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COMPARING ALTERATION IN KNEE JOINT KINEMATICS DURING GAIT IN CHRONIC STROKE PATIENTS WITH AGE MATCHED INDIVIDUALS ON LEVEL SURFACE

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ABSTRACT

Background: Stroke is the second leading cause of disability and early death worldwide post-stroke impairments in strength, coordination, and balance lead to gait complications and gait recovery is the major goal for individuals with stroke. The greater amount of alteration is observed at knee joint during stance and swing phase. The quantitative gait analysis system mainly including pressure monitor system, camera system, electromyography measuring system and wearable inertial sensor platform. However, above gait analysis system are limited in clinical practice. Kinovea® is a free 2D motion analysis software for computers that can be used to measure kinematic parameter

Aim: The aim is to compare the knee joint kinematics during gait on level surface among chronic stroke survivors with that of age matched healthy individuals.

Method: Chronic stroke patients having history of stroke for more than 6 months will be taken for the study and then compared with age matched normal healthy individuals. Video of gait pattern of the patients is taken and changes in knee kinematics are measured by using kinovea software and then gait pattern of normal healthy individual is compared with gait pattern of stroke patients and mean value of alteration between stroke patients and normal individuals is measured.

Outcome measure:

Kinovea software is used to measure knee joint kinematics.

Results:

Out of 180 subjects in which 90 are stroke patients and 90 are age matched normal individuals we found out that, more alteration is seen in lateral view kinematics as compared to anterior view kinematics of stroke patients and age matched individuals.

Conclusion:

Therefor the study concluded that, on an average alteration is seen in lateral view kinematics as compared to anterior view kinematics in stroke patients and age matched individuals.

Keywords: Stroke, kinovea, knee joint kinematics, gait analysis.

I. INTRODUCTION

Stroke is the second leading cause of disability and early death worldwide [1]. In India, adjusted stroke prevalence rate in rural areas is 84–262/100,000 and in urban areas 334– 424/100,000 whereas the incidence rate is 119–145/100,000 studies in India.[2] The risk of stroke after 55 years of age is 1 in 5 for women and 1 in 6 for men.[3]

Post-stroke impairments in strength, coordination, and balance lead to gait complications and gait recovery is the major goal for individuals with stroke.[4] More than 60% of stroke survivors have impaired activities of daily living due to persistent neurological deficits.[1] Lower extremity motor function is usually affected after a stroke, causing restrictions in mobility [5].Stroke survivors are exposed to additional risk factors of fall due to altered kinematics of all the joints of lower extremities in stance and swing phase during outdoor ambulation.[6]

The greater amount of alteration is observed at knee joint during stance and swing phase as role of the knee joint is anatomically coupled to the ankle joint in gait patterns observed in

post-stroke patients Studies report that in addition to gait velocity, knee sagittal pattern is a factor that permanently accounts for abnormalities of gait patterns. Prolonged affected knee hyperextension during stance occurs along with prolonged ankle plantarflexion, followed by low peak knee flexion during swing phase. Moderate or slight affected knee flexion or hyperextension during part of stance occurs usually in moderate or faster walking. These inferences provide no clear tendency regarding muscle strength status and quantification of altered kinematics at knee joint.[7]

Three-dimensional motion analysis systems are regarded the gold standard for gait analysis. They provide objective and quantitative data regarding kinematic and spatiotemporal parameters[12]. However, these systems have significant drawbacks, including expensive equipment costs, the necessity for skilled employees, long processing times, and the need for extensive installation locations.

Kinovea® is afree 2D motion analysis software for computers that can be used to measure kinematic parameters. This software allows us to analyze video without markers although its reliability may improve with the use of passive markers [15]. Kinovea® has been used in various studies to analyze running or vertical jumping in athletes [14-18].

The regular smart-phone with high-speed video recording (1920 × 1080 pixels at 60 fps) can also be used for video recording as a alternative method as it is already used for direct measurement of vertical jump height using kinovea motion analysis software .[19]

In stroke patients, studies evaluating gait kinematics emphasizing knee joint is lacking, hence this study is designed to evaluate altered knee kinematics among chronic stroke subjects. It is an attempt to evaluate kinematic gait parameters at the knee joint in stroke survivors, in comparison to typical adults .This is a observational exploratory study.

II. AIM

The aim is to compare the knee joint kinematics during gait on level surface among chronic stroke survivors with that of age matched healthy individuals.

III. OBJECTIVES

- To observe the alteration in the knee joint kinematics in chronic stroke patients during gait on level surface.
- To observe the knee joint kinematics in age matched healthy individuals during gait on level surface.
- To compare knee joint kinematics between chronic stroke patients and the age matched healthy individuals during gait on level surface.

IV. METHODOLOGY :-

- TYPE OF STUDY:- Observational study
- STUDY DURATION:- 6 month
- TYPE OF SAMPLING:- Purposive sampling.
- SAMPLE SIZE:- 188 [94 Each]
- STUDY SETTING:- Department of Neurosciences, Wanless Hospital, Miraj.

V. MATERIAL:-

- Two smartphones
- Laptop
- Kinovea software 0.8.15
- Tripod (phone holder)

VI. INCLUSION CRTIERIA

[For stroke survivors]

- Able to walk independently without orthotics.
- Able to walk with or without assistive devices or walking aids on the level surface.
- Stroke duration more than 3 months.
- Brunstroom grade 3 or more.
- Age above 18 years.

[For healthy individuals]

- Typical participants who did not have any condition that could potentially affect gait, including orthopedic, systemic illnesses, and cardiopulmonary morbidities, will be recruited to match the stroke survivors in age and gender.

VII. EXCLUSION CRITERIA

[For stroke survivors& healthy individuals]

- Did not have any other pathologies or co-morbidities that might influence gait pattern including sensory perceptual problems that may impair safety as identified in clinical examination
- Did not have any orthopedic dysfunction, fractures, vascular complications in the lower limb, lower limb or abdominal surgeries, and cognitive impairments that may affect safety.

III. PROCEDURE

Ethical clearance was obtained by the Institutional Ethical Committee, prior to the beginning of the study. The study will be performed at the Department of Neuro sciences, Wanless Hospital, Miraj with a platform (10 m × 3 m).Two regular smart-phone with high-speed video recording (1920 × 1080 pixels at 60 fps) . Both the smart phones will be mounted to tripods.

One camera with the tripod (Cam. 1) will be placed at 3 m from the midway of the study platform and 55 cm above the floor to cover anterior and posterior views. The second camera (Cam. 2) will be placed at a distance of 3 m lateral to the mid portion of the platform and 55 cm above the floor to cover lateral view. Figure 1 depicts the pathway and camera positioning. To ensure the technical aspects of recording and adjustments, both laptops will be operated by separate technicians.Greatest visualization of the lower limb joints was ensured by fixing the optical camera axis in respect to the knee joint 5.

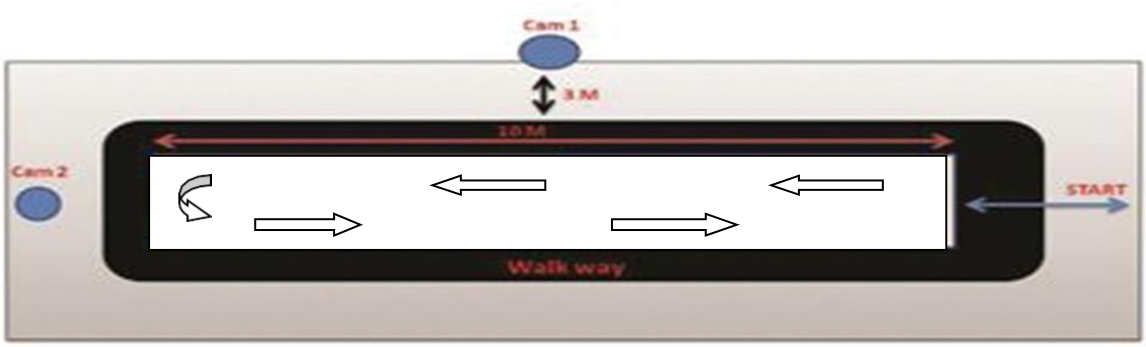


Figure 1: Schematic representation of the walkway and camera placements to record the gait of the participants

PARTICIPANT PREPARATION

Relevant bony land marks will be exposed and marked with fluorescent color tape markers of 25 mm. The bony landmarks are given in Table 1.

Table 1: List of bony landmarks identified Segment Bony prominence.

Hip and pelvis	Greater trochanter
Knee	Lateral condyle of femur
Ankle	Medial and lateral malleolus

(**a**) anterior (**b**) lateral

Knee joint angles calculation using Kinovea®

VIDEO RECORDING

Video recording will be completed under two phases. In Phase 1, stroke participants will be instructed to walk two laps at self-selected speed on the platform in bare foot condition. Recording on both cameras will be done simultaneously. A care giver will accompany the participant for safety but did not make any contact. In Phase 2, the same procedure will be repeated with age and gender-matched typical adults.

VIDEO ANALYSIS

Videos of typical participants will be imported to Kinovea0.8.15 version for analysis to draw normative values of ROM at knee joints, which is essential to make comparison with stroke survivors. Using different tools, the required points of the platform will be remarked on the software for better understanding (starting point, mid portion etc). Each event of the gait cycle will

be analyzed in terms of kinematics and recorded. The initial and final three to four cycles willnot be taken into consideration for analysis in order to control for initiation and fatigue. Thus, the cycles covered in the middle 6 m (three to four cycles) will be analyzed. Joint kinematics will be measured and recorded using different tools available in the software. Joint angles at the same event will be taken from at least three consecutive cycles to increase the accuracy in measurement. Likewise the Phase 1 (stroke survivors), videos will also imported to the software and analyzed and recorded.

IX. STATISTICAL ANALYSIS

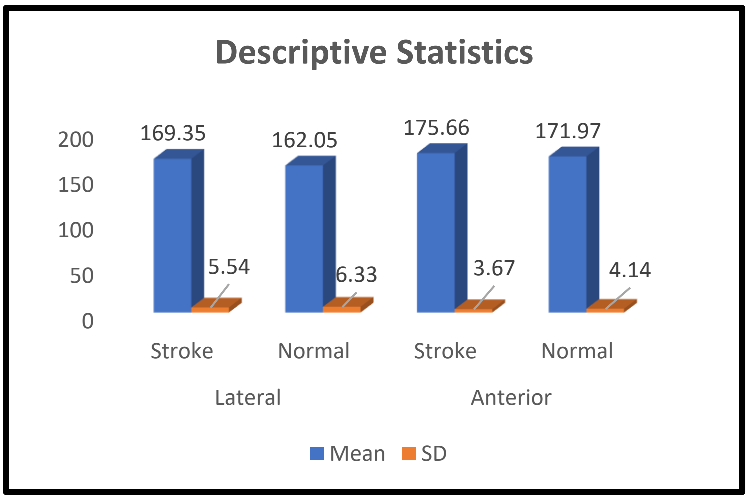
Descriptive statistics will be used to compile the ranges of motion at knee joint during the stance phase events of the gait cycle. Statistical analysis was performed using Statistical Package for the Social Sciences[SPSS] software 23. The level of significance was performed using Unpaired t test.

X. RESULTS

Data analysis was performed using Statistical Package for the Social Sciences [SPSS] software. Statistical analysis was done using Unpaired t-test.

Particular	Minimum	Maximum	Mean	SD
Age	45.00	80.00	61.26	9.43

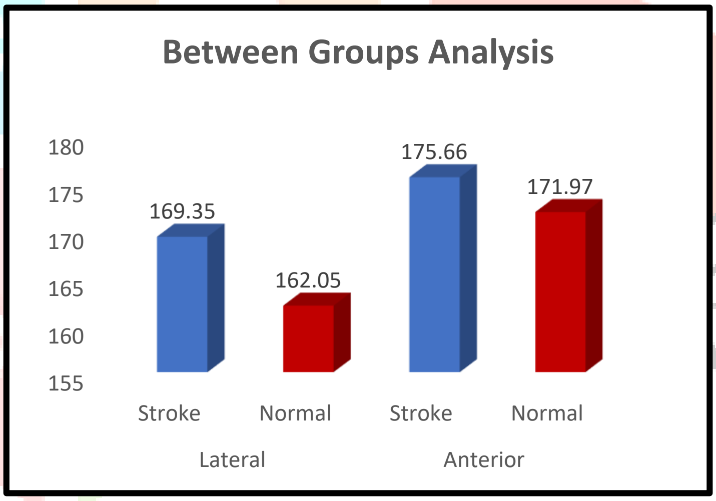
TABLE NO 1: Shows Mean and Standard Deviation of Baseline Data [Age].



Graph No.2: Shows Mean and Standard Deviation of lateral and anterior angle of stroke patients and normal age matched individuals

Particular	Group	Mean	SD	t-value	p-value
Lateral	Stroke	169.35	5.54	8.233	0.001*
	Normal	162.05	6.33		
Anterior	Stroke	175.66	3.67	6.327	0.001*
	Normal	171.97	4.14		

TABLE NO 3: Shows t-value and p-value of lateral and anterior angle of stroke patients and normal age matched individuals



Graph No.3: Shows between group analysis of lateral and anterior angle of stroke patients and normal age matched individuals

Result From analysis:

- On an average, more alteration is seen in knee joint kinematics of stroke patients as compared to age matched normal individuals.
- When compared, more alteration is seen in lateral view kinematics as compared to anterior view kinematics in stroke patients and age matched individuals.
- P-value is zero, which is less than 5% level of significance. So we may reject H0. In other words, we can accept alternative hypotheses H1.

XI. DISCUSSION

We considered the human body as a kinematic chain. Any change or alteration in any part of the kinematic chain would automatically influence the nearby joints. The proximal joints are frequently affected as a result of the most distal joints (ankle and foot).Muhammed Rashid, et al(2020)[20], indicated that, during different events of the gait cycle, a large difference in range of motion in ankle and subtalar joints was noticed between stroke survivors and typical participants. This study also demonstrated that stroke survivors show vast deviations from typical adults in ankle ROM. These results are consistent with existing literatures that stroke survivors have limited ROM in primary joints and the compensatory movements may increase ROM in secondary joints.

As knee joint is secondary to the ankle joint, the kinematic profiles of knee joint during gait performance in stroke patients will also get altered. So in this study, we examined the difference in knee joint kinematics of stoke patients compared with normal age matched individuals. In the present study 180 subjects in which 90 are stroke patients and 90 are age matched normal individuals are taken as per the inclusion and exclusion criteria. We found out that, more alteration is seen in lateral view kinematics as compared to anterior view kinematics of stroke patients and age matched individuals.

Muhammed Rashid et al (2020)[20], they have performed a preliminary exploratory study to evaluate kinematic gait parameters of the ankle joint in stroke survivors in comparison to typical adults. The study included seven chronic adult stroke survivors and seven age-matched normal people. A motion analysis programme, Kinovea 0.8.15, was used to record and evaluate ankle and subtalar joint kinematics at various points during the gait cycle. They concluded that the impact of gait deviations on joint kinetics is a future direction that will inform rehabilitation professionals on strategies to prevent joint loading, leading to dysfunction. Early intervention strategies to improve joint kinematics on different surfaces can potentially reduce the risk of fall, making the patient safe to ambulate on uneven terrains.

Basilio Pueo et al (2020)[19], this study aimed to validate and address the usefulness of the combination of smartphone and computer-based applications (Smartphone-Kinovea) against a laboratory-based Motion Capture System. They concluded that the Smartphone-Kinovea method is a valid and reliable instrument.

TjerkZult et al (2019)[21], this study looked at whether a low-cost 2-D motion capture system can accurately and reliably assess adaptive gait kinematics in people with central visual loss, older people, and younger people. Offline, the kinematic parameters were determined (crossing height, crossing velocity, foot placement, single support duration). All parameters had strong Pearson's correlations between the two systems (average r = 0.944, all p 0.001). They concluded that a low-cost 2-D video system can reliably and accurately assess adaptive gait kinematics in healthy and low vision subjects.

This study is useful for the analysis of the gait deviations in stroke patients and it will also help in creating a rehabilitation protocol for faster recovery of the patients.

XII. CONCLUSION

The findings of this study are important, as the deviations were remarkable and determine major fall risk, thereby having an effect on the QOL of stroke survivors. Analysis of gait should be concern as an a large-scale study given the burden of stroke survivors in India. The impact of gait deviations on joint kinetics could be a future direction that may inform rehabilitation professionals on methods to prevent joint loading resulting in dysfunction. Early intervention ways to enhance joint kinematics on different surfaces will potentially reduce the risk of fall, making the patient safe to walk.

The p value of this study is 0.001 which is less than 5% level of significance. So there will be significant alteration in the knee kinematics in chronic stroke survivors as compared to age matched individuals. Therefore the study concluded that, on an average alteration is seen in lateral view kinematics as compared to anterior view kinematics in stroke patients and age matched individuals.

III. LIMITATIONS AND SUGGESTIONS

- **Limitations:**

1. This study involves only chronic stroke patients, so further study can be done in acute/ subacute stroke patients.
2. Comparison between chronic and acute stoke patients can be done for evaluation of gait and for rehabilitation strategies.

- **SUGGESTIONS**

1. Further analysis using instrumentation in future in order to develop a clinical assessment tool for evaluation of gait can be done.

Study can be done on conservating treatment.

REFERENCES

1. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, et al: Global and re_gional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a system_atic analysis for the Global Burden of Disease Study 2010. Lancet 2012; 380: 2095–2128.

2. Jongbloed L. Prediction of function after stroke: A criticaly review. Stroke 1986;17:765-76.

3. Banerjee TK, Das SK. Fifty years of stroke researches in India. Ann Indian Acad Neurol 2016; 19:1.

4. Crosby LD, Marrocco S, Brown J, Patterson KK. A novel bilateral lower wextremitymirror therapy intervention for individuals with stroke. Heliyon 2016;2:e00208.

5. Chiu HC. Physical functioning and health-related quality of life: Before and after total hip replacement. Kaoh J Med Sci 2000; 16:285-92

6. Jacob E. Medifocus Guidebook on Stroke Rehabilitation. 1st ed. Silver Spring, Md.: Om;....p. ·3.

7. Beyaert, Christian, Rajul Vasa, and Gunilla E. Frykberg. "Gait post-stroke: pathophysiology and rehabilitation strategies." *Neurophysiologie Clinique/Clinical Neurophysiology* 45.4-5 (2015): 335-355.

8. Dobkin BH. Clinical practice. Rehabilitation after stroke. N Engl J Med 2005;352(16):1677—84.

9. Olney SJ, Richards C. Hemiparetic gait following stroke. Part I: characteristics. Gait Posture 1996;4(2):136—48.

10. Therapeutic_Motion_Analysis_of_Lower_Limbs_using_kinovea

11. Qiu S, Wang Z, Zhao H, Liu L, Jiang Y. Using body-worn sensors for preliminary rehabilitation assessment in stroke victims with gait impairment. IEEE Access. 2018 Mar 16;6:31249-58.

12. Daly, J.J.; Nethery, J.; McCabe, J.P.; Brenner, I.; Rogers, J.; Gansen, J.; Butler, K.; Burdsall, R.; Roenigk, K.; Holcomb, J. Development and testing of the Gait Assessment and Intervention Tool (G.A.I.T.): a measure ofcoordinated gait components. J. Neurosci. Methods **2009**, 178, 334–339.

13. Mills, . Motion analysis in the clinic: There's an app for that. J. Physiother. **2015**, 61, 49–50.

14. Bertelsen, M.L.; Jensen, J.F.; Nielsen, M.H.; Nielsen, R.O.; Rasmussen, S. Foot strike patterns among novicerunners wearing a conventional, neutral running shoe. Gait Posture **2012**, 38, 354– 356.

15. Damsted, C.; Larsen, L.H.; Nielsen, R.O. Reliability of video-based identification of footstrike pattern andvideo time frame at initial contact in recreational runners. Gait Posture **2015**, 42, 32– 35.

16. Damsted, C.; Nielsen, R.O.; Larsen, L.H. Reliability of video-based quantification of the knee- and hip angleat foot strike during running. Int. J. Sports Phys. Ther. **2015**, 10, 147–154

17. Balsalobre-Fernández, C.; Tejero-González, C.M.; del Campo-Vecino, J.; Bavaresco, N. The concurrent validity and reliability of a low cost, high-speed camera-based method for measuring the flight time of vertical jumps.J. Strength Cond. Res. **2014**, 28, 528–533.