools that were available in (48.3%) (33.3%), (10%), (3.3%) and (1.7%) of all hospitals respectively.

For pain control and modulation, paraffin wax was available in (78.3%) followed by transcutaneous electrical nerve stimulation (TENS) in (75 %) and hot packs in (51.7%) of all participated hospitals.

For desensitization and sensory re-education, tools were available in (13.3 %) while hand held vibration unit was available in (1.7%) of all hospitals.

Table (3): Equipment and Tools for Hand Physical Therapy in sixty Hospitals

Equipment and Tools	Frequency	%
Wound care		
* Whirl pool	11	18.3%
* Dressings	9	15.0%
Scar management		
* Ultrasound device	60	100.0%
* Pressure garments	0	0.0%
* Elastomer	0	0.0%
* Hand Held Vibration Unit	1	1.7%
* Silicone gel sheeting	0	0.0%
Edema Management		
* Intermittent pneumatic compressive device	6	10.0%
* High voltage pulsed current	29	48.3%
* Elastic compressive gloves and warps	1	1.7%
* Cold packs	20	33.3%
* Closed environmental therapy device	2	3.3%
Pain Management		
* Transcutneous electrical nerve stimulation (TENS)	45	75.0%
* Hot Packs	31	51.7%
* Paraffin	47	78.3%
Desensitization and sensory re-education		
* Hand held vibration unit	1	1.7%
* Desensitization and sensory re-education tools	8	13.3%
Range of motion		
* Continuous passive motion device (CPM)	6	10.0%
* Dynamic splinting	20	33.3%
Positioning		
* Static splinting	20	33.3%
* Supportive devices	35	58.3%
Muscle Re-education		
* Bio feed back	3	5.0%
* Electrical stimulation	57	95.0%
Strengthening exercises		
* Dynamometer	2	3.3%
* Mechanical weights	23	38.3%
* Putty materials	1	1.7%
Functional/ Co-ordination training tools	14	23.3%
Job simulation tools	6	10.0%

For range of motion devices, dynamic splinting was available in (33.3 %) while continuous passive motion device (CPM) was available in (10.0 %) of all hospitals.

For positioning of the injured hand, supportive devices was available in (58.3 %) followed by static splinting in (33.3 %) of all hospitals.

For muscle re-education, electrical stimulation device was available in (95.0 %) and biofeedback in (5.0 %) of all hospitals.

Mechanical weights were available in (38.3 %), while dynamometer in (3.3 %) and putty materials in (1.7 %) for muscle strengthening exercises of all hospitals.

Functional and co-ordination training tools were available in (23.3 %) and Job simulation equipment and tools were available in (10 %) of all hospitals.

Table (4) presents the collected data about the measuring equipment and tools that are commonly used in hand measurement in different hospitals.

Table (4): Equipment and Tools of Hand Measurement in sixty Hospitals

Type of measurement Tool	Frequency	%
Edema measurement.		
* Volumeter.	1	1.7%
* Circumferential tape measure.	34	56.7%
* Circumferential gauge.	0	0.0%
Range of motion measurement		
* Manual hand goniometer	15	25.0%
* Pulp to palm distance ruler	6	10.0%
Hand muscles testing		
* Hand grip Jamar dynamometer	9	15.0%
* Hand pinchiometer (pinch gauge).	2	3.3%
Cutaneous measurement		
* Cutaneous temperature gauge.	0	0.0%
* Semmes – Weinstein monofilaments (light touch/ deep pressure).	1	1.7%
* Two point discrimination.	14	23.3%
* Vibration tuning fork.	4	6.7%
* Commercial vibrometer.	0	0.0%
Dexterity Measurement		
* Moberg pick up test	0	0.0%
*Minnesota rate of manipulation test (MRMT).	0	0.0%
*Purdue pegboard test.	0	0.0%
Hand function measurement		
* Jebsen hand function test.	0	0.0%
*Sollerman hand function test.	0	0.0%
Work assessment	3	5.0%

For edema measurement, circumferential tape was available in (56.7%) followed by voltmeter that was in (1.7 %) of hospitals while there was no circumferential gauge available in all hospitals for edema measurement.

For muscle power testing, manual hand goniometer was available in (25 %) while pulp

to palm distance ruler was available in (10 %) of all hospitals.

For testing muscle power of the hand Jamar dynamometer for hand grip measurement was available in (15 %) while pinchiometer was in (3.3%) of all hospitals.

Two-point discrimination was tools present in (23.3 %), while tuning fork was in (6.7%) of hospitals. Semmes Weinstein monofilaments were present in (1.7 %) while no cutaneous temperature gauge or commercial vibrometer were available at any hospital.

Dexterity and hand function measurements were not available or performed at all categories of hospitals while work assessment was available in (5.0 %) of all hospitals.

DISCUSSION

As regards for the surgeons recommendations for the proper time of conducting physical therapy interventions for crushed hand patients, The results of the study emphasized the role of physical therapy to be included between surgeries as the majority of surgeons (42 surgeons) out of 65 from 60 hospitals recommended that physical therapy must be conducted between surgeries and not either after completion of surgeries or immediately after bone healing. Their opinions stressed on the earlier interventions of physical therapy treatment, the better results and rehabilitation outcomes could be achieved.

The importance of early intensive treatment of complex hand injuries including the rehabilitation program which should be commenced within a few hours after leaving the operation room. As the crushed hand patients may require multi staged re-constructive surgeries that may need long period of time according to the status of each patient, physical therapy treatment after completion of all surgeries will not achieve better results as the patients may encounter more detrimental and irreversible complications[8].

Although bone healing is considered as an important sign to begin physical rehabilitation, an immediate rigid internal fixation is believed to be the best used option to enhance fracture healing, and to provide adequate stability to begin the rehabilitation program early. This concept was corfirmed by the findings of many investigators, that the bony architecture must be re-established by immediate open reduction and rigid internal fixation in open hand fractures. Even with other methods of bone fixation, physiotherapy intervention should not be postponed until bone healing occurs; it should be commenced for uninjured parts of the hand and the whole upper extremity to avoid joint stiffness and contractures[9,10].

Concerning to the frequency of communication in between surgeons and therapists, twenty eight surgeons mentioned that they communicate Sometimes with therapists, most of those surgeons working at university and military hospitals while their recommendation for starting physiotherapy was between surgeries, While 21 surgeons communicate Seldom with therapists and most of them are working at health insurance and public hospitals which mean a presence of a defect in the frequency of communication in relation to the recommendation time among

team members in both university and military hospitals.

It was reported that the rehabilitative goals should be clearly defined and all members of the team work must understand and agree with them. This requires clear and frequent communication among team members. It also requires direction and leadership. A leader should be designated at the start so, the surgeon usually charged with prime responsibility for the patient's care. As when the main surgical and medical problems have been taken care of, the role of leader can be passed to whoever has the major involvement with the patient. They also added that every one on the team must be aiming at the same target and the only way rehabilitative goals can be clearly defined and supported is by good and continuous communication within the team members. They added also that patients should attend regular meetings of team work for clarifying methods, goals and expected outcomes. The patient's compliance and his motivation become worse when he finds his care is done by a committee whose members are not communicating with one another. On the contrary, most of surgeons (8 surgeons) in private hospitals stated that they are always need communication with physiotherapists. The results from this study clearly demonstrated the importance of the presence of interaction between the rehabilitation team members for the sake of the patients[11].

Analyzing the results about the type of communication used with physiotherapists also reveals that all the 65 surgeons communicate with physical therapists through written reports, while, 16 surgeons stated that their communication with physical therapists is through both verbal and written reports. The study emphasized the importance of using both types of communication between surgeons and therapists. Although verbal type is important, it should not superimpose the written report which used regularly for documentation and legality.

It was stated that importance of patient compliance in treatment of individuals with upper limb injuries. The therapist needs to be able to gain patient's co-operation and trust because the individual's commitment in following treatment regime during treatment sessions and at home is essential to the success and recovery of injury. He added that there are many factors which affect patient's compliance to treatment including fear of pain, lack of motivation and lack of understanding[12].

Concerning the availability of therapeutic equipment and tools that are commonly used in hand physical therapy. The results from table (3) showed that 11 whirlpools are available in 11 departments while the collected data represent responses of therapists towards different modalities and techniques, only 8 therapists use whirlpool as an effective modality for wound care of injured hand; therefore, it is concluded that 3 therapists don't use this device for wound care.

For superficial scar management, many tools that are effective in reducing and controlling scar maturation are not available or used by all participated therapists. These tools such as pressure garments, elastomers and silicone gel sheeting. As regard to edema management, it is observed that HVPC present in 29 departments while only 25 therapists use it as an edema reduction modality. About

desensitization and sensory re-education tools, they are available in 8 departments despite these tools were prepared by those therapists who are working at those departments.

For muscle re-education, biofeedback devices are available at only 3 departments, while putty materials are available at only one department as well as functional training tools are available at only 6 departments. From the above mentioned data, it is observed that some therapists are not aware or familiar by the effective use of some mentioned equipment and tools in treatment of different problems associated with hand lesions

The effect of high voltage pulsed current on reducing edema has been included in several studies. It was reported that there was a significant reduction of edema by the use of HVPC effect on permeability of microvessles to plasma protein by administering histamine like substance to increase capillary permeability. This is confirmed by the responses of 25 therapists among 60 therapists that emphasize on the great effect of HVPC on reducing edema associated with crushed hand injuries additionally twenty therapists agreed the used of cold application on reducing edema. This effect may be attributed to its vasoconstriction effect which helps reduction of swelling and edema produced in inflammatory reactions. They added that cold application is contraindicated in vascular insufficiency and sensory nerve lesions. From the above mentioned results, the modalities and techniques included in the checklist reveal the evidence of such program in the identification of the problems facing its application. These problems may include lack of presence of some of these modalities in different hospitals specially those located in the industrial communities, the lack of either experience of awareness of its use and the great number of patient's attendance which does not give the opportunity for the physiotherapists to apply manual modalities[13,14].

Concerning to the different tools that are used for hand measurements, the results in table (4) revealed either deficiency or absence of most of these measuring tools, this may be attributed mainly to the lack of interested or specialized hand therapists who become in a great need for the presence of those important tools for accurate assessment and recording all clinical information about each patient. This is an essential aspect for prognosis and follow up and consequently more perfect outcome. It is also observed that both dexterity and hand function measurements are not available in all 60 hospitals despite their simple and effective use to regain manipulative and functional skills of the hand.

Conclusion: the study concluded that physiotherapy has an essential role in post operative cases of crushed hand injury. There must always be continuous communication between team members through verbal and written reports. Also, other services as occupational therapy psychological therapy and social services all must be provided to patients with crushed hand injury. The results of the study highlighted the defects in the physical therapy management of patients with crushed hand injury and their causes.

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الملخص العربي

أسلوب علاج طبيعي مقترح لما بعد جراحة التجميل لانسحاق اليد

الغرض الأساسي في هذه الدراسة كان لتقييم الأساليب المتاحة في العلاج الطبيعي بعد جراحة التجميل لانسحاق اليد، ثم توزيع اثنان من نماذج الاستبيان على 65 جراح يد و60 أخصائي علاج طبيعي، يحتوي كل استبيان على جزئين. وقد أسفرت نتائج البحث على أن معظم المستشفيات المختارة تفتقر إلى وجود المتخصص من أخصائي العلاج الطبيعي في علاج اليد بجانب عدم وجود أجهزة قياسات لليد وكذلك افتقار التخاطب بين الفريق الطبي الذي يعمل في جراحات اليد.

وقد خلصت الدراسة إلى أهمية دور العلاج الطبيعي لمرضى انسحاق اليد بعد العمليات الجراحية مع ضرورة وجود فريق عمل متكامل ومتخصص ودائم الاتصال والتعاون بالإضافة إلى وجود قسم مجهز بالإمكانيات عالية التقنية.