

## Effective Procedure to Treat Knee Instability in Diabetic Patients

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**Abstract**—This article gives the permanent way of treating knee instability or in general terms, knee buckling in patients suffering from diabetes mellitus. Diabetic patients usually suffer from a lot of potential complications. One of the major setbacks is muscle degeneration due to protein imbalance. This leads to knee weakness and inability to walk normally. This is a main problem in old patients since they are more prone to fall and there is no permanent treatment as of now. Temporary methods like knee braces do not treat this and only act as an assist device. Our main aim is to provide an enduring solution to knee buckling

**Keywords**— diabetes mellitus, knee instability, muscle degeneration, protein imbalance, knee braces

### I. INTRODUCTION<sup>1</sup>

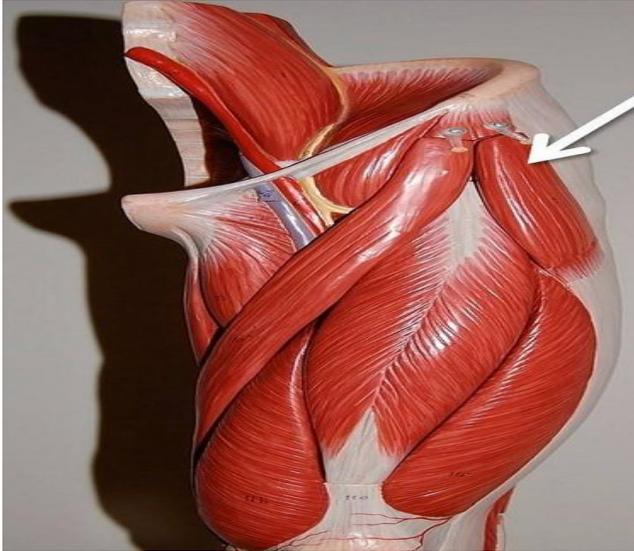
The disease diabetes mellitus in which the body's ability to produce or respond to the hormone insulin is impaired, resulting in abnormal metabolism of carbohydrates and elevated levels of glucose in the blood. It causes various complications like retinopathy, cardiovascular diseases, neuropathy, foot damage, muscle degeneration and knee instability. In this article we focus on knee instability because there is no permanent cure for it. The existing methods are knee braces, physiotherapy exercises and complicated surgery. Among these, surgery is slightly effective but it involves many complications. Knee buckling is when one or both the knees give out. It is also referred to as knee instability or weak knees. While it is often accompanied by pain, this isn't always the case. Frequent knee buckling also raises the risk of falling and seriously injury. In one study, 11.8 percent of adults aged 39-94 reported at least one episode of knee buckling in the past 3 months. It can affect people of all ages and levels of fitness especially when they have diabetes. This knee instability is due to the weakness of muscles known as quadriceps muscles that hold the knee cap in position.

### II. CAUSES FOR KNEE BUCKLING IN DIABETES MELLITUS

Knee buckling in diabetes is due to the degeneration of muscles in other terms known as muscle atrophy. Muscle atrophy refers to the condition in which there is a decrease in mass of the muscle, it can be a partial or complete wasting away of muscle. When muscle atrophies, this leads to muscle weakness, since the ability to exert force is related to mass. Due to diabetic condition, there is imbalance in the protein synthesis and protein degradation where the latter occurs more which leads to atrophy of muscle. Muscle atrophy occurs in the quadriceps muscle which leads to knee buckling in diabetic patients since quadriceps muscle is present in the front thigh and is responsible for the stability for the knee cap. Due to muscle atrophy there is a decrease in muscle tonicity which is the continuous and passive partial contraction of the muscles or the muscle's resistance to passive stretch during resting state. The tonicity of muscles decreases when there is a decrease in the protein level which is linked to muscle atrophy.

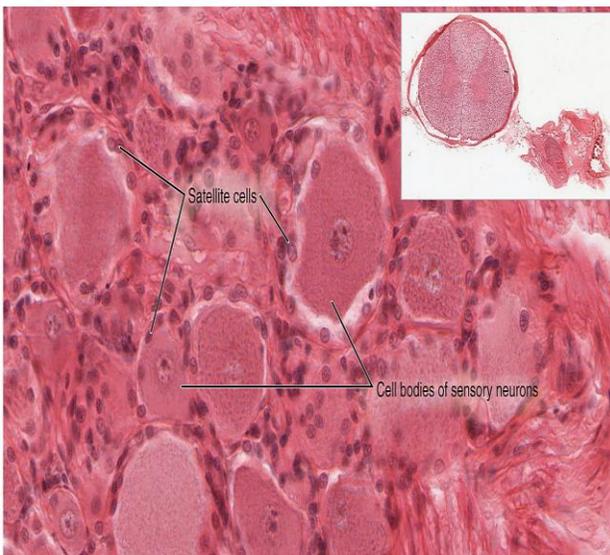
### III. RELATION BETWEEN FASCIA AND KNEE BUCKLING

A fascia is a sheet of dense connective tissue beneath the skin that attaches, stabilizes, encloses and separates muscles and other internal organs. It also plays an important role in human posture and movement regulation. Fasciae runs around and through the muscle and fasciae associated with quadriceps muscle known as "**Fasciae Latae**" which is type of deep fasciae that plays a major role in knee instability. Since atrophy of quadriceps muscles in diabetic patients leads to tightening of fasciae latae, it causes inability for contraction of quadriceps muscle which in turn indicates the decrease in muscle tonicity. Therefore tightening of muscle fasciae in diabetic patients also gives a major impact to knee instability. Deep fasciae are associated with muscles, nerves and the nerve running from spine to thigh which goes above and under fasciae latae is femoral nerve. Atrophy or shrinking of thigh muscles causes fasciae latae to tighten up, thus compressing the femoral nerve which leads to "**Femoral Neuropathy**". Femoral neuropathy contributes to tingling of knee and knee buckling since femoral nerve weakness affects muscles.



#### IV. SATELLITE CELLS AND KNEE STABILITY

Skeletal muscle **satellite cells** are quiescent mononucleated myogenic **cells, located** between the sarcolemma and basement membrane of terminally-differentiated muscle fibres. Satellite cells are precursors to skeletal muscle cells, able to give differentiated skeletal muscle cells. They have the potential to provide additional myonuclei to their parent muscle fiber, or return to quiescent state. They are inactive in muscle atrophy therefore is less in number in diabetic patients. It is used for regeneration and growing of the cells thus acting as muscle stem cells. Myostatin is a protein which inhibits the differentiation of satellite cells.



#### V. METHOD

a. By default, diabetic patients have atrophied muscle which contributes to knee buckling. Thus when satellite cells are generated in these areas, it causes cells to regenerate in that area and results in strengthening of muscles. Satellite cells induce hypertrophy in the body. It is also activated when skeletal muscle is injured at cellular level.

b. Our aim is to damage the quadriceps muscle to activate the satellite cells in that region to induce hypertrophy in the quadriceps muscle.

c. Satellite cells can be activated by mechanical stretch and electrical stimulation because both of them damage the muscle fibres and hence satellite cells move from their dormant state and are activated and go to the site which is damaged to regenerate the cells.

d. Electrical stimulation is preferred since it is able to maintain muscle tone and strength which would otherwise waste away.

e.

d. Continuous electrical stimulation or mechanical stretch is given to the atrophied quadriceps muscle over a period of time. Due to this the satellite cells move towards the damaged site and produce new cells.

e. This gives rise to new muscle fibers and increases the mass of the muscle. Increase in mass also results in the increase in tonicity of muscle. This helps in the contraction of the thighs and brings back the stability to the knee cap.

#### VI. CONCLUSION

Therefore by activating the satellite cells in the quadriceps muscles, regeneration of the muscles occur which cures the muscle atrophy gaining muscle mass. When the muscle mass increases, the fasciae surrounding it also loosens up thus releasing the compression on the femoral nerve. This cures femoral neuropathy. When the muscle is strengthened and muscle tonicity is increased which enables contraction. All this leads to the stabilization of the knee cap which ultimately fulfills our objective of treating knee buckling in diabetic patients.

#### ACKNOWLEDGMENT

The authors appreciate the extensive guidance from Dr.Hemachandran Ravikumar. They would like to acknowledge Rajalakshmi engineering college for their help during the research.

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