Acta Scientific Orthopaedics (ISSN: 2581-8635)

Volume 6 Issue 12 December 2023

Review Article

Instrumented Gait Analysis: An Under-Utilized Tool in Musculoskeletal Conditions?

Corene Gatt, Cynthia Formosa*, Alfred Gatt

Associate Professor, Faculty of Health Sciences, University of Malta, Malta

***Corresponding Author:** Cynthia Formosa, Associate Professor, Faculty of Health Sciences, University of Malta, Malta.

DOI: 10.31080/ASOR.2023.06.0868

Received: October 26, 2023

Published: November 17, 2023

Abstract

Although instrumented gait analysis has been around for decades, its utilisation in a clinical context is limited due to the interpretation of the complex outputs generated by these systems. This makes it difficult for physicians to fully understand and interpret such outputs unless they are trained extensively in this field. The proposal of a Traffic Lights System for easier interpretation of these results would enable more physicians and health professionals to readily understand these results, thus encouraging them to make greater use of such systems. This would ultimately imply that these systems would have a significant impact on patients' quality of life through a wider utilisation of these gait analysis systems resulting in a more accurate visualisation of movement to enable better understanding of the presenting pathologies, thus aiding in the formulation of a better treatment plan.

Keywords: Traffic Lights System; Gait Analysis; Gait; Gait Pathologies

Introduction

Gait analysis, the study of walking, has been around for many years in various forms. Initially starting as observational gait analysis, [1] in which the patient is observed walking and various observations are made to attempt detection of pathological gait, this is clearly the most accessible and easiest method of gait analysis. However, this method has various limitations, the most important of which are its subjective nature and the necessity to have the patient walk several times which can sometimes be difficult. This, on many occasions, could be an issue due to pain or difficulty in ambulation. Observational gait analysis has evolved into video gait analysis which permits the practitioner to record and observe the patient's gait repeatedly, with the possibility of also measuring some kinematics, i.e., joint movement without the inclusion of force.

Gait analysis has evolved substantially since its inception, with the gold standard nowadays being 3D instrumented gait analysis [2] in which various retro-reflective markers are placed on anatomical sites to build a 3D model of the patient's various body segments and allows reconstruction of the position and orientation of body segments in the space [3]. This highly specialized field eliminates the majority of issues related to subjectivity and, if performed correctly, can provide important objective measurements on the various joint movements that could potentially be very helpful during initial assessment or as a method to quantify effectiveness of treatment, be it surgery, podiatry, physiotherapy or any other intervention aimed at improving the person's gait characteristics [4,5].

Instrumental gait analysis is a specialised field in which highly trained analysts spend a considerable amount of time modelling the patient's movement to attempt to quantify problems associated with ambulation [6]. This could have very important repercussions on the patient's treatment regime, by informing the physician how the joints of interest are performing; namely their kinematics, or the amount of movement in each of the 3 body planes. For instance, how much flexion/extension, abduction/adduction and internal/external rotation that each knee is moving through each gait cycle. This would be important information if the patient were complaining of knee pain, for example. Comparing this movement to 'normative' data, which is data acquired by the laboratory from a number of non-pathological subjects, allows the physician to determine which type of motion is abnormal, thus leading to an understanding of a probable cause of injury or pathology in a particular patient. Yet it is noted that, although this information would be highly important for the management of this patient, the utilization of such analysis techniques is highly limited [7] and most often than not the physician would simply accept to do a physical examination of the knee joint or, at most, by observing the patient walk a couple of times along a corridor.

Whilst this may be acceptable from a clinical perspective, the main function of the knee joint is during dynamic movement; thus it would be highly beneficial to also obtain data regarding the actual functioning of the joint, rather than hypothesise what is affecting knee function through a static examination.

Previous challenges precluding the wider application of gait analysis include several factors, such as equipment costs, leading to limited availability of such laboratories and the amount of time needed to perform a comprehensive gait analysis [7]. However, nowadays, the cost of such equipment has reduced drastically, thus making it potentially available to clinics and not just hospital laboratories. Increasing the frequency of use, by utilising this technology more often using more and more patients, would also reduce the time necessary to perform such investigations as raters gain more experience.

There is a surprising lack of evidence relating to the actual interpretation of gait analysis data. Whilst there are validity and reliability studies on gait analysis systems themselves [8], the reliability of actual interpretations of the results, especially when relating to non-trained health professionals, are probably non-existent in literature. Only Mukaino., *et al*. [7] and Itoh., *et al*. [9] have pointed out that the main reason for this lack of utilisation of gait analysis may be due to the large number of graphs presented to the practitioner, thus limiting their use clinically.

However, a recent study has conclusive evidence that the majority of health care professionals who treat musculoskeletal conditions do not readily understand the complex graphical outputs generated by such systems [10], and they rely almost exclusively on reports generated by gait analysts who explain the results of such investigations. The author hypothesized that these complex graphs could be augmented by a Traffic Lights System that reports the severity of movement in the affected joint/s through colour representation (Figure 1). In this instance, GREEN would indicate a normative amount of movement, up to +/- 1 Standard Deviation (SD), AMBER or YELLOW would indicate movement between +/- 1SD and +/-2SD, whilst RED would indicate movement above +/-2SD. Findings from this study concluded that healthcare professionals preferred the outputs by the Traffic Lights System (Figure 1) than the Traditional Graphical Representation of joint movement (Figure 2) since they are much easier to understand and interpret.

Such a simplified system would allow healthcare professionals to understand the complex results generated by the gait analysis system more readily, with the result that they would request this type of investigation more often. This would thus enable them to fully appreciate the causation of the presenting pathology and would enable them to organize the optimal treatment plan for their patients [10].

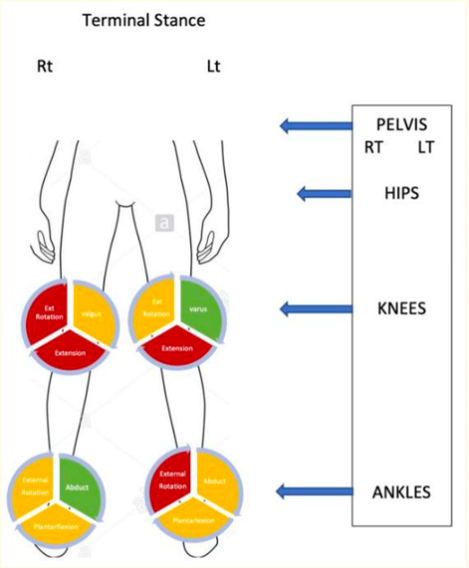

Figure 1: An example of an output representation utilizing the Traffic Lights System for the knees and ankles (adapted from Gatt, 2022).

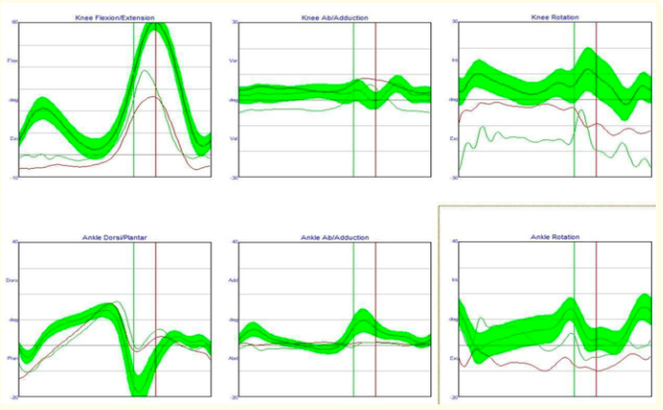

Figure 2: An example of Traditional gait analysis graphs for the knees and ankles (adapted from Gatt, 2022).

Conclusion

Indeed, such a simplification of these complex results through a more visual, colourful and user-friendly approach would imply that both patients and physicians would benefit more from the wider utilization of gait analysis. Certainly, at this stage, although well-known for its reliability and validity, this scientific study of gait is an under-utilized clinical testing modality that has the potential to be applied to a wider variety of patients with musculoskeletal pathologies if made simpler through the suggested Traffic Lights System.

Bibliography

1. Ridao-Fernández C., *et al*. "Observational Gait Assessment Scales in Patients with Walking Disorders: Systematic Review". *Biomed Research International* (2019).

2. Reid S., *et al*. "Reliability and validity of the Shaw gait assessment tool for temporospatial gait assessment in people with hemiparesis". *Archives of Physical Medicine and Rehabilitation* 92.7 (2011): 1060-1065.

3. Kim HY., *et al*. "Screw-home movement of the tibiofemoral joint during normal gait: three-dimensional analysis". *Clinics in Orthopedic Surgery*. 7.3 (2015): 303-309.

4. Cojan Carlea NA., *et al*. "Instrumented Gait Analysis for Assessing the Efficiency of a Complex Rehabilitation Program in Patients with Stroke - A Case Study". *In Applied Mechanics and Materials* 811 (2015): 347-352.

5. Wren TAL., *et al*. "Clinical efficacy of instrumented gait analysis: Systematic review 2020 update". *Gait and Posture* 80 (2020): 274-279.

6. Moon D and Esquenazi A. Instrumented Gait Analysis: A Tool in the Treatment of Spastic Gait Dysfunction". *Journal of Bone and Joint Surgery* 4.6 (2016).

7. Mukaino M., *et al*. "Clinical-oriented Three-dimensional Gait Analysis. Method for Evaluating Gait Disorder". *Journal of Visualised Experiments* (2018): 133.

8. Laroche D., *et al*. "Test-retest Reliability of 3D Kinematic Gait Variables in Hip Osteoarthritis Patients". *Osteoarthritis and Cartilage* 19.2 (2022): 194-99.

9. Itoh N., *et al*. "Quantitative assessment of circumduction, hip hiking, and forefoot contact gaitusing Lissajous figures". *Japanese Journal of Comprehensive Rehabilitation Science* 3 (2022): 78-84.

10. Gatt CM. "A novel method of presenting kinematic gait analysis data to healthcare professionals: the 'Traffic lights system' (Master's dissertation). University of Malta (2022).