The Study of Pertaining to Sujud Postures in Muslim Prayer Based on the Hadiths and EMG Analysis

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Abstract. Sujud (prostration) is one of the main pillars of a Muslim’s prayer. It involves seven limbs as derived from the sayings or the acts of Prophet Muhammad (peace be upon him) or the hadiths. However, the correct way in pertaining to sujud has received different opinions from Muslim scholars. The differences are based on the hadiths and there are two different ways of acts interpreted by Muslim scholars which are: preceding by hands or preceding by knees. Thus, this study investigated the differences in terms of statistical analysis using electromyography signals (EMG) of the lower limbs muscles, specifically the Gastrocnemius and Tibialis Anterior Muscles. Here, it was shown that there was no significant difference between the muscles on these postures of solat, although there are different opinions on the way of pertaining to sujud based on the authenticity of the hadiths and also their interpretation by the scholars.

1. Introduction

Solat is an act of worship to Allah which is obligatory for all the Muslims [1]. Solat consists of four reverential postures including standing (qiyam), bowing (rukuk), prostration (sujud) and sitting (qa’dah) [2]. The movement between the bowing positions to prostration is referred to as Pertaining to Sujud (PTS). Muslim scholars have different opinions regarding the correct ways to perform PTS which are: Knees Precede (KP) and Hands Precede (HP) [3]. These differences are based on the Prophet Muhammad’s sayings (hadiths) and also the opinions of fuqaha’ (Muslim scholars in Islamic jurisprudence). Figure 1 and 2 show the static posture of KP and HP respectively.

Figure 1: Static posture of Knees Precede during Pertaining to Sujud.

Figure 2: The static posture of Hands Precede during Pertaining to Sujud.
Certain scholars held the opinion of preceding knees during sujud due to a hadith narrated by Wa’il Ibn Hujr. He said “I saw the Messenger of Allah (peace be upon him) when he prostrated himself, he placed his knees on the ground before placing his hands and when he got up, he raised his hands before his knees” (Recorded by Abu Daud, al-Nasai, 2/207; Sahih Ibn Hibban) [4]. Some other scholars were inclined towards preceding the hands during pertaining to sujud which was based on a hadith narrated from Abu Hurayrah which said “The Messenger of Allah (peace be upon him) said: When one of you prostrate himself, let him not kneel down as a camel kneel down and let him place his hands before his knees.” (Recorded by Abu Daud) [5]. Thus, the meanings of these two hadiths narrated by Abu Hurayrah and Wa’il were literally contradictory to each other [2]. However, both of the ways were supported by different Muslim scholars, based on their understandings of the hadiths due to their strength and authenticity. Despite that, a study should be carried out to investigate whether these postures will impose a negative impact on the health.

EMG was used currently to study solat and its health effect. Safee et al. studied the similarities of EMG activity during solat and specific exercises. They proved that solat had a similar EMG characteristic with certain particular exercise movements, thus solat could be used as an alternative to certain types of exercises where they are able to maintain the lower limb performance [6]. The same group had also investigated the EMG activities on the medial and lateral of gastrocnemius muscles and they showed that there was no significant difference on these muscles activities during solat and the exercises compared [7].

Therefore, the purpose of this study was to investigate the differences of EMG signals activities between KP and HP during the static posture for PTS in solat, based on the narrated hadiths of Prophet Muhammad (PBUH) as stated before. As there are differences of opinions regarding the PTS during solat, this study was expected to contribute to the scientific evidence in terms of EMG level based on the differences of opinions in the hadiths about KP and HP, and this would give supporting evidence to the Islamic jurisprudence in this issue.

2. Methodology
2.1. Subject
A total of 20 subjects between the ages of 18-40 years old with normal body mass index had volunteered as the subjects for the study. The subjects chosen had healthy lower limb muscles with no medical history. Subjects were verbally informed and were shown a demo about the task given. Three repetitions were recorded in every posture of solat.

2.2. Apparatus
Disposable bipolar silver/silver chloride (Ag/AgCl) disc surface electrodes were affixed in pairs at the central position over the muscle belly of the chosen muscles [8]. The electrodes were attached on one-third of the line between the head of the fibula and the heel for gastrocnemius (Gas) and one-third of the line between the tip of the fibula and the tip of medial malleolus for the tibialis anterior (TA) for both right and left sides of the leg [9]. The common electrodes were attached to the medial malleolus for both sides. The electrodes were connected to the EMG data collector system ADInstrument Powerlab devices and the signal was recorded using the software LabChart version 7.0.

2.3. Experimental Procedures
2.3.1 Maximum Voluntary Contraction (MVC)
Amplitude (microvolt scaled) of the EMG signals can strongly vary between subjects and to overcome this situation, the reference value was normalized using the Maximum Voluntary Contraction (MVC) value of a reference contraction [8]. For Gas, subjects were sitting with the right angle of the hip on the fixated chair and performed a unilateral plantar flexion at the 90° ankle position [8]. For TA,
subjects were asked to go against the fixated bottom of the table as a manual resistance and worked the ankle unilaterally [8].

2.3.2 Tasks
The subjects performed the static postures of PTS with KP and PTS with HP for ten seconds with three repetitions. The best three seconds that stabilized the signals were extracted and analyzed [6].

2.3.3 Signal processing
EMG signal data were processed using MATLAB. The raw EMG signals data were filtered by bandpass 10-500 Hz to remove the noise [10]. They were later rectified and smoothed by a 20Hz low-pass filter to produce a linear envelope [11]. The smoothed data were calculated to get the Root Mean Square (RMS). The values of all the RMS were averaged and then normalized as the percentage of Maximal Voluntary Contraction (MVC) [6].

2.3.4 Data Analysis
Descriptive statistics was used to study the features of the entire signal [7]. Data were analyzed using the software Statistical Package for the Social Science (SPSS) version 24.0. Normality test was carried out to test the distribution of the data. As all the data were normally distributed, the Paired-Samples T-Test was used to examine the differences between HP and KP in terms of the EMG level of the lower limb muscles. The significant level was set at p<0.05.

3. Results and Discussions
All the data were analyzed using SPSS version 24 to determine the normality of the distribution. The results of the Normality Test are shown in Table 1, where all the data were normally distributed. There was no significant difference between the subjects as they performed the same postures of PTS in solat at the same muscles.

Table 1. Test of Normality. Values shown are the significant value set p<0.05

| Postures | Gas Left | Gas Right | TA Left | TA Right |
|----------|----------|-----------|---------|----------|
| Hands Precede | 0.640    | 0.097     | 0.077   | 0.174    |
| Knees Precede | 0.229    | 0.067     | 0.492   | 0.059    |

Table 2 shows the statistical test using the Paired Sample Test between HP and KP on the respective muscles. Statistically, it showed that there was no significant difference between the postures.

Table 2. Paired Sample Test. Values shown are the significant value set up p<0.05

| Paired Postures | Gas Left | Gas Right | TA Left | TA Right |
|-----------------|----------|-----------|---------|----------|
| Hands Precede – Knees Precede | 0.224    | 0.675     | 0.960   | 0.600    |

Table 3 shows the EMG level of the muscles during the respective posture of PTS in terms of the percentage of MVC. The results showed that PTS preceded by hands was slightly better in the EMG level in comparison to the PTS preceded by knees. Statistical results showed that there was
no significant difference between the different postures of PTS, as it showed a very small percentage of difference of the EMG level between the HP and KP.

Table 3. EMG level in terms of % MVC

| Postures       | Gas Left | Gas Right | TA Left | TA Right |
|----------------|----------|-----------|---------|----------|
| Hands Precede  | 52.01    | 52.17     | 55.46   | 58.29    |
| Knees Precedes | 48.12    | 50.43     | 55.23   | 56.56    |

EMG level activity is influenced by the joints angle and the body postures [12]. PTS with hands and PTS with knees consumed the same behavior of the body posture. During PTS for both KP and HP, Gas and TA muscles act on the same behavior but with different angles. Gas is flexing and TA is extending. The joint angles for the Gas action muscles during PTS is in the range of 50° and TA is in the range of 20°[1]. Here, a difference of angles resulted in no significant differences in EMG level of the lower limb muscles.

In this study, it showed that there was no significant difference in the different opinions of hadiths for the PTS postures in terms of the EMG level on lower limb muscles statistically. Small differences in the angle and the same postural behavior [1] conducted had influenced the results. As the results had no significant difference, the posture may not affect our lower limb muscle negatively. Although there is an uncertainty due to the differences of opinions in the Islamic jurisprudence to which posture is the best, it was proven through an EMG analysis that both differences did not cause harm to the body, at least in terms of muscular activities of the lower limb.

Sujud is the act of prostration to Allah, where the forehead is placed on the ground as an awareness of the Muslim being the servant of Allah [2]. In theory and practical, sujud has plenty of benefits to health. In terms of physiology and biology, the postures of sujud can strengthen the muscles in the head and upper limb while placing the forehead on the ground. The behavior of the postures on the lower limb muscles can increase the flexibility of the current muscles. It helps towards a better gait proportion and acts as a treatment to avoid Flat Foot disease [13].

4. Conclusions

In conclusion, PTS with hands and knees in terms of EMG levels on the lower limb muscles showed no significant difference. As it had no significant difference, it should not affect negatively to human health, at least to the lower limb muscles. Previous studies had shown the benefits of sujud towards health in terms of psychology, brain, heart and muscles [13-15]. The EMG study showed that although there are different opinions on the correct PTS, both acts may lead to the same benefits in the aspects of health. Further study in this issue may be more towards the application of electroencephalogram (EEG) and electrocardiogram (ECG) signals to investigate the biological phenomenon during solat, where it may contribute to the enhancement of the Islamic knowledge and a better understanding of the human functions.
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