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Biomechanics Analysis of Static Stretching using Dartfish Express in PGMI Sports Learning

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Abstrak

Penelitian dibuat bertujuan mendapatkan hasil analisis biomekanika gerakan *statis sterching* mahasiswa PGMI yang mengikuti pembelajran olahraga. Metode yang digunakan dalam penelitian adalah metode survey dengan cara dokumentasi dan observasi. Populasi penelitian ini mahaiswa PGMI angkatan 2019 UNISMA Malang, sampel penelitian ini 25 mahasiswa pada kelas A dan B dengan teknik pengambilan sampel random sampling. Analisa biomekanika dilakukan dengan dokumentasi gambar dan video, hasil gerakan dianalsis menggunakan *dartfish express.* Anaslis biomekanika yanag muncul pada gerakan *statis sterching* berdiri ditempat terdapat Hukum 1 Newton yang meliputi titik berat, keseimbangan dengan sudut mendekati 90 derajat. Saat melakukan gerakan mencondongkan badan terdapat hubungan jarak dan sudut dari titik pusat, hukum 3 Newton yang meliputi titik berat, gerak linear dan mendekati sudut angular 90. Sedangkan pada gerakan badan menyamping terdapat Hukum 3 Newton, momentum, titik berat dan Hukum 2 Newton.

Kata kunci: Analisis biomekanika, static streching, dartfish express, PGMI

Abstract

The aim of the study was to obtain the results of the biomechanical analysis of the static movement of sterching PGMI students who took part in sports learning. The method used in this research is a survey method by means of documentation and observation. The population of this study was students of PGMI class 2019 UNISMA Malang, the sample of this study was 25 students in class A and B with random sampling technique. Biomechanical analysis is carried out with image and video documentation, the results of the movement are analyzed using dartfish express. Biomechanics analysts who appear in the static sterching motion stand where there is Newton's 1st law which includes the center of gravity, balance with an angle close to 90 degrees. When doing a leaning

motion, there is a relationship between distance and angle from the center point, Newton's 3rd law which includes the center of gravity, linear motion and approaches an angular angle of 90. Whereas in sideways body movement there are Newton's 3rd Law, momentum, center of gravity and Newton's 2nd Law.

Keywords: Biomechanical analysis, static stretching, dartfish express, PGMI

PRELIMINARY

Ergonomic movement habituation is important for every individual who is involved in physical activity, including students of Madrasah Ibtidaiyah Teacher Education (PGMI) in doing sports learning. Not all PGMI students have a hobby of exercising so that some simple movements in sports become something foreign to do. Before starting sports learning, ideally, it begins with a warm-up session which includes the deepest stretching stage. The collected field data found many movements that were not in accordance with the initial purpose of doing stretching, there were even movements that if done consistently could trigger injury (Shingjer 2018).

A detailed analysis of student movements with existing limitations needs to be carried out to evaluate movement techniques in sport science using the availability of smartphones. Dartfsih Express as a means of online and offline video software that is integrated with the android system allows users to view, edit, and analyze videos for the purposes of justifying sports movements Subagio et al (2019) as a point for conducting biomechanics analysis on PGMI students. Stretching movements are the foundation for initiating movement activities with simple adaptations to complex movements. Ztella et al (2019) explained that there are various types of stretching that are commonly used, namely static stretching, dynamic stretching, proprioceptive neuromuscular facilitation (PNF) and ballistic stretching. Of the four types of stretching, the findings in another study explain that 42.1% more do static stretching with the reason that doing it is simpler, and most of them are taught from generation to generation from sports educators with a history of previous education levels (Zulfahmi 2018).

In addition to sports studies, there are lectures for learning natural, social, language, mathematics, art and thematic knowledge to be mastered by students in preparation for becoming competent classroom teachers. If students only rely on sports learning to enrich their movements to become classroom teachers, it is certainly impossible for students to be able to have perfect movement skills and skills (Poerwanto, S., & Firdiansyah 2019). Benda et al (2021) explained that in theory it takes continuous repetition of at least 3 months to master new techniques/movements that are perfect and efficient. Mastery of new movements is too far for PGMI students, researchers take the most common thing to do before doing sports, namely

warming up in the form of static stretching. Static stretching movements become the focus in objects that are analyzed biomechanically with the dartfish express application.

Static stretching is the most commonly known type of stretching and is done to stretch muscles before training. This type involves placing a joint that is held in a certain position so that it can stretch the muscle for some time. The opinion of Merce et al (2022) explains that this heating is considered safe and can increase flexibility optimally. With efficient static stretching movements, it will ease the adaptation of the body to carry out movements in a systematic and structural manner, and to determine the efficiency of motion, biomechanics must be analyzed. Biomechanics is a field of application of motion mechanics that combines the disciplines of applied mechanics, biology and physiology. Biomechanics concerns the human body and almost all living things. The biomechanical analysis in this static stretching movement aims to determine the principles of motion and physics that appear in the static stretching movement consisting of the initial attitude, step / step and final movement. PGMI students are required to be able to position themselves as professional educators through the support of technological transformation with the sophistication of industry 4.0 through the use of Dartfish Express as an application to analyze the bimechanics of a series of static steching motions.

METHODS

The method used in this research is a survey method by means of documentation and observation. The population of this study was 234 students of PGMI class of 2019 UNISMA Malang, the sample of this study was 25 students of class A and B with the sampling technique of random sampling in the form of a lottery (Bhaskar & Kishore 2017). Movement observation to determine the analysis of static stretching movements from the biomechanics review. Biomechanical analysis in static stretching movement begins with taking pictures of a series of static stretching movements. Then do the documentation of the step or series of movements sequentially from simple movements to complex movements, the first picture is taken when it is ready and goes to 5 counts, each movement is taken from the vertical position to the final position of the step motion. Every movement movement is taken a picture, the results are inserted into the Dartfish Express application to be analyzed biomechanically with the parameters of angle, distance, axis of axis and force.

RESULTS AND DISCUSSION

The available standing position in the picture below is normal and correct, where the body's ready position is not too leaning forward, backward and sideways. In this movement there are many options for doing this type of stretching. The law that applies is Newton's 1st law,

namely if there are no reacting forces, the velocity and acceleration of an object do not change. The object will be at rest or in uniform motion along a straight line.

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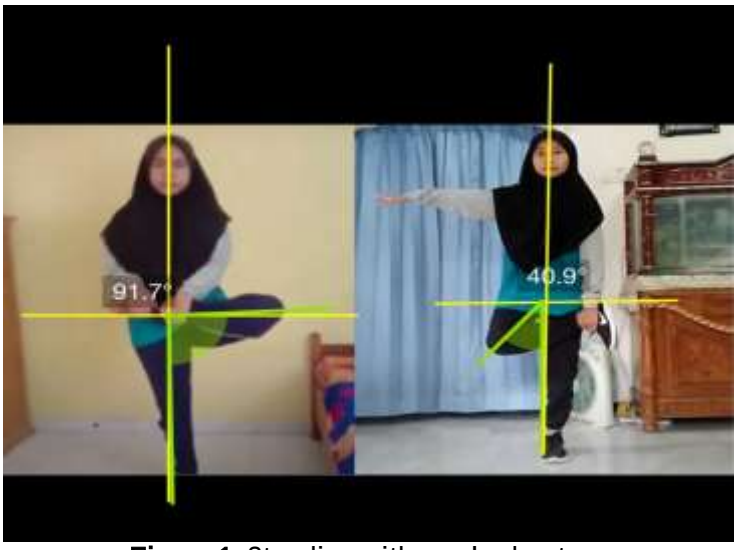


Figure 1. Standing with one leg bent

Movement according to the picture has a comparison in doing in the amount of angle formed. The image in Kiki is recorded at 91.7 degrees with a stationary position for the entire left leg. In the picture on the right, an angle of 40.9 degrees is formed and it looks not optimal for the purpose of the movement that should pull the gluteus maximus muscle behind. Ready when in a normal position will facilitate the efficiency of movement. This position has a center of mass, there is a catch point of the resultant gravity on each member of the system, the sum of the moments of the force about this capture point (center of mass) is equal to zero and the direction of this force towards the center of the earth is w (w = m.g). The weight in this normal ready

movement is in the same position as the center of mass, namely when the body is in a normal position with support on one foot (Bolger et al. 2021).

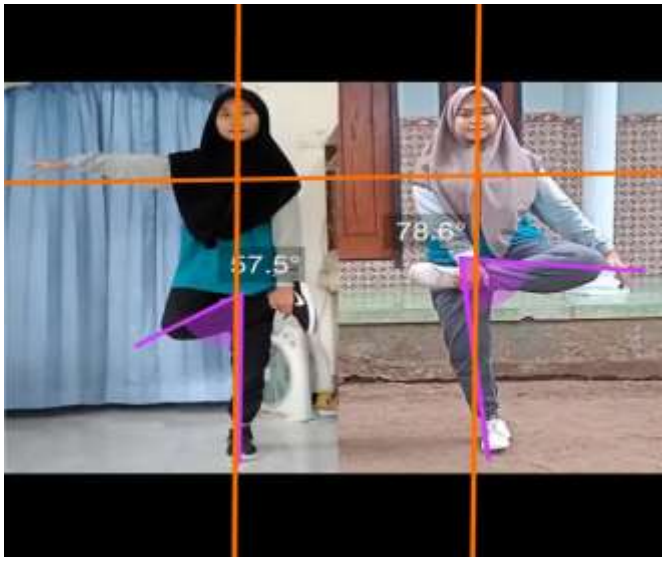


Figure 2. Comparison of the previous image (Standing with one leg bent)

Stable equilibrium occurs when an object is conditioned in such a way that attempts to disturb it must lift its center of gravity. Thus the left object tends to fall back to its original place and away from the goal of static stretching to pull the transverse fibers of the gluteus mximus muscle. Figure 2 on the right makes it possible to pull inward beyond an angle of 78.6, it can be explained that the higher the fulcrum the more stable the balance.

An unstable or unsteady balance occurs when only a slight push is needed to knock an object over. This occurs when the center of gravity falls to a lower point when the object is lifted. The body position where a person's body must be normal, should not lean too much forward or backward, because when the body is not in a normal position, it will be more difficult to move the body position, such as a standing position it will be easier to move the body position (Ebrahimi and Hosseini 2021), than the body position when squatting. Newton's law explains Faction=Freaction, meaning that when there is an upward impact, the downward impact should be directly proportional to the automation keeping it from falling. Because the angular movements of the forearm and upper arm condition the knees, the palms can move linearly, thereby providing linear motion to the footstool in performing a one-legged standing motion with the legs bent inward as shown in Figures 1,2 and 3.

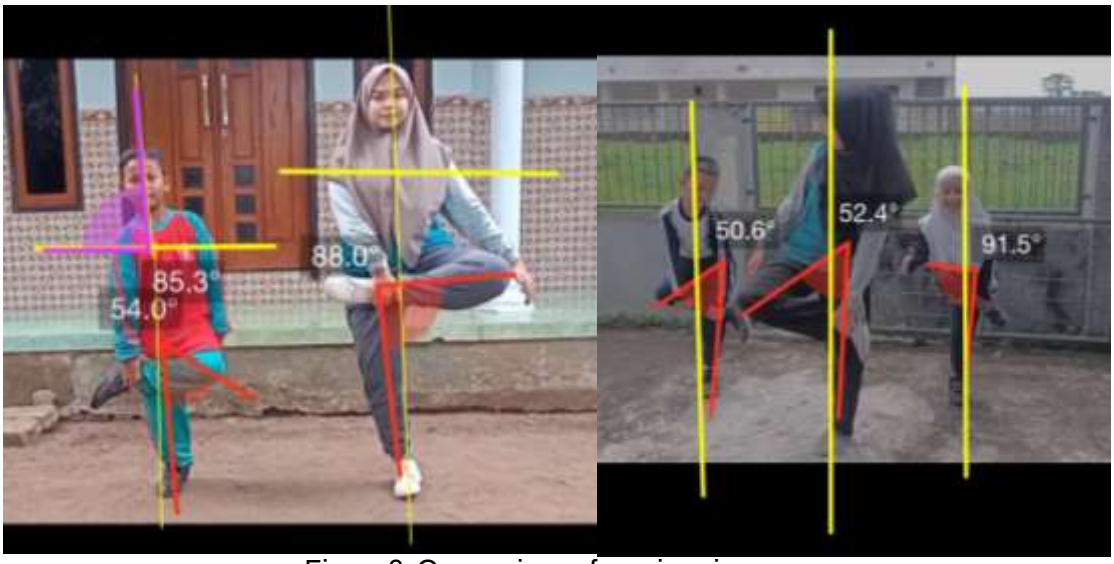


Figure 3. Comparison of previous images

The momentum of the object when doing the same movement as the picture above makes the movement imperfect if it is recorded at an angle smaller than 80 degrees, dal more than an angle of 93 degrees. In the event of this attack, the body tends to move forward and maintain the attitude of the legs not to touch the ground so that momentum or the amount of movement occurs in the forward direction so that the body is carried forward when doing other movements systematically (Kilic, Uyanik & Caglak, 2022). This effect can also be caused by the weight of the sample.

There is a sample of children in uniform in the field data, this is an additional object for the pure sample because in their learning the lecturer provides applications to be applied in real terms in supporting classroom learning. According to Figure 3 on the right, there are differences in angles, namely 50.6 degrees, 52.4 degrees and 921.5 degrees. The first and second pictures don't focus on favor in stretching and only focus on conveying information so that the stretching movement for the gluteus maximus is ignored (Gursoy & Ozcan 2021).

The heavier the sample, the greater the momentum. Likewise, when stopping from performing attacking motion techniques, a player whose body weight is relatively large will find it difficult to stop and make the next move.

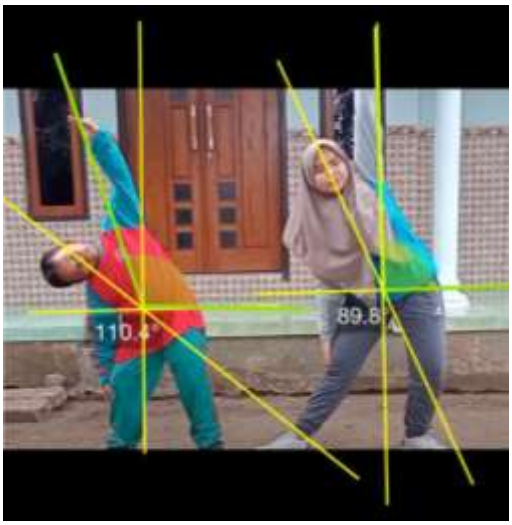
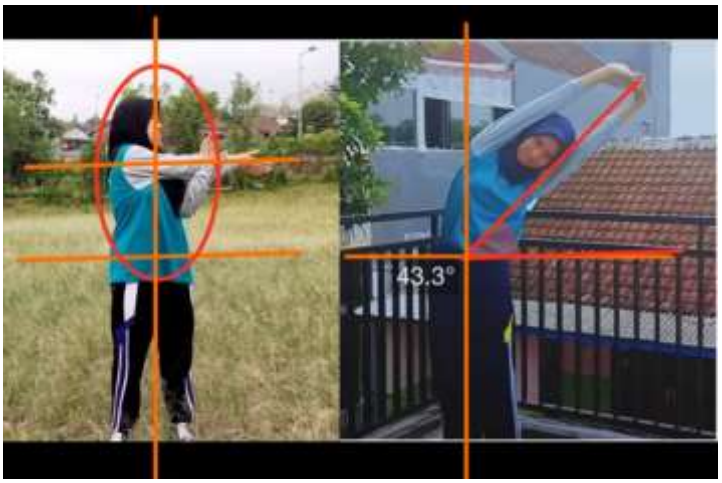


Figure 4. Body movement leaning to the right and left hand above the head

Newton's 3rd law here applies when performing the technique of dropping / turning the body to the side and will apply a force on the floor and the floor will provide a force on the body which is equal to the force produced when the body pushes the floor in the direction of the force. The change in the average momentum of an object is equal to the resultant force acting on it, this is in accordance with Newton's 2nd Law, the object depends on the mass and acceleration given.



Gambar 5. Gerakan condong samping

Dartf fish recapitulates this movement as having different goals in the similarity of movement desires. Biomechanical analysis in static stretching movements, it is true that there are biomechanics or physical principles that exist in basic fencing movements including, ready, step / step and execution. This is in accordance with the observation of each basic movement

and analyzed any physical relationships based on the theoretical understanding of existing physics and can be applied to static stretching movements.

The position of the body in Figure 5 on the left shows an error in doing this, this is not justified in carrying out this movement because it does not have the pressure that should be used to pull the hundred anterior muscle. In the picture on the right side, there are 43.3 degrees and it has been adjusted to the tilt angle of 45 degrees, this will result in more benefits for pulling micro totots on the lateral side.

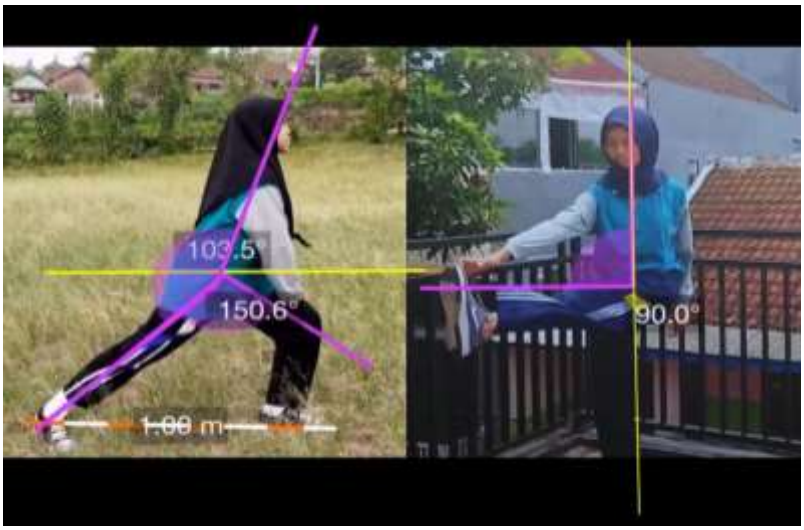


Figure 5. Side leaning movement

Figure 5 on the left has an ideal position for foot movement with a width of 1 meter or twice the standard width of the shoulder. For the waist position with the upper traction device, it was recorded at 103.5 degrees, which should not be more than 90 degrees. It is possible to maximize the overall traction of the trapezius muscle (Salleh, Laxman, & Jawawi 2015). The picture on the right shows the ideal size for the angular leg with one foot as a support, what is inefficient in the picture is the position of the left foot that is not free and relaxed to support body balance.

When the position is attempted, it is better to be in the normal position, not leaning too forward or backward because to facilitate the mobility of moving the limbs, not only moving, when the anatomical position it will be easier to move back to its original position. The location of the center of gravity always changes according to the attitude, and is very decisive for the movement technique (Gurol 2019) (Ayan 2018). The center of gravity does not stay at one point, but moves in the direction of its motion.

In general, the PGMI students who were the samples did not have good and efficient mastery of the sterching motion. There are still many PGMI students who do not pay attention to the main purpose of stretching movements, only doing it randomly without paying attention to movement efficiency even though it is only a simple movement. To create movement efficiently there should be periodic evaluation in consultation with experts so that they are able to practice ergonomic static stretching movements based on biomechanical analysis.

CONCLUSION

Biomechanics analysis that appears in static stretching in the form of standing motion where there is Newton's 1st Law (if the resultant force on an object is equal to zero, then an object that was initially at rest will continue to remain at rest. While an object that was initially moving will continue to move at a constant speed)) which includes the center of gravity, and balance at an angle close to 90 degrees. When doing a leaning motion there is a relationship between distance and angle from the center point, Newton's 3rd law (If object A exerts a force on object B, then object B will exert a force on object A, which is the same magnitude but opposite in direction) includes the center of gravity, linear motion and approaching an angular angle of 90. While the sideways body movement there are Newton's 3rd Law, momentum, center of gravity and Newton's 2nd Law (the acceleration of an object caused by a force is directly proportional to the magnitude of the force and inversely proportional to its mass).

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