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Correlation between Glenohumeral Subluxation and Hand Dexterity after Stroke

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Abstract

Background: Glenohumeral subluxation (GHS) is a common post-stroke complication that can be considered an important contributor for other disabilities.

Aim of Study: This study aimed to investigate the relationship between glenohumeral subluxation and hand dexterity after stroke.

Patients and Methods: Thirty stroke patients of both genders, between 45 and 65 years old with mean of (54.86±7.19) participated in this study. The glenohumeral subluxation was evaluated using X-ray radiograph, finger breath test and the hand dexterity was evaluated by Purdue pegboard test. The upper limb function evaluated by fugle-Meyer.

Results: No previously existing differences in demographic variables or outcome measures were found. There was a significant difference between X-ray analysis scores and PPBT scores. In addition, a significant negative correlation was found between van classification scores and PPBT scores, whereas there was no significant correlation between FMA and X-ray analysis scores.

Conclusion: There is a relationship between glenohumeral subluxation and hand dexterity in poststroke patients.

Key Words: *Stroke – Glenohumeral subluxation – Dexterity – Spasticity - Radiographs – Purdue pegboard test.*

Introduction

ONE of the main causes of death worldwide is stroke with an estimated number of 5.5 million fatalities each year. Therefore, stroke is a condition that has major economic and social repercussions and is of enormous public health significance **[1]**. In addition to the high mortality rate associated with stroke, up to fifty percent of survivors have been left with permanent disabilities. The most well-known of these disabilities is glenohumeral subluxation (GHS), which has an incidence of 81% causing a delay in the recovery of upper limb function. The three most prominent problems of post stroke glenohumeral subluxation are pain, a reduced range of motion in the shoulder, and decreased function activities in the affected upper limb. Therefore, without any physical therapy intervention and rehabilitation, expect a risk that the glenohumeral subluxation will worsen over time and become irreversible and restrict the upper limb function **[2]**.

Hand dexterity is causal for many daily tasks and significantly affects quality of life, it is defined as a manual ability requiring rapid coordination of fine and gross movements based on a variety of capacities gained through training, knowledge, and experience. There are two distinct types of dexterity: Fine and gross. Fine dexterity is the skill of manipulating incredibly small objects precisely with only the fingertips. Gross dexterity is the arm-hand coordination required to manipulate large objects. Most daily activities, such as self-care, dressing, and feeding, require a combination of fine and gross dexterity as well as other upper limb movements **[3]**.

The appropriate upper limb activity runs from proximal to distal in the kinetic chain as a result of interaction among multiple joints. So, if there is disruption by any pathological changes of glenohumeral joint or any other segments there will decrease the amount of energy produced by the body due to theses biomechanical abnormality and will be reflected to the upper limb and may negatively affectthe quality of movement **[4]**.

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Therefore, the current research aimed to investigate the relationship betweenglenohumeral subluxation and hand dexterity after stroke.

Patients and Methods

Assessment of eligibility was determined for sixty patients recruited from the Neurology outpatient clinic at Kasr El-Aini Hospital, Cairo University from date March 2022 to August 2022 with ethical committee No: P.T.REC/012/003560. Thirty patients fulfilled the study's inclusion criteria and were permitted to participate. The following were the criteria for participation in the study: (1) Patients had to be between the ages of 45 and 65. (2) They had to have been diagnosed with a first-ever stroke; (3) The duration of their condition must have been more than six months; and (4) They had to be able to follow basic instructions. Excluded from the study were patients with visual deficits, cerebellar lesions, any contracture or deformity of the upper extremity, or other neurological disorders along with stroke. Before the procedure, signed informed consent was collected from each patient participated in the study. All clinical evaluations were performed by a physiotherapist who is blind to the study's objective.

Assessment of glenohumeral subluxation:

The glenohumeral subluxation of post-stroke patients was evaluated radiographically and reported in millimeters. Unsupported radiographs of the glenohumeral joint's anterior-posterior views were obtained. The classification system was originally suggested by Van Langenberghe et al. **[5]**, which was utilized to assess glenohumeral subluxation. In this classification system, grade 0 indicates a normal joint, grade 1 indicates a V-shaped widening, grade 2 indicates a moderate subluxation, grade 3 indicates an advanced subluxation and grade 4 indicates a dislocation. Subluxation was diagnosed in patients whose radiographs were evaluated as grades 1 to 4 **[6]** (Fig. 1).

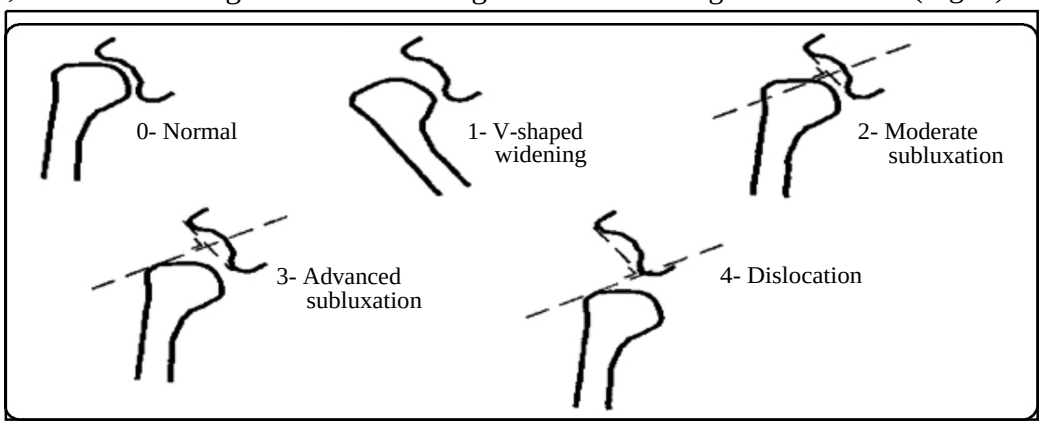

Fig. (1): 4 Classification of subluxation. Van Langenberghe and Hogan (1988) described the used methodology. The two dashed lines represent the line that connects the superior and inferior margins of the glenoid fossa and the line that bisects it.

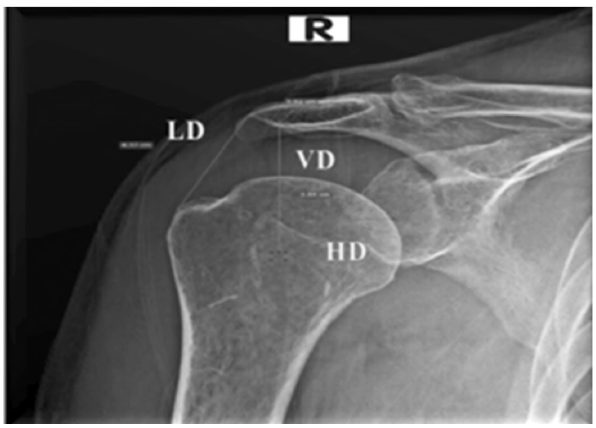

Fig. (2): Radiographic examination of glenohumeral subluxation. The lateral distance (LD) was measured from the lateral border of the acromion to the greater tuberosity of the humerus, vertical distance (VD) was measured from the inferior acromial point to the central point of the humerus head, and the horizontal distance (HD) was measured from the central point of the glenoid fossa to the central point of the humerus head.

Additionally, shoulder subluxation was quantified using the modified method described by previous investigators measured distances from a single anterior- posterior radiograph **[7]**. They use three reference points as follow: 1- The central point of the glenoid fossa. 2- The central point of the humeral head. 3- The most inferior lateral point on the acromion surface of the acromioclavicular joint) (Fig. 2) show radiographic examination of glenohumeral subluxation.

Assessment of hand dexterity:

Validity and reliability of the Purdue Pegboard Test have been well established through significant studies in both healthy professions and diagnostic categories of neurological conditions **[8]**. The subject should be comfortably seated upright in a standard chair **[9]** that has a firm back and no armrests. The trunk must remain in contact with

the back of the chair throughout testing, the subject was instructed and regularly reminded not to lean forward, stand up, or move sideways. All tests are performed unilaterally, the subject is always asked to start with both hands in pronated position on the table, the testing table directly in front of the patient at the level of the subject's mid abdomen, with the difference in chair-table height of about 30 cm considered optimal with a 15-cm distance from the anterior torso to the front edge of table, this distance allows enough upper-extremity mobility for the patient to be able to reach the Purdue Pegboard, which is placed on the table with the row of cups at the top of the board **[10]**. The current study used the one-hand subtest. The subtest consists of inserting pins into the corresponding holes on a board with the testing hand from a seated position. The score is the total number of pins inserted in 30 seconds **[9]**.

Assessment of upper extremity by fugl-meyer:

The upper-extremity subscale of the Fugl-Meyer Assessment (FMA) is a gold standard test that was used to assess motor deficits and showed to be validated in stroke patients. It consists of 33 upper extremity items which assess shoulder, elbow, forearm, wrist, and hand movements and reflexes, in addition to coordination and speed. The rating is based on a three-point ordinal scale. (0-cannot perform, 1-performs partially, 2-performs fully). The maximum possible score is 66, which indicates a full recovery **[11,12]**.

Statistical analysis:

SPSS v.28 was used to conduct statistical analysis of data. (IBM, Armonk, NY, USA). The Shapiro-Wilk test and direct data visualization were used to analyze and represent quantitative data, and the mean and standard deviations were used to determine whether the data were normally distributed. Numbers and percentages were used for expressing categorical data. The Pearson's correlation was used to conduct correlation analysis. The level of significance for all tests utilized in the statistical process was set to p-values 0.05, and they were all two-sided.

Results

The demographic data with the minimum and maximum ages of all the participants were 45 and 65 years, with a mean and standard deviation of 54.867.19 (years). With a sum of 20 (66.7%) males and 10 (33.3%) females. Statistically, there was a significant negative correlation between PPBT of the affected side at 30sec and scores of X-ray analysis and the lateral dimension of the X-ray analysis of the affected side (Fig. 3) and there was a significant correlation between PPBT of the affected side at 30 sec and the vertical dimension of the X-ray analysis of the affected side (p<0.05) (Fig. 4), (Table 1).

Table (1): Correlations between the PPBT and X-ray scores.

Variable	PPBT affected 30 sec
LD affected:	
r-value	–0.404*
p-value	0.027
VD affected:	
r-value	–0.344*
p-value	0.048
HD affected:	
r-value	–0.070
p-value	0.713

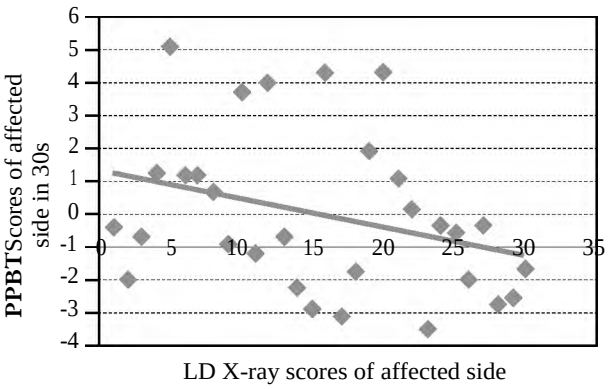

Fig. (3): Correlation between the Lateral dimension scores of X-rays and PPBT scores of the affected side in 30s.

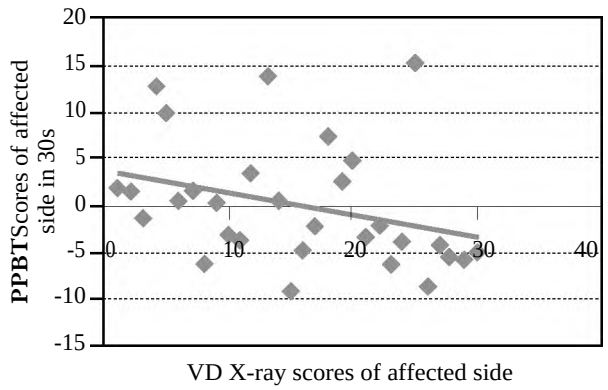

Fig. (4): Correlation between the vertical dimension scores of X-rays and PPBT scores of the affected side in 30.

Moreover, there was a significant difference between the PPBT scores and VAN classification score (p<0.05) (Table 2), (Fig. 5). In contrast to this, there was no statistical significance correlation between X-ray analysis scores and fugl-meyer UE (p>0.05).

Table (2): Correlations between the PPBT and VAN classification.

Variable	VAN classification
PPBT affected 30 sec:	
r-value	–0.342*
p-value	0.0488

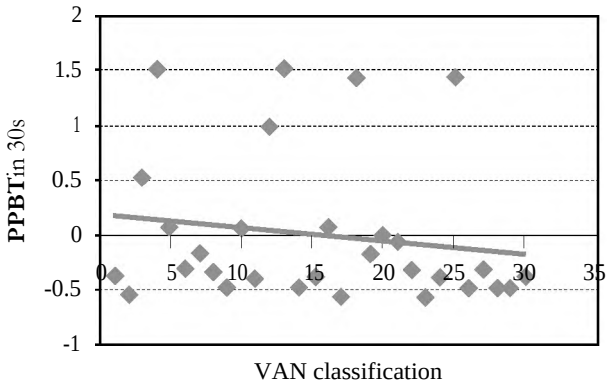

Fig. (5): Correlation between the VAN classification scores and PPBT scores of the affected side in 30s.

Discussion

This study was conducted to investigate the relationship between glenohumeral subluxation and hand dexterity afterstroke. The results revealed there is a relationship between glenohumeral subluxation and hand dexterity after stroke.

This study revealed that there is significant correlation between the scores of X-rays vertical distance and PPBT scores and there was a significant correlation between the lateral distance of X-ray analysis and PPBT scores, respectively.

These results come in agreement with the study of Huang et al., **[7]** who concluded that there is strong correlation between vertical and horizontal distances and the weakness of supra spinatus, biceps and the subsequent poor motor function. He found a correlation between vertical distance as predictive value for supra spinatus and biceps and poor function and revealed there is a correlation between the lateral distance measured from acromion to greater tuberosityas predictive value for supraspinatus tendinitis measured by high resolution ultra sound and the function outcomes .Also, he confirmed that supraspinatus muscle is responsible for preventing the lateral translation, as it naturally works with the other muscles such as long head of biceps to prevent the glenohumeral from subluxation downward and forward.

Moreover, this study agrees with the correlation study by Ushnish et al., **[13]** that was carried out on thirty post-stroke patients aged from 45 to 65 who were examined for Gleno-humeral subluxation (GHS). High-resolution Ultrasonography was used to assess the extent of GHS by measuring the discrepancy in Acromion-Greater Tuberosity Distance (AGTDD) between the two glenohumeral joints. In addition, Sensorimotor recovery of the affected limb was evaluated with the Fugl-Meyer Assessment Scale for the Upper Extremity. (FMA-UE). The study revealed that GHS has the most detrimental impact on the motor recovery of the affected upper limb.

Also, this study showed a negative significant correlation between the VAN classification of subluxation and the scores of PPBT which is agreed with Burhan et al., **[6]** who conducted his study on A total of 73 stroke patients with GHS found that presence of GHS can affect daily living activities by decrease of shoulder active and passive range of motion and Patients with GHS have a low torque value and loss of total work and poor level functional independence.

Additionally,the result of this study is agreed with Kumar et al. **[14]**, that concluded that GHS leadsto decrease in shoulder range of motion, muscle strength, and upper limb function therefore, proper treatment must be conducted.

In addition to the previous studies, Jung SH et al., **[15]** study of 59 stroke patients stated that the presence of glenohumeral subluxation throughout the subacute stage of stroke may be useful as a predictor for the motor function of the affected upper extremity, including hand function.

On the contrary, there was no correlation between FMA and X-ray analysis scores. Many studies are agreed with this result as Zorowitz et al. **[16]**, who concluded no correlation between vertical distance of subluxation and Fugl-Meyer scores, it can mayhypothesized that was due to disabilities regarding control over individual joints in the upper extremities which had not examined (e.g., problems extending the fingers or elbows).

So, the good management of shoulder subluxation from day one after stroke it expect good upper limb and hand function.

This study has few limitations. The sample size was small. This study did notinclude acute and subacute patients due to the small sample size. There is no evaluationdone about the possible effects of the rehabilitation programs on GHS. Therefore, there is recommendation for prospective studies using larger sample numbers and other quantitative techniques as ultrasonography.

Conclusion:

Considering the results revealed at the end of this study, it has been clearly identified that glenohumeral subluxation and hand dexterity are closely related in post stroke patients and the greater the chance of returning the strength of the muscles surrounding the glenohumeral joint after a stroke, the more necessary for that joint to target the hand toward the goal reached in daily tasks,consequently good of upper limb function. Therecommendation for physiotherapists is to focus on the early intervention for glenohumeral subluxation which means more improvement of upper limb function and prevent further complications.

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العلاقة بين ملخ الكتف وبراعة اليد فى مرضى السكتة الدماغية

يعد ملخ الكتف من المضاعفات الشائعة الحدوث فى المرضى المصابين بالسكتة الدماغية ويترتب عليه قلة وظائف الطرف المصاب مما يسبب الكثير من الاعاقات خاصة فى وظائف اليد.

الهدف من الدراسة : التحقق من وجود علاقة بين ملخ الكتف وبراعة اليد فى مرضى السكتة الدماغية.

المرضى وطرق الدراسة : أجرى هذا البحث على ثلاثين مريض بالسكتة الدماغية من الدرجة الخفيفة من كلا الجنسين بعد مرور أكثر من ستة أشهر من تاريخ الإصابة وتراوحت أعمارهم ما بين ٤٥ إلى ٦٥ سنة حيث كان كل المشاركين مصابين بملخ الكتف بعد الإصابة وتم تقييم ملخ الكتف لجميع المشاركين بالتصوير الشعاعى للكتف بالأشعة السينية وباختبار FB كما تم تقييم براعة اليد باستخدام جهاز Pegboard Purdue ومقياس Meyer (UE) Fugl لوظائف الطرف العلوى الخاص بمرضى السكتة الدماغية.

النتائج :وجود ارتباط طردى ذو دلالة إحصائية بين قياسات الأشعة السينية لملخ الكتف ونتائج تقييم براعة اليد. وعدم وجود ارتباط إحصائى بين مقياس لوظائف الطرف العلوى وبين قياسات الأشعة السينية للكتف المصاب.

الاستنتاج :ملخ الكتف له تأثير سلبى على جودة براعة اليد فى مرضى السكتة الدماغية وينبغى التدخل السريع واتخاذ الإجراءات اللازمة لعلاج ملخ الكتف بدءا من اليوم الأول للإصابة بالسكتة الدماغية.