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Original Article

Estimation of Atraumatic Hip Microinstability Among Long-distance Truck Drivers in Western Maharashtra: A Cross-Sectional Study

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ABSTRACT

Introduction: Hip micro-instability is a growing concern in adults, contributing to hip joint dysfunction and early osteoarthritis. Around 20-25% of people aged 50 and older suffer from hip and knee pain due to chronic wear and tear of joint cartilage. Hip instability is often characterized by painful extra-physiologic hip movements. Long-distance truck drivers often travel long routes with their hips in an ergonomically compromised position, causing pain due to vibrational forces and postural stress.

Methods: A six-month cross-sectional study was conducted in a rural tertiary care hospital in Karad, involving 103 long-distance truck drivers aged 35-45, working over 12 hours a day and 5 days a week without trauma history. The drivers were assessed using the Anterior Apprehension Test, Prone Apprehension Test, and AB-HEER test. The data was analyzed using statistical procedures, providing valuable insights into the drivers' experiences and potential health issues.

Results: The study found that over 12% of participants experienced hip micro-instability, with a significant positive correlation between driving years and pain. The assessment revealed anterior hip micro-instability in flexion (P value = 0.0121), adduction, and internal rotation ranges, while posterior instability was observed in extension, abduction, and external rotation ranges.

Conclusion: The study revealed that over 12% of participants had hip micro-instability. Among truck drivers, anterior hip micro-instability was more common due to capsular laxity caused by prolonged exposure to vibrational forces acting axially over the hip and spine. The study also discovered the existence of hip micro-instability related to ligamentous laxity.

Keywords: Hip joint dysfunction, Hip micro-instability, Hip osteoarthritis, Joint laxity

Introduction

In India, there are an estimated 5–6 million truck drivers, of whom 3.5–4 million are categorized as long-distance drivers.[1] Previously, the Hip joint was particularly considered as a constrained joint that has a powerful suction seal; which helps the joint to achieve its full functional ability.[2,3] So, hip

joint instability was rarely considered or it was thought to be some pathological occurrence like trauma or any kind of developmental bony abnormality like acetabular dysplasia; but the recent evidence of anatomic and finite elemental analysis studies suggests that the relationship between the femoral head and the acetabulum is not perfectly congruent/spherical.[4-7] It is considered to be quasi-hemispherical, as the acetabulum covers only 170° of the femoral head. The posterior coverage is greater than the anterior coverage, which is due to the acetabular tilt of 48° degrees in the coronal plane and 21° in the sagittal plane. The femoral neck is noted to be inclined superiorly by 130° relative to the femoral shaft and anteverted by 10° relative to the femoral trans-condylar axis. Under the influence of physiologic loads there is flattening and widening of the weight-bearing surfaces; and also a translation measuring up to 2-5mm which is observed at the joint.[8, 9]

Micro-instability of the hip is one such new pathology which is generally defined as a painful supra-physiological mobility of the hip that is associated with architectural and functional abnormalities that impair the hip stability.[10-12]

Several risk factors have been noted and described which are responsible for the supra-physiologic motion of the femur relative to the acetabulum, which is classified into 6 categories.[13]

(1) *Bony abnormalities*
(2) Connective tissue disorders
(3) Post-traumatic
(4) *Micro-traumatic*
(5) Iatrogenic
(6) Idiopathic.

The symptoms of hip micro-instability include pain, apprehension, or sensation of instability which can be seen acting only upon the activities demanding major hip involvement. The pain is majorly observed in the inguinal fold which has been progressive over a period of time.[13]

The patho-mechanics for hip micro-instability usually begins with some abnormalities present anatomically in and around the joint; which are subtle or significant in the presence of repetitive forces across the joint. These repetitive forces consist of joint rotation and axial loading which cause damage to the soft tissue stabilizers of the hip, including the labrum and the capsule-ligamentous complex, which then ultimately results in increased translation of femoral head over the acetabulum, stressing the surrounding soft tissues, increasing the labral tension and causing micro-trauma to the joint capsule which leads to labral breakdown and capsular ligament stretching resulting in symptomatic hip micro-instability. Micro-instability once setin, can further cause damage to the bony as well as the chondral surfaces leading to early degenerative changes. Such individuals may or may not have underlying joint laxity.[14,15]A wide range of inflammatory and degenerative conditions affecting soft tissues and skeletal structures that are brought on by or made worse by work or environments associated with it are collectively referred to as work-related musculoskeletal disorders (WMSDs). If treatment for MSDs is delayed, they may worsen and become more serious injuries.[16] One of the largest populations that account for work-related musculoskeletal disorders in the spine and hip is considered to be high mileage truck drivers.[17,18]According to the 2006 statistics, analysis by the Bureau of LabourUS, the drivers of heavy vehicles like trucks and tractors are associated with the second highest number of occupational illnesses and injuries.[19]Similarly some studies show a great prevalence of Work-related musculoskeletal problems (WMSDs) in drivers in the Iranian population.[20]This population has been often linked with the presence of musculoskeletal pain arising due to poor posture, where the drivers are exposed to prolonged periods of vibrational forces acting axially over the spine and hip. This contributes as a major factor in inducing musculoskeletal pain.[21-24]

Loading and unloading heavy goods, decoupling the trailers, tarpaulins to be strapped down, and jumping up and down from the vehicle seat are

the other factors that are linked to the occupation or collectively termed occupational stressors which are also responsible for musculoskeletal pain.[25]Such mechanically demanding activities are carried out by the following large periods of inactivity, lack of preparedness and usually an undernourished body considering the unhealthy eating habits and rest periods during the travel. Such a negative lifestyle is also an important factor leading to musculoskeletal pain amongthem.[26]

There have been limited studies investigating the occurrence of hip pain and hip micro-instability in truck drivers. Therefore, it is critical to assess if hip micro-instability is present as an alternative cause for hip pain in truck drivers.

Methods

This study was conducted in a rural tertiary care hospital in Karad and according to the previous study, prevalence of a total of 103 individuals were randomly selected based on the following selection criteria. They are as follows 1. Long-distance truck drivers by occupation 2. Within the age group of 35-45yrs 3. Working for more than 12 hours in a day 4. Working for 5 days/week 6. No history of trauma.[17] They were assessed by using the Anterior Apprehension Test, Prone Apprehension Test, and AB-HEER test. The recruited subjects were the ones who complained of pain in the hip during their visit to the occupational health screening camp organized at a tertiary care hospital, in Karad, Maharashtra.

Sample size (n) $=(Z_{1-}\propto/2)^2(p)(q)/d^2$

$= 1.96\times1.96\times0.7\times0.3/(0.05)^2$

$= 80$

Where; Z=1.96 at 95% confidence level

p = prevalence=78%=0.7

q=1-p

d=5%=0.05

But in this study, 103 individuals were included.

All the patients were explained the aims, objectives, procedure, and benefits of the current research work along with written consent and verbal informed consent that was taken from all the patients before including them in this study.

The screening was divided into two parts: Interview and Physical Assessment. Interviewing consisted of the collection of Demographic information of the patients including name, age, number of years of driving, presence of any other pathology and/or medications, and presence of ligamentous laxity if yes the score was noted as per Beighton's criteria and a precise subjective pain assessment encompassing Visual Analogue Scale at rest and on movement was documented before physical assessment of the patients was started by first assessing for tenderness which was recorded after palpation at the site of pain and graded according to the grades of tenderness; a range of motion was assessed with the help of goniometer for all the hip ranges; strength of hip musculature was assessed with manual muscle testing of all the muscle groups and graded according to the grades of MMT; provocative maneuvers such as Abduction-Extension-External Rotation test, Anterior Apprehension Test, Posterior apprehension test wasperformed.

The Anterior Apprehension Test/HEER (Hyperextension-External Rotation) is performed with the patient in a supine lying position over the examination plinth at the foot end of the plinth and the legs lying freely off the plinth. The examiner stands over the examination side and applies an anteriorly directed force at the hip, while the contra-lateral hip is flexed by the patient himself holding the extremity. Now the examiner passively hyperextends and externally rotates the ipsilateral hip. If anterior hip pain is provoked in this maneuver, then it indicates positive test results.[27,28]

The Prone Apprehension Test is performed with the patient in a supine position. The examiner stands on the examination side, and the subject's affected hip is placed in 90° flexion, abduction, and internal rotation. The examiner then exerts a force anteroposteriorly downwards on the knee. If any pain sensation is induced it indicates that the test is positive for posterior labral lesion/posterior instability.[27,28]

The AB-HEER test is performed with the patient

in a side-lying position with the affected hip placed upwards. The examiner then abducts the hip to 30°- 45°, extends, and rotates externally. An anteriorly directed force is applied to the posterior aspect of the greater trochanter. A positive test result yields pain in the anterior hip region.[27,28]

Results

The results of the present study revealed that there was the presence of hip micro-instability with hip pain amongst the subjects which caused discomfort. It revealed that over 12% of participants showed positive results for hip micro-instability. A significant positive correlation was observed between the number of years of driving to pain *(p-value < 0.0001)*.On assessment, there was an increase in flexion, adduction, and internal rotation ranges which hence revealed anterior hip micro-instability (P value = 0.0121) as compared to extension, abduction, and external rotation ranges which revealed posterior instability. However, the severity of pain was observed to be related to the years of driving by the subjects. The presence of ligament laxity is a major factor in ruling out hip micro-instability from any other pathology. Depending upon the type of instability i.e. anterior instability or posterior instability the range of motion which was affected was determined.

A total of 103 participants were evaluated for the study. The participants were between 35-45 years and had complaints of pain in their hips (Table 1).

Table 1: Demographic Variables

Demographic variables	No of participants	Percentage of participants(%)
Age		
35-38	29	28.15 %
39-42	38	36.89%
43-45	30	29.12%
More than 45	6	5.82%
Pain region (severity on VAS)		
Gluteal region	19	18.42%
Inguinal region	47	45.63%
The proximalaspect of lateral thigh	24	23.30%
Pain in all 3 regions	13	12.6%
Years of driving		
10-15	49	47.57%
16-20	48	46.60%
More than 20	6	5.82%
Exercising/Non-exercising		
Exercising	0	0%
Non-exercising	103	103%
Laxity		
Present	14	13.59%
Absent	89	86.41%

Among the 103 individuals complaining of hip pain, 12% of them were positive for hip micro-instability and 4% of individuals showed femoral-acetabular impingement and the remaining 84% of individuals need further investigation to rule out the significant root cause for their hip pain.

(Figure 1)

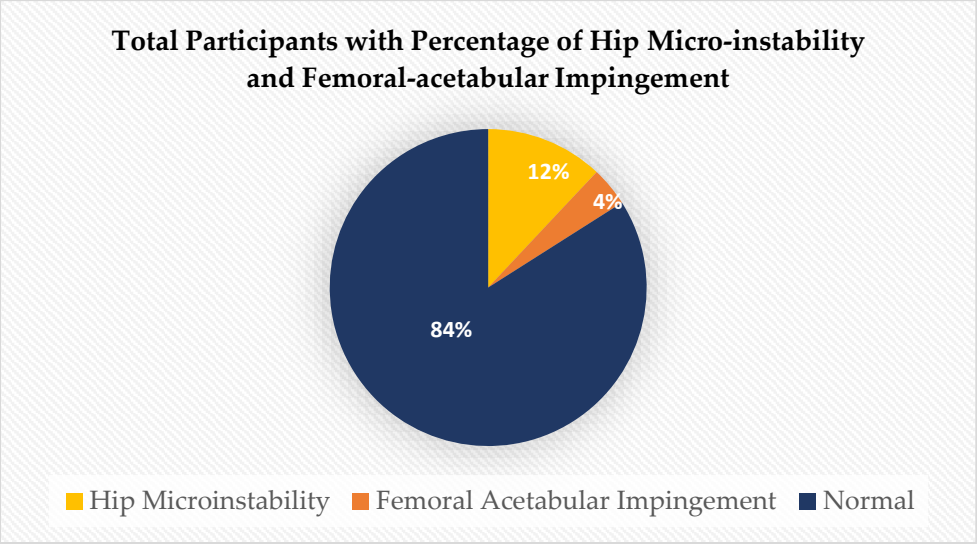

Figure 1: Total participants with the percentage of hip micro-instability and femoro-acetabular impingement

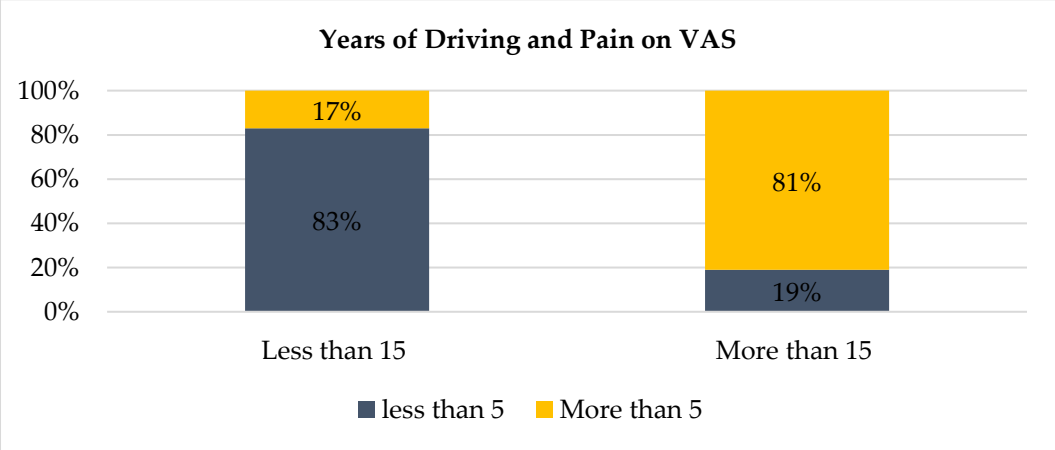

Figure 2: Years of Driving and Pain on VAS

Figure 2 demonstrates a correlation between the number of years of driving and the intensity of pain experienced by the truck drivers, regardless of the presence/absence of hip micro-instability. It was observed that 83% of participants who have less than 15 years of driving experience; showed an average VAS of less than 5 and the remaining 17% more than 5. And similarly, for the subjects who were driving for over more than 15 years; 19% of them showed an average VAS falling below 5 and over 81% of them above 5.

As per previous studies, it is estimated that ligamentous laxity may or may not be present in individuals who have hip micro-instability. The above graphs depict that among the individuals who do not have ligamentous laxity only 5% of them are those who have been diagnosed with hip micro-instability whereas the individuals who have laxity present 79% of them have been diagnosed with hip micro-instability. This thus infers that laxity might be present or absent in individuals with hip micro-instability. (Figure 3)

Figure 4 reveals that the individuals who showed positive results for anterior micro-instability showed significantly increased flexion, internal rotation, and adduction ranges than normal ranges as compared to extension, external rotation, and abduction ranges.

Figure 5 demonstrates that the individuals who

showed positive results for posterior micro-instability showed significantly increased extension, external rotation, and abduction ranges than normal ranges as compared to flexion, internal rotation, and adduction ranges.

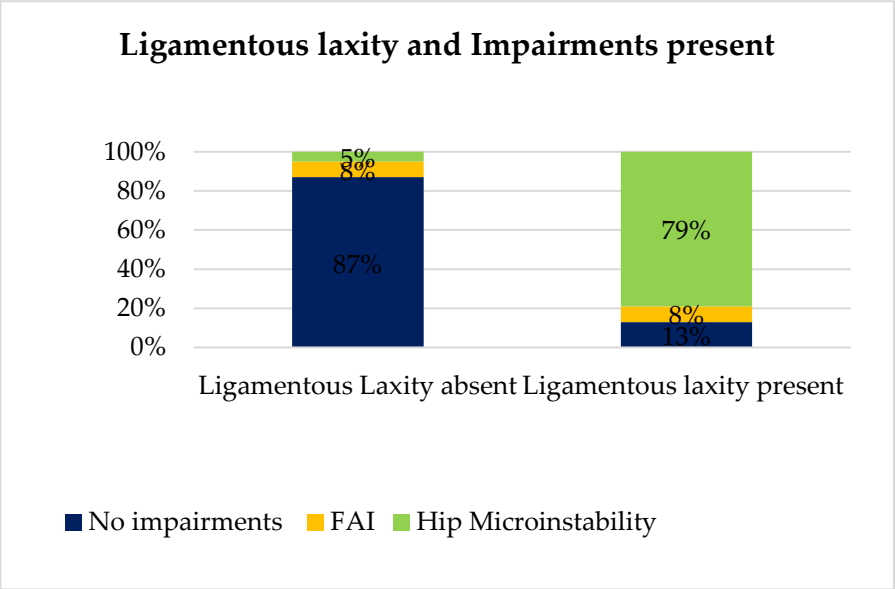

Figure3: Ligamentous laxity and Impairments present

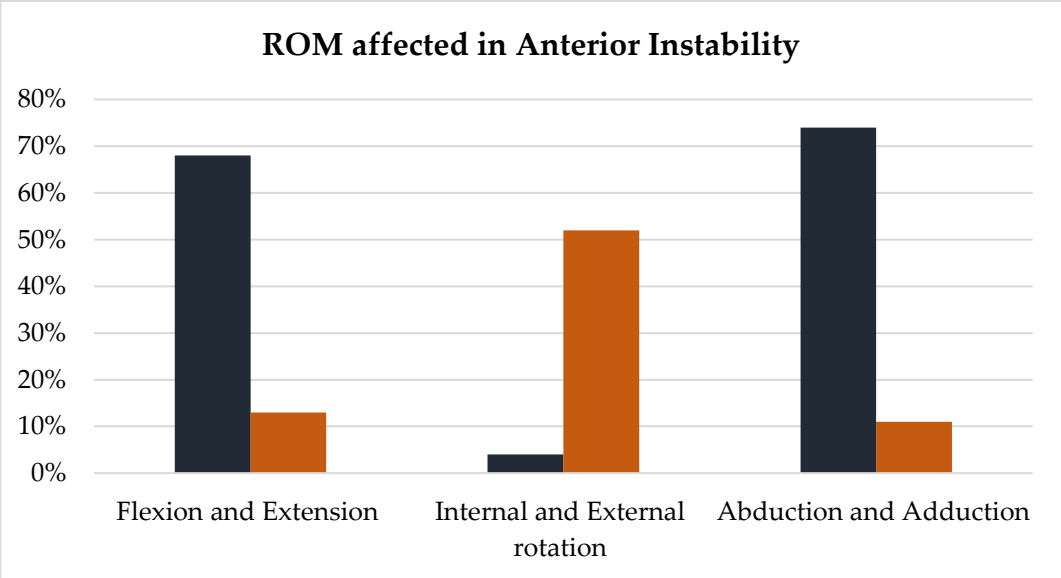

Figure 4: ROM affected in Anterior Instability

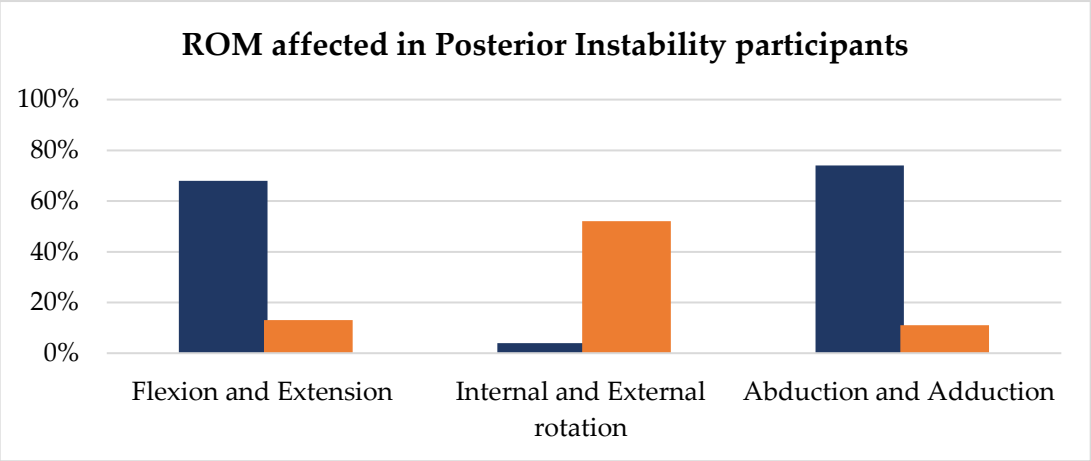

Figure 5: ROM affected in Posterior Instability participants

Discussion

The hip is regarded as an anatomically stable joint because it has passive, active, and neurological elements that work together to promote stability. Truck drivers have been often linked with the presence of musculoskeletal pain arising due to poor posture, wherein the drivers are exposed to prolonged periods of vibrational forces acting axially over the spine and hip. This contributes as a major factor in inducing musculoskeletal pain. Investigations suggest that hip musculoskeletal pain as a whole is one of the main causes of hip micro-instability. Hence, it is important to evaluate the presence of hip micro-instability among long-distance truck drivers.

A review by A.Dangin *et. al* included studies using interviews, clinical examination and imaging as an assessment tool for the evaluation of hip micro-instability as hip instability cannot be diagnosed alone with imaging.[29] Whereas, in our study, we used clinical examination as the standard assessment method along with interview assessment. Another study by D'Hemecourt P and Rodriguez M *et al* used physical assessment as a key investigation method rather than relying on the static imaging modalities for the understanding of micro-instability.[30,31] Whereas this study's results showed that a significant population reflected the presence of hip micro-instability as an underlying cause of pain and discomfort. The results were confirmed with statistical analysis using the "chi-square test". After this, 12% of subjects reflected the presence of hip micro-instability, which thus helps us to bring this pathology into the limelight.

Additionally, Philippon M *et al* depicted that 35% of people presented with hip micro-instability, post previous hip surgery who needed to undergo a revision surgery.[32] Similarly, a study done by McCormick F *et al* depicted that 78% of patients presented radiographic evidence of capsular and iliofemoral defects on the imaging studies done by magnetic resonance arthrography (MRA) who reflected on the symptoms of hip micro-instability after previous surgery.[33] Comparing the study results with Philippon M *et al* and McCormick F *et al*, their findings for the evidence of hip micro-instability were among the post-operative population. Whereas, in our study, we included subjects who don't have a history of surgery or trauma to the hip.[3]

As per studies done by Riboh JC et al and Grahme R, most of the patients who were hyper-laxative showed the presence of microinstability.[34,35] Whereas, Luis Cerezal *et* al stated that hip laxity and micro-instability are not co-related. The subjects who presented with symptoms directed toward laxity; were categorized as positive for micro-instability. Whereas, asymptomatic subjects who were able to subluxate a joint, definitely had laxity but not micro-instability. Clinically, it concluded that a patient with micro-instability will have laxity in both hips, but only the

symptomatic subjects were classified as having micro-instability.[36]Similar results were inferred from our study where 79% of hyper-laxative individuals were diagnosed with the presence of hip micro-instability. While 5% of the population who were diagnosed with hip micro-instability did not report the presence of underlying joint laxity. This opens a new door for further research on whether the presence of joint laxity should or should not be considered as the diagnostic criteria while ruling out hip micro-instability cases.

A study by Dangin*et* al brings into focus the co-relation of capsule relaxation/laxity which focuses on the increase in the range of motion in the joint capsule. The study suggested that the anterior capsule relaxation/anterior laxity led to an increase in the flexion range of motion.[37] While our study was focused on two aspects i.e. anterior or posterior micro-instability; the subjects that showed positive results for anterior micro-instability had anterior capsule relaxation leading to increased flexion, internal rotation, and adduction. Whereas, the subjects' that showed positive results for posterior micro-instability had posterior capsule relaxation leading to increased extension, external rotation, and abduction ranges.

As per the study done by Domb *et* al ; standard assessmentsfor the diagnosis of micro-instability are the three physical examination tests, AB-HEER test, Anterior apprehension test, and Posterior apprehension test. While performing the AB-HEER and anterior apprehension test the hip is externally rotated, which has been shown to result in anterior translation of the femoral head thus depicting anterior capsule relaxation/instability was used.[38] Thus, with this reference anterior and posterior micro-instability was assessed in our study. Also, another study by Shu Safran *et* al performed the posterior apprehension test, wherein the hip is internally rotated and thus, posterior translation of the femoral head has been noted.[14] Also as per Daniel J. Hoppe *et* al the AB-HEER test is the most accurate predictor of hip instability because of its combination of high sensitivity and specificity. However, all 3 tests showed specificities and positive predictive values above85%which makes our reference standards stronger.[27,28]

A cross-sectional study conducted in the community aimed to ascertain the prevalence of low back discomfort among drivers of three wheels. According to the study's findings, three-wheel drivers had moderate to severe emotional and functional interferences as well as moderate to severe low back pain. Within one working day, over half of the subjects described their most severe pain episode.[39]A case study in the year 2022 focused on the employees who worked in the construction industries which was regarding the return to the job of a construction worker following an injury. This study only focused on the rotator cuff injuries of the shoulder but lacked in discussing other underlying problems like changes in the back, in overall posture as well as the impact of their on their hips.[40]

Another study conducted by Sandeep Shinde et al; in the year 2021 consisted of individuals who had pes planus deformity. The study results revealed that individuals with pes planus deformity showed proximal to distal muscular imbalance and a structured strengthening exercise protocol was given to these individuals. This exercise regime further helped in reducing the muscular imbalance.[41] Similarly, further research regarding the truck drivers can be carried out which can focus on providing strengthening protocol for them to improve their hip micro-instability. One more research in the form of a case study was done in January 2023, which was about a female kitchen worker with Kienbock's disease which spoke only about the hand and the consequences faced because of the disease. Herein, early physiotherapy was given to reduce pain, improve the strength of the wrist and finger flexor extensors, improve the range of motion, and vocational rehabilitation to resume her work. But again, being a kitchenworker it is not necessary that problems can be only seen in hands but they can also be seen in other joints specifically the lumbar spine, hips, and knee which were left

unnoticed.[42] Further research can be carried out to see if there is any possible micro-instability seen in these workers as a result of long-standing postures.

Considering the occupational problems of truck drivers and the possible mechanism of injury of hip micro-instability, which are seen to be prevalent in this population hence our study focused on these subjects. Any other study addressing hip pain in truck drivers has not been reflected anywhere. Thus, the further possibility for the extent of degeneration can be ruled out using radiologic evidence standards to enhance the importance of the prevalence of this pathology.

Conclusion

The study revealed that 12% of truck drivers exhibited hip micro-instability. Notably, anterior hip micro-instability was more prevalent than posterior hip micro-instability among this group. The capsular laxity, influenced by prolonged exposure to vibrational forces acting axially over the hip and spine, contributed to these findings. Additionally, the study highlighted the presence of hip micro-instability due to ligamentous laxity.

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References

1. Pandey A, Benara SK, Roy N, Sahu D, Thomas M, Joshi DK, et al. Risk behaviour, sexually transmitted infections and HIV among long-distance truck drivers: a cross-sectional survey along national highways in India. AidsAIDS. 2008 Dec 1;22:S81-90. Available from: https://doi.org/10.1097/01.aids.0000343766.00573.15.
2. Nepple JJ, Philippon MJ, Campbell KJ, Dornan GJ, Jansson KS, LaPrade RF, et al. The hip fluid seal—Part II: The effect of an acetabular labral tear, repair, resection, and reconstruction on hip stability to distraction. Knee Surgery, Sports Traumatology, Arthroscopy. 2014 Apr;22:730-6.Available from: https://doi.org/10.1007/s00167-014-2875-y.
3. Philippon MJ, Nepple JJ, Campbell KJ, Dornan GJ, Jansson KS, LaPrade RF, et al. The hip fluid seal--Part I: the effect of an acetabular labral tear, repair, resection, and reconstruction on hip fluid pressurization. Knee Surg Sports Traumatol Arthrosc. 2014 Apr;22(4):722-9. Available from: https://doi.org/10.1007/s00167-014-2874-z.
4. Afoke NY, Byers PD, Hutton WC. The incongruous hip joint. A casting study. The Journal of Bone & Joint Surgery British Volume. 1980 Nov 1;62(4):511-4.Available from: https://doi.org/10.1302/0301-620X.62B4.7430237.
5. Dy CJ, Thompson MT, Crawford MJ, Alexander JW, McCarthy JC, Noble PC. Tensile strain in the anterior part of the acetabular labrum during provocative maneuvering of the normal hip. JBJS. 2008 Jul 1;90(7):1464-72.Available from: https://doi.org/10.2106/JBJS.G.00467.
6. Safran MR, Lopomo N, Zaffagnini S, Signorelli C, Vaughn ZD, Lindsey DP, et al.In vitro analysis of peri-articular soft tissues passive constraining effect on hip kinematics and joint stability. Knee Surgery, Sports Traumatology, Arthroscopy. 2013 Jul;21:1655-63. Available from: https://doi.org/10.1007/s00167-012-2091-6.
7. Song Y, Ito H, Giori N. Goal of bony resection in femoroacetabularimpingement: a 3-D CT anatomic study. In: PosterPresentation at 55th Annual Meeting of the Orthopaedic Research Society. Las Vegas, NV; 2009. p. 22–5. Available from: https://doi.org/10.1002/jor.20852
8. Gilles B, Christophe FK, Magnenat-Thalmann N, Becker CD, Duc SR, Menetrey J, et al . MRI-based

assessment of hip joint translations. Journal of biomechanics. 2009 Jun 19;42(9):1201-5.Available from: https://doi.org/10.1016/j.jbiomech.2009.03.033.

9. Charbonnier C, Kolo FC, Duthon VB, Magnenat-Thalmann N, Becker CD, Hoffmeyer P, et al . Assessment of congruence and impingement of the hip joint in professional ballet dancers: a motion capture study. The American journal of sports medicine. 2011 Mar;39(3):557-66.Available from: https://doi.org/10.1177/0363546510386002.

10. Jackson TJ, Peterson AB, Akeda M, Estess A, McGarry MH, Adamson GJ, et al. Biomechanical effects of capsular shift in the treatment of hip microinstability: creation and testing of a novel hip instability model. The American Journal of Sports Medicine. 2016 Mar;44(3):689-95.Available from: https://doi.org/10.1177/0363546515620391.

11. Kalisvaart MM, Safran MR. Microinstability of the hip—it does exist: etiology, diagnosis and treatment. Journal of hip preservation surgery. 2015 Jul 1;2(2):123-35.Available from: https://doi.org/10.1093/jhps/hnv017.

12. Domb BG, Philippon MJ, Giordano BD. Arthroscopic capsulotomy, capsular repair, and capsular plication of the hip: relation to atraumatic instability. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2013 Jan 1;29(1):162-73.Available from: https://doi.org/10.1016/j.arthro.2012.04.057.

13. Safran MR. Microinstability of the hip—gaining acceptance. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2019 Jan 1;27(1):12-22. Available from: https://doi.org/10.5435//JAAOS-D-17-00664

14. Shu B, Safran MR. Hip instability: anatomic and clinical considerations of traumatic and atraumatic instability. Clinics in sports medicine. 2011 Apr 1;30(2):349-67.Available from: https://doi:.org/10.1016/j.csm.2010.12.008

15. Boykin RE, Anz AW, Bushnell BD, Kocher MS, Stubbs AJ, Philippon MJ. Hip instability. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2011 Jun 1;19(6):340-9.Available from: https://doi.org/10.5435/00124635-201106000-00004

16. Roli D, Ali I, Neekhra V. Work related musculoskeletal disorders in electrical, telecommunication and instrument mechanics of armed forces. International Journal of Occupational Safety and Health. 2020 Jul 5;10(1):18-27.Available from: https://doi.org/10.3126/ijosh.v10i1.29878.

17. Porter JM, Gyi DE. The prevalence of musculoskeletal troubles among car drivers. Occupational medicine. 2002 Feb 1;52(1):4-12.Available from: https://doi.org/10.1093/occmed/52.1.4.

18. Porter JM, Porter CS, Lee VJA. A A survey of driver discomfort. In Lovesey, E.J. (ed). Contemporary Ergonomics. 1992;262-7. London: Taylor & Francis. Available from: https://doi.org/10.1016/j.trf.2019.04.017.

19. Morales K. UK government to appoint occupational health "tsar" to reduce work related illness. BMJ. 2005 Oct 27;331(7523):986. Available from: https://doi.org/10.1136/bmj.331.7523.986-f.

20. Sadri GH. Risk factors of Musculoskeletal Disorders in Bus Drives. Arch Iranian Med 2003;6(3):214-5. Available from: https://doi.org/10.1002/hfm.20387.

21. Seidel H, and Heide R. Long term effects of whole-body vibration: a critical survey of the literature. International Archives of Environmental Health, 1986;58, 1-26.Available from: https://doi.org/10.1007/BF00378536.

22. Hulshof C, Veldhuijzen van Zanten B. Whole-body vibration and low-back pain: a review of epidemiologic studies. International archives of occupational and environmental health. 1987 Mar;59:205-20.Available from: https://doi.org/10.1007/BF00377733.

23. Bovenzi M, Hulshof CTJ. An updated review of the epidemiologic studies on the relationship between exposure to whole-body vibration and low back pain . International Archives of Occupational Environmental Health. 1999; 72(6): 351-65.Available from: https://doi.org/10.1007/s004200050387.

24. Mansfield, NJ. Human Response to Vibration, 1st Ed. 2005 (London: CRCPress). https://doi.org/10.1121/1.4836496.

25. Phillips DL. Truck drivers and lower back pain. Chiropractic Health Care. 2003. Available from: https://www.drphillipschiro.com/lower-back-pain

26. Jack FR, Piacentini MG, Schröder MJ. Perception and role of fruit in the workday diets of Scottish lorry drivers. Appetite. 1998 Apr 1;30(2):139-49.Available from: https://doi.org/10.1006/appe.1997.0115.

27. Hoppe DJ, Truntzer JN, Shapiro LM, Abrams GD, Safran MR. Diagnostic accuracy of 3 physical examination tests in the assessment of hip microinstability. Orthopaedic Journal of Sports Medicine. 2017 Nov 23;5(11).Available from: https://doi.org/10.1177/2325967117740121

28. Magee DJ. Orthopedic Physical Assessment.Elsevier Health Sciences; 2013. Available from: https://evolve.elsevier.com/cs/product/9780323239790?role=student

29. Dangin A, Tardy N, Wettstein M, May O, Bonin N. Microinstability of the hip: a review. Orthopaedics & Traumatology: Surgery & Research. 2016 Dec 1;102(8):S301-9.Available from:https://doi.org/10.1016/j.otsr.2016.09.002.

30. d'Hemecourt PA, Sugimoto D, McKee-Proctor M, Zwicker RL, Jackson SS, Novais EN, et al . Can dynamic ultrasonography of the hip reliably assess anterior femoral head translation?. Clinical Orthopaedics and Related Research. 2019 May;477(5):1086-98.Available from: https://doi.org/10.1097/CORR.0000000000000457.

31. Rodriguez M, Bolia IK, Philippon MD, Briggs KK, Philippon MJ. Hip screening of a professional ballet company using ultrasound-assisted physical examination diagnosing the at-risk hip. Journal of Dance Medicine & Science. 2019 Jun 15;23(2):51-7.Available from: https://doi.org/10.12678/1089-313X.23.2.51.

32. Philippon MJ, Schenker ML, Briggs KK, Kuppersmith DA, Maxwell RB, Stubbs AJ. Revision hip arthroscopy. The American journal of sports medicine. 2007 Nov;35(11):1918-21.https://doi.org/10.1177/0363546507305097.

33. McCormick F, Slikker W, Harris JD, Gupta AK, Abrams GD, Frank J, et al. Evidence of capsular defect following hip arthroscopy. Knee Surgery, Sports Traumatology, Arthroscopy. 2014 Apr;22:902-5.Available from: https://doi.org/10.1007/s00167-013-2591-z.

34. Riboh JC, Grzybowski J, Mather III RC, Nho SJ. Atraumatic hip instability in patients with joint hypermobility. Operative Techniques in Sports Medicine. 2015 Sep 1;23(3):203-12.https://doi.org/10.1053/j.otsm.2015.05.002.

35. Grahame R, Bird HA, Child A. The revised (Brighton 1998) criteria for the diagnosis of benign joint hypermobility syndrome (BJHS). The Journal of Rheumatology. 2000 Jul;27(7):1777-9. Available from: https://doi.org/10.3109/10582452.2010.501303.

36. Cerezal L, Arnaiz J, Canga A, Piedra T, Altónaga JR, Munafo R, et al. Emerging topics on the hip: ligamentum teres and hip microinstability. European journal of radiology. 2012 Dec 1;81(12):3745-54.Available from: https://doi.org/10.1016/j.ejrad.2011.04.001.

37. Dangin A, Tardy N, Wettstein M, May O, Bonin N. Microinstability of the hip: a review. Orthopaedics & Traumatology: Surgery & Research. 2016 Dec 1;102(8):S301-9.Available from: https://doi.org/10.1016/j.otsr.2016.09.002.

38. Domb BG, Brooks AG, Guanche CA. Physical examination of the hip.In: Guanche CA, ed. Hip and Pelvis Injuries in Sports Medicine. Philadelphia:Wolters Kluwer/Lippincott Williams and Wilkins; 2010:62-70. Available from: https://doi.org/10.1177/2325967117740121.

39. Kebede EB, Terfa YB, Tucho AE, Germossa GN, Hailu FB, Abdisa B, et al. Self-reported low back pain intensity and interferences among three-wheel drivers in Southwest of Ethiopia: A Community-Based Cross-sectional Study. International Journal of Occupational Safety and Health. 2023 Oct 10;13(4):512-20. Available from: https://doi.org/10.3126/ijosh.v13i4.51657.

40. Shinde S, Ghadage P. Return to Job of A Construction Worker by Comprehensive Functional and Vocational Rehabilitation. International Journal of Disabilities Sports and Health Sciences. 2022 Dec 12;5(2):150-7. Available from: https://doi.org/10.33438/ijdshs.1106819.

41. Sawant Janhavi M, Shinde S. Effect of lower limb proximal to distal muscle imbalance correction on functional pes planus deformity in young adults". Journal of medical pharmaceutical and allied sciences. 2021;10(4):3469-73. Available from: https://doi.org/10.22270/jmpas.V10I4.1477.

42. Shinde S, Arulekar R, Dhane S, Bhende R, Saptale A. Comprehensive Functional and Vocational Rehabilitation of A Kitchen Worker with Kienbocks Disease. International Journal of Disabilities Sports and Health Sciences. 2023 Feb 2;6(1):53-9. Available from: https://doi.org/10.33438/ijdshs.1191467.