ISSN 2786-0183
Helwan International Journal for Nursing Research and Pratctice
Vol. 1, Issue 1, Month: June 2022, Available at: https://hijnrp.journals.ekb.eg/

The Effect of Nursing Intervention protocol on Controlling Extremities Muscle Contracture for Critically Brain Injured Patients

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Abstract

Traumatic brain injury (TBI) constitutes a major health and socioeconomic problem throughout the world. Traumatic brain injury is a common cause of disability worldwide. **Aim of this study** was to determine the effect of nursing intervention protocol on controlling extremity muscle contracture for critically brain injured patients. **Design:** A quasi-experimental research design was utilized in this study. **Sample:** A purposive sample of 60 adult patients from both genders admitted to hospital with traumatic head injury was involved in this study. **Setting:** data were collected from the Surgical Intensive care units at the surgical hospital affiliated to Ain Shams University. **Tools:** Three tools were used for data collection (I) A structured interview questionnaire sheet, which included (a) Socio Demographic Assessment Questionnaire, (b) Clinical Data Assessment Sheet, (c) Glasgow Coma Scale Assessment Sheet. (II) Muscle Contracture Assessment Sheet**,** which included (a) End feel of the affected extremity Assessment Sheet, (b) Observational Checklist of upper and lower extremities, and (III) Goniometer Scale Assessment sheet. **The results:** the study revealed that, there was a highly statistically significant difference between the study and control group regarding the level of muscle contracture and goniometer scale scores. **Conclusion:** Range of motion exercises, splinting of ankle and wrist, and changing position every 2 hours applied to traumatic brain injured patients have a positive effect on reducing and controlling extremities muscle contracture. **Recommendations:** Range of motion exercises should be taken into consideration as a routine nursing care for each patient with traumatic head injury.

Keywords: Nursing intervention, Muscle contracture, Traumatic brain injury.

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INTRODUCTION

Head injury is a broad classification that includes injury to the scalp, skull, or brain. It is the most common cause of death from trauma in the United States. Approximately 1.4 million people receive treatment for head injuries every year. Of these, 235,000 are hospitalized, 80,000 have permanent disabilities, and 50,000 people die. Traumatic brain injury is the most serious form of head injury. The most common causes of traumatic brain injury are motor vehicle crashes, violence, and

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falls. An estimated 5.3 million Americans today are living with a disability as a result of a traumatic brain injury **(Hinkle& Cheever, 2018).**

Traumatic brain injury (TBI) constitutes a major health and socioeconomic problem throughout the world. It is the leading cause of mortality and disability among young individuals in high income countries, and globally the incidence of TBI is rising sharply, mainly due to increasing motor-vehicle use in low-income and middle-income countries **(Shehab, Ibrahim & Abd-Elkader, 2018).**

Traumatic brain injury is a common cause of disability worldwide. Contractures are a common complication of traumatic brain injury and may occur in up to 84% of cases. The most commonly affected joints are: the hip, shoulder, ankle, elbow and knee, with a significant percentage of patients developing contractures in five or more joints **(Hickey & Strayer, 2019)**.

Contractures are a common complication of neurological conditions such as stroke, spinal cord injury, traumatic brain injury, and cerebral palsy. They are characterized by a reduction in joint mobility and an increase in resistance to passive joint movement. Contractures are due to neural and non-neural factors, including spasticity and structural changes in soft tissues. Spasticity is characterized by an increased resistance to passive joint movement due to involuntary muscle contraction. Contractures can result in deformities, pain, and skin breakdown and may restrict activity and participation. For these reasons, the treatment and prevention of contractures are important goals of therapy for people with neurological conditions **(Katalinic, Harvey& Herbert, 2011)**.

Contractures are characterized by reduced range of motion (ROM) and increased stiffness. The increased resistance to stretch caused by changes in the mechanical properties of tissues is due to both neurally and non-neurally mediated factors. Non-neural factors include changes in mechanical properties of tissue resulting from stress deprivation, and may be secondary to orthopedic injury, heterotopic ossification, use of a splint or plaster, pain, paralysis, severe spasticity or any disorder that restricts movement. Contractures also produce structural changes within muscles; myofibril shortening and loss of sarcomeres are often observed, as well as the relative increase in connective tissue causing loss of elasticity **(Baagoe et al., 2019)**.

Significance of the study:

The Centers for Disease Control and Prevention (CDC) estimates that there are 2.5 million emergency department (ED) visits in the United States each year, the majority of which are for a mild TBI. As a result of TBI, approximately 52,000 people die (contributing to about 30% of all injury-related deaths), 275,000 are hospitalized, and 80,000 to 90,000 will have long-term disabilities **(CDC, 2016).**

Head injury (HI) is one of the most common causes of death and disability worldwide. Every year, millions of people succumb to traumatic brain injuries most of them products of car crashes. It is unfortunate that Egypt occupies first place worldwide in the incidence of road accidents at a rate of 60 victims per day and that based on latest statistics carried out by the Egyptian Central Agency for Mobilization and Statistic Egyptian Central Agency in 2016 **(Mohammad, 2018)**.

A common complication following a TBI are contractures. Contractures can be defined as a loss of joint mobility due to structural changes of muscles, tendons, and ligaments and other non-bony structures. The performance of daily routine tasks

ISSN 2786-0183
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can be significantly impaired due to the prevalence of contractures. Although the passive movement of joints and stretching are standard treatments performed by physiotherapists for patients with TBI in the ICU. This is most likely due to the patients' rather brief length of stay in the ICU. In addition, mobility is seldom limited in the long term and contractures occur relatively infrequently **(Hellweg, 2012).**

Stretch is widely used for the treatment and prevention of contractures. The aim of stretch is to maintain or increase joint mobility by influencing the extensibility of soft tissues spanning joints. Stretch can be administered with splints and positioning programs, or with casts which are changed at regular intervals (**Katalinic et al., 2010)**.

Aim of the Study

The aim of this study was to determine the effect of nursing intervention on controlling extremities muscle contracture for critically brain injured patients through the following:-

- Assess patients' health status.
- Design and implement nursing intervention for controlling muscle contracture based on patient's needs.
- Evaluate nursing intervention on controlling extremities muscle contracture for critically brain injured patients.

Research hypothesis

At the end of the study:

Patients who will receive the nursing intervention for controlling extremities muscle contracture will have lower level of muscle contracture than those patients who will not receive the nursing intervention as measured by tool (II&III).

Subjects and methods

Research design:

A quasi- experimental research design was utilized in this study.

Setting:

The study conducted in the Surgical Intensive care units at the surgical hospital affiliated to Ain Shams University Hospitals.

Subjects:-

A purposive sample of 60 adult patients from both genders admitted to hospital with traumatic head injury was involved in this study from the above mentioned setting which was divided into two equal groups study & control group 30 patients in each group with the following criteria:-

Inclusion criteria:

1. Adult Patients from both genders from20-60 years old.
2. Moderate and severe brain injury**.**
3. Newly admitted patient within 48 hours of admission.

- **Exclusion criteria:**

1. A patient who hadMusculoskeletal problem.

Tools of data collection:-

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The investigator used three tools to collect the data during the study:-

Tool I: Structured Interviewing Questionnaire: which developed by the researcher based on literature review and divided into three parts:

Part I: Socio Demographic Assessment Questionnaire airwhich used to assess the patient's medical data as age, sex, level of education, marital status, occupation, level of education, and previous hospitalization.

Part II: Clinical Data Assessment Sheet which used to assess Patients medical diagnosis, past medical history, intubation, mode of ventilation, the patient's weight, height, upper and lower extremities length, vital signs and type of feeding.

Part III: Glasgow Coma Scale Assessment Sheet which adopted from **Winkler, Rosen, & Alfry, (1984)**, which used to assess patients' conscious level for four weeks during nursing intervention. The GCS is divided into 3 items; eye opening, motor response, and verbal response.

Tool II: Muscle Contracture Assessment Sheet which adopted from **Thomas, (2008)**, which divided into two parts:

Part 1: End feel of the affected extremity Assessment Sheet which used to assess the degree of muscle contracture and end feel of affected part which varies from a fixed to a springy end feel. A springy or bouncy end feel at end range indicates a good elasticity, while a hard end feel represents poor elasticity. Fixed contractures manifest as a rock-hard end feel. Non-fixed contractures generally allow for at least 10 degrees of passive range of motion. Performing a passive stretch to a patient's comfortable end range. End feel can be documented as follows:
Fixed contracture = Rock-hard end feel, no play (this means that when the researcher tries to move the patient`s arm or leg it doesn't move in a different range of motion). **Poor** = 1-3 degrees of play at the end feel (means that the patient's extremity moves with a small degree). **Fair** = 4-6 degrees of play at the end feel (means that the patient`s extremity moves with a little angle). **Good** = 7-10 degrees of play at the end feel (means that the patient`s extremity moves well, but it doesn't give a full angle of motion). **Excellent**= Springy and bouncy end feel; 11+ degrees of play (means that the patient`s extremity moves in a different direction without any resistance).

Part II: Observational Checklist of upper and lower extremities which used to assess upper and lower extremities degree of contracture such as loss of skin elasticity, limited mobility of joint, tightness of most tendon and muscles, passive stretching increase pain, pallor appearance, pulse lessens sings, paresthesia, paralysis, firmness of tissues on palpation, rigidity, closed of hand fingers, and foot drop.

Tool III: Goniometer Scale Assessment sheet which adapted from **Norkin & White, (2016)**, Goniometry scale used to assess the total amount of available motion, such as (flexion and extension) at a specific joint for upper extremities joints such as (shoulder, elbow, forearm, and wrist) and lower extremities joints such as (hip, knee, ankle, and foot) by using a goniometer. Every joint movement has a normal degree by using a goniometer, which measures the available range of motion at a joint.

ISSN 2786-0183
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Operational Design:

It includes the preparatory phase, content validity, reliability, ethical consideration, pilot study and field work.

Preparatory phase:

It included reviewing of related literature and theoretical knowledge of various aspects of the study using books, articles, internet, periodicals and magazines to develop tools for data collection.

Tools validity:

Content validity was conducted to determine whether the tool covers the aim. The tools were revised by a jury of 5 experts: Associate professors and Lecturers of medical surgical nursing from faculty of nursing, Helwan University who reviewed the content of the tools for comprehensiveness, accuracy, clarity, relevance and applicability, minor modification were done.

Ethical Considerations:

An approval was obtained from the study subjects individually and scientific ethical committee of the faculty of nursing at Helwan University. They have been assured that anonymity and confidentiality were guaranteed and the right to withdraw from the study at any time. Ethics, values, culture and beliefs were respected.

Pilot study:-

A Pilot study was carried out with 10% (not less than 10 patients) of the sample under study to test the applicability, clarity and efficiency of the tools. The modifications were done for used tool, then final form was developed. Patients in the pilot study were excluded from the study group.

Field work:

Sampling was started and completed within twelve months from March (2020) until the end of February (2021). Testing the validity of the proposed tools using content validity added for testing the reliability. The purpose of the study was simply explained to the patients' family who agree to participate in the study prior to any data collection. The researcher started to collect data from patients when they admitted. Data collection was done 4 days/week by the researcher in the morning and afternoon shifts. Patients' medical records were used to obtain the past and present medical history, cause of injury, date of admission, glasgow coma scale, signs and symptoms, previous hospitalization, history of chronic disease and co-morbidity.

Administrative Design:

An official permission was obtained from the general manger of Ain Shams university hospitals in which the study was conducted. A letter was issued to them from the faculty of nursing, Helwan University, explained the aim of the study to obtain the permission for data collection.

Statistical Design:

Qualitative data were presented as frequencies (n) and percentages (%). Chi-square test (or Fissure's Exact test when applicable) were used for comparisons between the two groups. McNemar's test was used to study the change at the end of treatment for binary variables. Friedman's test and Wilcoxon signed-rank test were used to study the change at the end of treatment for other qualitative variables. Numerical data were presented as mean, median, standard deviation (SD) and range

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values. Student's t-test was used to compare between mean age values in the two groups. Mann-Whitney U test was used to compare between two groups.

The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM SPSS Statistics Version 26 for Windows.

Results

Table (1): Percentage distribution of demographic characteristics for the two studied group (n=60):-

Item	Study group (n=30)		Control group (n=30)		X^2	P
	No	%	No	%		
Gender:						
Male	19	63.3	20	66.7	0.073	0.788
Female	11	36.7	10	33.3		
Age group:						
20-40	18	60	20	66.6		
41-60	12	40	8	33.3	0.327	0.667
Age (Mean ± SD):	36.33± 12.66		34.46±13.97		t=0.071	0.944
Educational level:						
Illiterate	3	10	6	20		
Read and write	2	6.7	3	10		
Secondary level	10	33.3	7	23.3	1.76	0.242
University education	15	50	14	46.7		
Marital status:						
Single	8	26.7	14	46.7		
Married	20	66.6	13	43.3	2.07	0.356
Widow	2	6.7	3	10		
Occupations:						
Employed	15	50	11	36.7		
Unemployed	11	36.7	16	53.3	10.04	0.087
Retired	1	3.3	1	3.3		
Housewife	3	10	2	6.7		

*: Significant at $P \leq 0.05$

Table (1) shows that, there was no statistically significant difference between socio-demographic characteristics of the two groups regarding gender (P-value=0.788), mean age (P-value=0.667), marital status (P-value = 0.356), educational level (P-value= 0.242) as well as occupation (P-value = 0.087).

Table (2): Descriptive statistics for the two studied groups regarding patient oxygenation and modes of mechanical ventilation (n=60):-

Item	Study group (n=30)		Control group (n=30)		X^2	P
	No	%	No	%		
Level of consciousness:						
• Totally unresponsive	13	43.3	10	33.3		
• Comatosed	16	53.4	17	56.7	14.62	0.931
• Semiconscious	1	3.3	3	10		
• Fully conscious	0	0	0	0		

ISSN 2786-0183
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Vol. 1, Issue 1, Month: June 2022, Available at: https://hijnrp.journals.ekb.eg/

Oxygenation:						
• Intubated:	27	90	26	86.7		
• Oxygen mask	3	10	4	13.3	2.319	0.314
Mode of ventilation:						
▪ CMV	8	29.6	2	8.3		
▪ SIMV	18	66.7	18	75	6.400	0.094
▪ CPAP	1	3.7	4	16.7		

*: Significant at P ≤ 0.05

Table (2) clarifies that, 56.7% of the control group and 53.4% of the study group were comatosed with glasgow coma scale less than 8. 90% of the study group were intubated on a mechanical ventilation, as well 86.7% of the control group. 66.7% of the study group and 75% of the control group were under the SIMV mode of ventilation (synchronized intermittent mandatory ventilation).

Table (3): Comparison between the two studied groups regarding end feel muscle contracture in the 1st week and 4th after admission (n=60):-

Item	1st week				X2, P	4th week				X2, P
	Study group		Control group			Study group		Control group		
	No	%	No	%		No	%	No	%	
Fixed contracture	0	0	0	0	3.533, 0.316	3	10	7	23.3	26.96, 0.000*
Poor	3	10	1	3.3		1	3.3	7	23.3	
Fair	3	10	1	3.3		3	10	6	20	
Good	10	33.3	15	50		12	40	4	13.3	
Excellent	14	46.7	13	43.3		11	36.7	6	20	

*: Significant at P ≤ 0.05

Table (3) illustrates that, there was no statistically significant difference between the study and the control groups regarding end feel muscle contracture in the first week of admission with (p-value=0.316), while there was a highly statistically significant difference between the study and control groups regarding muscle contracture in the fourth week from the admission with (p-value=0.000).

Table (4): Comparison between the two studied groups regarding muscle contracture assessment in upper extremities (n=60):-

Variable	Study group (n=30)				Control group (n=30)				X2	P
	Yes		No		Yes		No			
	N	%	N	%	N	%	N	%		
Loss of skin elasticity and extensibility in right arm.	5	16.7	25	83.3	17	56.7	13	43.3	10.335	0.001*
Loss of skin elasticity and extensibility in left arm.	5	16.7	25	83.3	16	53.3	14	46.7	8.864	0.003*
Tightness of most of tendon and muscles in right hand.	1	3.3	29	96.7	14	46.7	16	53.3	15.022	0.000*
Tightness of most of tendon and muscles in left hand.	1	3.3	29	96.7	14	46.7	16	53.3	15.022	0.000*
Limited mobility of joint in upper extremities.	0	0	30	100	14	46.7	16	53.3	18.261	0.000*

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Pallor appearance is seen in upper extremity.	2	6.7	28	93.3	8	26.7	22	73.3	4.320	0.04*
Pulselessness signs is a clear signs.	0	0	30	100	7	23.3	23	76.7	7.925	0.005*
Firmness of tissues on palpation.	3	10	27	90	13	43.3	17	56.7	8.523	0.004*
Rigidity of limbs.	1	3.3	29	96.7	10	33.3	20	66.7	9.017	0.003*
Closed of fingers of right hand.	5	16.7	25	83.3	17	56.7	13	43.3	10.335	0.001*
Closed of fingers of left hand.	5	16.7	25	83.3	17	56.7	13	43.3	10.335	0.001*
Paralysis of upper extremities.	1	3.3	29	96.7	0	0	30	100	1.017	0.500
Paresthesia.	1	3.3	29	96.7	2	6.7	28	96.7	0.351	0.500

*: Significant at P ≤ 0.05

Table (4) demonstrates that, there was a highly statistically significant difference between the study group and the control group regarding upper extremities muscle contracture assessment (P-value 0.001to 0.001) and there are no statistically significant difference between the studied groups regarding paralysis of the upper extremities with (p-value = 0.500).

Table (5): Comparison between mean scores of goniometer scale for upper extremities joints in the 1st and 4th week from admission for the two studied group (n=60):-

Item		1st week		t, P	4th week		t, P
		Mean ± SD			Mean ± SD		
		Study group	Control group		Study group	Control group	
Shoulder							
Flexion	RT	142.67±14.13	138.60±18.21	0.471, 0.665	131±16.01	94.50±46.78	4.136, 0.000*
	LT	139.17±9.34	138.67±13.40	0.304, 0.521	130.12±13.24	91.50±7.49	3.514, 0.000*
Extension	RT	36±7.70	34.17±7.59	0.929, 0.524	30.83±3.49	21.67±8.44	5.495, 0.000*
	LT	36.5±6.71	35.33±5.56	0.240, 0.751	31.60±3.79	22.23±8.45	3.314, 0.001*
Abduction	RT	143.33±13.15	144.37±15.29	0.424, 0.576	133.17±13.09	96.67±41.07	4.638, 0.000*
	LT	142.32±12.41	143.3±16.91	0.600, 0.123	132±12.38	93.83±35.88	3.797, 0.007*
Internal rotation	RT	66.33±8.09	65.67±11.59	0.468, 0.728	58.27±7.44	44.50±13.53	5.238, 0.028*
	LT	68.3±11.92	65.67±12.17	0.824, 0.954	60.67±3.41	44.83±19.45	4.214, 0.007*
External rotation	RT	72.33±15.24	72.17±15.57	0.172, 0.479	67.83±6.91	52.83±19.45	4.625, 0.000*
	LT	71.81±18.80	73.33±13.81	0.337, 0.218	69.67±12.10	49.17±15.98	3.034, 0.001*
Elbow Flexion	RT	142.17±11.04	138.21±18.21	1.174, 0.189	134.83±13.29	84.83±19.45	3.144, 0.000*
	LT	139±12.21	137.33±25.73	1.012, 0.714	134.33±15.41	83.67±47.93	2.817, 0.000*
Wrist				0.212,			4.836,
Flexion	RT	56.17±7.51	54.83±7.25	0.283	49.17±4.17	33.57±17.17	0.000*
	LT	54±5.19	54.33±9.73	0.403, 0.399	48.57±3.75	30.33±17.12	4.173, 0.000*
Extension	RT	52.33±7.18	55.33±6.94	0.126,	44.47±4.69	35±17.27	4.734,

ISSN 2786-0183
Helwan International Journal for Nursing Research and Pratctice
Vol. 1, Issue 1, Month: June 2022, Available at: https://hijnrp.journals.ekb.eg/

				0.299			0.000*
	LT	50.33±4.10	54.5±7.96	0.977, 0.129	45.83±1.89	34.7±15.96	4.054, 0.000*
Radial deviation	RT	18.17±3.59	18.33±3.30	0.451, 0.288	14.33±2.25	11.33±5.07	4.934, 0.002*
	LT	17.80±3.11	18±1.44	0.157, 0.374	15.37±0.850	11.17±5.03	3.542, 0.000*
Ulnar deviation	RT	27.67±4.30	26.67±4.61	0.451, 0.288	23.40±1.67	18.53±8.40	4.390, 0.000*
	LT	26.93±2.77	25.87±4.43	0.281, 0.717	22.20±0.484	17.17±8.82	3.341, 0.000*

*: Significant at P ≤ 0.05

Table (5) clarifies that, there was no statistically significant difference between the study and control groups regarding mean scores of goniometer scale of upper extremities joints during the 1st week with (P-value= 0.665 to 0.288). Also, there was a highly statistically significant difference between the study and control groups regarding mean scores of goniometer scale of upper extremities joints during 4thweek with (P-value= 0.000 to 0.000).

Discussion

The result considering gender of the studied patients, the present study showed that, two thirds of patients in the study and control groups were male. This finding could be due to nature of hard work and its hazards, males are working on it such as driving cars and increasing motor-vehicle used by males in low-income and middle-income countries which increase the rate of accidents. This result is in accordance with **Leung, (2014)** in their study, which about "Physiotherapy management of contractures after acquired brain injury", who reported that, the majority of the study and control groups were male.

As regards to the age of the studied patients, the present study revealed that, that the mean age of the study and control groups were (36.33± 12.66 & 34.46± 13.97). This finding could be due to that most of the road traffic accident has no age and happened accidentally and could be due to the use of motor vehichles used by youth which increase the rate of accidents. **As well,** this results supported by **Lennon, Ramdharry and Verheyden, (2018),** in their book "Physical Management for Neurological Conditions", they reported that most of the age of the studied patient with TBI ranged from15-45 years old.

In relation to studied patients` educational level, half of the study group and half of the control group were university graduates, while the minority was illiterate in both groups. This result is not consistent with the finding of **Laratta et al., (2021)** which about "Marital stability and quality of couple relationships after acquired brain injury: a two-year follow-up clinical study. In Healthcare" who reported that one quarter of the studied patients were university educated.

In relation to marital status, the study result illustrated that, two thirds of the study group and half of the control group were married. This finding could be due to the majority of the studied patients were aged between 20-60 years old. This finding is consistent with the finding of **Ghoneim et al., (2012):** which about "Impact of Implementing Nursing Care Protocol on Moderate Head Injured Patient's Outcome",

ISSN 2786-0183
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Vol. 1, Issue 1, Month: June 2022, Available at: https://hijnrp.journals.ekb.eg/

who clarified that the half of their studied patients were married. **As well,** This result supported by **Laratta et al., (2021)** which about "Marital stability and quality of couple relationships after acquired brain injury: a two-year follow-up clinical study. In Healthcare" who reported that the majority of the studied patients were married.

In relation to level of consciousness, the study result illustrated that, the majority of the study group and half of the control group were totally unresponsive in a coma. This finding is consistent with the finding of **Abdelsalam et al., (2019),** in their study, which about "Critically Head Injured Patients: Improving Nurses` Awareness and Self–Efficacy to Control Extremities Muscles Contracture", who clarified that, about half of the studied patients were totally unresponsive.

The present study clarified that, there were a highly statistically significant difference between study and control group regarding muscle contracture, which there are increasing level of muscle contracture of the control group, while there are decreasing in level of muscle contracture of study group after 4 weeks of nursing intervention with (P-value =0.000). This finding due to application of nursing intervention, including (range of motion, splinting and positioning), which decrease level of muscle contracture in the study group than the control group. The result is in line with **Leung, (2014)** in his doctoral thesis, which titled "Physiotherapy management of contractures after acquired" in Sydney School of Medicine, University of Sydney, Australia, who reported that, passive stretch with motor exercises has been the most commonly used physical intervention for prevention and correction of contractures.

Also, This study finding is also congruent with **Skalsky & McDonald, (2012)**, in their study "Prevention and Management of Limb Contractures in Neuromuscular Diseases", who revealed in their study that, prevention of contractures requires early diagnosis and initiation of physical medicine approaches, such as passive ROM and splinting before contractures are present or while contractures are mild.

Similarly, the study result is also in the same line with **Leung, Harvey, & Moseley, (2013),** in their study entitled "An intensive programme of passive stretch and motor training to manage severe knee contractures after traumatic brain injury: a case report" who illustrated that, the use of a high dose of passive stretch in conjunction with motor training may be an option to consider for correcting severe contractures following acquired brain injury.

Regarding shoulder range of motion, the study finding shows that, there are statistically significant difference between the study and the control groups regarding mean scores of goniometer scale of the shoulder joint after 4 weeks of nursing intervention, the patients of the study group still have normal goniometer scores of the shoulder compared to the control group. This finding due to application of nursing intervention on the study group, which decrease the level of muscle contracture. These finding is similar to **Perera, Perera & Karunanayake, (2017)** in their study entitled "Effectiveness of early stretching exercises for range of motion in the shoulder joint and quality of functional recovery in patients with burns-a randomized control trial", who demonstrated that an early sustained stretching exercise regime significantly improved the ROM and functional recovery of the shoulder joint involving the axilla.

As regards to ankle ROM, the study finding revealed that, there are a statistically significant difference between the study and the control group regarding mean scores of

ISSN 2786-0183
Helwan International Journal for Nursing Research and Pratctice
Vol. 1, Issue 1, Month: June 2022, Available at: https://hijnrp.journals.ekb.eg/

goniometer scale of the joint after 4 weeks of nursing intervention, the patients of study group still have normal goniometer scores of the joint compared to the control group. This finding due to application of nursing intervention on the study group, which decrease level of muscle contracture. This finding was agreed by **Leung & Stroud, (2018)**, in their study titled "Long-term resolution of severe ankle contractures using botulinum toxin, serial casting, splinting, and motor retraining", who illustrated that, successful corrections of severe and chronic contractures of ankle joint using a programme of intensive passive stretch after botulinum toxin injections. The effects were maintained long term by splinting and motor training programs.

Also, this finding is agreed by **Glanzman et al., (2011),** in their study "Serial casting for the management of ankle contracture in Duchenne muscular dystrophy" who reported that, improvement in range of motion of ankle joint with the application of serial casting.

Regarding ankle contracture, the study finding showed that, majority of muscle contracture in the control group were an ankle contracture. This finding could be due to foot drop of the foot without any support or ROM exercises. This finding was agreed by **Robinson et al., (2008)**, in their study titled "No difference between wearing a night splint and standing on a tilt table in preventing ankle contracture early after stroke: a randomised trial ", who reported that contracture of the ankle is a common impairment following stroke.

Conclusion

Regular stretch produce clinically important changes in joint mobility, spasticity, or activity limitation in people with neurological conditions. Range of motion exercises, splinting of ankle and wrist, and changing position every 2hours applied to traumatic brain injured patients have a positive effect on reducing and controlling extremities muscle contracture.

Recommendation

Based upon results of the current study, the following recommendations are suggested:

Recommendations related to patients:

- Range of motion exercises should be taken into consideration as a routine nursing care for each patient with traumatic head injury.
- Passive stretch and splinting should be teached to all critical nurses to prevent and control muscle contracture.
- Goniometer scale should be available in the critical area to determine the degree of each joint and discover any joint contracture.
- Polices and rules should be made for application of ROM exercises as a routine care for patient with traumatic brain injury.

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