A systematic review protocol on biomechanical changes in spinal loading in young adults with post traumatic knee stiffness

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Abstract

Post-traumatic knee stiffness (PTKS) is one of the most common complications of injuries occurring around the knee joint. Post-traumatic knee stiffness can occur due to fibrotic transformation of peri-articular structures or the formation of intra-articular adhesions. On the basis of restrictions in range of motion (ROM), causative factors of post-traumatic knee stiffness can be divided into flexion contractures, extension contractures and combined contractures. Generally, flexion contractures are due to posterior adhesions or anterior impingement or both and extension contracture is due to anterior adhesions or posterior impingement or both.

Musculoskeletal injuries are the commonest type of injuries in sports and other physical activities, which comprises of 80% of injuries. Knee joint which is most frequently injured body part, knee joint injuries constitutes a significant percentage of injuries in all sportspersons, both professional and recreational. The body acts together in a closed kinetic chain and any alteration in movement at one joint influences movement at other joints. Ground reaction forces act through the linkages of the feet, knees and legs into the spine and pelvis. Distortions in spinal regions and pelvis can be due to altered biomechanics of the knee joint. There are various factors through which the relationship between low back pain or disorders and knee pain can be explained. A closed kinetic relationship exists between the lumbar spine and knee joint and any dysfunction in knee or lumbar region may result in compensation, joint dysfunction and pain in either one or both the regions. Understanding this relationship between the biomechanical deviations in the knee joint and its implications on spinal posture and loading will improve the effectiveness of individual case management.

Background

Post-traumatic knee stiffness (PTKS) is one of the most common complications of injuries occurring around the knee joint. Post-traumatic knee stiffness can occur due to fibrotic transformation of peri-articular structures or the formation of intra-articular adhesions. On the basis of restrictions in range of motion (ROM), causative factors of post-traumatic knee stiffness can be divided into flexion contractures, extension contractures and combined contractures. Generally, flexion contractures are due to posterior adhesions or anterior impingement or both and extension contracture is due to anterior adhesions or posterior impingement or both[1].

Post-traumatic knee stiffness is a major complication of the knee joint after trauma or surgery. It can be classified into 2 types: intra-articular adhesion type and extra-articular adhesion type. On the basis of limitations of motion, PTKS can also be classified into flexion limitations and extension limitations. The intra-articular and extra-articular adhesion with flexion and extension limitations coexist in PTKS due to various reasons like- high-velocity injury, the occurrence of infection after surgery, improper treatment and rehabilitation[2].

Physical activity plays an important role in maintaining health and well-being for individuals of all ages and has been responsible for decreasing health risks and body mass index, and increasing physical competency and social interaction. But, physical activity also carries a risk of injury, which can jeopardizes physical, psychological, social, emotional, and economic well-being of an individual. Participation in sports and other physical activities is considered a major risk factor for knee injury among young adults. Knee joint is the most commonly injured joint in adolescent athletes, in USA, with an estimated 2.5 million injuries per year. Such type of injuries usually requires expensive surgery and extensive rehabilitation. A knee injury can temporarily and to some extent permanently affects physical activity and physical capabilities. In addition, while knee injuries can affect injured individuals economically, they also pose a burden on the health care system[3].

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Immobilization of knee joint for long period of time can result in reduced range of motion and eventually its stiffness. This can lead to muscle contractures and instability of the knee joint. Post-traumatic knee stiffness is a common complication after knee arthroplasty, ligament repairs and trauma. Reduced knee joint range of motion suggests an intra-articular pathology. The extra-articular restriction to flexion may be due to tightness of the quadriceps as a result of quadriceps fibrosis or due to presence of bony mass behind the knee[5].

The intra-articular causes of stiffness can be re-modeling of tissues leading to intra-articular adhesions, retraction of peri-articular soft tissues, excessive proliferation of fibrous scar tissue, and bone impingement due to intra-articular mal-union; and the extra-articular causes of stiffness can be adhesion of the quadriceps to femoral aponeurosis, femoral callus or inter muscular septum, or due to retraction of the muscle fibers due to formation of skin adhesions and scar tissue in the deeper layers[6].

Reduced range of motion in flexion can occur due to anterior adhesions (joint capsule, quadriceps, quadriceps bursa, patellar retinaculum), posterior impingement (femoral mal-union), and patella infera. Recent radiographs of knee joint are important in diagnosing the bony pathology. Radiographs of the femur bone are also required in case of its facture. CT and MRI can prove to be a useful tool in distinguishing the reasons behind the stiffness and can help in determining the presence of ligament, meniscus or cartilage injuries and the presence of bony mal-union in the joint. Reduced range of motion in extension or flexion deformity, can occur due to contracture of anterior cruciate ligament and posterior cruciate ligament. On the other hand reduced range of motion in flexion can occur due to anterior impingement and contracture of the posterior joint capsule[7].

Human body is a series of multiple segments and all the segments of the body act together in closed kinematic chain and if any change occurs in the structure of one segment then directly or indirectly, it becomes responsible for bringing compensatory changes in adjacent segments and joints. In response to the changes in the knee joint, compensatory changes occur in the pelvis and other joints in lower extremity. Reduction in the range of motion of the knee joint leads to increased motion of pelvis and the change in kinematic interaction affect mobility and stability of the lumbar spine and can cause pain and dysfunction in lumbar region of the spine[8].

The body acts together in a closed kinetic chain and any alteration in movement at one joint influences movement at other joints. Ground reaction forces act through the linkages of the feet, knees and legs into the spine and pelvis. Distortions in spinal regions and pelvis can be due to altered biomechanics of the knee joint**.** There are various factors through which the

relationship between low back pain or disorders and knee pain can be explained. A closed kinetic relationship exists between the lumbar spine and knee joint and any dysfunction in knee or lumbar region may result in compensation, joint dysfunction and pain in either one or both the regions[9].

Understanding this relationship between the biomechanical deviations in the knee joint and its implications on spinal posture and loading will improve the effectiveness of individual case management. Directing the attention of the physical therapists to assess and evaluate the complete body posture of the patient and to not to just focus their entire attention on the symptomatic area is important only, as changes in the posture of the knee can produce long-term effects both in spinal and pelvic regions. If these alterations are neglected then symptoms can be referred to other parts because of the failure of properly diagnosing the underlying, being in the knee.

Objectives

The primary objective of this review is to evaluate systematically the biomechanical changes in spinal loading among patients with post-traumatic knee stiffness

Key review question-

1. What is the impact of knee stiffness on lumbar spine loading?

   P= Adult patients with post-traumatic knee stiffness.

   I= No intervention.

   C= any comparator

   O= any measure of outcome related to assessment of functions and load on lumbar spine

   S= any kind of setting in any area/country

Secondary review questions-

1. What precautions and contraindications need to be taken into account while evaluating the changes in lumbar spine loading in patients with post traumatic knee stiffness?

The articles selected from the search findings for the key review question will be reviewed further to answer the secondary review question. Selected articles will be investigated for additional information:

2. What challenges are faced by the researcher while evaluating the changes in lumbar spine loading in patients with post traumatic knee stiffness?

Methods

Study design

This systematic review protocol will be reported according to the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P).

Eligibility Criteria

Type of study

All cross-sectional studies evaluating the impact of knee stiffness on loading of lumbar spine will be included in this systematic review protocol, including feasibility studies, pilot studies. RCTs, review articles, editorials, case studies, qualitative studies, animal studies and study protocols will be excluded.

Participants

Studies will be involved only human participants of 35 year age with post traumatic knee stiffness. There will be no restriction on unilateral or bilateral involvement of knee. Both the genders i.e. males and females will be included. Studies involving animals as participants will be excluded from the review. Studies with patients suffering with other acute/chronic serious illness will be excluded from the study. Studies involving mentally challenged or psychosocially unfit patients will also be excluded in this review.

Interventions

Studies without interventions will be included in this review. Any comparator will be included.

Outcome Measures

Outcomes measures for evaluation of biomechanics to monitor the motions of lumbar spine, related to the kinetics and kinematics of lumbar spine, forces acting on lumbar spine with validated tools for functional assessment and spinal load assessment should be used at least once in the studies will be included.

Language

We will only consider full text articles published in English.

Search Strategy for identification of relevant studies

A comprehensive search will be conducted at the library of Lovely Professional University (LPU) and library of Swami Vivekanand Subharti University (SVSU), Meerut during the period

of 6-9 months. All bibliographic databases of published research papers which are easily accessible will be assessed. All databases included will be searched and all the papers published till 2018 will be included. The electronic database will include Google Scholar, Index Copernicus, JSTOR, Pubmed/Medline, Science Direct, Scopus and Web of Science.

The terms in the title 'knee joint stiffness' or 'stiffness of knee' or 'post-traumatic knee joint stiffness' or 'meniscal injury at knee' or 'ligaments injury at knee' and 'fracture at knee joint' or 'fracture around knee' and 'lumbar spine biomechanics' or 'kinetics of lumbar spine' or kinematics of lumbar spine'.

Study records

All the searched results will be merged using reference management software 'Mendeley'.The result of electronic searches will also be saved to the researcher's account on PUBMED. The principal investigator/researcher will create a shared folder on 'Google drive' to encourage and facilitate collaboration among reviewers and to make it accessible by all the researchers. The physical backup will be maintained by keeping the printed copies of summaries of all the screened articles.

Data extraction

Data from included studies will be extracted using a standardized data extraction form. Two reviewers 'Sumit Raghav' and 'Anshika Singh', both physiotherapists, will search the databases independently and screen the titles and abstracts for eligibility. The searched titles and abstracts will be examined carefully and irrelevant reports will be removed. The full text of selected potentially relevant articles will be obtained; multiple articles of the same study on different database will be linked to minimize the duplication. Both the reviewers will thoroughly assess full text articles to check their compliance in accordance with the inclusion and exclusion criteria.

The correspondence with the authors will be done to clarify if there is any confusion present. In case of disagreement between the researches, the decision of third reviewer 'Suresh Mani' will be considered final. The data analysis/ synthesis of the articles meeting the eligibility criteria will be done by the reviewer 'Sumit Raghav'. The reviewer will also search the references for articles manually to include in data extraction.

Risk of bias

To assess the risk of bias the Cochrane collaboration tool will be used. To assess the quality of literature Modified Downs and Black 27 point scale will be used.

Quality of evidence

A narrative synthesis of the selected studies from the search findings will be provided due to the likely heterogeneity of the outcome measures. Patient's population and outcome measures will be described in a narrative summary. Information on adherence to the protocol, resources used, compliances monitoring and expenditure will extracted from the selected studies, if available. Revman software will be used for meta-analysis.

Discussion

In our knowledge, this review will be the first review on previous evidence related to evaluate the lumbar spine loading among patients with post traumatic knee stiffness. This review will provide an answer to the question on the effect of knee stiffness on lumbar spine loading. Information related to the safety measures that have been taken to prevent adverse events during the biomechanical analysis of lumbar spine loading will be included.

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References

1. *Pujol, N., Boisrenoult, P. and Beaufils, P. (2015) 'Post-traumatic knee stiffness: Surgical techniques', Orthopaedics and Traumatology: Surgery and Research, pp. S179–S186. doi: 10.1016/j.otsr.2014.06.026.*
2. *Pujol, N., Boisrenoult, P. and Beaufils, P. (2015) 'Post-traumatic knee stiffness: Surgical techniques', Orthopaedics and Traumatology: Surgery and Research, pp. S179–S186. doi: 10.1016/j.otsr.2014.06.026.*
3. *Gage, B. E. et al. (2012) 'Epidemiology of 6.6 million knee injuries presenting to United States emergency departments from 1999 through 2008', Academic Emergency Medicine, 19(4), pp. 378–385. doi: 10.1111/j.1553-2712.2012.01315.x.*
4. *Nicolini, A. P. et al. (2014) 'Common injuries in athletes' knee: experience of a specialized center', Acta Ortopédica Brasileira, 22(3), pp. 127–131. doi: 10.1590/1413-78522014220300475*
5. *Schiavone Panni, A. et al. (2009) 'Stiffness in total knee arthroplasty', Journal of Orthopaedics and Traumatology, pp. 111–118. doi: 10.1007/s10195-009-0054-6*
6. *Pujol, N., Boisrenoult, P. and Beaufils, P. (2015) 'Post-traumatic knee stiffness: Surgical techniques', Orthopaedics and Traumatology: Surgery and Research, pp. S179–S186.*

doi: 10.1016/j.otsr.2014.06.026

7. *Pujol, N., Boisrenoult, P. and Beaufils, P. (2015) 'Post-traumatic knee stiffness: Surgical techniques', Orthopaedics and Traumatology: Surgery and Research, pp. S179–S186. doi: 10.1016/j.otsr.2014.06.026*
8. *Burnett, D. R. et al. (2015) 'Biomechanics of lower limbs during walking among candidates for total knee arthroplasty with and without low back pain', BioMed Research International, 2015. doi: 10.1155/2015/142562*
9. *Alfeky, F. M., Draz, A. H. and Elsayed, W. H. (2016) 'The effect of knee osteoarthritis on lumbar proprioception', International Journal of PharmTech Research, 9(4), pp. 80–91*