

## EFFECTIVENESS OF PLYOMETRIC TRAINING ALONG WITH THERABAND EXERCISE ON Q ANGLE, DISTANCE OF ANKLE MEDIAL MALLEOLUS AND FUNCTIONAL PERFORMANCE OF FEMALE BASKETBALL PLAYER WITH GENU VALGUS

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### **ABSTRACT**

**BACKGROUND:** Genu valgum is one of the common type deformity, referred as knock knees. In most of the cases, athletes and other sports persons may develop as a result of underlying weakness of lower limb muscles due to repeated and vigorous activities.

**OBJECTIVES:** The objective of this current study is to evaluate the effects of plyometric training along with theraband resistance exercises in the management of Genu Valgum.

**SUBJECTS AND METHODS:** The study design was a single case study. A 23 years old female basketball player with genu valgum was taken for this study.

**RESULT:** The pre-test and the post-test values of Y balance test, of non-dominant foot is 79.2% and 88.4% respectively. The pre and post-test values of Y balance test of dominant foot was 80.4% and 90.5% respectively. The pre and post-test values of Q angle was 25 and 22. The pre-test and the post-test values of intermalleolar distance was 8 and 6 respectively. Thus, statistical analysis shows significant improvement in Q angle, distance between ankle medial malleolus and functional performance of female athlete after 8 weeks.

**CONCLUSION:** The study concluded that there was statistically significant effectiveness of plyometric training along with theraband exercise on reduction of Q angle, distance between ankle medial malleolus and improvement in the functional performance of female basketball player with genu valgus.

**CLINICAL IMPLICATION:** Plyometric training exercise of knee is found to produce significant effect when combined with theraband resistance exercise to manage genu valgum in athletes.

**KEYWORDS:** Genu valgum, Q angle, Intermalleolar distance, Plyometrics, Theraband, Basket ball

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## INTRODUCTION

Genu valgum is otherwise known as knock knee. The word Genu valgum is derived from the Latin word which means Genu-knee, valgus-turned outward(knock) <sup>(1)</sup>. Genu valgum or knocked knees are part of the coronal plane deformities of the lower extremity. It is a common lower leg deformity usually seen in toddlers, pre and early school age children. It is also commonly seen in obese people when they work long time in standing position. Individuals with severe valgus deformities are typically unable to touch their feet together while simultaneously straightening the legs.

Majority of patients are asymptomatic and have no functional limitation. This condition can be preceded by flat feet and occasional medial foot and ankle knee pain <sup>(2)</sup>. The weakness of lower limb muscles followed by internal rotation of femur and external rotation of tibia, shift the gravitational pull to outside of the knee. Intermalleolar distance has been used to assess the degree of valgum<sup>(3)</sup>.Genuvalgum is an abnormal condition of knee where the medial tibiofemoral angle is greater than  $185^{\circ}$ . An increase in the normal tibiofemoral angle results in Genu valgum or “knock knees”. Compressive forces are increased on the lateral aspect of the knee whereas tensile force is decreased medially <sup>(4)</sup>.Higher percentages of occurrence were found among the obese category. Thus, the chance of occurrence of valgus knee in overweight school children is 6.0 and 75.7 times higher than among thin or eutrophic subjects. This deformity is more common in females compared to males as females normally have a wider pelvis. Bilateral Genu valgum is caused due to Obesity/Overweight. Due to overweight your placing a lot of stress on your knees as your knees can only handle a limited amount of load. So now this extra amount of load will place too much pressure on your knees. Unilateral Genu valgum is caused due to Post traumatic Tumour, Infection.

The knee complex is one of the most often injured joints in the human body. Dynamically the knee complex is responsible for moving and supporting the body during a variety of both routine and difficult activities. The knee complex is composed of two distinct articulations located within a single joint capsule. The anatomic (longitudinal) axis of the femur is oblique, directed inferiorly and medially from its proximal to the distal end. The anatomic axis of tibia is directed almost vertically. Consequently, the femoral and tibial longitudinal axis normally form an angle medially at knee joint of  $180^{\circ}$  to  $185^{\circ}$ , that is the femur is angled up to  $5^{\circ}$  of vertical, creating a slight physiologic valgus angle at the knee. If the medial tibiofemoral angle is greater than  $185^{\circ}$  an abnormal condition called genu valgum exist. Genu valgum shifts the weight bearing line on to the lateral compartment, increasing the lateral compressive force while increasing the tensile force on the medial structures. The presence of genu valgum creates a constant overload of lateral or medial articular cartilage, respectively which may result in damage to the articular cartilage and development of frontal plane knee laxity<sup>(4)</sup>.The Q angle (quadriceps angle) is the angle formed between a line connecting the ASIS to the midpoint of patella and a line connecting the tibial tuberosity and midpoint of patella. A,Q angle of  $10^{\circ}$  to  $15^{\circ}$  measured with the knee either in full extension or slightly flexed is considered as normal. Symptoms may include Knee or hip pain, Foot or ankle pain Feet not touching, Stiff or sore throat, A limp while walking, Reduced range of motion in hips Difficulty walking or running.

It is investigated using plane radiograph. It is diagnosed by calculating the Q angle, also diagnosed by goniometer to check the tibio femoral angle. It is important to determine whether the deformity is primarily originating from the femur or tibia. The tibiofemoral angle is measured as the angle formed by lines drawn along the long axis of femoral and tibial shafts. This can be assessed by goniometer while the subject is in standing position with patella pointing forward and both knees touching each other. The medial tibiofemoral angle is greater than  $185^{\circ}$  is considered as Genu valgus<sup>(6)</sup>.In this

condition the Centre of gravity [COG] that descends from the centre of hip joint tends to outside of knee joint. Subsequently altering the pattern of the body weight.

The intermalleolar distance greater than 8 cm is considered pathologic. Rarely in cases where valgus alignment continues to increase, it can be associated with an out-toed gait, lateral subluxation of patella, and rubbing of knees together while walking. Treatment of Genu valgum depends on the causes and severity of the symptoms.

In case of athletes, due to repeated sports activities, lot of stress is transferred to knees and this extra stress is placing much pressure on the knees. And it will force knee into knock knee position. Conservatively, managed by weight loss, exercise. It can be corrected by wearing knock knee braces. Medical management include Vitamin D supplements, Nonsteroidal anti-inflammatory drugs if over the counter option like naproxen. In PT management It involves stretching and strengthening exercise, heel wedges. Gradual knee mobilisation is the main part of treatment here. In order to relieve pain electrotherapy treatment modalities can be given.

## **METHODOLOGY**

### **Study Design**

The study design was a single case study. A 23 years old female basketball player with genu valgum was taken for this study.

### **Methods**

The subject received plyometric exercise followed by theraband resistance exercise for 45 minutes per session, 3 days in a week for 8 weeks. The pre and post score values of functional performance was measured using Y balance test. Q angle measurement was done using goniometer and IMD was measured using Vernier caliper. Before starting the study pre-score values of Y balance test, Q angle and distance between ankle medial malleolus were measured followed by measurement at end of 2<sup>nd</sup> week, end of 4<sup>th</sup> week and end of 6<sup>th</sup> week. After the 8<sup>th</sup> week post score was measured and the data was recorded.

## **DESCRIPTION OF EXPERIMENTAL INTERVENTION**

### **Plyometric Training**

Plyometric training first made its name through state sports trainers in the former East Germany in 1970's. Yuri Verkoshansky known as the father of Plyometrics, published his study in plyometrics in 1964. It is a type of exercise training that uses speed and force of different movement to build muscle power<sup>(7)</sup>. This training can improve our physical performance and ability to do different activities.

These are exercises that involve explosive movement. The improvement of functional performance using plyometric training is more because of the neural adaptation. Plyometric training is used for faster activation of motor units for more suitable neuromuscular adaptation.

## **THERABAND EXERCISES**

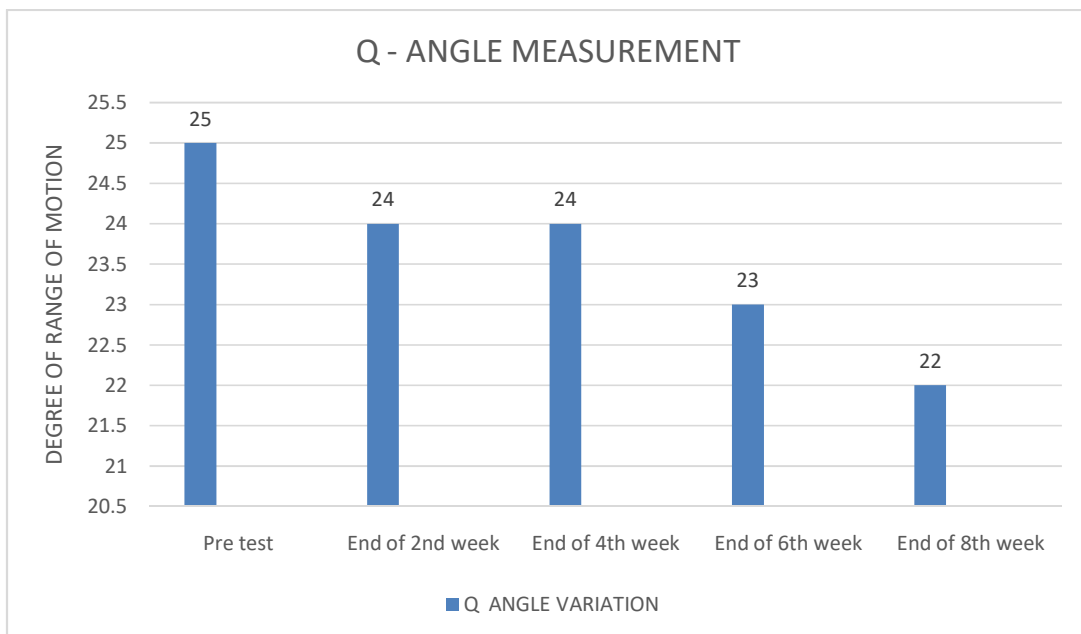
The first patent for a product similar to today's resistance band was filed in 1895 in Switzerland by Gustav Gossweiler. It was introduced in the form of stretchy rope with handles. A resistance band is an elastic band used for strength training. It

refers to form of exercise where you lift or pull against resistance. Strengthening this muscle in hip joint causes the femur to be rotated externally and prevent it from internal rotation.

A factor that increases the Q angle is femoral abduction; thus, it could reduce the Q angle by increasing the strength of hip abductor muscles. Some of the exercises included in this study is the side lateral raise, squat, resistance band pull apart, chest press<sup>(8)</sup>.

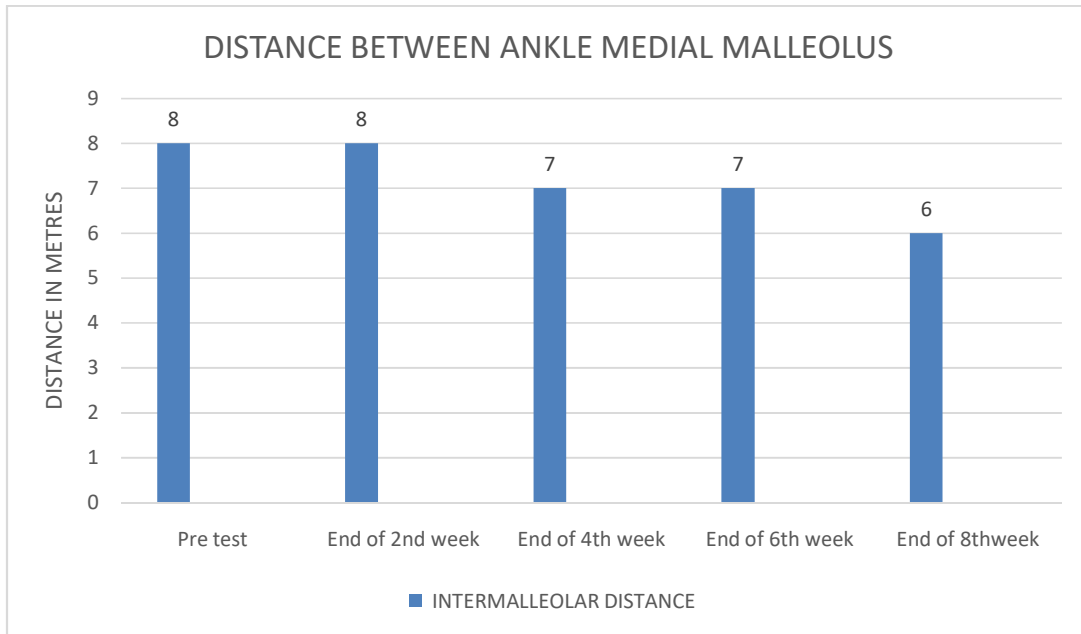
## RESULTS

The pre-test and the post-test values of Y balance test, of non-dominant foot is 79.2% and 88.4% respectively. The pre and post-test values of Y balance test of dominant foot was 80.4% and 90.5% respectively. The pre and post-test values of Q angle was 25 and 22. The pre-test and the post-test values of intermalleolar distance was 8 and 6 respectively. Thus, statistical analysis shows significant improvement in Q angle, distance between ankle medial malleolus and functional performance of female athlete after 8 weeks.



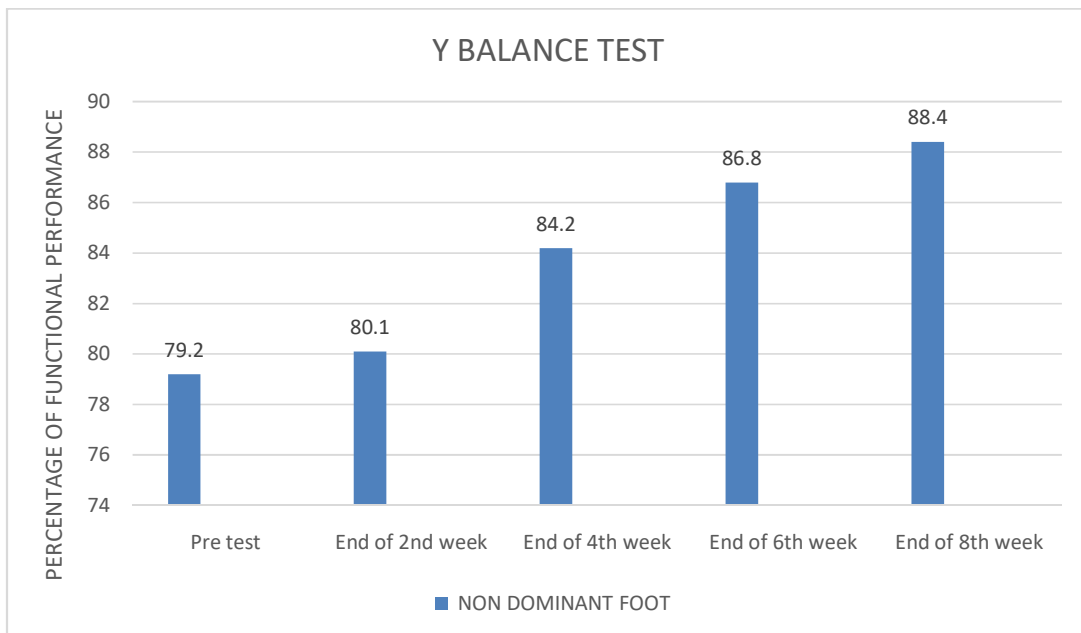
**Figure 1: Descriptive Analysis for Q Angle Variation using Goniometer.**

The pre test and post test values of goniometer was 25 and 22 at 3% level of significance. This proved that there was a significant reduction in Q angle among genu valgum subject after application of theraband resistance exercises.



**Figure 2: Descriptive Analysis of IMD using Vernier Caliper.**

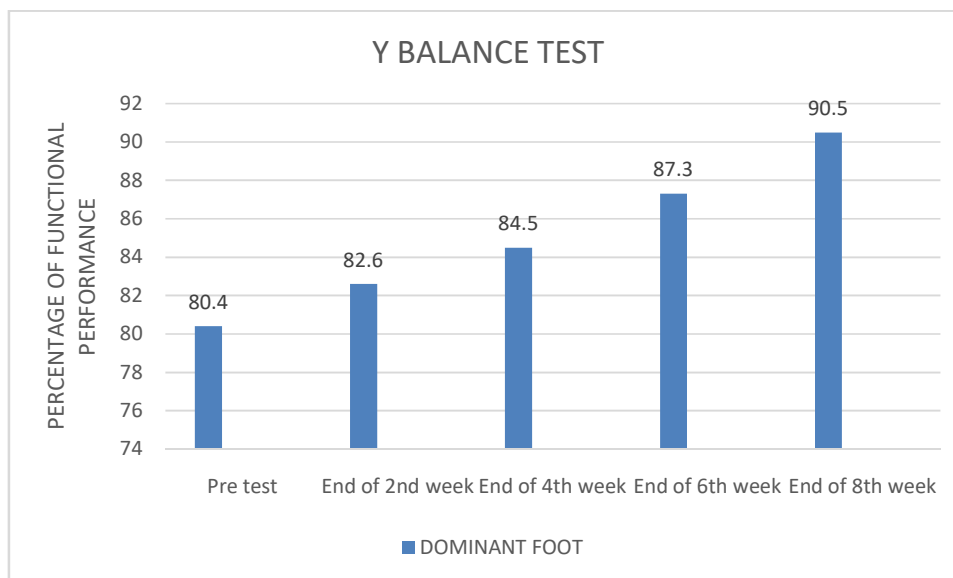
The pre test and post test values of vernier caliper was 8 and 6 at 2% level of significance. This proved that there was a significant reduction in IMD among genu valgum subject after the application of theraband exercises.



**Figure 3: Descriptive Analysis for Functional Performance using Y Balance Test. (Non-Dominant Foot).**

Limb length: 85cm

Composite score- $((ANT+PM+PL)/3 * Limb\ length) * 100$



**Figure 4: Descriptive Analysis for Functional Performance using Y Balance Test (Dominant foot).**

The pre test and post test values of dominant and non dominant foot shows significant improvement in genu valgum subject after the application of plyometric training exercise.

## DISCUSSION

Misalignment of the knee, such as genu valgum drastically affects the function of the joint and can cause knee loading during sports activity and everyday life. Misalignment of the knee, such as genu valgum drastically affects the function of the joint and can cause knee loading during sports activity and everyday life. Sports like basketball are one of the lower extremity dominant sport due to foot and leg movements. Over training and repetitive movements can cause postural disorders in athletes knee joint. Individuals with severe valgus deformities are typically unable to touch their feet together while simultaneously straightening the legs.

CODY.L. et al (2019): They conducted a study on YBT a valid and reliable assessment in older adults. The primary aim of the study was to evaluate the validity of lower quarter Y balance test in older adults. The secondary aim was to provide the reliability within this population. A total of 30-15 males and n-15 female performed the YBT-LQ, 30-s chair stand test. 8 foot up and go test and single leg stance and activities specific balance confidence scale questionnaire. The YBT was performed on two separate occasion by two investigators in random manner. The intra class interval correlation (3.1) score for the reliability of YBT-LQ was 95%. So, the YBT appears to be a valid and reliable assessment tool for subjects.

FAHIMEH SOHEILIPOUR et al (2020): This study was performed on 280 overweight or obese patient who referred to hospital with which the authors are affiliated in Tehran between 2017 and 2018. Several non-radiological method including measuring Q angle using goniometer and inter-malleoli distance were used to determine genu varum and genu valgum. The prevalence of genu varum and valgum was 8.6% and 10.0% respectively. There was a significant adverse co relation between the Q angle and BMI. Also the mean BMI in patients with and without genu valgum was 43.39 kg/m<sup>2</sup> and 41.58 kg/m<sup>2</sup> respectively.

RENU GUPTA et al (2020): Angular deformities of knee are one of the common basis of presentation at orthopaedic clinic and intermalleolar distance (IMD) is an essential anthropometric tool for evaluation of angular status of lower limb. 500 healthy subjects were taken for IMD measurement in standing or supine position by Vernier caliper. IMD in standing position was 42.47mm and in supine position was 34.45mm. Mean IMD in male in standing position was 40.01mm while in female it was 43.74mm observed. Significantly higher value in female, in standing position and in higher age group were observed. The mechanism for improvement of balance using plyometric exercise and reduction of Q angle and intermalleolar gap distance by theraband resistance exercise is as follows.

In this study a 23 years old female basketball player visited the outpatient department of PPG college of physiotherapy having history of genu valgum. The patient had difficulties in balance while performing daily activities and the subject received plyometric training exercise which is progressed to theraband exercise for 8 weeks, 3 days in a week, 60 min per session. Y balance test, goniometer and Vernier caliper were used as outcome measurement tool. The statistical analysis shows significant improvement in Q angle, distance between ankle medial malleolus and functional performance of female athlete after 8 weeks.

The possible reason for improvement in the balance after plyometric training is the increase in exercise pressure created by facilitating and synchronizing the large and fast twitch motor units, stimulation of muscle spindle, reduction of golgi tendon organs' inhibitory effect, and the increase in the coordination of muscles involved in the co-contraction activities. Individuals with genu valgum deformity encounter weakness in the muscles of femoral abductor and internal hamstring. The benefit of theraband exercise include variable resistance, these exercises enhance muscle strength and endurance in the weakened lower limb muscles. Performing 8 weeks of theraband exercises demonstrated a significant improvement in strengthening the weakened muscles, therefore the alignment of femur and tibia improved and reduced the Q angle and approached the ankle medial malleolus.

### **LIMITATION**

- The study was a short duration study
- Follow up was not done
- Home exercise was not assigned during the study period

### **CONCLUSION**

Finally the study concluded that there was a statistical effectiveness of plyometric training along theraband exercise on reduction of Q angle, ankle medial malleolus and improvement in the functional performance of female basketball player with genu valgus.

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