

3d gait analysis in osteoarthritis patients

Deepiksha chouhan¹, Dr. Deepali Patil²

¹Bpt final year, Ravi Nair Physiotherapy Collage, Wardha, India

²Associate professor and HOD, Department of Musculoskeletal Physiotherapy, Datta Meghe Institute of Medical Sciences, Sawangi Meghe, Wardha, Maharashtra, India.

Email: dvjphysio@gmail.com

DOI: 10.47750/pnr.2022.13.S06.375

Abstract

A three-dimensional gait analysis system is currently widely employed as a clinical tool for determining kinematic values in musculoskeletal illnesses. Osteoarthritis is a degenerative illness that first affects the articular cartilages and then progresses to the bones and joints. More often involved are load-bearing joints such as hip and knee. Types of osteoarthritis includes primary and secondary osteoarthritis depending on the cause. Gait patterns and variables are altered in individuals with osteoarthritis. In osteoarthritis individuals, 3d gait analysis is commonly used to evaluate time and distance variables of gait. Advanced electronic systems uses infrared (IRR) cameras linked to a computer to acquire kinematic data including gait speed, stride length, and joint angles, which are used to create kinematic patterns when walking. In terms of identifying the mechanisms that produce gait disturbance and understanding compensatory gait methods, these measurements appear to be relevant in OA. Kinematic data could also be used in clinical trials to assess the efficacy of OA therapies. Various intrinsic and extrinsic factors has an influence in measurement of variables. The purpose of this review is to identify the effectiveness of 3d system in evaluating kinematics in osteoarthritis patients. To find out the changes in different kinematic variables.

Keywords: Osteoarthritis, 3d gait analysis, kinematics, motion analysis .

INTRODUCTION

As the innovation of three-dimensional (3D) evaluation of human gait has evolved substantially in the previous decade, kinetics and biomechanical data obtained and appropriately analysed by skilled investigators is currently offered as a therapeutically effective tool in musculoskeletal illnesses. 3d gait evaluation uses computerised motion system with infrared digital cameras to study the biomechanics (kinematic & kinetics) in the human while walking or running, this allows the physiotherapist or clinicians to evaluate the patients pattern of walking and various kinematics using 3d system. Various motion analysis labs have been established which includes a team of biomedical engineer, technicians, physiotherapist, occupational therapist and other skilled professionals. 3d motion analysis helps in better clinical decision making and also allows to determine the treatment, rehabilitation or whether the patient needs surgery. It is a beneficial for the physiotherapist in planning appropriate treatment or rehabilitation protocol.

Osteoarthritis is the most frequently occurring arthritis in the globe (OA). The two kinds of osteoarthritis are primary osteoarthritis and secondary osteoarthritis. Joint discomfort and impaired function are the most classic symptoms of OA, although the illness can present itself in a variety of ways, ranging from an unnoticed incidental finding to a severe and irreversibly disabling disorder.(1) Changes includes destruction of cartilages, erosion of subchondral bone, changes in ligaments, menisci and capsules. Elderly people are more commonly affected with OA.

3D Gait analysis:

Advanced optoelectronic systems use infrared cameras coupled to a computer to acquire kinematic metrics such as gait speed, stride length, and joint angles, which establish kinematic patterns in the course of walking. These metrics seems to be relevant in Osteoarthritis in terms of identifying the mechanisms that cause gait disturbance and comprehending compensatory gait techniques. Furthermore, kinematic data may be relevant in clinical studies to measure the efficacy of OA treatments. Clinical implications at the individual level could include patients with hip or knee OA being directed to motion analysis laboratories

for proper evaluation. Furthermore, many OA patients may experience alterations in gait characteristics prior to the onset of clinically functional impairment.(2) There is no way to completely control all of the determinants that affects the result of a gait analysis. Both intrinsic and extrinsic factors can cause variation in 3D gait data. Extrinsic factors, for example, can arise as a result of changes in putting the reflective markings in place. Factors that affects you from within are Intra-individual variances that occur naturally are an example of mistake. Neither of which can be predicted from trial to trial or subject to subject. Lowered. Age and walking speed, for example, might both have an impact. Contribute to the normal heterogeneity of gait between individuals. Several walking trials are used to measure these parameters. To offer a metric, data is usually collected within the same session.(3)

Gait in osteoarthritis:

In a study, after correcting for walking speed, Kubota et al., outlined the gait attribute of 12 people who had typical osteoarthritis of both the hip. Patients walked with a higher number of steps and ankle power generation, had an anterior pelvic tilt during entire phases of gait, a dropped pelvis during stance, and had a smaller step width, hip extension and abduction angles, and a lower hip abduction moment, according to the data. (4). Gait disparities were found to be more when patients walked faster in two examination evaluating gait in people having only one hip affected with osteoarthritis. (5,6). This disparity would be most probably because of decreased forces produced by muscle as a consequences of pain. (7-20)

The medial compartment is the most frequent site of Osteoarthritis in the knee, leading to a varus deformity and higher adduction moment. Patients had a tendency to rotate their leg externally at the time of stride and slow down their walking speed to lessen the strain on the medial compartment. (21-30)

When compared to healthy participants, people with ankle Osteoarthritis walked at a reduced self-decided speed, ranging from 0.75 to 1.10 m/s.(9). According to Khazzam et al., people who were affected with ankle osteoarthritis walked at a speed that is 67 percent slower as compared to normal people. The results of research looking at cadence and stride length differ, but the majority show that persons with ankle osteoarthritis take less steps in a minute and had reduced strides. Patients with ankle OA also showed reduced dorsiflexion range and loss of the first rocker, commonly known as 'rapid plantar flexion,' at the time of loading response, according to Khazzam et al. This difference in gait pattern could be linked to pain in ankle. (31-33)

In different trials, session, laboratories inaccuracy in lower limb biomechanics were quantified at each and every point of the gait cycle for each participant. The two experimental situations had different walking speeds. As a result, the standardised speed has increased significantly. The diversity in speed of walking was minimised. The average kinematic errors varied depending on the joint, segment, and plane. The most significant inter-lab kinematic errors were seen in both the hip and knee flexion and hip extension in the sagittal and transverse planes. The biggest inaccuracies are registered by rotation. The findings show that dependable gait data can be gathered in a variety of gait laboratories. We compared lower limb kinematic and kinetic data in this study. Gathered on ten healthy volunteers who were tested in three different gait laboratories. The hardware in each of the three laboratories was different. Setups, markers, and examiners that could be used. Inconsistencies in the laboratory are a result of these factors.(3)

In a study where Observational gait analysis (OGA) and three-dimensional gait analysis were compared revealed that, Out of all the parameters assessed only distance and time variables of gait excluding the stance phase gave better reliability and validity than kinematic variables in OGA. (11)

According to a study, 3d gait analysis was found to be safer and easier but it was not cost effective and larger spaced labs are needed with longer time duration which may be a limitation in clinical practise.(2)

CONCLUSION:

3d gait analysis is an emerging technology used to assess kinematic and kinetics with the use of computerised system and IRR emitting cameras .In osteoarthritis individuals it help to evaluate changes in distance and time variables in gait. Gait analysis labs are the new upcoming technology used in various neurological and musculoskeletal diseases. As inferred from various studies it was revealed that 3d gait analysis can be used to distinguish healthy individual and osteoarthritis patients. Its benefits are it is safer and easy to operate while drawbacks are that it is cost- ineffective and time consuming procedure. Some says that it is controversial to say, if helps in clinical decision making or not while others believed that it allows the clinician to plan

treatment /surgery/rehabilitation protocol accordingly. Also with its growing demand we can say that it can be useful in future for assessment of osteoarthritis and thus will help in planning rehabilitation protocol for the patients.

REFERENCES

1. Sen R, Hurley JA. Osteoarthritis. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 [cited 2022 Apr 19]. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK482326/>
2. Ornetti P, Maillefert JF, Laroche D, Morisset C, Dougados M, Gossec L. Gait analysis as a quantifiable outcome measure in hip or knee osteoarthritis: A systematic review. *Joint Bone Spine*. 2010 Oct 1;77(5):421–5.
3. Kaufman K, Miller E, Kingsbury T, Russell Esposito E, Wolf E, Wilken J, et al. Reliability of 3D gait data across multiple laboratories. *Gait Posture*. 2016 Sep 1;49:375–81.
4. Kubota M, Shimada S, Kobayashi S, Sasaki S, Kitade I, Matsumura M, et al. Quantitative gait analysis of patients with bilateral hip osteoarthritis excluding the influence of walking speed. *J Orthop Sci*. 2007 Sep 1;12(5):451–7.
5. Lafuente R, Belda JM, Sánchez-Lacuesta J, Soler C, Poveda R, Prat J. Quantitative assessment of gait deviation: contribution to the objective measurement of disability. *Gait Posture*. 2000 Jun;11(3):191–8.
6. Möckel G, Perka C, Labs K, Duda G. The influence of walking speed on kinetic and kinematic parameters in patients with osteoarthritis of the hip using a force-instrumented treadmill and standardised gait speeds. *Arch Orthop Trauma Surg*. 2003 Jul 1;123(6):278–82.
7. Hurwitz D, Hulet C, Andriacchi T, Rosenberg A, Galante J. Gait compensations in patients with osteoarthritis of the hip and their relationship to pain and passive hip motion. *J Orthop Res Off Publ Orthop Res Soc*. 1997;
8. Broström EW, Esbjörnsson AC, von Heideken J, Iversen MD. Gait deviations in individuals with inflammatory joint diseases and osteoarthritis and the usage of three-dimensional gait analysis. *Best Pract Res Clin Rheumatol*. 2012 Jun 1;26(3):409–22.
9. Houdijk H, Doets HC, van Middelkoop M, Dirkjan Veeger HEJ. Joint stiffness of the ankle during walking after successful mobile-bearing total ankle replacement. *Gait Posture*. 2008 Jan 1;27(1):115–9.
10. Khazzam, M., Long, J.T., Marks, R.M. and Harris, G.F. (2006) Preoperative Gait Characterization of Patients with Ankle Arthrosis. *Gait & Posture*, 24, 85-93. - References - Scientific Research Publishing [Internet]. [cited 2022 Apr 19]. Available from: [https://www.scirp.org/\(S\(lz5mqp453edsnp55rrgict55.\)\)/reference/referencespapers.aspx?referenceid=1835487](https://www.scirp.org/(S(lz5mqp453edsnp55rrgict55.))/reference/referencespapers.aspx?referenceid=1835487)
11. Tas S. Diz Osteoartriti Hastalarda 3-Boyutlu Yurume Analizi ile Gozlemsel Yurume Analizi Sonuclarının Karsilastırılması. *ACTA Orthop Traumatol Turc* [Internet]. 2015 [cited 2022 Apr 21]; Available from: <http://www.aott.org.tr/en/a-comparison-of-results-of-3dimensional-gait-analysis-and-observational-gait-analysis-in-patients-with-knee-osteoarthritis-133884>
12. Mukherjee, S., T. Sebastian, and J. Gawai. “A Brief Review on Importance of Mental Health First Aid Kit for Depressed Adolescents.” *Journal of Pharmaceutical Research International*, August 23, 2021, 201–8. <https://doi.org/10.9734/jpri/2021/v33i41B32359>.
13. Mukherjee, S., T. Sebastian, and J. Gawai. “Effectiveness of Mental Health First Aid Kit for Depression and Psychological Well-Being in Adolescents.” *Journal of Pharmaceutical Research International*, July 1, 2021, 122–28. <https://doi.org/10.9734/jpri/2021/v33i34A31831>.
14. Muley, Parikshit Ashok, Dalia A. Biswas, and Avinash Taksande. “A Pilot Study Investigating the Effect of Glycemic Control on Electrodiagnostic Parameters in Type II Diabetic Patients.” *Journal of Pharmaceutical Research International*, June 22, 2021, 146–53. <https://doi.org/10.9734/jpri/2021/v33i32B31756>.
15. Muley, Sonal, Chetan Saoji, Nikhil Pande, and Shruti Sanghavi. “Awareness of Myopia amongst Parents of School Going Children in a Survey Done in a Tertiary Care Centre in Vidarbha Region, India.” *Journal of Pharmaceutical Research International*, July 15, 2021, 1–6. <https://doi.org/10.9734/jpri/2021/v33i37B31997>.
16. Mulye, Sachin, Revatdhama J. Meshram, and Krishnakumar Thakrani. “Impact of a Head Covering on Photo-Therapy Induced Hypo-Calcaemia in Full-Term Neonates with Hyper-Bilirubinemia.” *Journal of Pharmaceutical Research International*, December 15, 2021, 102–7. <https://doi.org/10.9734/jpri/2021/v33i58B34177>.
17. Murarka, Shriya Prakash, Sunita Shrivastav, Ranjit Kamble, Hamza Dargahwala, Prutha Khakhar, Zynul John, Purva Dhannawat, and Shruti Rathi. “Comparative Evaluation of Discomfort, Expectations and Functional Experiences during Treatment of Class II Malocclusion with Forsus Fixed Functional Appliance and Sharma’s Class II Corrector - A Questionnaire Based Survey.” *Journal of Evolution of Medical and Dental Sciences* 10, no. 8 (February 22, 2021): 474–78. <https://doi.org/10.14260/jemds/2021/104>.
18. Mutyalwar, Sunaina, Priyanka Paul Madhu, Amit Reche, Kumar Gaurav Chhabra, and Sayali Deshpande. “Knowledge, Attitude, and Practice of Dental Implants among Dental Post Graduates and Practitioners in Wardha District, Maharashtra: A Cross Sectional Study.” *Journal of Pharmaceutical Research International*, December 11, 2021, 119–23. <https://doi.org/10.9734/jpri/2021/v33i54B33772>.
19. Nagdive, Amit B., Ravi Singh Bhainsora, Rouchelle Fernandes, Prakash B. Behere, and Siddharth Sethi. “Pseudocyesis Leading to Folie-à-Deux.” *Journal of Neurosciences in Rural Practice* 12, no. 02 (April 2021): 419–23. <https://doi.org/10.1055/s-0041-1726615>.
20. Nagdive, Amit, Prakash B Behere, Rouchelle Fernandes, Aniruddh P. Behere, Debolina Chowdhury, and Richa Yadav. “Diseased Body and Diseased Mind: Mind Your Psychological Health during Lockdown.” *Journal of Pharmaceutical Research International*, July 28, 2021, 287–94. <https://doi.org/10.9734/jpri/2021/v33i38B32125>.
21. Nagore, Aditi N., Deepali S. Patil, and Om C. Wadhokar. “Effect of Myofascial Release Technique Verses Conventional Therapy in Tension Neck Syndrome: A Research Protocol.” *Journal of Pharmaceutical Research International*, October 15, 2021, 409–13. <https://doi.org/10.9734/jpri/2021/v33i46A32883>.
22. Nagtode, Tushar, Y. R. Lamture, Venkatesh Rewale, P. Tanveer, and Aditya Mundada. “Posterior Gastric Perforation – Rare Surgical Emergency: A Case Report.” *Journal of Pharmaceutical Research International*, December 15, 2021, 143–46. <https://doi.org/10.9734/jpri/2021/v33i58B34183>.
23. Naik, Srinivas, Satish Mahajan, Dhruv Talwar, and Gaurav Jagtap. “Acute Pancreatitis Complicating a Case of Dengue Fever: Double Trouble.” *Cureus*, November 13, 2021. <https://doi.org/10.7759/cureus.19523>.
24. Naik, Srinivas, Dhruv Talwar, Sourya Acharya, Sunil Kumar, and Deepti Shrivastava. “Hyperemesis Gravidarum Presenting as Severe Hypokalemic Periodic Paralysis and Type II Respiratory Failure: A Different Form of Thyroid Storm?” *Cureus*, November 14, 2021. <https://doi.org/10.7759/cureus.19566>.
25. Nandwana, Varsha, Jaskaranpreet Kaur, Ripudaman Singh, Sanobar Jaka, Gagan Kaur, Era Rawal, Keerthika Mathialagan, and Ozge C Amuk Williams. “Predictors of Hospitalization for Manic Episode in Alzheimer’s Dementia: Inputs From an Inpatient Case-Control Study.” *Cureus*, August 20, 2021. <https://doi.org/10.7759/cureus.17333>.
26. Nanotkar, Payal, Vaishali Tembhare, Khushabu Meshram, Pooja Kasturkar, Savita Pohekar, Jaya Khandar, Samrudhi Gujar, and Achita Sawarkar. “Case

- Report on Sacrococcygeal (Teratomas) Germ Cell Tumor.” *Journal of Pharmaceutical Research International*, October 29, 2021, 698–703. <https://doi.org/10.9734/jpri/2021/v33i47A33063>.
27. Narang, Simran, Pratik Phansopkar, Laukik Vaidya, Neha Chitale, and Dushyant Bawiskar. “Bridging the Gap between Locking Compressive Plate, Skin Grafting and Rehabilitation for Tibia Fracture: A Case Report.” *Journal of Pharmaceutical Research International*, July 15, 2021, 284–91. <https://doi.org/10.9734/jpri/2021/v33i37A32010>.
 28. Narayane, Madhavi Madhukar. “Benefits of Online Doctor Consultation During the Pandemic.” *Bioscience Biotechnology Research Communications* 14, no. 6 (June 15, 2021): 53–56. <https://doi.org/10.21786/bbrc/14.6.13>.
 29. Nashine, Rupam R., Amit R. Nayak, Aliabbas Husain, Gargi D. Mudey, Hatim F. Dagainawala, Lokendra Singh, and Rajpal S. Kashyap. “Development of an Improved Whole Blood Assay for Diagnosis of Latent and Active Tuberculosis Cases.” *Journal of Pharmaceutical Research International*, July 27, 2021, 197–209. <https://doi.org/10.9734/jpri/2021/v33i38B32115>.
 30. Nathani, Harsh, Medhavi V. Joshi, and Pratik A. Phansopkar. “Impact of Early Rehabilitation in a Complex Case of Non-Union of Tibial Plafond Fracture with Osteosynthesis Associated Infection – A Case Report.” *Journal of Pharmaceutical Research International*, November 24, 2021, 55–61. <https://doi.org/10.9734/jpri/2021/v33i51B33511>.
 31. Nayak, Sushanth Ramanath, Meenakshi Pate Yeola, Samatha Ramanath Nayak, Kratika Kamath, and Pratikshit Singh Raghuvanshi. “Role of Focused Assessment with Sonography for Trauma in the Assessment of Blunt Abdominal Trauma – A Review.” *Journal of Evolution of Medical and Dental Sciences* 10, no. 1 (January 4, 2021): 45–50. <https://doi.org/10.14260/jemds/2021/9>.
 32. Ngente, Elizabeth Remsangzuali, Vaibhav Chaudhari, Nita Fodekar, Pranali Gathe, Samiksha Ghume, Shruti Jambhulkar, and Kavita Gomase. “Protocol on Effect of Planned Teaching on Knowledge Regarding Menstrual Blood Banking among Nursing Students.” *Journal of Pharmaceutical Research International*, December 15, 2021, 220–24. <https://doi.org/10.9734/jpri/2021/v33i58A34109>.
 33. Nikose, Sunil Sheshrao, Devashree Nikose, Shashank Jain, Aditya Kekatpure, Kiran Saoji, Rahul Chaudhary, and Gajanan Pisulkar. “Determinants of Regeneration and Strength of Hamstrings after Anterior Cruciate Ligament Reconstruction—Fate of Hamstring Tendon.” *International Orthopaedics* 45, no. 7 (July 2021): 1751–60. <https://doi.org/10.1007/s00264-020-04932-z>.