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Introduction

It is very effective to use an accelerometer for motion analysis[1]. It can measure the force of the part of the body that is impossible of measurement by using an accelerometer. For example, the accelerometer can measure the lateral thrust of the knee[2]. However, is a quantitative evaluation possible only with an accelerometer? There are no reports of measuring pain threshold using only an accelerometer.

The purpose of this study is to find the pain acceleration threshold in patients with knee OA.

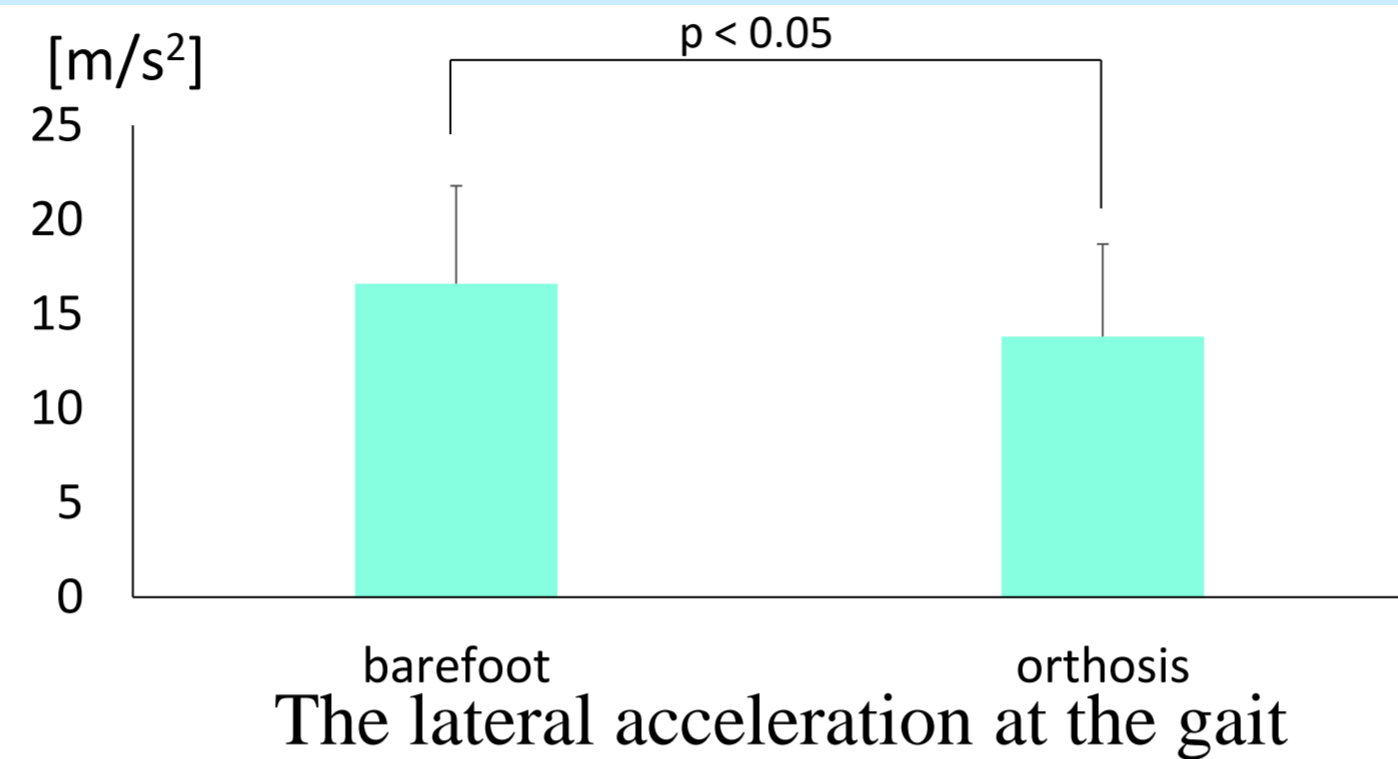
Method

The study population comprised 8 women (mean age, 70.9 years [SD, 6.8 years]; mean height, 150.0 cm [5.9 cm]; mean weight, 53.3 kg [4.9 kg]). All the members were osteoarthritis of the knee (grade 3-4). Written informed consent was obtained from all the participants before initiating the study.

A triaxial accelerometer was attached to the subjects' skin over center of the lateral condyle of the diseased side. The participants were tested in two conditions of the "bare foot" "orthosis: lateral wedge insole". The participants walked at their preferred but constant speed (mean 2.9 km/h [11%]) about 10m. The same experiment was repeated thrice. The following parameter was calculated peak acceleration. The mean value for each parameter was determined. The sampling frequency of the accelerometer was 100 Hz. The lateral acceleration of two groups compared it in t-test.

Results

All cases were not painful by putting on an orthosis. The lateral acceleration was a maximal value in the heel contact phase. The lateral acceleration at the gait were barefoot 16.6 m/s² [5.2 m/s²]; mean [standard deviation] and orthosis 13.8 m/s² [4.9 m/s²]. The lateral acceleration of the orthosis group significantly from barefoot group decreased.



Conclusion

According to Newton's equation of motion, the acceleration is in proportion to an ipsilateral force. Because lateral acceleration decreased, a lateral thrust decreased. But, we do not have value identification of significant acceleration because standard deviation of the acceleration varies. Also, it is not possible to determine the presence or absence of pain by setting an acceleration threshold. Therefore, we can use an accelerometer as a simple and easy clinical evaluations tool. Although there is no target value for acceleration known as a "pain threshold," we found that pain decreases when acceleration decreases. This is extremely useful data when determining the effectiveness of treatment. For example, by measuring acceleration when it is difficult to understand the effectiveness of treatment, it can be determined that pain is reduced with less acceleration. However, comparing that acceleration with someone else's is meaningless.

References

- [1] Hiyama Y, Asai T, Wada O.: Effect of improvement in quadriceps strength asymmetry on trunk movement asymmetry after total knee arthroplasty. *Gait Posture*. 2020 Jun;79:21-25.
- [2] Maly MR, Robbins SM, Stratford PW, Birmingham TB, Callaghan JP.: Cumulative knee adductor load distinguishes between healthy and osteoarthritic knees--a proof of principle study. *Gait Posture*. 2013 Mar;37(3):397-401.

Ethical Permissions

This study was conducted with the approval of the ethical review board of the institution to which I am affiliated. The experiment was conducted in accordance with the Declaration of Helsinki. Written documents were given to the subjects and oral explanations were given. In addition, consent to participate in the experiment was confirmed by submitting a consent form.

Relevance for Patient Care

We can use an accelerometer as a simple and easy clinical evaluations tool. Although there is no target value for acceleration known as a "pain threshold," we found that pain decreases when acceleration decreases. This is extremely useful data when determining the effectiveness of treatment. For example, by measuring acceleration when it is difficult to understand the effectiveness of treatment, it can be determined that pain is reduced with less acceleration. However, comparing that acceleration with someone else's is meaningless.

