



A STUDY OF APPLICATION OF LEVER MECHANISMS IN YOGASANA AND GYM EXERCISE

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Abstract: The three classes of levers were found to be very useful for doing yogasanas and the exercise in gym. It was found that the effects observed by adjusting the body postures in particular yogasanas are similar to that produced after performing regular gym exercise. The tension produced in the particular muscle or muscle contraction while doing the exercise improved the health of the persons performing both yogasanas and gym exercise. Both isometric and isotonic contractions of muscles were observed when yogasanas or gym exercises were performed. The seated dumbbells triceps extension, calf raises and seated dumbbells biceps curl exercise resulted in developing the triceps brachii, calf muscles and biceps muscles respectively where class I, class II and class III lever systems were used. Without any gym equipments or any other costly tools the similar benefits were observed in the persons doing yogasanas like utthit padmasan (elevated lotus posture), tadasana (palm tree pose), chaturang dandasana. Also, it was found that the yogasana exercise is more beneficial for common man in every aspect as compared to gym exercise. The profession body builders are advised to perform yogasanas along with gym exercise to get the additional benefits of yogasanas.

Keywords: Classes of lever, Gym exercise, Yogasanas, Muscle contraction

Introduction:

Fitness is the key of success for athletes. To keep fit throughout the sports carrier different exercises are regularly performed by the athletes. Every exercise is nothing but the predetermined and disciplined movements of the body parts. Looking at our body structure bones, ligaments and muscles form the levers in the body that create movements in the body parts. A lever is a device that allows you to do work by transmitting or modifying force or motion i.e. it is a simple machine that changes the direction or magnitude of a force [1] and makes the work easier for use according to principle of moment of force; it involves moving a load around a pivot using a force (effort). Archimedes discovered the principle of mechanical advantage in the lever [2]. Thus the amplification of force can be achieved by using mechanical advantage. Principle of moments of forces states that equilibrium is established when the sum of the moments of the forces acting in a clockwise direction is equal to the sum of the moments of the forces acting in a anticlockwise direction. Hence it is possible to overcome a very large force at a short distance from the fulcrum with a very small force at a large distance from the fulcrum

[2]. Levers are classified according to the position of pivot (fulcrum), effort (force) and load (weight to be lifted) as given below.

Class I lever: pivot is between effort and load

Class II lever: load is between pivot and effort

Class III lever: effort is between pivot and load

A joint of bones forms the pivot, and muscles apply force to lift or push a weight (load). Most of the levers in our body are class III while number of class I and class II levers is very less. By lifting or pushing a weight by hands or legs a tension is produced in the related muscles that may change the length of the muscles depending on the type of muscle contraction. A muscle contraction is isometric if the muscle tension changes but the muscle length remains the same but, when the length of muscle changes and tension remains the same a muscle contraction is isotonic [3][4][5][6]. If the muscle length shortens the contraction is concentric but if the muscle length increases, the contraction is eccentric [3][7]. Various types of exercise using gym equipments and by doing yogasanas produce both the types of muscle

contractions that result in building or strengthening the muscles at desired sites in the body making our body strong and attractive. During daily busy schedule of man it is a need of everyone to do the regular exercise. Yogasanas, power gym or aerobics exercises attracted large interest in recent years due to the observed positive changes in the body physique, muscle strength and mental stability.

Methodology:

To observe the effect of gym exercise and yogasanas using levers in the human body 30 subjects at the age of around 21 years were chosen from the students of Post Graduate Teaching Department of Physical Education, RTM Nagpur University. These 30 subjects were divided into three groups A, B and C. Group A were told to do gym exercise, 10 subjects from group B performed yogasanas and remaining 10 subjects from group C formed the control group, did not performed any exercise. The students selected were healthy without ailments. Initially, training of gymnasium exercise and yogasanas were given to both the groups respectively followed by practice under supervision for six months. The stress is given on the development of triceps, calf and biceps muscles where class I, class II and class III lever mechanism were used respectively. The measurements of calf and biceps muscles of the subjects from all the groups were recorded at the regular intervals of 1 month up to next 6 months to observe the effect of exercise using the principle of class II and class III while skin-fold measurements were taken to study the effect of seated dumbbell triceps extension that is the application of class I lever mechanism.

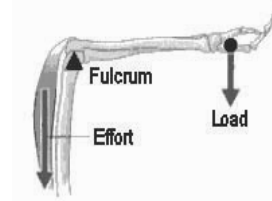
Class I Lever mechanism:

To improve the triceps muscles that require elbow extension, class I lever mechanism (figure 1a) was used by both the groups. Group A were instructed to perform seated dumbbell triceps extension (figure 1b) while group B performed utthit padmasana as shown in figure 1c. In seated dumbbell triceps extension the pivot (elbow joint) is located between the load (dumbbell) and the

effort is produced by triceps muscles. The up and down movements of dumbbells behind the head produces triceps muscle contraction.

Uthhit padmasana means elevated lotus posture. In this posture it is observed that the total weight (load) of the body is balanced by the plams. The pivot is elbow and the force is produced by the triceps muscles. This means it is a class I lever mechanism. In addition to triceps muscles it was observed that the elevated lotus posture is beneficial for development of abdominal muscles where again a class I lever mechanism works. The weight of lifted lower part of the body acts as a load, ball and socket joints in pelvic girdle as the fulcrum and effort is produced by the abdominal muscles. Utthit padmasana also results a lowering the fat percentage at the abdominal muscles site and a six pack had been started to develop. Seated dumbbell triceps extension and utthit padmasana activates the triceps muscle sites that reduces the skinfold at that site.

Figure 1:



1a. Lever of class I



1b. Seated dumbbell triceps extension



1c. Utthit Pdmasana

The effect of seated dumbbells triceps extension and utthit padmasana was observed by recording the triceps skin-fold and hence the fat percentage at the triceps site of each subject in all groups. For the measurement Lange skin-fold callipers with 0.5 mm gradation was used.

Class II lever mechanism:

To improve the calf muscles class II lever mechanism (figure 2a) was used by the groups A and B. Group A were instructed to perform calf raises exercise (figure 2b) while group B performed tadasana as shown in figure 2c. Calf raises method requires extending the ankle. The pivot is located near the toes and the effort is produced by calf muscles. The load is a body weight. The whole body was moved up and down around the pivot near toes. Both concentric and eccentric contractions were observed while using gym equipment as shown in figure 2b. But in the final posture of tadasana isotonic contraction was observed in the calf muscles as it is a steady posture. The measurements of calf circumference of each subject in all three groups were taken by seamless measuring tape and recorded at the interval of one month after beginning of exercise for next six months.



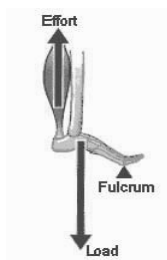
2c. Tadasana

Class III lever mechanism:

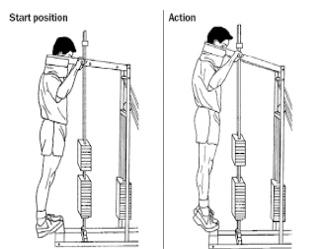
Most of the movements of body parts uses class III lever (fig 3a). We have selected the biceps muscles for the observation. To see the effect of the exercise by using class III lever mechanism, group A was instructed to do seated dumbbell curl exercise (fig. 3b) while group B had performed chaturang dandasana (fig. 3c) regularly. The measurements of biceps muscles of subjects in all three groups were taken by seamless measuring tape at the intervals of one month from beginning of exercise for next six months. To determine the actual size of the bicep measurements were taken by flexing the biceps and holding the end of the measuring tape at the base of bicep on the inside of the arm and moving over the highest point of the muscle to the base of the muscle at the outside.

Figure 3:

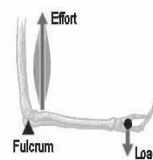
Figure 2:



2a. Class II lever



2b. calf raises method



3a. Class III lever



3b. Seated dumbbell curl



3c. Chaturang dandasana

Seated dumbbell curls employ a class III lever, with the force being exerted by the biceps muscle between the fulcrum at the elbow joint and the dumbbell weight in our hands. Group A is asked to perform seated dumbbell curls while chaturang dandasana is practiced regularly by subjects in Group B. Both concentric and eccentric contractions were observed in the subjects of Group A when they were performing seated dumbbell curl exercise. In the final pose of chaturang dandasana there are no movements of upper and lower arms about

the pivot and the tension in the biceps muscles remains constant despite a change in the muscle length. Accordingly the isotonic contraction of biceps muscles was observed in this case. It was observed that due to the variation in length/ tension the biceps muscles were strengthened and their size is also increased in both the groups. The measurements were taken by seamless tape and recorded at the interval of one month after beginning of exercise for next six months.

Table of measurements: 1

Class of lever used in exercise	Date of measurement	Measurement	Measurements of control group A (Mean value)	Measurements of control group B (Mean value)	Measurements of control group C (Mean value)
Class I	01.09.2016	Triceps skinfold	18 mm	17.5 mm	18.5 mm
Class II		Calf circumference	31.5 cm	31.4 cm	31.2 cm
Class III		Biceps	16 cm	15.8 cm	15.9 cm
Class I	01.10.2016	Triceps skinfold	18 mm	17.5 mm	18.5 mm
Class II		Calf circumference	31.6 cm	31.4 cm	31.2 cm
Class III		Biceps	16.3 cm	16 cm	15.9 cm
Class I	01.11.2016	Triceps skinfold	17.5 mm	17 mmmm	18.5 mm
Class II		Calf circumference	31.8 cm	31.5 cm	31.2 cm
Class III		Biceps	16.6 cm	16.3 cm	15.9 cm
Class I	01.12.2016	Triceps skinfold	17 mm	16.5 mm	18.5 mm
Class II		Calf circumference	32 cm	31.6 cm	31.2 cm
Class III		Biceps	17 cm	16.6	15.9 cm
Class I	01.01.2017	Triceps skinfold	16 mm	16.5 mm	18.5 mm
Class II		Calf circumference	32.3 cm	31.7 cm	31.2 cm
Class III		Biceps	17.4 cm	16.8	15.9 cm
Class I	01.02.2017	Triceps skinfold	16 mm	16 mm	18.5 mm
Class II		Calf circumference	32.5 cm	31.8 cm	31.2 cm
Class III		Biceps	17.7 cm	16.9 cm	15.9 cm
Class I	01.03.2017	Triceps skinfold	15 mm	16 mm	18.5 mm
Class II		Calf circumference	32.6	31.8 cm	31.2 cm
Class III		Biceps	17.8 cm	16.9 cm	15.9 cm

Conclusions:

- a) It is confirmed that the yogasanas and gym exercise benefited the subjects to improve their muscle size and to reduce the skinfold and hence the reduction in fat percentage at the activated muscle sites. No noticeable change in the muscle size or skinfold was observed in the samples of the control group.
- b) It is observed that the increase in muscle size was more in subjects performing gym as compared to subjects performing yogasanas.
- c) Any type of gym exercise was found to develop only one muscle at a time which is activated by the dumbbell weight or plate weight. This is a drawback of gym exercise but one type of yoga posture developed or resulted in strengthening more than one muscle.
- d) Along with strengthening of muscles yogasanas added more flexibility to the subjects of group B which was not found in Group A performing gym exercise or in a control group.
- e) Improvement in balance of the body, decrease in fatigue are the additional advantages observed in yogasana performers.

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