

Knee Angles During a Walking Gait Analysis

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EXSI 335 Kinesiology

Introduction

According to Perry (2002), a normal gait cycle consists of seven stages (Figures 1-7). According to Perry (2002), a normal gait cycle should consist of 60% of the movement in the support, or stance, phase and 40% in the swing phase. There are several variables to consider that might alter a normal gait cycle such as walking velocity and neuromusculoskeletal deficiencies.

There are several types of joints in the body: hinge, ball and socket, saddle, gliding, and pivot. Each joint plays a different but important role in the body. The hinge is the most common type of joint, and the knee is a prime example of the hinge joint. According to Seel, Raisch, and Schauer (2014), the knee is not perfectly constrained to rotate around a single axis. Abduction and adduction and knee rotation internally or externally may exceed a joint change of up to 10° (Seel et al., 2014). However, this information is rarely included in publications but should be considered when evaluating the angles of the knee during walking.

The purpose is to determine how knee angles change during specific stages of the walking gait compared to research. The subject is a young, healthy, moderately active adult, so it is hypothesized that the subject's knee angle change during each stage will fall within the range of a healthy adult's walking gait.

Initial Swing

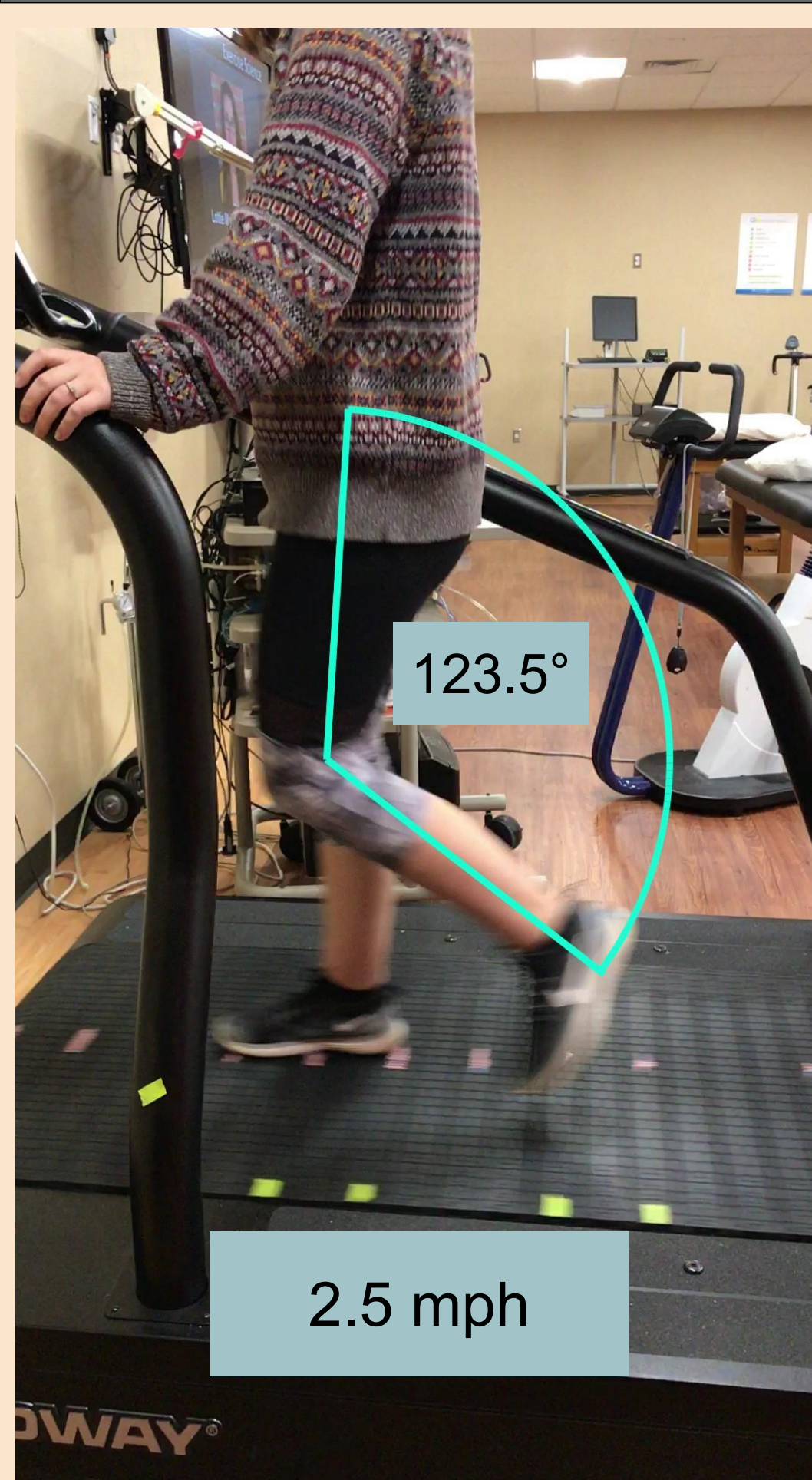


Figure 5 Initial Swing

During any gait analysis, it is shown that in order for the foot to clear the ground, a 60° knee flexion is needed (Perry, 2002). Since the pre swing should be around 40°, 20° should be added to the previous snapshot angle. The client's knee flexion in the initial swing was 56.5°. This is a 23.8° increase from the pre swing. This indicated that the client has a normal initial swing. The

major muscles involved in this swing are: extensor hallucis longus, flexor hallucis longus, sartorius, iliacus, and tibialis anterior (Streifeneder, 2018).

Load Response

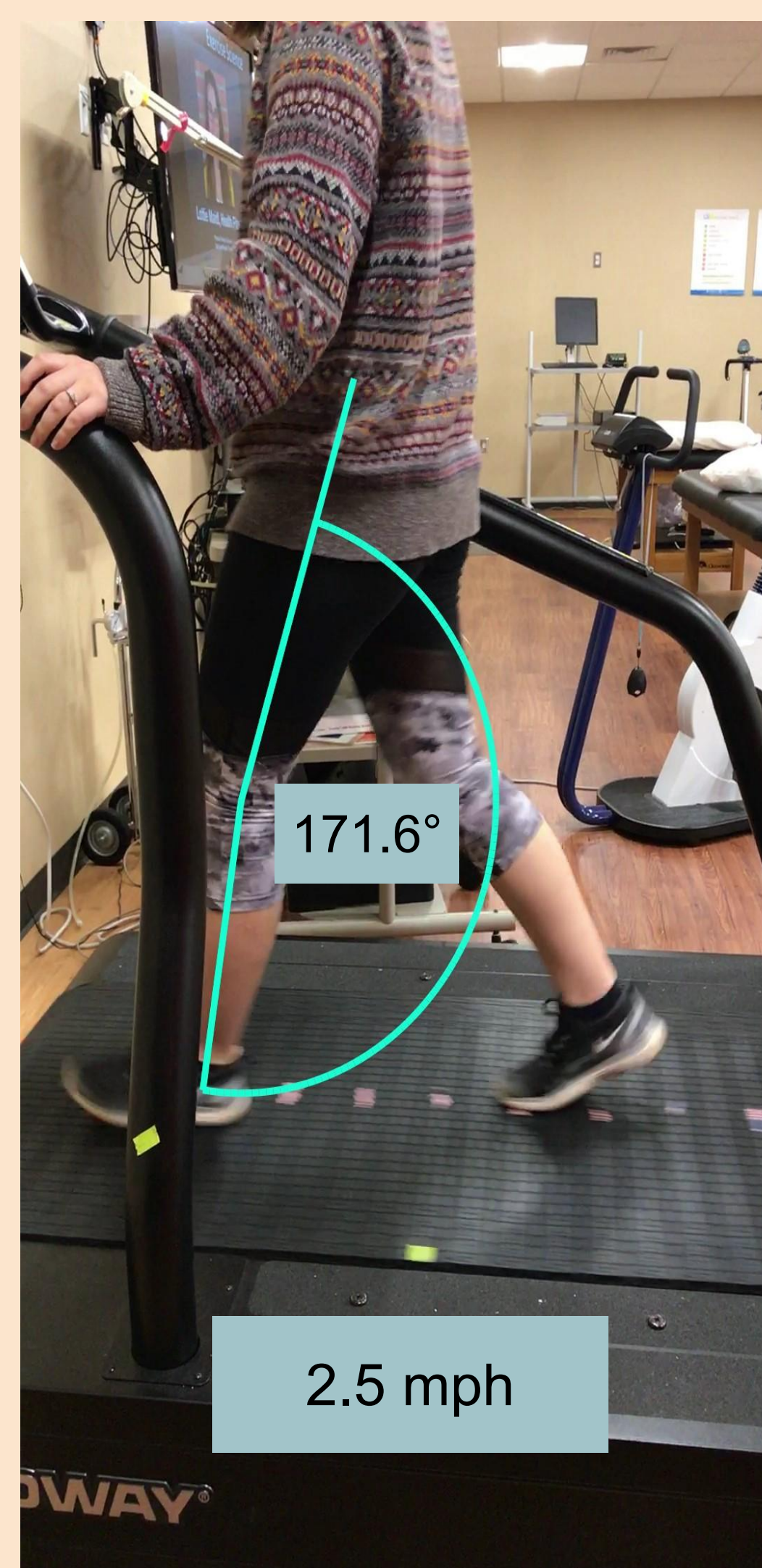


Figure 1 Load Response

According to Perry, (2002), a normal knee flexion angle during the loading response is 15°. During the loading response, the subject exhibited a knee flexion angle of 8.4°. This difference is significant enough to be considered a discrepancy. A major goal during this initial portion of the gait analysis is to ensure that the weight is shifted in order for stability to occur and to enable the body to propel forward in the sagittal plane to move into the next stance (Perry, 2002).

During this stance the muscles that are activated are: quadriceps femoris, tibialis anterior, gluteus medius, gluteus maximus, adductor magnus, tensor fascia latae, tibialis posterior, and peroneus longus (Streifeneder, 2018).

Mid Stance

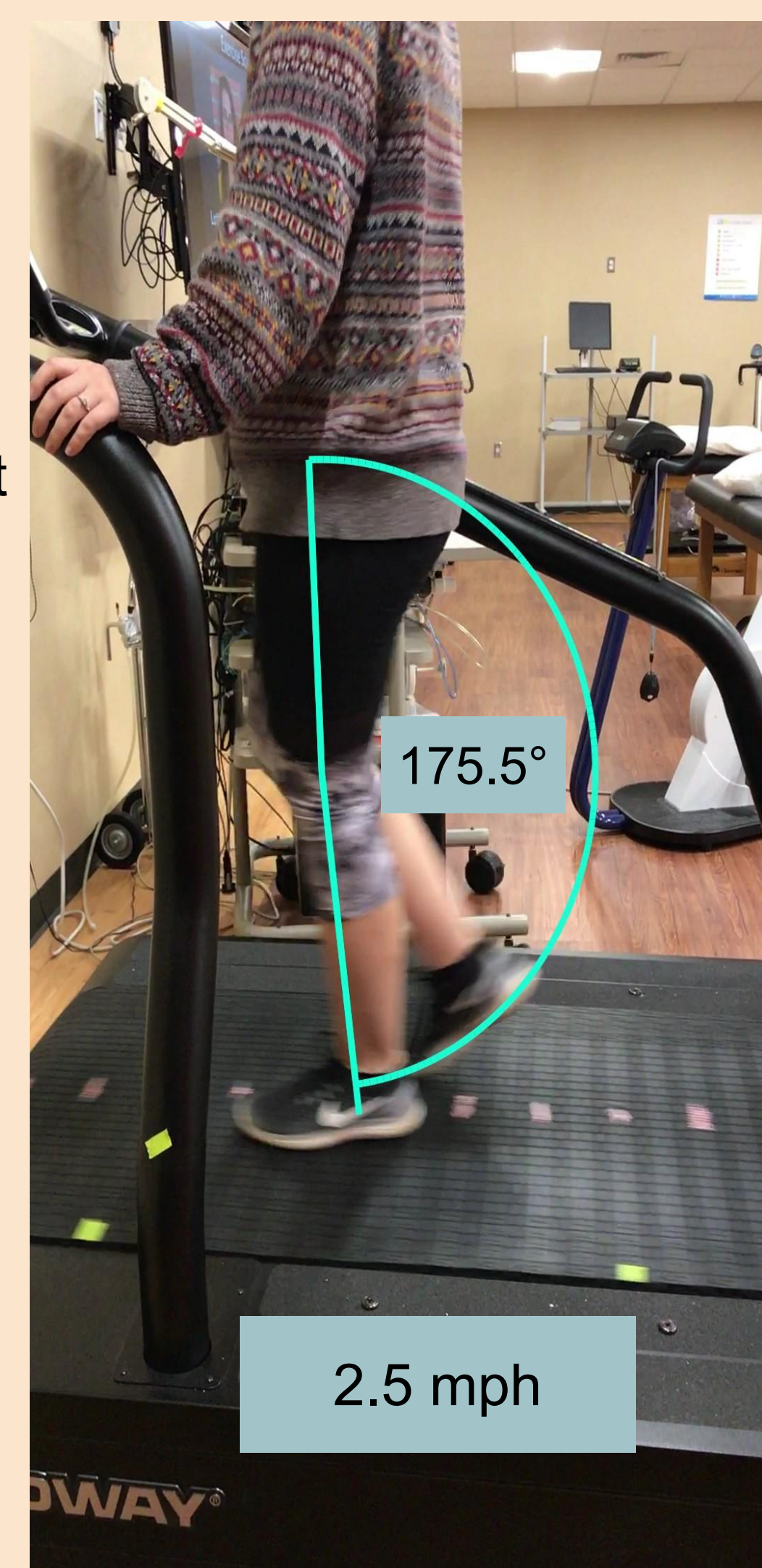


Figure 2 Mid Stance

The subject's knee angle during the mid-stance position was 4.5°. As limb support is initiated, knee flexion may increase slightly and may reach 18°. The subject's knee angle change only slightly increased. This may be due to the subject having a strong gastrocnemius and soleus, which are both vital muscles during the mid-stance stage (Brunner & Rutz, 2013). The major objective during this stage is for the

body to advance on leg in front of another while remaining stable (Perry, 2002). The major muscles that are activated during this stance are the gastrocnemius and the soleus (Streifeneder, 2018).

Terminal Stance

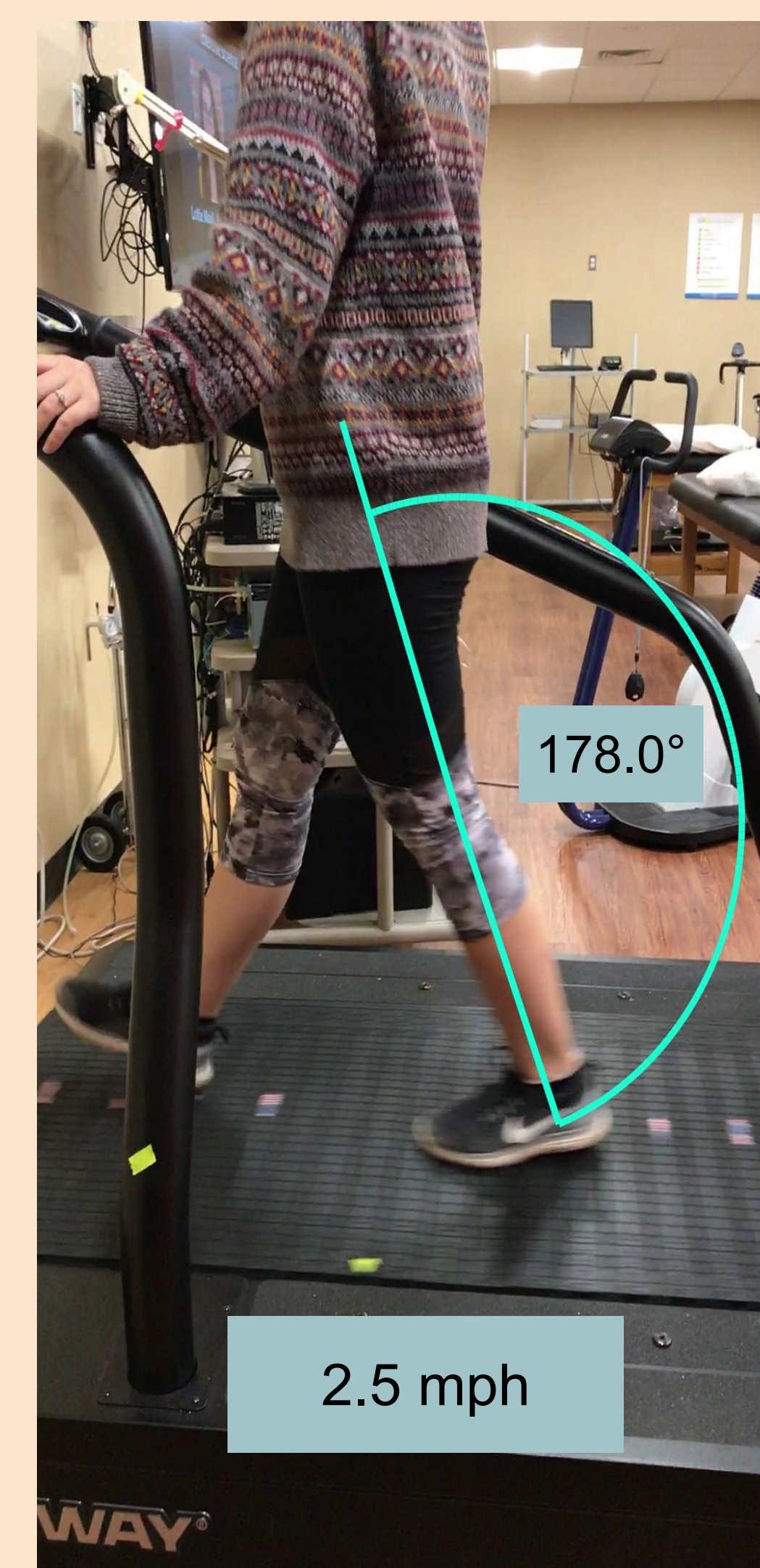


Figure 3 Terminal Stance

According to Perry (2002), maximum knee flexion during terminal stance will vary from 0° to 5°. The subject had a change of 2°, which falls within the range indicating a normal gait. During this the tibia is stabilized on the foot, so the body weight is shifted forward in the sagittal plane. The ankle and foot are important during this stage in relation to making sure the body's center of gravity is shifted forward. The major muscles

involved in this stage are: soleus, gastrocnemius, flexor digitorum longus, flexor hallucis longus, tibialis posterior, peroneus longus, and peroneus brevis (Streifeneder, 2018).

Pre Swing



Figure 4 Pre Swing

According to Perry (2002), during pre swing, the knee should rapidly flex to approximately 40°. The subject had a knee angle change of 32.7°. Since this is within 8° of a normative value, this may be considered a discrepancy between the normative data and the gathered data in this analysis. Potential variables that may contribute to this discrepancy

include the snapshot being slightly off of the actual pre swing or the client's knee is not as flexible as the normative data. The major muscles involved in this stage are: gastrocnemius, soleus, rectus femoris, and adductor longus (Streifeneder, 2018).

Mid Swing



Figure 6 Mid Swing

During the mid swing stage of the gait analysis, knee flexion should be around 30° (Perry, 2002). The knee at this point can extend without much effort due to the relaxation of the flexor muscles (Perry, 2002). The client's knee flexion during the mid swing was 51.7°. This was about 20° larger than what it should have been, indicating that the knee either did not sufficiently flex because of a

muscular discrepancy or an incorrect snapshot during the video. The major muscles involved during this stage are: semimembranosus, semitendinosus, biceps femoris, and tibialis anterior (Streifeneder, 2018).

Terminal Swing



Figure 7 Terminal Swing

The major objective during terminal stance, the final stage of the walking gait, is for the knee to fully extend in the sagittal plane and experience an angle change of 0° to 5° (Perry, 2002). During this stage, the quadricep is providing the force to extend the knee while the hamstring ensures the knee does not overextend (Perry, 2002). The client in this analysis had a

of 1.6° which is precisely accurate compared to the normative data. The major muscles involved in this stage are: quadriceps femoris, semitendinosus, semimembranosus, biceps femoris, and tibialis anterior (Streifeneder, 2018).

Common Discrepancies

The phases of the gait cycle that included discrepancies are the load response, pre swing and mid swing. Inadequate angles change of the knee can be caused by weakness of the quadriceps. Knee stability may be inhibited if the hamstrings and single joint hip extensors insufficiently exchange their intensities, which may lead to discrepancies of knee angle changes (Perry, 2010). Additionally, lateral stability may be hindered if the hip abductors are not adequately activated. Single-leg limb support may be limited if the soleus and gastrocnemius do not increase their intensity as the walking gait progresses.

Neurological disorders may cause discrepancies in the walking gait. The signs of an unsteady gait may appear as weakness of one leg or both legs. Knee buckling, small slow steps, a swaying gait, a hyperkinetic gait, and a crouching gait are a few examples of an disordered gait (Lamoth, Deudekom, Campen, Appels, Vries, & Pijnappels, 2011). Physiotherapy may be beneficial in assisting these disorders.

Conclusion

During most stages of the gait cycle, the subject exhibited normal knee angle changes. However, during a few of the stages the subject's knee angle changes do not match the norms. The subject has no known musculoskeletal issues or balance problems, but the analysis shows that there might be a slight musculoskeletal or balance issue. The client should focus on strengthening the leg muscles and complete balance improving exercises.

References

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