DESIGN OF APPARATUS TO STUDY HUMAN ELBOW JOINT MOTION

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Abstract-**In this paper, the development of an experimental procedure to examine the human elbow joint motion is described. The experiment will be set up to measure the amount of forces and range of motion of the elbow joint. The experiment will be useful in monitoring patients who underwent elbow joint operation.**
***Keywords* - Elbow joint motion**

I. INTRODUCTION

The study of human joint motion has become very important in the area of orthopaedic and rehabilitation. Physicians and researchers may use the result to keep track of the progress of patients after surgery. Previous methods have been used to collect the joint motion data such as the accelerometric method, the goniometric method [1], [2].

Many research works has been done in human body joint analysis such as interrupted light photography method, camera monitoring method [1]. This apparatus can measure not only the angular movement but also the joint torque at the elbow joint.

II. BACKGROUND

The first step before analyzing the joint movement of the human is to know the basic principle of the anatomy. There are three bones creating movement at the elbow joint: humerus, ulna and radius. The humerus is the longest bone of the upper extremity extended from the shoulder to the elbow. The forearm, connected from the humerus, consists of the *ulna* and the *radius*. The upper end of ulna is curved with the end of humerus to allow flexion and extension or hinge joint at the elbow. Fig.1 shows the range of motion of the flexion-extension, which is about 150 degrees measured from the stretched arm in flexion. The extension can be zero degree or approximately 10 degrees below neutral anatomical position.

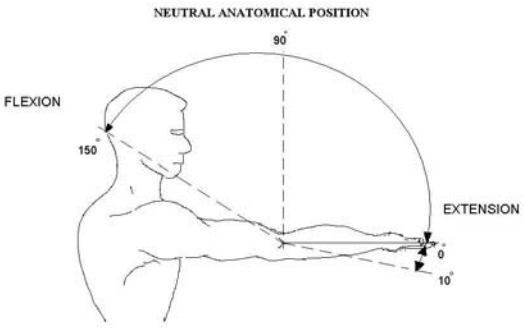

Fig. 1. Flexion-Extension range of motion

The *ulna* and the *radius* give the supination-pronation at the hand and forearm joint [7]. The rotation of both sides is about 80-90 degrees from neutral as shown in Fig.2. The average torque created at the elbow joint is 7 kg-m in male and 3.5 kg-m in female. The maximum flexion position in the supination position is about 90 – 110 degrees [5,6,7].

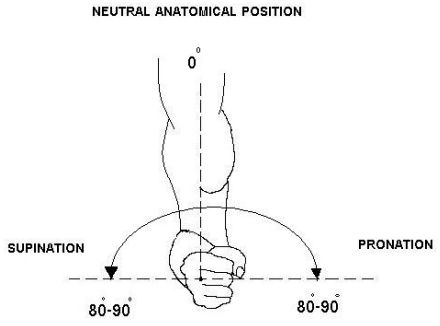

Fig. 2 Supination-Pronation range of motion of the right arm

The maximum torque for elbow extension is about 4 kg-m in male and 2 kg-m in female. The supination-pronation torque is 800-900 g-m in male and 350-550 g-m in female [3,4].

III. DESCRIPTION OF THE APPARATUS

The apparatus consists of a chair equipped with a strap on upper arm and forearm. The flexion-extension angle can be measured relative to the movement of these two sections. The scale will be used to measure the torque in flexion-extension on both sides. During the measurement one side of scale will be released to allow free movement for example, the tension adjustment at the extension end will be released in flexion torque measurement and vice versa. The arrangement of the system is shown in Fig.3.

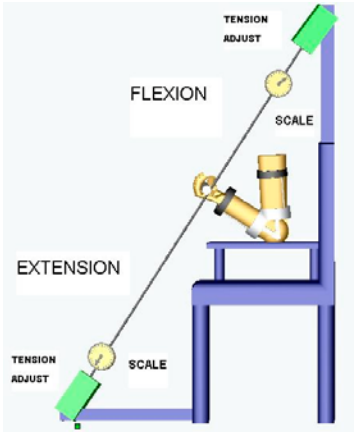

Fig. 3 Flexion-Extension measurement apparatus

A second apparatus is to investigate the supination-pronation torque and movement. The appratus conceptual design is shown in Fig.4. It consists of a chair equipped with a handle. The supination-pronation angle is measured as the forearm perpendicular to the upper arm and the elbow located fixed to the body.

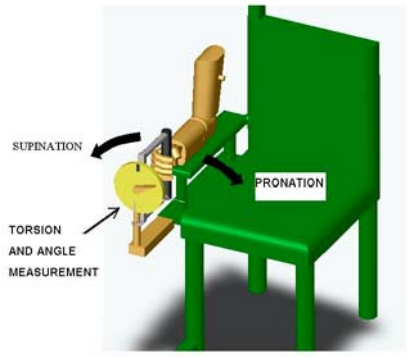

Fig. 4 Supination-Pronation measurement apparatus

The torque can be measured by attaching a scale on the opposite side while rotate in pronation or supination as shown in Fig. 5.

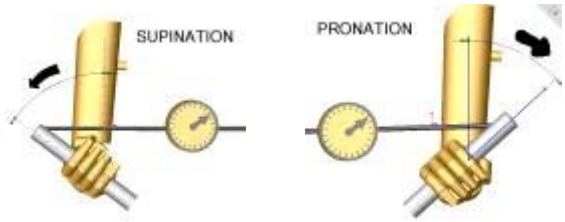

Fig. 5 Torque measurement in Supnation and Pronation of right hand

The measurement data will be collected by read out of the scale in the front.

IV. SUMMARY

The design and development of the apparatus to study human elbow joint motion has been described in this paper. The parameters are the flexion-extension angles and joint torques, supinaion-pronation angles and joint torque. Data can be useful in constructing elbow motion assistant tool in the future. As the designing concept here is very basic but it can be applied to electronics measurement for later use. As our future work, the goal is to design and construct an elbow assistant tool to help the patients after elbow surgery.

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