



DARTFISH VIDEO GAIT ANALYSIS

Purpose of this Guide

This guide will provide brief explanations of gait analysis along with instructions regarding how you can use Dartfish analyzer tools to properly assess the gait of a client.

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INTRODUCTION

Many thanks to Paul Langer, DPM, <http://paullangerdpm.com>, Author: Great Feet for Life: Footcare & Footwear for Healthy Aging, for compiling the evidence-based theory to gait analysis.

This article is written as a superficial overview of video gait analysis. An understanding of the theory and practice of clinical gait analysis is required in order to truly become proficient at gait analysis. The resources listed at the end of this article are important reading for anyone who may be considering incorporating video gait analysis into their athletic or clinical assessment.

Video Gait analysis has been increasingly used to evaluate a subject's movement patterns in order to assist in diagnosing pathologies, improving sports performance and/or monitoring therapeutic interventions such as gait retraining or footwear changes.

The tools incorporated into Dartfish high speed video analysis software allow observers to slow down, magnify, and manipulate the video image in order to do such things as calculate joint angles and obtain other measurements. A recent study showed that the reliability of gait parameter data was higher with Dartfish® software than with standard video software that lacked these tools (25).

A professional level gait analysis involves much more than watching a video of gait. A detailed clinical exam would also include muscle strength and balance testing, static and dynamic range-of-motion measurements, footwear evaluation, detailed injury and medical history and a review of the athlete's training program. This would usually be done prior to the video gait analysis.



THE GAIT CYCLE

- **The gait cycle** begins when the foot contacts the ground and ends when the same foot contacts the ground on the next step. The two major components of the gait cycle are the stance phase and the swing phase. These cycles may be further broken down into key points such as initial contact, mid-stance, toe-off for each side.
- **The stance phase of gait** refers to the point in the gait cycle where the foot is in contact with the ground. In normal walking, stance begins at the heel and transitions to the toe and lasts approximately one second. A walker lands with 1-1.5x bodyweight.
- **The swing phase of gait** occurs after the foot leaves the ground until the next foot contact occurs. The leg is swinging forward and preparing for the next foot strike. Abnormalities or asymmetries in swing phase may indicate a problem during contact that is being compensated for while the leg is in the air.
- **Walking vs. Running:** In walking gait there are periods when both feet are in contact with the ground simultaneously and at least one foot is always in contact with the ground at any given time. In running gait only one foot contacts the ground at a time and there are periods where neither foot is in contact with the ground.
- **Running gait is more variable.** Eighty percent of runners land on their heel when in shoes, and the remaining twenty percent of runners land either on their mid or forefoot. The foot is in contact with the ground for one tenth to five tenths of a second while the runner is landing with 2.4-3.0 times their bodyweight. Overuse injuries to the lower extremity are typically caused during the stance phase of gait.
- **Barefoot running vs. running in shoes:** It has been well documented that humans move differently when barefoot, so comparing barefoot running gait to gait in shoes is like comparing apples to oranges. Walking barefoot provides a baseline assessment of a subject's weight bearing functional movement pattern and is an important part of any analysis. Anyone will quickly see that it is much more difficult to confidently assess the alignment of the foot once it is covered by a shoe – even with high speed and stop-motion video. (20)



GAIT ANALYSIS PROTOCOL

Most gait labs and clinics have their own specific criteria and protocols for video gait analysis. The protocol described here is just one example of how it may be done to obtain a relatively quick biomechanical profile and functional assessment. The specific protocol used is determined by the expertise of the observer(s), the lab and/or setting of the study and by the goals of the analysis whether they are improving sports performance, evaluating an injury or assessing therapeutic interventions.

Warm up/adaptation to treadmill: The video gait exam does not start immediately. Subjects need to acclimate to the walking/running surface, either a track or a treadmill, by allowing at minimum of 4-5 minutes of warm-up in order to acclimate to the running surface and environment. It is important to remember that humans move differently on treadmills as well as when they know they are being observed. (32)

Walking and running speed: In most settings the test subject should select the walking/running speed based on their comfort. It is known that humans are pre-programmed to move in the most metabolically efficient manner for the given conditions so forcing a subject to run at a speed or cadence that does not feel natural or comfortable to them will affect the validity of any observations made (33, 34, 35). The patient's movement patterns will change with alterations in the speed of the treadmill. For example, running stride lengthens, knee flexion at contact and foot contact time decrease when speed is increased. If on a treadmill, the speed of each individual's video session should be recorded so that follow-up evaluations on that subject will most closely duplicate the conditions of previous studies.

Clothing: Compression shorts and sleeveless tops are ideal in order to visualize the best detail. Loose clothing obscures movement and makes it more difficult to place markers on anatomic landmarks. Again, assessing the movement of the foot inside the shoe is also very difficult which is why initial assessment of foot motion should be done barefoot.

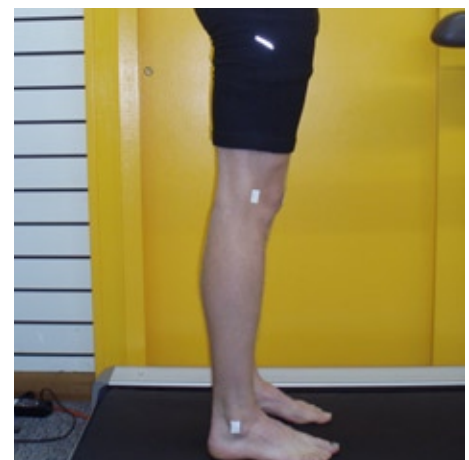
Skin markers: Observation can be done either with or without markers but measuring functional joint angles are best done with markers. Reflective or standard athletic tape may be used for skin markers. It is important to keep in mind that it takes experience and knowledge of anatomy to place markers properly. Improperly placed markers will dramatically reduce reliability of observations. A known limitation of skin markers is that the skin is freely moveable over the joint so it should not be assumed that the skin marker is a 100% accurate depiction of joint movement. The Pro software uses clear contrast to accomplish tracking; therefore, choose a tape that visibly contrasts with the subject.



Anterior Hip & Knee: Place over boney landmarks of anterior superior iliac spine (hip) and at bisection of patella (knee).



Heel & tibia bisection: Place over vertical bisection of posterior heel and lower leg.

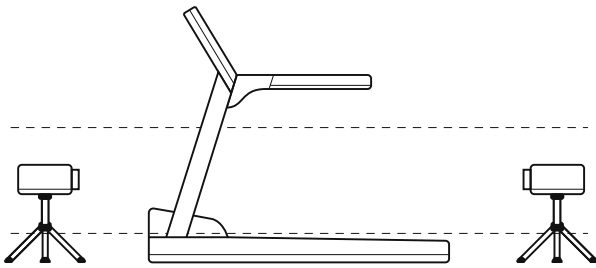


Lateral knee and ankle markers: Place at lateral joint line of knee and apex of fibular malleolus.

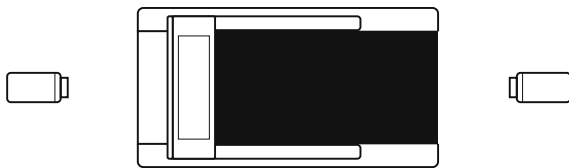


VIDEO CAMERA PLACEMENT

In addition to understanding basic gait protocol, you must also have basic knowledge about how to properly set-up the filming area. Views from the front, back and side should be obtained in order to assess at least two dimensions. The view from behind is most useful for assessing rear foot motion, hip obliquity, shoulder and arm motion. The front view is most useful for knee adduction, in-toeing/out-toeing, shoulder height and arm symmetry. The lateral view allows for visualization and measurement of hip, knee and ankle flexion and extension. The camera should be placed sufficiently close to the subject to capture the area of interest. A wide angle lens can be helpful in some settings. Some examiners may capture a head-to-toe video during baseline walking; then focus on the legs only for example, during running gait. It is important that the camera is equal in height and level with the area being observed and the lens is 90 degrees to the subject if one wishes to make accurate angle measurements of joints using Dartfish® tools. Dartfish distance tools require a point of reference in the same plain as the athlete to calibrate measurement. Mark the treadmill side and back with a tape of a meter, for example. Many tripods have built-in levels to assist in this. A carpenter's level should be used to ensure that the deck of the treadmill is level both from front to back and side to side. The floor and treadmill can be marked with tape to make repeatability easy and quicker when moving the camera and lining up the subject. Use the shutter speed and focus features of the camera to optimize subject clarity and avoid blurring of the movement. Lighting should be direct on the subject and avoid backlighting which may darken the camera aperture intake.



Camera placement sideview



Camera placement from top



SOFTWARE SET-UP AND CAPTURE

The **ProSuite** version of the software allows two-camera synchronized capture from a live video feed. This allows remote control capture of two video clips simultaneously. Both the Pro and the basic Connect version import video from a variety of sources for post-capture analysis. If you have only one camera or the Connect version, you can easily capture video from different views. Capture video from the first view, and then move the camera to another side.

See the Appendix 1. A full User Guide is built into the software under the **Help**.



OBSERVATIONS

A typical gait analysis protocol starts with a general assessment and becomes more focused. Initial assessment looks for symmetry and smoothness of movement while observing the subject from head to toes. Observations should be made from the front, back and side with the subject on a runway or on a treadmill with zero incline. The patient should warm-up and then self-select the walking or running speed.

GENERAL OBSERVATIONS

- alignment of head
- shoulder height/symmetry
- symmetry of arm swing
- asymmetry of internal/external rotation of legs
- angle and base of gait
(the angle of the feet in relation to the lower leg when observed from behind and how far apart the feet land when hitting the ground)
- stride length
- asymmetry of Weight Shifting at the Hips
- movement of the trunk and rise of the body are assessed and measured (1, 10, 11).

Note

Although measuring speed, cadence and stride length is easily done, many researchers question the value of these measurements since there is such a broad range of normal. For example, intrinsic factors such as subject height, sex, and extrinsic factors such as length of runway, treadmill or even room size affect these gait parameters. (9,13, 14)

ORDER OF ASSESSMENT

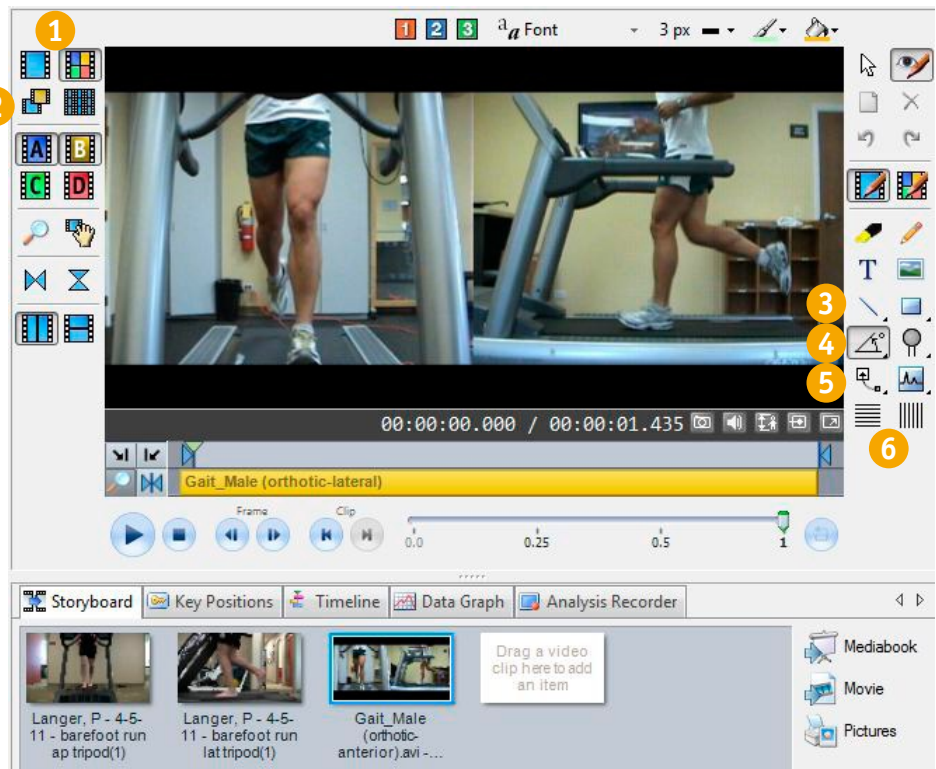
- Walking barefoot
- Running in subject's footwear which may also include insoles or orthotics



ANALYZER MODE

In order to accurately assess arm swing, trunk movement, foot strike, etc., you must use a measurement tool. The Dartfish Analyzer Mode tool will allow you to view the video frame-by-frame and take measurements of such movements. The Analyzer can compare up to four videos at a time, blend, annotate and mark important moments within videos. See Help>Analyzing Performance. A variety of analysis tools are available. Appendix 1.

- 1 Single or Split Screen view
- 2 Blend mode
- 3 Lines
- 4 Measurement tools
(mouse right-click to expose)
Timer, distance, angle, reverse angle
- 5 Magnify Clone tool
- 6 Horizontal and vertical lines





KEY KINEMATIC ANGLES TO OBSERVE

Key kinematic angles and events as described by Kirtley in his text, *Clinical Gait Analysis Theory & Practice* (10) are as follows below. These are not, of course, the only key events that should be considered but they do include the most important elements of gait analysis. The ranges of what are considered normal range of motion are variable and are best considered as benchmark figures as there is not universal agreement on what actually constitutes normal in terms of many parameters of human movement.

- **ANKLE DORSI-FLEXION AT CONTACT** (Figures 1 & 1a)
- **MAXIMUM REAR FOOT EVERSION** (Figures 2, 2a & 2b)
- **KNEE FLEXION AT CONTACT** (Figure 3)
- **KNEE ADDUCTION IN LATE STANCE** (Figure 4)
- **ANKLE PLANTAR-FLEXION DURING PUSH-OFF** (Figure 5)



ANKLE DORSI-FLEXION AT CONTACT

Select the frame just as the foot contacts the ground. The angle is drawn with the apex at the bottom heel surface of the foot and one arm through the ankle joint to the mid-shaft of the leg (tibia) (28). Additional key positions from the side can include: Initial Contact, Stance (mid-stance), and Toe-off (pre-swing).

Normal: 10 degrees dorsi-flexion -10 degrees plantar-flexion. Heel strikers will be dorsiflexed but mid and forefoot strikers will be plantarflexed.

Significance: A tight Achilles tendon or calf muscles may limit ankle motion and can predispose an athlete to Achilles tendonitis or other injuries.

Figure 1: Ankle dorsi-flexion at contact is 6 degrees in this heel striking runner (90-84=6)

(See Resource 29)

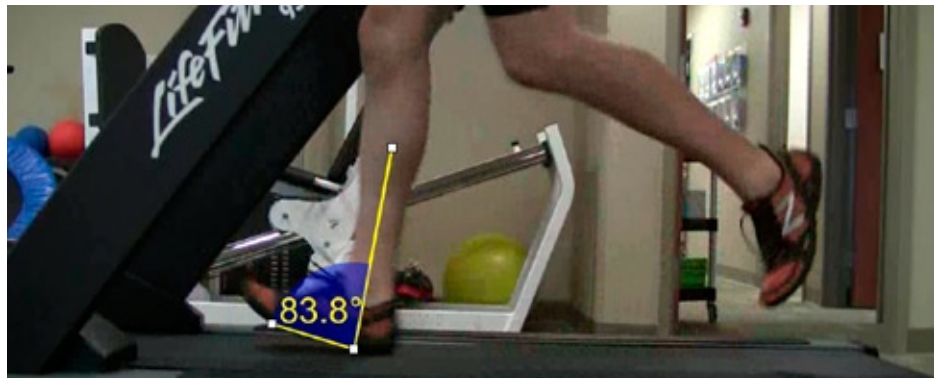
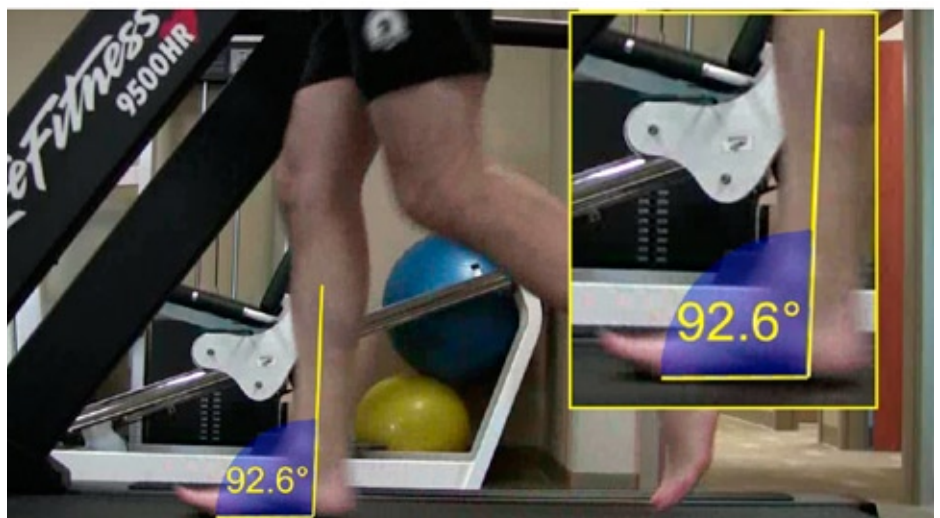


Figure 1a: Ankle less dorsi-flexed in this barefoot runner which is typical without shoes due to the more mid-foot landing pattern

(See Resource 29)





MAXIMUM REAR FOOT EVERSION

Select the frame from the video at the point just before the heel starts to lift off the ground. The angle is drawn with the apex at the level of the ankle, with one arm along the center of the lower legs, and the other along the center of the heel. This is much easier to observe when the patient is barefoot. Additional key positions from rear include: Maximum rear foot eversion and prolonged rear foot eversion of both R and L.

Normal: The rear foot should be vertical as the heel starts to lift in late stance phase of gait.

Significance: When the rear foot everts too much and/or too long this is known as over-pronation and has been linked to overuse injuries such as Achilles tendonitis, patellofemoral pain, iliotibial band syndrome and plantar fasciitis. The duration of pronation is important to note, even more so than the amount of pronation, because prolonged pronation is far more problematic.

Figure 2: Runner demonstrating excessive rear foot eversion (over-pronation) in late contact phase of gait. The rear foot should be at or close to 180 degrees (vertical) at this point in the gait cycle.



Figure 2a: Same runner as figure 2 barefoot. Over-Pronation is relatively common and has been implicated in some overuse injuries. Stability running shoes, insoles and/or orthotics may be used to address over-pronation.



Figure 2b: Rear foot angle as measured in relation to horizontal plane of treadmill in a runner who pronates excessively in the late stance phase of gait (it is important to make sure treadmill is level before making this measurement). Again, rear foot should be close to vertical at this point in the gait cycle.





KNEE FLEXION AT CONTACT

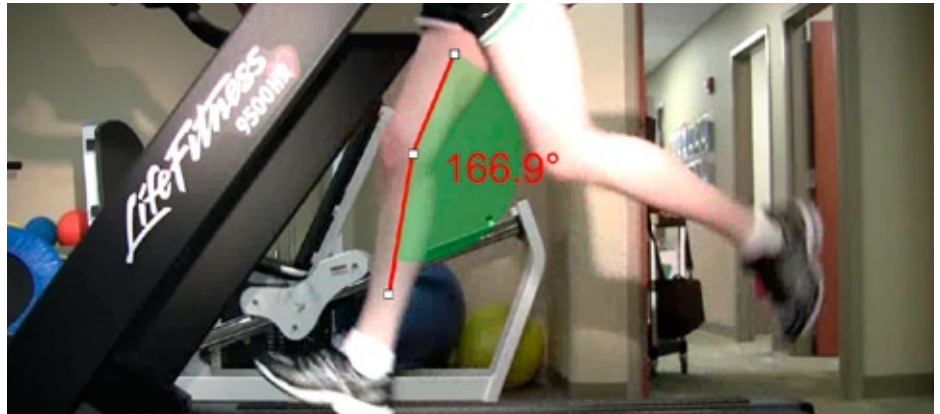
Below is knee flexion at contact. Select the frame just as heel contacts the ground. Apex of angle is placed at level of knee joint with arms bisecting the thigh and the lower leg respectively. Other key positions may include mid-stance and toe-off.

Normal: Peak knee flexion is approximately 15-40 degrees.

Significance: Impact loads to the knee are increased with a straighter (less flexed) knee at initial contact. Faster running speed and longer strides result in decreased knee flexion at initial contact.

Figure 3: Runner demonstrating normal knee extension at initial contact.

For an athlete who is recovering from a knee injury, we may recommend shortening the stride 10% to reduce the load to the knee at contact.



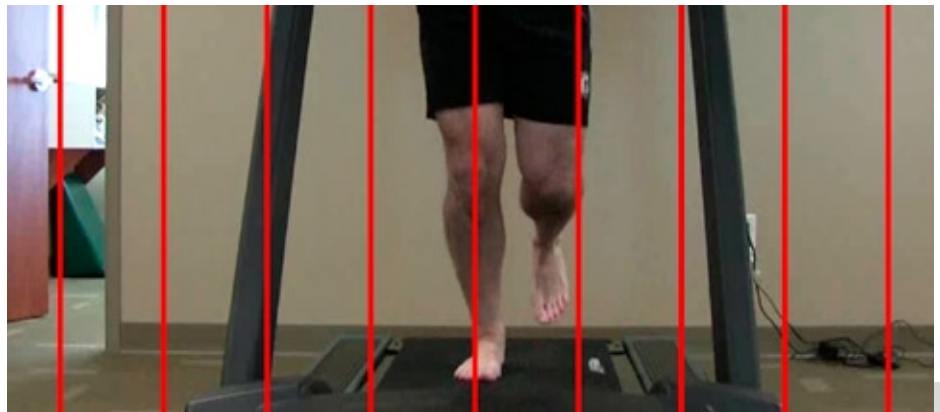
KNEE ADDUCTION IN LATE STANCE

Using the vertical line tool, drag a line to the midline of the knee after selecting the frame of video where the knee is at its lowest point (maximum knee flexion). Additional key points include R and L heel-strike, mid-stance and toe off.

Normal: As the knee flexes during the stance phase of gait, the patella should line up with the 2nd toe.

Significance: Deviations away from the second toe place strain on the knee and can be the result of an over-pronated foot, over-supinated foot and/or weakness of the core muscles. Patellofemoral pain, iliotibial band syndrome and Achilles tendonitis are often related to abnormal knee adduction.

Figure 4: Runner demonstrating normal knee adduction right leg in late stance phase of gait. Note that the vertical line through the patella (knee cap) is in line with 2nd digit of the foot.





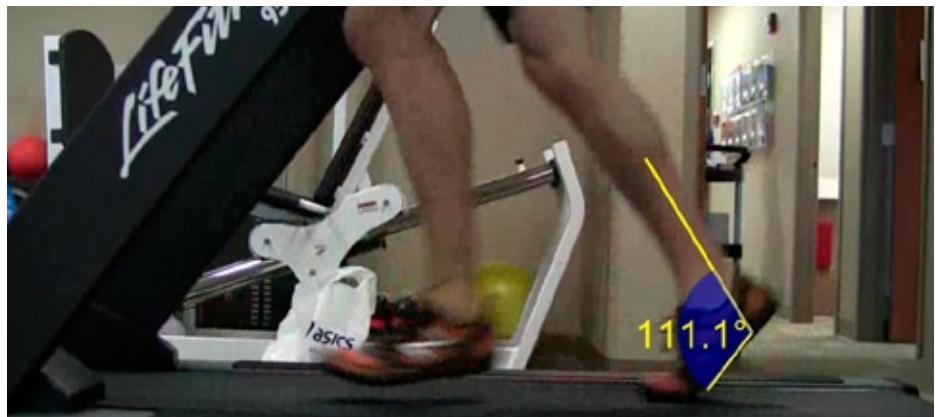
ANKLE PLANTAR-FLEXION DURING PUSH-OFF

Select the frame from the video when the toe is about to leave the ground, and then measure the angle by placing apex at the bottom and back of the ankle. Finally, place the arms through the center of the leg.

Normal Range: approximately 20-30 degrees

Significance: Restricted ankle motion, restricted great toe motion or weakness of the calf muscles can cause compensations that result in Achilles tendonitis, plantar fasciitis and may even affect the knee, hip or low back.

Figure 5: Ankle plantar-flexion at toe-off would be calculated as 21 degrees ($111-90=21$). This is within normal range.



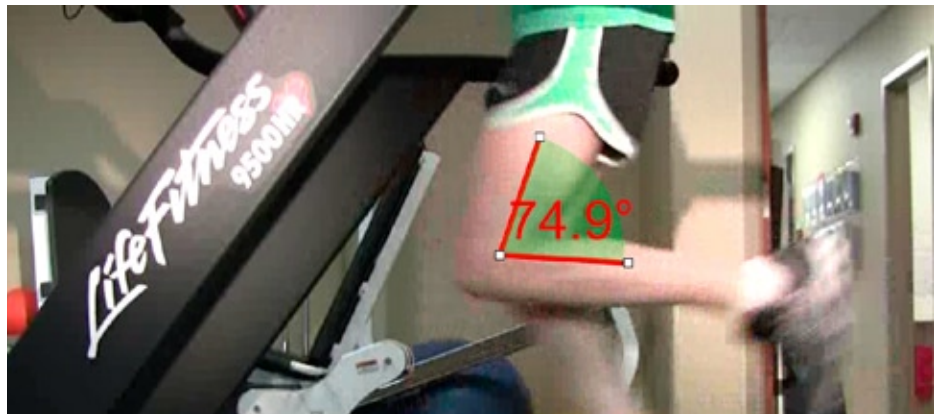
KNEE FLEXION IN SWING PHASE

Select the frame from the video in which the knee is at the peak of flexion in the swing phase. Place the apex at the level of the knee and arms, along bisections of the thigh and low leg.

Normal Range: 5 – 130 degrees

Significance: Restricted knee range of motion can indicate imbalances between hamstrings and quadriceps which may contribute to knee, hip or thigh injuries.

Figure 6: Restricted or asymmetric knee flexion may indicate a muscle imbalance or restricted ankle, knee or hip range of motion.





HIP MOTION – PELVIC OBLIQUITY

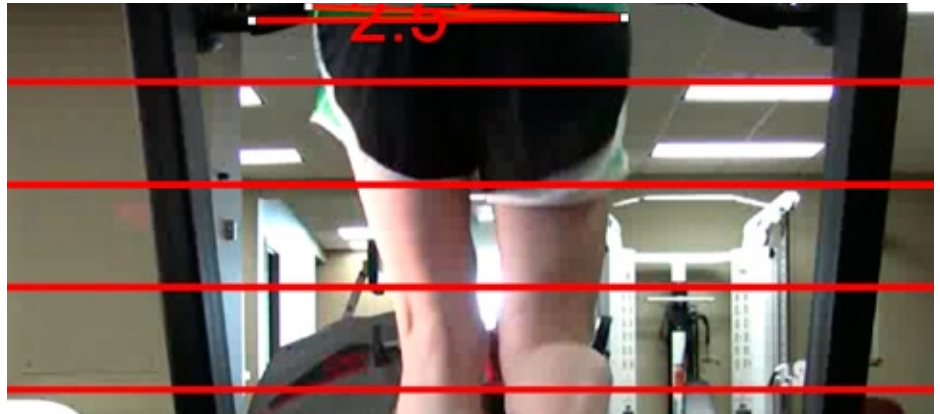
Use a horizontal line grid and/or place markers over the posterior superior iliac spine, and then measure the angle between a horizontal line grid and horizontal bisection of the markers.

Normal walking gait: the pelvis drops 4-5 degrees from the stance leg to the swing leg (1).

Significance: Asymmetry may indicate limb length inequality, dysfunction of the spine and/or hip joints, muscle imbalances such as weakness of gluteus medias.

Figure 7: Pelvic obliquity in mid-stance at 2.5 degrees is within normal range

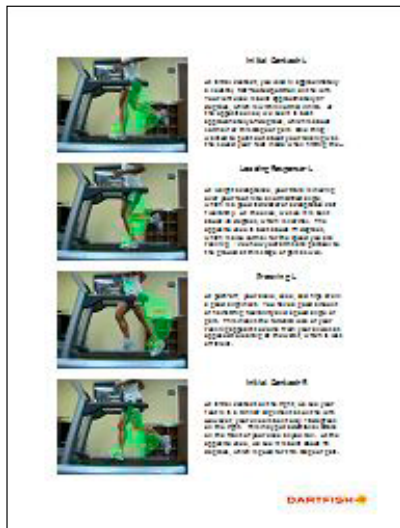
This point may be easier to find by using a long piece of tape placed at the greater trochanter (boney bump on side of the hip).



KEY POSITIONS

The Key Position feature allows key points of observation to be saved within the video as an embedded picture at that moment with drawings and written comments. These observations may be printed or published in an interactive video with key positions. These key positions may be used as a Template that can be easily imported for standard assessment protocol. See Appendix 1 for Quick Guide.

There is still no single universally agreed-upon model of normal human gait. However, to aid in developing your observational expertise, sample Mediabooks with printable Key Positions are featured on the on www.dartfish.tv/PT channel.



Note

Gait analysis is not black and white – it is still very much part art and part science. The science is becoming better and better especially with the availability of such tools as Dartfish®.

- Paul Langer, DPM



RESOURCES

1. DeLisa, JA (ed) *Gait Analysis in the Science of Rehabilitation*, Department of Veterans Affairs Scientific and Technical Publications, Baltimore, MD 1998
2. Lehmann, JF, et al, *Biomechanics of Normal Gait*, *Phys Med Rehab Clin North Am*, 3:125-38, 1992
3. Krebs DE, Edelstein JE, Fishman S. Reliability of observational kinematic gait analysis. *Phys Ther* 1985;65(7):1027-33.
4. McGinley JL, Goldie PA, Greenwood KM, Olney SJ. Accuracy and reliability of observational gait analysis data: judgments of push-off in gait after stroke. *Phys Ther* 2003;83(2):146-60.
5. Koman LA, Mooney 3rd JF, Smith BP, Goodman A, Mulvaney T. Management of spasticity in cerebral palsy with botulinum-A toxin: report of a preliminary, randomized, double-blind trial. *J Pediatr Orthop* 1994;14(3):299-303.
6. Williams, G Et al. Observational gait analysis in traumatic brain injury: Accuracy of clinical judgment, *Gait & Posture*, 2009 (9):454-459.
7. Lord SE, Halligan PW, Wade DT. Visual gait analysis: the development of a clinical assessment and scale. *Clin Rehabil* 1998;12:107-119.
8. Tenore N, Fortugno F, Viola F, et al: Gait analysis as a reliable tool for rehabilitation of chronic hemiplegic patients. *Clin Exp Hypertens* 2006, 28:349-55
9. Eastlack, ME, Et al. Interrater reliability of videotaped observational gait analysis assessments, *Phys Ther*, 1991, 71(6):465-472
10. Kirtley, C, *Clinical Gait Analysis Theory & Practice*, Elsevier Churchill Livingstone, London, 2006
11. Whittle, MW, *Gait Analysis: An Introduction*, 4th edition, Butterworth Heineman Elsevier, Philadelphia, 2007
12. Huerta JP, Et al. Effect of 7-degree rear foot varus and valgus wedging on rear foot kinematics and kinetics during the stance phase of walking, *JAPMA*, 2009 99(5): 415-421
13. Oberg, T, Et al. Basic gait parameters: reference data for normal subjects 10-79 years of age, *J Rehab Research & Development*, 1993 (30):210-233
14. Murry MP, Et al, Comparison of free and fast walking patterns of normal men, *Am J Phys Med*, 1966, (45):8-24
15. Nigg BM, *Biomechanics of Sport Shoes*, Calgary, 2007
16. Saunders JB, Inman VT, Eberhart HS, The major determinants in normal and pathological gait, *JBJs*, 1953, (35A):543-558
17. Inman VT, Ralston HJ, Todd F, *Human Walking*, Williams & Wilkins, Baltimore, 1981
18. Crowell HP, Milner CE, Hamill J, Davis IS, Reducing impact loading during running with the use of real-time visual feedback, *J Ortho & Sports Phys Rehab*, 2010 40(4):206-214
19. Alexander R, A model of bipedal locomotion on compliant legs. *Phil Trans R Soc London*, 1992; 338(B): 189-98
20. Stacoff A, Et al, Tibiocalcaneal kinematics of barefoot versus shod running, *J Biomech*, 2000 (33): 1387-1395
21. Dierks TA, Et al, Lower extremity kinematics in runners with patellofemoral pain during a prolonged run, *Med & Sci in Sports & Exercise*, 2011, 43(4):693-700
22. Wrobel JA, Armstrong DG, Reliability and validity of current physical exam techniques of the foot and ankle, *JAPMA*, 2008;98(3):191-206
23. KEENAN AM, BACH TM: Video assessment of rear foot movements during walking: a reliability study. *ArchPhys Med Rehabil* 77: 651, 1996.
24. MACKAY AH, LOBB GL, WALT SE, ET AL: Reliability and validity of the Observational Gait Scale in children with spastic diplegia. *Dev Med Child Neurol* 45: 4, 2003.
25. Borel S, Et al, Video analysis software increases interrater reliability if video gait assessments in children with cerebral palsy, *Gait & Posture*, March 18, 2011; online abstract prior to publication
26. McPoil TG, Cornwall MW: *Applied Sports Biomechanics in Rehabilitation: Running*, in Zachazewski JE, MaGee DJ, Quillan Ws (eds.) *Athletic Injuries in Rehabilitation*, Philadelphia, W.B. Saunders, 1996:356
27. O'Conner FG, Hoke B, Torrence A, Video Gait Analysis, in O'Conner FG, Wilder RP, (eds.) *Textbook of Running Medicine*, New York, McGraw-Hill, 2001
28. Norkin, Cynthia C. and Levangie, Pamela K., *Joint Structure and Function: a comprehensive analysis*; F.A. Davis Company; 2nd Edition, Philadelphia, PA, 1992
29. Clarkson, Hazel M., MA, BPT and Gilwich, Gail B., M.Sc., B.Sc.O.T., *Musculoskeletal Assessment: Joint Range of Motion and Manual Muscle Strength*, Williams & Wilkins, Baltimore, MD, 1989
30. Divert C, Baur H, et al, Barefoot-shod running differences: shoe or mass effect? *International Journal of Sports Medicine*, 2008;29, 512-518
31. Squadrone R, Gallozi C, Biomechanical and physiologic comparison of barefoot and two shod conditions in experienced barefoot runners, *Journal of Sports medicine & Physical Fitness*, 2009, (49) 6-13
32. Jeng SF, Liao HF, Lai JS, Hou JW. Optimization of walking in Children, *Medicine & Science in Sports & Exercise*, 1997;29(3) 370-376
33. Alexander RM, Optimization and gaits in the locomotion of vertebrates, *Physiology Review*, 1989 (69), 1199-1225.
34. Masani, K, Kouzaki M, Fukunaga T, Variability of ground reaction forces during treadmill walking, *Journal of Applied Physiology*, 2002 (92) 1885-1890
35. Abernethy BA,*, Hanna AA, Plooy AB The attentional demands of preferred and non-preferred gait patterns, *Gait and Posture* 2002 (15) 256-265



REFERENCES

“Dartfish is the single most useful technology that I have incorporated into my sports medicine practice since I started more than 10 years ago. There isn’t a better clinical tool in terms of assisting in dynamic assessment, follow-up on treatment, facilitating patient communication and providing unique visual marketing of my practice.”

Paul Langer, DPM, Twin Cities Orthopedics, Performance Sports Lab

Adjunct Clinical Faculty, University of Minnesota Medical School

Author: Great Feet for Life: Footcare & Footwear for Healthy Aging

<http://paul langerdpm.com/2011/10/video-gait-analysis-in-the-podiatric-sports-medicine-clinic/>



“With almost five years experience rehabilitating endurance athletes, I have found that the most valuable strategy in treating runners is making them aware of their weaknesses. With Dartfish software, I am able to break down running form and educate patients on how their biomechanics are contributing to their dysfunction. This allows the patient to buy into their treatment, and never fails to aide the runner in reaching that “Aha!” moment of understanding why they are injured. From using live feedback for running retraining, to utilizing the drawing tools for analysis, Dartfish is an invaluable tool in my practice.

Erin N. Coomer PT, DPT, OCS

Co-Manager, Endurance Sports Program, AthletiCo



“Chronic problems of the lower extremity are usually overuse injuries. Overuse implies motion, so it is important that we assess how you move. This is accomplished with Dartfish software by capturing a digital video sequence of you walking and running on a treadmill. We then analyze this video on a frame-by-frame basis to identify any biomechanical movement abnormalities. This information builds on what we learned during the orthopedic exam, and allows us to begin honing in on the cause of your pain or injury.”

Dr. Brett Purdom, The Foot Mechanic

www.thefootmechanic.com/



“If the client can visualize their mechanical issues, they will better understand what the therapist is saying. Dartfish is the communication tool that passes language and medical terminology. They can see it; therefore, therapists can help them reach their goals... It is also a photographic communication tool for the physicians, all professional and insurance providers.”

Kevin Wallewein DPT, MPT, BMET, Memorial Health System

[Video Conference Presentation](#)





"As a sports medicine physical therapist, I know certain movements are associated with lower extremity injuries. We found that these same movements are also associated with decreased athletic performance, including running tolerance, vertical jump and 40 yard dash. As a clinician, I knew by capturing and analyzing movement patterns I could improve movement efficiency and effectiveness. This led me to develop the Dynamic Movement Assessment (DMA), which is a tool we use to assess weaknesses, tightness and proprioceptive issues that cause pathological movement patterns. However, the DMA was primarily subjective until combined with Dartfish video technology. Dartfish allows us to objectively quantify movement we see during our assessment and measure the impact of interventions we use to improve movement. The results are amazing. Now we can correct pathological movement patterns and greatly improve overall outcomes. Clients benefit through marked decreases in injury rates and dramatic improvement in athletic performance."

Trent Nessler, PT, DPT, MPT

Owner, Accelerated Conditioning and Learning

www.dartfish.tv/acltv

www.aclprogram.com



"Frame-by-frame, angle measurement, and side-by-side are useful tools to show our patients how their running gait is causing their injuries. It allows us to teach them proper mechanics so they may avoid injury and increase performance."

Adam St.Pierre, Exercise Physiologist and Biomechanist

Boulder Center for Sports Medicine

www.bouldersportsmedicine.org

www.bouldersportsmedicine.org/runninggaitanalysis.html



I use Dartfish for running education with students of all ages. Having tested participants with Dartfish enhanced video and EMG has helped to distinguish issues of muscle-activation timing from issues of muscle-fiber recruitment. In live training, Dartfish helps students recognize how easily they can control their own stride-frequency, hip-extension (location of foot when it strikes the ground), foot-strike pattern (heel, mid-foot & forefoot etc.), and not to mention body posture. Live Dartfish-generated video feedback has always been a "teachable moment" for adolescents, high school & college students as well as middle-age & elder athletes; Dartfish is an integral part of the Metadynamic running training program.

Todd Nunan, New Western Glory

www.nwglory.com/pages/kram.html

