Frontiers in Community Service and Empowerment
Multidisciplinary : Rapid Review : Open Access Journal **e-ISSN: 2827-8747 p-ISSN: 2829-3029**

COMMUNITY SERVICE ARTICLE **OPEN ACCESS**

Manuscript received July 26, 2022; revised August 23, 2022; accepted August 27, 2022; date of publication December 30, 2022 Digital Object Identifier (**DOI**): https://doi.org/10.35882/ficse.v1i4.24

How to cite Triwiyanto, Torib Hamzah, Sari Luthfiyah, Bedjo Utomo, Urip Mudjiono, "Application of bio-electrical instruments for monitoring the effect of muscle massage on post-stroke patients through electromyography signal measurement., vol. 1, no. 4, pp. 119–123, Desember. 2022.

Application of Bio-Electrical Instruments for Monitoring the Effect of Muscle Massage on Post-Stroke Patients Through Electromyography Signal Measurement

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ABSTRACT The problems faced by partners are: in carrying out traditional massage massage practice activities, partners do not carry out the process of recording medical conditions before or after the massage process. Thus, this causes partners to be unable to remember the conditions before and after the provision of traditional massage therapy. In addition, when giving traditional massage to patients who have to return periodically, partners cannot know the impact after giving traditional massage. So, to know the result is to ask questions to the patient (e.g. "how is the result after the massage?"). Therefore, monitoring the massage process in post-stroke patients is qualitative and subjective. The implementation methods are: Measuring the physical and medical parameters of the patient such as weight, height and blood pressure, before and after the partner performs traditional massage to the patient, the bio-electrical muscle signal (EMG) is measured by attaching electrodes to the partially paralyzed limbs. Next, the patient contracted the muscle by pressing a rubber ball connected to an electronic pressure measuring module. Together with partners, they monitor the measured value of the muscle bio-electric signal (which is displayed on the computer panel), c) monitor the bio-electric signal in post-stroke patients who undergo traditional massage therapy in subsequent therapy activities (2-5 therapies). The output of PKM activities with the title "Implementation of Muscle Bio-electric Signal Measurement to Monitor the Healing Process of Post-Stroke Patients as an Effort to Support Traditional Massage Workers" is the device that can be used by the partners to monitor the effect of the massage to the patient. The targets and achievements expected in this PKM activity are that partners can monitor the effectiveness of traditional massage with the support of science and technology.

INDEX TERMS: muscle bio-electrical signals, paralysis, muscle functional, post-stroke

I. INTRODUCTION

According to the results of the Basic Health Research, Ministry of Health of Indonesia in 2018, the prevalence of stroke patients (per 1000 population) based on diagnosis in the population aged more than 15 years is increasing from 7 (per 1000 population) in 2013 to 10.9 (per 1000 population) in 2018 (Health, 2018) (Johnson, Onuma, Owolabi, & Sachdev, 2016). After a stroke, a person may experience monoplegia, haemiplegia, diplegia, and quadriplegia, which is partial or complete paralysis of the body. The mildest consequence of stroke is monoplegia, which is paralysis of the upper limbs.

Someone who experiences upper body paralysis can reduce daily activities and productivity. The partner in this community service programme is one of the residents of Jl. Parikesit RT 05 RW 03 Picis Hamlet, Balongdowo Village, Candi District, Sidoarjo Regency. The resident has been practising traditional urate massage for approximately 20 years. Most of the people who use the service are from the local area of Sidoarjo Regency 75% and a small portion from outside Sidoarjo Regency (25%). Most of the patients who visit for massage therapy are patients who experience paralysis caused by post-stroke. Both total and partial paralysis. People believe that massage will speed up the healing process. Therefore, traditional massage activities are still in demand by most people.

In carrying out traditional massage activities, partners practice after office hours (Monday to Friday, from 19.00 to 22.00), because these activities are part-time activities of partners. In carrying out traditional massage practice activities, partners do not carry out the process of recording medical

e-ISSN: 2827-8747 p-ISSN: 2829-3029

conditions before or after the massage process. Thus, this causes partners to be unable to remember the conditions before and after the provision of traditional massage therapy. In addition, when giving traditional massage to patients who have to return periodically, partners cannot know the impact after giving traditional massage. So, to know the result is to ask questions to the patient (e.g. "how is the result after the massage?"). Therefore, monitoring the massage process in post-stroke patients is qualitative and subjective.

As stated by previous researchers, bio-electrical signals or electromyography are influenced by muscle contractions in the related limbs [1]–[5] Whether or not the muscle contraction is normal is influenced by the functionality of the limbs, for example the upper limbs (hands and arms) or the lower limbs (legs). So for post-stroke patients who experience paralysis, it will indirectly affect the characteristics of muscle bio-electrical signals (EMG) both in amplitude and frequency [6]–[10].

Under the research group "Intelligent medical rehabilitation devices", the Department of Electromedical Engineering, Poltekkes Kemenkes Surabaya, in the Microcontroller Laboratory has developed research related to functional muscles in humans for the purposes of making prosthetic hands for amputees and exoskeletons for patients who experience decreased muscle function caused by post-stroke [11]–[13] . Based on the number of patient visits to perform massage therapy in an effort to heal the post-stroke process, this shows the importance of the role of alternative medicine. So it is necessary to implement science and technology for the community to help the process of monitoring the healing of post-stroke patients through the measurement of bio-electrical signals (EMG) [14]–[16]. Based on the problems previously described, the objectives of this community service activity are to provide knowledge to partners regarding the function and placement of sensors in the EMG signal measurement process on limbs that are paralyzed due to post-stroke[17]; provide knowledge to partners, so that muscle contraction can occur, the patient must carry out contraction activities, namely by pressing a rubber ball connected to an electronic system that shows certain measuring values with a pressure scale (0-40 mmHg); provide knowledge to partners how to monitor the condition of post-stroke patients after the massage therapy process based on the results of measuring bio-electrical signals (EMG)..

II. METHOD

This community service with the "Community Partnership Programme" scheme is entitled: "Implementation of Muscle Biolectric Signal Measurement to Monitor the Healing Process of Post-Stroke Patients as an Effort to Support Traditional Massage Workers". The steps of the activity plan in providing solutions to partners are outlined in steps as shown in Figure 3.2. After conducting observations and discussions, the following steps were taken: Prior to the implementation of PKM activities, the proposer and partners coordinated to determine the patient criteria for the application of this PKM activity, namely specifically for post-stroke patients with massage therapy [8], [18]–[20]. Before the measurement and monitoring process, we conducted physical and medical measurements, such as blood pressure conditions, heart health and diabetes.

III. IMPLEMENTATION

This activity involves lecturers and students. The lecturers involved have expertise in electronics, biomedical engineering and nursing science. Meanwhile, the students involved in this activity are 4th semester students in the Electromedical Engineering Department. In this activity, the job descriptions and responsibilities of the activity implementers are as shown in FIGURE 1 and FIGURE 2.

FIGURE 1. Preparation for the Opening of PKM Activities at Balongdowo Village Hall

FIGURE 2. Opening of PKM by Lurah Balongdowo

Students: helped prepare the electronic module for the measurement of muscle bio-electrical signals (EMG), testing and simulating the measurement of muscle bio-electrical

 e-ISSN: 2827-8747 p-ISSN: 2829-3029

signals using a phantom to ensure the functional of the device. Students also helped prepare the stimulation ball module to measure the patient's grip strength and conducted simulation tests to ensure the device's work (FIGURE 3 and FIGURE 4).

FIGURE 3. PKM participants consisting of lecturers and students of the Department of Electromedical Engineering, Poltekkes Kemenkes Surabaya

Lecturers in the field of electronics and biomedicine: evaluate the readiness of the muscle bio-electrical signal (EMG) measuring module together and provide instructions for the correct calibration and measurement process. Nursing lecturers: study the anatomy of body parts related to the muscles to be measured and the placement of electrodes (muscle bio-electric sensors) [21]–[24].

FIGURE 4. Explanation of massage in stroke patients

In addition, we also measured medical parameters such as blood pressure and interviewed the patient's condition before the measurement process. Measuring the patient's physical and medical parameters such as weight, height and blood pressure (FIGURE 5 and FIGURE 6).

FIGURE 5. Measurement of Blood Pressure and Glocose level of the PKK cadre participants

FIGURE 6. Anthropometric measurements of post-stroke patients before massage

Before and after the partner performed traditional massage to the patient, the bio-electrical muscle signal (EMG) was measured by attaching electrodes to the part of the body that

 e-ISSN: 2827-8747 p-ISSN: 2829-3029

was partially paralyzed. Next, the patient contracted the muscle by pressing a rubber ball connected to an electronic pressure measuring module. Together with partners, monitor the measured value of the muscle bio-electrical signal (displayed on the computer panel). Monitoring bio-electrical signals in post-stroke patients who underwent traditional massage therapy in subsequent therapy activities (2-5 therapy's) (FIGURE 7 to FIGURE 10)

FIGURE 7. Initial monitoring of bio-electrical signals in a post-stroke patient undergoing massage massage therapy.

FIGURE 8. Pelaksanaan pemijatan pasien pasca stroke.

FIGURE 9. Pelaksanaan pemijatan pasien pasca stroke.

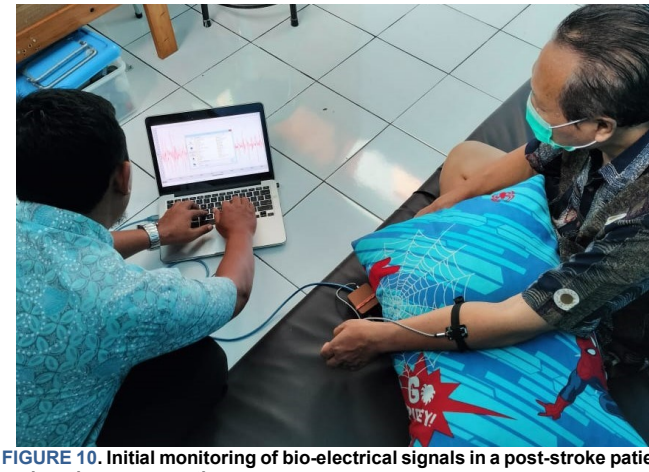

FIGURE 10. Initial monitoring of bio-electrical signals in a post-stroke patient undergoing massage therapy

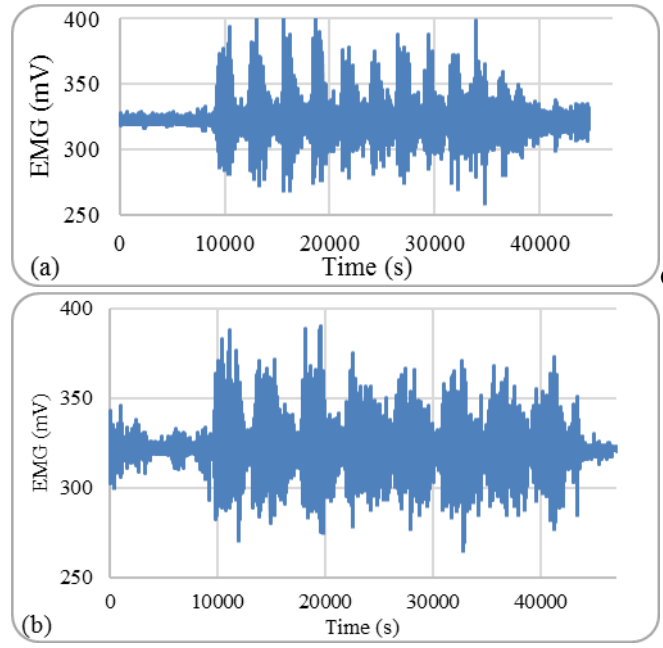

FIGURE 11. The EM signal (a) pre massage and (b) post massage.

FIGURE 11 shows the EMG signal for pre and post massage to the post stroke patient. The Figure shows that after massage the EMG signal shows more active compare to pre-massage [25]–[27].

V. TARGET AND ACHIEVEMENT

The targets and achievements to be obtained in this PKM activity are to assist partners in solving the problem of monitoring the effectiveness of traditional massage massage on restoring muscle functional weakness caused by post-stroke events. The targets and achievements are described as follows: The expected target for partners is that partners can monitor the effectiveness of traditional massage on the functional recovery of muscles in the hand caused by post-stroke events quantitatively, namely through measuring muscle bio-electrical signals and hand grip strength. The achievements that can be measured in this implementation are the ability of partners to use the muscle bio-electrical module and determine whether there is a functional increase in muscle through bio-electrical parameters and grip strength. Target, partners can improve alternative treatment services for patients who experience functional decline in limbs caused by post-stroke scientifically and supported by the application of bio-medical technology and computer systems. The achievements that can be measured at this stage are the level of patient satisfaction through questionnaire forms given to patients every time they do traditional massage. After the test, the health cadres filled the Pudji Rochyati scorecard. The results

VI. CONCLUSION

By applying a computer-based bio-electrical instrument, it is possible to monitor muscle signal activity after the massage process. Electromyography (EMG) signal contraction is highly dependent on the condition of the post-stroke patient, which is how long the patient goes through the healing process after a stroke. The position of the electrode placement on the surface of the skin to be measured by the bio-electrical instrument greatly determines the quality of the EMG signal measurement results. Partners can understand how to operate bio-electric instruments for monitoring muscle activity pre-post massage. For further community service activities, a bio-electric instrument system needs to be equipped with features that can analyze the measurement results so that users can understand the measurement results directly. Respondent measurements should be repeated between 5-10 measurements to get better results.

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