**Scope**
**Volume 13 Number 4 December 2023**

# Ergonomic and Biomechanical Approaches to Correct Sit-To-Stand by using Kinovea Software

**Madeshwaran Elumalai**
Assistant Professor,
ABSMARI-Abhinav Sports Medicine and Research Institute, Pahala, Bhubaneswar, Odisha, India
ORCHID ID-0000-0002-7278-8824

**Dr. Priyadarshini Mishra (PT)**
Associate Professor
ABSMARI-Abhinav Sports Medicine and Research Institute, Pahala, Bhubaneswar, Odisha, India
ORCHID ID-0000-0002-2101-3615

**Abstract**
An abridged synopsis of the case report: A Male patient, Banfar, aged 22, visited the Department of Movement Science in conjunction with an Orthopaedic physical therapist due to lower back pain. We proceeded to gather the patient's history and demographic information, including presenting symptoms of difficulty in sit-to-stand movement. The diagnosis made by using Kinovea software was mechanical low back pain or lumbosacral dysfunction. We discovered that he had a sacral sitting posture instead of an ischial tuberosity sitting posture, and he also had an improper coping style when transitioning from sitting to standing. He was a medical student. We recommended treatment for him to correct his posture and improve his sit-to-stand movement phases and patterns. The study utilized kinematics analysis of sit-to-stand and postural correction as outcome measures.

**Keywords:** Low back pain, lumbosacral dysfunction, Kinovea software

## Introduction

This case report aims to create awareness about the physical deconditioning that occurs as a result of a sedentary lifestyle and to explore ergonomic strategies for preventing movement dysfunction. It emphasizes the need to learn and actively engage in proper movement patterns during daily tasks. The reason for publishing this case report is to highlight the lack of adherence to ergonomic practices among medical practitioners in their everyday routines. This study serves as an enlightening resource for medical professionals and raises awareness among individuals and the public regarding the significance of ergonomics and movement science. Makhsous et al. (2009) concluded that adopting a sitting position with less support for the ischial bones and more support for the lower back leads to a decrease in the amount of pressure on the lower back and a decrease in the activity of the muscles in the lower back, this could potentially help relieve lower back pain that is caused by sitting for long periods of time.[1]

A Biomechanical approach in sitting to standing prevents muscle imbalance and even prevents under-active adaptation of tissues,according to Roebroeck et al 1994 this evidence concluded that after seat-off most muscles were concentrically active, whereas the shortening velocity of the rectus femoris was very low. Thus hip and knee joints were extended and a relatively high knee moment was delivered to control the ground reaction force in a slightly backward direction.[2]

Pop et al said when sitting, the primary support for the upper body weight is provided by the is chialtuberosities. Increased pressures at the is chialtuberosities are closely linked to increased spinal stresses.[3]
Lis et al stated several occupational risk factors like extended sitting, together with uncomfortable body positions, significantly raise the chances of experiencing lower back pain.[4]
Consequently, we anticipated that this method of treatment would target some key risk factors of lower back pain by providing improved support to the lower back to retain its natural curve (lumbar lordosis), and by reducing strain on the ischial bones to lessen the load on the lower spine. The hypothesis of this study posited that assuming the Off-Loading position would decrease the amount of pressure exerted on the lower back and lessen the level of muscle activity in patients with lower back pain (LBP).

**Case presentation**

| |
|---|
| **Abhinav Bindra Sports Medicine and ResearchInstitute**<br>**Department of Movement Science**<br>**(Gait Lab)** |

| | |
|---|---|
| **Name** | **Mr. Krishna Banafar** |
| **Age** | **22 years** |
| **Gender** | **Male** |
| **Date** | **14/08/2023** |
| **Diagnosis** | **Mechanical low backache** |
| **Evaluation** | **Movement analysis of Sit to stand** |

**Kinematic Data of Sit to Stand**

| S. No | Movement pattern | Atypical Pattern | Critical Events |
|---|---|---|---|
| Figure (a) |  **SITTING**  **FLEXION MOMENTUM PHASE** | **SITTING**<br>• The LOG of the knee falls more forward.<br>• Sitting with arm support.<br><br>**FLEXIONMOMENTUM**<br>• reliance on arms<br>• Insufficient ankle dorsiflexion. | • More Anterior translation of proximal articular knee joint seen.<br><br>• Initial Foot placement backward (10 cm behind the knee)<br>• Peak Movement generation in the trunk. |
| b |  **MOMENTUM TRANSFER PHASE** | • Slow lean with arms forward<br>• maximal stress of lower extremity | • Continued flexion of hips<br>• Continued dorsiflexion of feet. |

| | | | |
|---|---|---|---|
| c |  **EXTENSION PHASE** | • Insufficient extension of knee and ankle.<br>• Insufficient extension of hip and knee. | • Sequence of lower limb extension of knee,hip,ankle<br>• foot placement backward behind the knee. |
| d |  **STABILIZATION PHASE** | • Insufficient of Relative postural adjustments. | • Relative postural Ankle strategy .<br>• Mild sway seen. |

**Discussion**

After getting the kinematics data of a subjectthese are Movement analysis findings in each phase of sit to stand

- **Flexion momentum**
    - Knee stabilization is decreasing due to weakness of the Quadriceps femoris muscle on the bilateral side with an altered segmental line of gravity in the knee joint.
    - The tibialis anterior muscle is underactive so the anterior translation of the knee is more.
- **Momentum Transfer :**
    - During dorsiflexion of foot - soleus muscle weakness which indicates the excessive tibial forward translation.
    - The ground reaction force is seen to be much higher than lift off phase.

- **Extension Phase:**
    - Gluteus maximus muscle seen under active.
    - In this phase hip extension not that much occurs which indicates poor hip strategies.
- **Stabilization Phase:**
    - In this phase weakness of the gastrocnemius muscle indicates less ankle stability.

**Limitations:**

- Comprehending ergonomics and movement science within an Indian clinical environment poses significant challenges for individuals.
- The awareness of human movement science in India is notably deficient, to the extent that even the central government of India lacks recognition of the significance of movement experts and ergonomic specialists.
- In India, there is a high level of awareness among athletes in the sports area, so if you are interested, you may give it a try.

**Conclusion**

Upon conducting a comprehensive assessment of various ways and approaches for patients, it was observed that his pain intensity decreased upon initiating the practice of adapting ischial tuberosity sitting.

**Reference:**

1. Makhsous, M., Lin, F., Bankard, J. et al. Biomechanical effects of sitting with adjustable ischial and lumbar support on occupational low back pain: evaluation of sitting load and back muscle activity. BMC Musculoskelet Disord 10, 17 (2009).
2. Roebroeck ME, Doorenbosch CA, Harlaar J, Jacobs R, Lankhorst GJ. Biomechanics and muscular activity during sit-to-stand transfer. ClinBiomech (Bristol, Avon). 1994 Jul;9(4):235-44.
3. Lis AM, Black KM, Korn H, Nordin M. Association between sitting and occupational LBP. *Eur Spine J.* 2007;**16**:283–298.
4. Andersson GBJ, Örtengren R. Myoelectric back muscle activity during sitting. *Scand J Rehabil Med.* 1974;3:73–90.
5. Black K, Lis A, Nordin M (2001) Association between sitting and occupational low back pain. In: Grammer symposium, Ulm, Germany. Ergomechanics, Chap. 1, pp 11–35