Future of Gait Analysis

A Podiatric Medical Perspective

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Abstract

Despite the plethora of information on human gait analysis, its continued use as a clinical tool remains uncertain. Analysis of gait dysfunction has become integral to podiatric medical practice, and, like many specialized fields, it is rapidly changing to meet the needs of the future. Practice in the 21st century is predicated on the concept of multidisciplinary working approaches and a growing trend toward evidence-based practice, in which gait analysis could play a prominent role. This article provides a historical synopsis of instrumented gait analysis and its associated subcomponents and discusses the salient issues concerning its future role in podiatric medicine. (J Am Podiatr Med Assoc 95(2): 130–142, 2005)

Analysis of human walking has intrigued clinicians and researchers for more than a century. The bipedal method displayed by humans is regarded as a fundamental adaptation that separates us from other primates, yet it is commonly taken for granted, until something goes wrong. Waters and Mulroy describe the bipedal method as being complex, involving coordinated interactions of numerous physiologic systems for the smooth advancement of the body with the least mechanical and energy expenditures. Although the goal of walking is forward progression, limb motion is based
on the need to maintain a stable column, symmetry, and integrated synchronous movements. A variety of conceptual approaches have been established to understand normal gait and the related terminology from both orthopedic and podiatric medical perspectives. Understanding the basic principles of normal gait provides a foundation for understanding pathologic and compensatory gait deficits.

In 1898, Von Beyer introduced the concept of a "closed kinetic chain" representing the musculoskeletal system of the lower extremities. This lower kinetic chain is considered by Donatelli to comprise the lumbar spine, pelvis, hip, knee, ankle, foot, and subtalar and metatarsophalangeal joints. Oatis describes the complex, interdependent relationship of how a structure affects the motion of a body part, how its motion affects the forces applied to the structure, and, finally, how the forces in turn influence the structure. For example, the talocalcaneal joint produces three-dimensional (3-D) motion of the rearfoot that leads to intricate loading patterns (forces) on the calcaneus and talus that could predispose to structural pathology in susceptible individuals.

The foot is a complex, multiarticular structure consisting of 26 bones, 33 joints, and more than 300 soft-tissue structures. It is regarded as the terminal structure in the kinetic chain, and it plays a pivotal role in that it essentially dissipates compressive, tensile, and shear forces while simultaneously permitting rotary motions during the stance phase of gait. A basic principle of podiatric medical biomechanics states that the foot should function as a shock absorber, a mobile adapter, and, finally, a rigid lever. Few individuals meet the musculoskeletal criteria of normalcy of the lower kinetic chain. For example, inadequacies of the foot can have a profound effect on the more proximal joints, such as the tibiofemoral and patellofemoral joints, and on the lumbar spine and sacroiliac joint complex. In contrast, intrinsic pathologies of the knee, such as anterior cruciate ligament deficiency, influence the thigh-to-foot angle and foot pronation. Familiarity with such interrelationships enables clinicians to enhance their clinical assessment and treatment outcomes.

An unprecedented wealth of knowledge and burgeoning interest in health care have led to increasing specialization in many fields, and podiatric medicine is no exception. A move toward multidisciplinary approaches to health care has evolved during the past few decades, with teams often led by a consultant physician or surgeon and comprising a combination of highly skilled health professionals. Podiatric physicians concern themselves with a multitude of systemic disorders that manifest in the lower extremities as well as with conditions characteristic of the foot and ankle. For example, the podiatric physician is often a prominent member of the diabetic or rheumatoid team because plantar pressure measurement is often used for certain assessment strategies. From a professional
perspective, inherent in the concept of such a team is the assumption that each member has a clear understanding of the role of all other members. Interestingly, McGee and Ashford\textsuperscript{14} reported that 50\% of nurses were not aware that podiatrists undertook gait analysis. There is no doubt that multidisciplinary teams are a fundamental aspect of a variety of patient groups, which continues to increase the quality of care for the patient\textsuperscript{15} and, therefore, should be encouraged.

During the early 1970s, Archie Cochrane popularized the concept of evidence-based practice, which is defined as the "conscientious, explicit and judicious use of current best evidence in making decisions about the care of patients."\textsuperscript{16} Arguably, such a precept of decision making is modifying many healthcare policies. In the United Kingdom, \textit{A First Class Service: Quality in the New NHS}\textsuperscript{17} states that "evidence based practice must be in every day use," along with other factors of clinical governance and lifelong learning for all health professionals, which in turn will influence health information providers and services. In today's parlance, the phrase "evidence-based practice" has become ubiquitous, essentially challenging clinicians to discover the balance between science and clinical results. Instrumented gait analysis has been shown to be an excellent method of demonstrating change in overall treatment philosophies of disease.\textsuperscript{18–23} Despite the mystifying deluge of technical jargon of the 21st century, it is important to consider a statement by Holzreiter and Kóhle\textsuperscript{24}: ". . . gait is merely not a mechanical problem, it is a personal expression." From a distance, even the untrained eye can recognize friends and family by the way they walk. Gait analysis originated primarily through basic descriptions of the gait cycle and, arguably, used to be a guessing game. The scientific foundations of gait analysis evolved because of the inability of the human eye to measure the many interrelated components of bipedal gait. The human eye cannot perceive events that occur in less than 1/12 of a second.\textsuperscript{20} Saleh and Murdoch\textsuperscript{25} suggest that visual observation is unreliable. During their study, the observers recorded only 22\% of the predicted gait deviations. In addition, they were unable to comment on 16\% of all required observations. \textit{Gait} is defined as "a style of walking," and \textit{analysis} comes from the Greek word \textit{analytein}, meaning "separation into component parts."\textsuperscript{26} Essentially, this is what gait analysis involves: using different measurement techniques to describe individual moments and motions (kinematics, kinetics, etc) that are building blocks of normal gait. By using gait-analysis tools, for example, a clinician can objectively compare specific aspects of a patient's gait pattern in cases of presurgical and postsurgical intervention. Gait analysis is thought to reduce comparative assumptions based on previous subjective ideas.
of how patients walked before treatment intervention. However, by its very nature, gait analysis reduces the dynamic complex of human gait to a static presentation, usually graphs and tables. Such a component prevents the human eye from using its exquisite capabilities of global pattern recognition.\textsuperscript{27} In the podiatric medical setting, the computer-generated printout that accompanies selected parameters, such as peak pressures at the medial forefoot, is regarded only as a guide. The final decision concerning abnormal mechanics is left up to the podiatric physician. Perhaps our ability to observe and interpret measurements of human movement has been a primary factor limiting the growth of the field.

The integration of elegant engineering, advances in instrumentation, and imaging techniques, together with the continuous evolution of computer technology, have propelled the art and science of human movement analysis beyond basic description toward a prominent role in surgical decision making, orthosis design, rehabilitation, ergonomics, and analysis of the athletic patient. The aims of this article are to discuss the fundamentals and related foundations of gait analysis and to provide a critique of existing methods and future directions in the study of human walking, with particular reference to podiatric medicine.

**A Step Back in Time**

The tenuous beginnings of gait analysis are traceable to early historic times and involve a progressive evolution that represents an amazing panorama of discovery and invention. Its evolution is important to understanding the growth of certain methods and theoretical assumptions. The Greeks and Romans presented many questions concerning human movement.\textsuperscript{28} During the 15th and 16th centuries, Leonardo da Vinci’s interest in the accuracy of painting reinvigorated the curiosity about human movement. This inspired artists to make "graceful counterbalancing and balancing in such a way so that the figure shall not appear as a piece of wood."\textsuperscript{29} The work of Issac Newton followed in the 17th century, with his proclamation of the three laws of motion. During the 18th century, the Weber brothers, Eduard and Wilhelm, one a mathematician and the other an anatomist, conducted the first formal biomechanical investigations. Although they listed more than 150 hypotheses, the sophisticated equipment needed to perform such experiments had not yet evolved.\textsuperscript{30}

The 19th and 20th centuries were times of revolution, in which industrialization transformed the environment. Technology became more firmly based in science, and science began to depend more on new technology. Etienne Jules Marey of Paris could be considered the person who changed the study of human walking from an observational to a quantifiable
science. Marey was a prolific pioneer of instrumentation and was one of the first to use photography as a photogrammetric tool. In fact, Marey was the first person to synchronize kinematic and force measurement. In 1872, Eadweard Muybridge was hired by Leland Stanford, the governor of California, to investigate the question of "unsupported transit." Using Stanford's own horse, Occident, Muybridge developed a special high-speed multiframe still camera that took a sequence of 25 photographs. His results were astonishing, revealing that all of Occident's feet left the ground at one time. Muybridge continued his work with photographs of both humans and animals and went on to publish two classic volumes, Animals in Motion (1899) and The Human Figure in Motion (1901).

In 1891, Braune and Fischer applied the principles of Newtonian classic mechanics to human gait. Their methods of gait analysis have persisted to this day, with perhaps the only major difference being time components of data recordings. Braune and Fischer's data analysis took two nights to record just three walking cycles.

In 1945, Inman et al added further value to the field of gait analysis by initiating systematic collection of normal and amputee data. Separate contributions by Saunders et al, Rose and Gamble, Sutherland, Perry, and others have increased the understanding of human performance. Modern computer technology has supplemented a unique constellation of gait parameters in both normal and pathologic gait. Because of this progressive advancement in technology, several techniques have emerged to analyze gait; these techniques fall into four distinct areas and are discussed in the following section. It is beyond the scope of this article to give a detailed historical description of gait analysis, and the reader is referred to the publications by Cavanagh and Henley and Steindler.

Fundamental Components of Gait Analysis

Energy Consumption

One of the goals of human walking is to move the body forward in an energy-efficient manner. Selected walking velocity allows a minimum amount of energy to be used per distance traveled. Any deviation from normal walking velocities results in an increase in energy expenditure, such as demonstrated in step-page gait. Energy consumption or metabolic analysis replicates the physiologic "energy cost" of human walking. Traditional measures used are heart rate (telemetry), oxygen consumption, and the generation of total carbon dioxide (Douglas air bag). Such parameters are viewed in terms of velocity and distance walked during the collection period. Until recently, patients walked on a treadmill while data were recorded. However, recent research has found that the treadmill alters certain gait parameters, and measurements are now taken with patients free-walking at
their own selected velocity, thus encouraging a natural cadence. Despite informing the investigator of the energy disbursement relative to a patient’s gait pattern, such information fails to demonstrate why and how a disadvantage or advantage was obtained. Waters and Mulroy\textsuperscript{2} reported how a patient with a Syme amputation used less oxygen than someone with a transtibial amputation, but they failed to describe the reasons for this phenomenon. In podiatric medicine, it is thought that foot orthoses have a role in improving energy consumption.\textsuperscript{38} However, it is theorized that the improvement in biomechanical efficiency is outweighed by a negative effect of the weight of the orthoses. In general, considering such inherent limitations, other components of gait analysis must be used.

**Electromyography**

Muscles provide the power required for human walking. The creation of power necessary for human walking is a very complex task. It involves the effective use of body weight falling forward during the step. To change this, muscle action can be used to assist the body’s inherent ability to walk efficiently. Muscles act to accelerate, stabilize, and decelerate segments of the body via concentric, isometric, and eccentric activity.\textsuperscript{33} Electromyography is the study of muscle function through analysis of the electrical signals emanated during muscular contraction. One drawback of electromyography is that researchers and clinicians fail to provide enough information and detail on the protocols, recording equipment, and procedures to allow other investigators to consistently replicate their studies.\textsuperscript{39} Essentially, there are two types of electromyography: clinical (diagnostic) and kinesiologic.\textsuperscript{40} Diagnostic electromyography is predominantly conducted by a neurologist or physiologist and undertakes studies of the motor unit action potential. Each motor unit action potential has a firing rate that depends on time and force generation. The Fourier transform (frequency analysis) is used to assess motor unit action potential firing pulses. This assists, for example, in the diagnosis of neuromuscular pathologies, such as myasthenia gravis, when the action potential fails to reach its peak.\textsuperscript{41}

Kinesiologic electromyography is predominantly reported in the gait literature and studies muscular function as related to the motion of body segments. This provides the timing of the muscle activity regarding specific joint or segment motion. Additionally, many studies have attempted to examine the strength and the force production of the muscles themselves. Two main types of electrodes are used in kinesiologic electromyography: surface and fine wire. A distinct advantage of surface electrodes is that their application produces no pain or discomfort. In addition, they are easy to affix, are reproducible, and function well with movement applications. However, surface electrodes have a large pickup
area, increasing the chances of "cross talk" from adjacent muscles. In addition, only superficial muscles can be assessed using surface electrodes. Fine-wire electromyography requires a needle to be inserted into the belly of the muscle, thus causing potential pain for the subject. The advantage of this method is a more specific pickup area, with isolation of specific superficial muscles. Also, deep, small muscles can be accurately assessed. Despite these advantages, the pain associated with insertion of the fine wires can increase the spasticity of the muscle, resulting in cramping in some cases. The repeatability of insertion of the fine wire is questionable because it is difficult to insert the needle into precisely the same location each time. Electromyographic data are also notoriously difficult to interpret; in addition, identifying correct locations with minimum magnetic effects poses a predicament. In general, the correct locations of the electrodes are achieved by applying the electrodes to the largest mass (muscle belly) of the muscle, and they are usually aligned in accordance with the muscle fibers. To ensure reliability of this process, suitable bony landmarks are identified to ensure repeatability of the electrode placement. Furthermore, the use of a motor point finder facilitates accurate and correct placement.

Despite such problems, electromyography could be a useful tool of assessment for many podiatric medical interventions, although its use in podiatric medicine is not widespread. However, Tomaro and Burdett used surface electromyography to assess changes in muscle activity of the tibialis anterior, peroneus longus, and gastrocnemius muscles with and without foot orthotic intervention. Significant differences were noted in the duration of tibialis anterior muscle activity at heel strike in the orthotic device group, but no significant changes were identified with the other muscles.

**Kinematics**

Kinematics measures the geometry of motion without considering the forces that cause the motion and can be two-dimensional (2-D) or 3-D (eg, Vicon Motion Analysis System [Oxford Metrics Ltd, Oxford, England], Elite Motion Analyser [Bioengineering Technology and Systems, Milan, Italy], GAITRite [CIR Systems, Clifton, New Jersey], OrthoTrak Motion Analysis System [Motion Analysis Corp, Santa Rosa, California], MacReflex Motion Analysis System [Qualisys AB, Partille, Sweden], and Peak Performance Motion Analysis System [Peak Performance Technologies Inc, Englewood, Colorado]). Most systems convert 2-D data from several cameras into 3-D data to facilitate measurement of human gait when there is out-of-plane motion. Both 2-D and 3-D systems use reflective external markers; the 3-D system, however, requires technologically advanced equipment coupled
with powerful low- and high-frequency cameras and compatible software for data analysis and presentation. Such systems, unfortunately, have come under question because they have not proven to be cost-effective. In addition, the type of analysis depends on the expertise of the user and the physical accommodations. A space of 130 cm² is required to accommodate the cameras in a format to produce 3-D analysis. Additionally, recordings, on average, take up to 1 hour per subject. In contrast, 2-D analysis is attractive to the clinician and researcher because fewer markers and cameras are required for data acquisition and, as a result, the processing is quicker and cheaper. However, of fundamental importance is that motion is planar. For example, the knee of a healthy individual moves in the sagittal plane—flexion and extension. In the presence of femoral or tibial torsion, distortion of the data will appear because the joint plane is not parallel to the observing plane; this is commonly known as kinematic cross talk. Davis et al provide evidence of such a conceptual barrier by investigating the differences between 2-D and 3-D analysis using nonpathologic subjects. Joint angles for the hip and knee were consistent across both methods, but this is probably because such joints demonstrate the smallest out-of-plane motion. The ankle, however, displayed the greatest sensitivity across the two methods owing to the ankle joint being externally oriented out of the sagittal plane by approximately 7° to 10°. It is important to remember, however, that human walking is a 3-D event. The published literature should perhaps be considered with caution because many conclusions were based on the use of 2-D analysis.

Despite the apparent informative component that kinematic analysis provides, many authors have highlighted the inaccuracy associated with skin-mounted markers. Using the Selspot 1 kinematic system (Selcom AB, Partille, Sweden), Fuller et al evaluated the validity of skin-mounted markers compared with skeletal pins and noted that the markers moved by up to 20 mm when measuring underlying bone motion. Such errors should be considered when analyzing data, and they highlight the need for future studies that minimize errors associated with movement of skin-mounted markers.

**Kinetics**

Kinetics is the study of forces that are responsible for motion of the body. Unlike kinematics, the kinetics of motion cannot be observed and requires certain types of instrumentation or calculated formats from kinematic data. Kinetic parameters generally
measured include reaction forces between the foot and ground, joint torques, energy, and power. During human walking, ground reaction force changes in direction and magnitude as a result of the body’s motion. A force platform is required for determining kinetics because it measures ground reaction forces and moments occurring between the foot-ground interface. A variety of transducers, including strain gauges and piezoelectric transducers, have been used to record such parameters (eg, AMTI, Advanced Medical Technology Inc, Watertown, Massachusetts; Bertec, Bertec Corp, Columbus, Ohio; Kistler, Kistler Instruments Ltd, Hants, England). In comparison, pressure platforms such as the Musgrave (W.M. Automation, Antrim, Northern Ireland) and EMED (Novel Electronics Inc, Minneapolis, Minnesota) systems, which use force-sensing resistors and transducer technology, provide more information on area as well as vertical force. Another approach to measuring dynamic loading of the foot is in-shoe pressure systems (Pedar, Novel Electronics GmbH, Munich, Germany; F-Scan, Tekscan, South Boston, Massachusetts; Parotec, Paromed Medizintechnik GmbH, Munich). In-shoe systems eliminate the need for subject "targeting," which has proven to be problematic with pressure and force plate systems. In addition, data can be collected outside of the gait laboratory. Although extremely useful, these systems detect vertical load and cannot record shear forces during walking. Despite such advantages, the physical presence of the insole can prove to be problematic in a variety of ways, thus contravening Kelvin’s law, which states that the act of measurement or observation should not affect the quantity being measured or the behavior being observed. In addition, Hennig et al comment that trailing cables from data loggers or simply the thickness of the insole could alter the subject’s gait pattern. However, with improvements in technology, the size and weight of the data loggers and the use of memory cards have reduced the chance of affecting the subject’s gait pattern. The real advantage of an in-shoe pressure measurement system is to be able to see changes in gait patterns when custom foot orthoses are used in patient care. The use of this technology is in its infancy, but early evidence of its effectiveness has been published. One of the interesting principles of pressure analysis involves the concept of weight transfer through the foot to the supporting surface. In-shoe sensor systems essentially measure the percentage of the vertical component of force at any given time in the step. This takes into account that when the force applied is directly vertical to the area being measured, the load is greatest. Leading to peak load and then away from it would denote motion toward versus motion away from vertical. For example, the calcaneus reaches peak load by approximately 12% to 15% of the gait cycle. It then demonstrates a progressive
decrease in load until heel-off becomes visible. The peak load coordinates with the point in time when the center of mass is directly over the calcaneus. As the center of mass advances during the step, the load under the calcaneus decreases as the vertical loading capacity diminishes while the orientation from absolute vertical changes. Consistent with this, when loads are constant, there is no change in motion. Should this occur during a step and under a specific weightbearing area of the foot, it would indicate that this particular segment would have momentarily stopped moving during this portion of the step. This concept has been referred to as Sagittal Plane Facilitation Theory, and it is one of the newer ideas in podiatric medical biomechanical thinking.\textsuperscript{59–64}

The Future

Previous discussion has surveyed the corridors of antiquity, revealing a fleeting glimpse of the intellectual notables whose labors and achievements have contextualized present knowledge while providing the basis for emerging principles of conceptual frameworks and treatment paradigms. The promise of the future is almost without limit, but what potential role does podiatric medicine have to play? Many challenges exist to help the science of gait analysis further evolve into an effective assessment tool. To consider the future, one must consider the fundamental conceptual and practical barriers inherent to instrumented gait analysis.

Anecdotal experience is a composite of traditional podiatric medical practice and teaching, which may not represent the average case and, therefore, may be influentially biased in clinical decision making. As previously discussed, observational gait analysis is a common method used in podiatric medical practice because of its simplicity, rapidity, and low cost, but it is equally approached with caution because of its subjective nature and associated low intrarater and interrater reliability.\textsuperscript{65,66} Conversely, instrumented gait analysis identifies the fast, simultaneous motions that occur during walking that cannot be seen with the naked eye. In doing so, it provides a better understanding of both normal and pathologic gait and demonstrates good intrarater and interrater reliability.\textsuperscript{67–70} From a clinical perspective, instrumented gait analysis can provide objective measures to assist in the planning of treatment as well as measures of the outcome of treatment used. In addition, it helps many clinicians distinguish between primary disorders and secondary coping mechanisms that are often missed during observational gait analysis.\textsuperscript{71} Such examples include the anterior cruciate ligament–deficient knee and the concept of quadriceps avoidance gait and, more recently, the identification of increased tibial translation and subsequent foot pronation.\textsuperscript{10,11} Furthermore, some surgical techniques have been
discarded because the informative component of instrumented gait analysis has replaced the "birthday syndrome" procedures with single-event, multilevel surgery, which is often used when treating children with neuromuscular pathology. Many authors support the use of instrumented gait analysis for both research and clinical purposes. Gage considers the clinical use of modern instrumented gait analysis techniques to be essential. His assumption is based on the view of clinical experience, continuous evolution in the accuracy of many technology-driven systems, and the perceived related inability of clinicians to identify primary or secondary gait deviations. A salient feature of many new healthcare systems will be greater emphasis on disease prevention and a variety of clinical outcome measures for which instrumented gait analysis could play a prominent role. However, despite apparent support of instrumented techniques to measure the many interrelated components of gait, controversy remains regarding its usefulness in clinical practice in terms of determining treatment interventions and patient outcomes because such parameters can vary significantly. In many cases, instrumented gait analysis is not automatically considered essential to treatment planning to restore optimal function. However, such methods are still in their infancy, and associated advantages and disadvantages are gradually emerging. Issues that inhibit the use of instrumented gait analysis in the clinical setting come from an array of sources related to a variety of limitations and demands.

Perhaps a major reason clinicians have questioned the use of instrumented gait analysis is the acquisition of new philosophies in relation to gait mechanics. Such a consensus is similar to sentiments expressed with the introduction of magnetic resonance imaging for musculoskeletal pathology during the early 1970s. Many clinicians were resistant to learning a new technology because its use did not demonstrate significant advantages over other methods, such as computed tomography. In addition, economic feasibility kept many institutions from using such methods. However, magnetic resonance imaging is now considered an essential component of diagnostic evaluation. Its increased use and continuously evolving technology have reduced the price of such equipment. Could instrumented gait analysis follow suit? In addition, anxiety and alienation associated with computers in general has led to their limited use in many health professions. Kidd and McPhee state that healthcare professionals older than 30 years have in the past been thought of as the "lost generation" with regard to information technology. However, such attitudes are changing and will continue to change as the technology of today and tomorrow fades into the background, becoming ubiquitous in everyday life.
Geographic issues and financial constraints have limited the use of instrumented gait analysis. The Western world has seen continuous evolution of the delivery of health care, with policies varying by location. Arguably, instrumented gait analysis could be described as "artificial analysis." During data collection, patients often walk on flat, short walkways with electrodes, markers, and trailing cables attached to their lower limbs, which have the potential to disrupt normal gait patterns; this technique does not provide an ideal representation of how patients would walk and adapt to varying situations in everyday circumstances. For example, Kelvin’s law and an increase in the coefficient of friction is usually a confounding factor that needs to be identified by the researcher undertaking in-shoe plantar pressure measurement. Many of the techniques can be labor-intensive for both the investigator and the patient, with some kinematic data recording sessions lasting more than 2 hours. Perhaps this is not a major problem in the realm of research, but such time requirements are not convenient for the clinician. Data analysis from instrumented gait analysis has proven to be complex and challenging to many clinicians and researchers and requires additional training. Investigators must be aware of the numerous potential sources of error during data collection, analysis, and interpretation. Such sources of error include the placement, size, and type of electrodes and markers; body structure; effects of age and different systemic pathologies; durability of equipment; calibration and artifact errors; and investigator bias. Many centers that use instrumented gait analysis employ staff from various disciplines with differing levels of technical expertise. At present, there are no standardized protocols used for data collection, analysis, and interpretation. As a result, comparison between centers is difficult, with some analyses being subjected to as many interpretations as there are interpreters.

After reviewing some of the most salient aspects of instrumented gait analysis, we propose using the acronym STEP FORWARD to identify reasoned key strategic markers for the future direction of instrumented gait analysis with respect to podiatric medicine (Table 1). Although complete use of the proposed acronym may be limited owing to the financial and time constraints previously highlighted, it is hoped that the acronym can identify key aspects for a wide range of clinicians and researchers. Implementation of the acronym in health (podiatric medical) policies will not only enhance communication but
also justify the use of instrumented gait analysis. The acronym not only highlights the use of the World Wide Web as an essential parameter for communication but also identifies its use as a salient educational tool. Overall, it is hoped that the proposed acronym will serve as an essential and adaptable tool for dialectic reasoning for using instrumented gait analysis for decision-making processes and evidence-based practice. The components of the acronym are detailed in the following subsections.