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IDENTIFICATION OF SOLEUS MUSCLE ON THE USE OF HIGH HEEL SHOES I Dewa G.H.Wisana, Priyambada C. Nugraha, Liliek Soetjiatie, Triana Rahmawati Electro Medical Engineering Department Health Polytechnic Surabaya Pucang Jajar Timur No. 10 Surabaya, Indonesia Email: hariwisana@yahoo.com ABSTRACT Background Several studies have reported that the proportion of the prevalence of foot problems in women is associated with the use of high heels. Seeing the effects on the muscles of the legs, the research on the adverse effects of the use of high-heeled shoes necessary. Method Collecting data in this study using Electromyography tool that generates data in the form of a leg muscle sEMG signals respondents. The data used was obtained from adult

women, aged 20-40 years and weigh 40-60 kg here in after as research subjects. Research subjects wearing shoes with 3, 5 or 7cm high heel for 2 (two) hours each day. Analysis is based on the frequency of the signal indicates that the use of shoes with high heels affect the increase in the frequency of the soleus muscle is from the start frequency of 120- 150 Hz into a higher frequency of 130-200 Hz on the heel 3cm, into a high frequency of 90-120 Hz at 5cm heel and into the frequency of 150-200 Hz at 7cm high heels. Results High heel Shoes worn on respondents greatly affect the soleus muscle of the respondents. Keywords: High Heels, Soleus Muscles, EMG Signals, Signal Frequency INTRODUCTON Good shoes have health function and aesthetics. In terms of health, shoes protect and maintain the cleanliness of the foot and helps the feet support the body. In terms of beauty, the shoe can help the appearance. [1] shoe is one that played a role in the activities of a woman. From year to year, the trend of high heel shoes continues to grow, and eventually become permanent fashion trends for women. High heel shoe model is the most common pointy stilettos, sabrina, blocks, and blade. Agency survey in the United States noted 59% of women wear the high heels of the shoes at least 1 hour up to 8 hours per day. [2] Several studies have reported that the proportion of the prevalence of foot problems in women is associated with the use of high heels. Researchers in the US found that women who wear high heels for 40 hours each week, will change the way passes than women who used to wearing flat shoes. [3] The use of shoes that do not fit the biomechanical step foot in a long time can change the shape of the foot and make the injury to the muscles of the calf and heel. Biomechanics is the mechanical foot rule to run, which is when the heel of the foot raised and pinned body weight on the front foot and then leg swung forward. One of the health problems caused by high-heeled shoes is osteoarthritis. Osteoarthritis is part of arthritis. Symptoms include pain and stiffness in the joints of the bones. Generally, complaints arose in knee and hip joints. If left to spread the pain to the surrounding muscles. At the lower stage, a complaint can be treated with medication and exercise movement. In later stages require surgery cushion joint replacement. [4] Seeing the effects on the muscles of the legs, the research on the adverse effects of the use of high-heeled shoes necessary. Fig.1 Limbs Muscle[6] Is the use of high-heeled shoes in a relatively short time also affects leg muscles? This will be explained in this study. Research related to the use of high- heeled shoes in a short time (the duration of the use of up to 1 hour) has not been revealed in previous studies, especially in Indonesia. Researchers saw an opportunity to conduct research related to the classification of sEMG signals using high-heeled shoes with the FFT method. Surface Electromyography (sEMG) has been used in research and clinical applications for noninvasive assessment of neuromuscular, in several different areas such as sports science, neurophysiology and rehabilitation. Interval Muscle Interval activation useful to evaluate motor coordination and treatment success. Surface myoelectrical signal can be used to assess the EMG signal. RESEARCH METHOD Collecting data in this study using Electromyography tool that generates data in the form of a leg muscle sEMG signals respondents. The data used was obtained from adult women, aged 20-40 years and weigh 40-60 kg here in after as research subjects. Research subjects were asked to Fig.3 FFT Flowchart wear shoes with three types of different high heel shoes can be seen in Fig.2. Before the data collection research subjects should be examined health conditions by measuring blood pressure. Raw Data in EMG signal form obtained from EMG instrument with a sampling frequency when performing data acquisition at 1 kHz. Data obtained from EMG instrument is decimal data from the EMG signal on the soleus muscles. Furthermore, a Fast Fourier Transform Fig.2 Research Design (FFT) Proses which produces EMG signals in the frequency domain. FFT results can be Heel used was 3 cm, 5 cm and 7 cm. obtained from the information contained in Research

subjects wearing shoes with a high the frequency of the EMG signal. [8] Then it heel shoe 3, 5 or 7 cm for 2 (two) hours each will look for the value of the MPF of the day. This activity is repeated for 10 (ten) EMG signal on leg muscles. FFT process days for each type of heel. and calculating the value of MPF can be seen in Fig.2. RESULT The Fourier Transform is a method to transform the time domain signal into a frequency domain signal. This transformation is important in the analysis of the signal due to the frequency domain signal characteristics can be observed more clearly and manipulated more easily than in the time domain signal. In the frequency domain, the signal is represented as a set of values that indicates the number of signals that the unit is in a certain frequency. [7] This study uses FFT to obtain frequency information which forms the value of EMG signals. When the FFT process has been done then continued the process of calculating the value of MPF. This study uses FFT to obtain frequency information which forms the value of EMG signals. When the FFT process has been done then continued the process of calculating the value of MPF. Fig.4 Normalized Amplitude Signals Mean Frequency Soleus Muscle in 3 Cm heel Analysis is based on the frequency of the signal indicates that the use of shoes with high heels affect the increase in the frequency of the soleus muscle. In start condition, mean power frequency begin from 90 to 100 Hz. When te woman use heel 3cm the Mean Power Frequency increase into a 130-180 Hz on the heel 3cm can see in figure 5. Fig.5 FFT Soleus Muscle in 3 Cm heel Mean Power Frequency increased from 90- 120 Hz at 5cm heel from starting MPF 90-100 Hz can see in figure 6. Fig.6 FFT Soleus Muscle in 5 Cm heel Mean Power frequency have a frequency 150 -200 Hz at 7cm high heels from the start frequency 90Hz-100 Hz, Can see in figure 7. Fig.7 FFT Soleus Muscle in 7 Cm heel DISCUSSION Analysis is based on the frequency of the signal indicates that the use of shoes with high heels affect the increase in the frequency of the soleus muscle is from the start frequency of 90-100 Hz into a higher frequency of 130-200 Hz on the heel 3cm, into a high frequency of 90-120 Hz at 5cm heel and into the frequency of 150 -200 Hz at 7cm high heels. Table.1 MPF Soleus Muscle Start Resp Condition 3 cm Heel 5 cm Heel 7 cm Heel (Hz) (Hz) (Hz) (Hz) 1 96.507 134.825 131.41 190,196 2 90.025 188.085 96.062 201.151 3 96.04 156.242 95.364 177.196 4 95.323 150.014 94.044 205.489 5 92.545 145.3 108.548 200.194 6 98.817 138.543 98.983 184.86 7 91.021 144.806 95.364 207.976 8 94.908 135.329 114.184 182.752 9 97.392 152.015 108.548 266.281 10 91.281 142.963 98.738 161.281 change the frequency of gastrocnemius muscle. Frequency stays in the range 60-80 Hz. In the gastrocnemius muscle use the heel of 3-7 cm is not much change the frequency range MPFnya. This indicates that the gastrocnemius muscle, no changes in frequency due to the use of high heel shoes. Recommendation High Heels Shoes will lead to high pressure at the surface of the soles of your feet so that would trigger a condition metatarsalgia severe pain or cramps caused by the anterior part of metatarsus, usually you will experience pain in the heel and ankle. The use of high heels for long periods can cause problems on your feet. Use High heels less than an hour Acknowledgment This research was conducted at the Laboratory of Electronics and Laboratory of Medical Elektronics in Electromedical Engineering Department, Surabaya Health Polytechnic. REFERENCES Esenyel M, Walsh K, Walden JG et al. Kinetics of high-heeled gait. J Am Podiatr Med Assoc (2003) 93: 27-32. Fig.8 Mean Power Frequency Soleus Muscle Casale R, Rainoldi A, Nilsson J et al. Can continuous physical training counteract aging effect on myoelectric fatigue? A CONCLUSION surface electromyography study AND RECOMMENDATION application. Arch Phys Med Rehabil (2003) 84:513–517. Conclusion Zwarts MJ, Drost G, Stegeman DF. Scattering Mean Power Frequency Recent progress in the diagnostic (MPF) in the soleus muscle produce MPF use of surface EMG for neurological value at a frequency of 100-200 Hz. diseases. J electromyogrKinesiol Scattering

Mean Power Frequency (MPF) in (2000) 10:287–291. the gastrocnemius muscle produce MPF Mannion AF, Dumas GA, Stevenson JM et value at a frequency of 60-80 Hz. The use of al. The influence of muscle fiber size high heels 7 cm increase in frequency affects and type distribution on the soleus muscle of the initial frequency of electromyographic measures of back 100-120 cm into the frequency 180-200 Hz. muscle fatigability. Spine (2008) In the soleus muscle MPF values can be 23:576–584. grouped clearly on the use of shoes with Pearce, Evelyne C. Anatomi dan Fisiologi different heel. This shows that the heel untuk Paramedis. Jakarta: Gramedia height worn on respondents greatly affect the (1985) soleus muscle of the respondents. The use of Cameron, John. R. Fisika Tubuh Manusia. high heels from 3 cm to 7 cm does not Jakarta: EGC (2006) Tanudjadja, H. Pengolahan Sinyal Digital & Sistem Pemrosesan Sinyal. Yogyakarta: ANDI (2007) Hermens HJ, Freriks B, Merletti R. et al. Seniam 8: European recommendations forsurfaceelectromyography. Roessingh Research and Development, Netherlands. (1999) 583 584 585 586 587