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RESEARCH ARTICLE

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A CASE REPORT ON MENISCUS REHABILITATION TO ENHANCE BALANCE USING BALANCE MASTER TRAINING

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Abstract

The anterior cruciate ligament, one of the knee's ligaments, works as a passive stabilization of the knee joint to prevent excessive anterior tibial translation, and the meniscus is a crescent-shaped pad located between the ends of the upper (femur) and lower (tibia) leg bones. ACL and meniscal tears can cause instability in the knee joint, and adequate rehabilitation is required to handle everyday functional activities. A 24-year-old male runner athlete presented with the complaint of reduced range of motion, pain at the site of the medial aspect of the knee joint and instability during standing. In investigation the patient showed with ACL grade 1 sprain and grade 3 medial meniscus tear came to OPD for rehabilitation. We have focused on reduction of pain and gaining strength in lower limbs and improving static and dynamic balance. We used i- balance platform in which patterned game was given to patient progressing to the difficulty level of maintain the balance of the body along with the strengthening of the lower limb muscles including quadriceps, hamstring and calf. Balance master proprioceptive training shows early recovery in the patient's daily activities and improved the quality of life and stability of the knee joint. Balance training program using Balance Master is effective in rehabilitation protocol for meniscus tear.

INTRODUCTION

The most frequent disease of the knee is meniscal tears, with a mean yearly incidence of 66 per 100000.[1] Due to their participation in competitive athletics, high school and college students make up the majority of this age group. If the ACL is partially torn, conservative treatment with a strengthening, stretching, and proprioceptive program may be recommended to make up for the ACL's impairment.[2] 11% of sudden knee problems and 31% of ongoing knee problems are caused by meniscus tears.[3] In physical therapy, the i- Premium Balance Master is a platform for balance. The participant stands on two force plates sitting on four load cells, and the device measures the force exerted by each foot. The whole force data is supplied to the computer system where calculations are carried out. The inclusion of automated metrics and feedback systems makes the system unique and

beneficial to both the participant and the researcher. The gold standard for evaluating balance and postural control is computerized dynamic posturography (CDP).[4]

Static balance is the capacity to maintain one's center of gravity over a predetermined base of support while a standing on a solid surface.[5]Static stability is typically the primary factor taken into account while evaluating static balancing. The capacity to maintain the body as immobile as possible is known as static steadiness.[6] The capacity to keep the COG within the LOS while a moving BOS (locomotion) was referred to as dynamic balance. Dynamic balancing has been reclassified in light of the advancement of force plate technology to now encompass employing an unstable surface, shifting the COG around a stationary supporting base, as in the LOS test, or even obstructing eyesight while attempting to maintain balance.[7]

This case report describes the use of the i-Premium Balance Master in the rehabilitation of a patient with a meniscus tear.

CASE REPORT

A 24-year-old male runner athlete was referred to the sports department of MGM school of Physiotherapy Aurangabad. He presented with the complaint of reduced range of motion, pain at the site of the medial aspect of the knee joint and instability during standing. The patient had a history of ACL grade 1 sprain and grade 3 medial meniscus tear due to heavy training and while climbing stairs had a twist in the knee joint and fell down due to pain. The patient presented pain 7/10 on the numeric pain rating scale (NPRS) on the initial day.

PHYSICAL EXAMINATION

The examination started with the Active and Passive ROM of the knee joint using goniometer. Girth measurements were taken above, at, and below each knee joint for comparison to assess muscle atrophy and a little atrophy was seen over calf muscles. Palpation of joint line tenderness is a valuable component of the evaluation of a meniscal patient. We assessed it for strength using MMT bilaterally for hamstrings, quadriceps, calf and ankle plantar and dorsiflexion and found weakness over the left quadricep muscle and weakness of gastrocnemius and soleus was seen.

With regard to balance, we used the double-leg stance test, often known as the Romberg test, to assess both static and dynamic balance. and using a balance master turned out to be very detrimental to balance and joint stability as shown in Figure 1.

INVESTIGATION

MRI of the left knee joint confirmed a partial tear/sprain of the ACL near its tibial attachment and a grade III tear of the posterior horn of the medial meniscus.

DIAGNOSIS

Based on the investigation report the case was diagnosed as a post-op medial meniscus tear.

INTERVENTION

We followed the patient for up to 12 weeks. The aim was to relieve our patient’s pain, increase ROM, and improve balance to restore function without limitations. We gave strengthening protocol up to 12 weeks and focusing on the balance of the lower extremity we used the i-Premium Balance Master. The balance platform has variations in balance-related games through which the patient went and performed it successfully. Progressing to the levels in games containing maze, static, stepper, tennis and chase game. Following the protocol for meniscus rehabilitation to enhance balance. (See Figure 1,2 and 3).

Figure 1. Patient balancing on I-Premium Balance Master

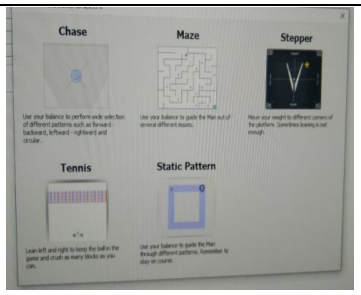

Figure 2. Different balance training game modules on I-Premium Balance Master

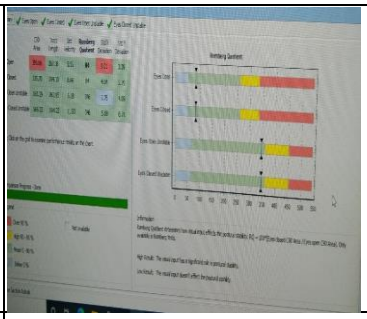

Figure 3. Results of Romberg test on stable and unstable surface of I-Premium Balance Master

GOALS:

1st -3rd week

During the first week of treatment, we educate the patient on the reduction of pain and gaining strength in lower limbs and improving static and dynamic balance. Whenever necessary, the patient was supported with verbal feedback as well was informed the patient regarding his prognosis and emphasized the importance of physical therapy. (See Table 1).

4-6th week:

With the exercise mentioned above we progressed to the repetition and duration of the protocol while progression of balance was assessed separately using balance master. (See Table 2).

Table 1. (Treatment protocol for 1st to 3rd week)

Exercise	Repetition/Duration	Area
Warm-up	10 minutes	On stationary cycle
TENS	For 14 minutes thrice, a week.	Over the medical aspect of the knee joint
Quadriceps Isometrics	10 Repetition	Left knee joint
Leg press	10 Reps	Using medicine ball bilaterally
Wall supported squats	7 Reps	up to 45 degrees
Patella mobilization		Left knee joint
VMO	10 Reps	Using yellow Thera-band over left knee joint
CLAMSHELL	15 Reps	Both sides
DF/PF	10 Reps	Both sides using yellow Thera-band
SLR	10 Reps	In all Planes bilaterally
Bridging	10 Reps	
Stretching	30 Sec 5 Reps	Gastrocnemius, soleus, hamstring and piriformis
Proprioception	5 sets of 10 Sec	Using green Thera-pad bilaterally
Balance	5 Minutes	Performed Maze game using balance Master

Table 2. (Treatment protocol for 4th to 12th week)		
(Treatment protocol for 4th to 6th week)		
Exercises	**Repetition/ Duration**	**Area**
As mentioned above in Table 1		
Balance Training	10 Minutes	Performed Maze and Static pattern game using balance Master
(Treatment protocol for 7th to 8th week)		
As mentioned above in Table 1		
Balance	10 Minutes	Performed Maze, Static pattern and stepper game using balance Master
(Treatment protocol for 9th to 10th week)		
As mentioned above in Table 1		
Balance	10 Minutes	Performed Maze, Static pattern, stepper and Tennis game using balance Master
(Treatment protocol for 11th to 12th week)		
As mentioned above in Table 1		
Balance	10 Minutes	Performed Maze, Static pattern, stepper, Tennis and chase game using balance Master

RESULTS

According to the scoring of the games mentioned below in the (Table 3) the progressive high score system including (Table 4) Pre and Post-Rhomberg tests had a significant effect on the patient's balance and stability.

Table 3. Scoring of games on I-Premium Balance Master		
Games	**Pre**	**Post**
Maze	30	74
Static pattern	25	77
Stepper	35	89
Tennis	46	98
Chase	55	105

The scores for different games on the I-Premium Balance Master showed significant improvements post-play. Maze went from 30 to 74, Static Pattern from 25 to 77, Stepper from 35 to 89, Tennis from 46 to 98, and Chase from 55 to 105. These increases indicate substantial enhancements in skills targeted by these games, such as balance, coordination, and overall performance.

Table 4. Scoring of Rhomberg test on I-Premium Balance Master				
Rhomberg test	**Pre**		**Post**	
	Std x Deviation	Std y Deviation	Std x Deviation	Std y Deviation
Eyes open stable surface	9.01	3.39	5.02	1.05
Eyes closed unstable surface	4.04	5.79	3.08	4.19
Eyes open on an unstable surface	2.76	4.09	1.16	3.04
Eyes closed unstable surface	5.88	5.88	4.58	4.67

The table 4 presents the scoring of the Rhomberg test conducted using the I-Premium Balance Master, measuring participants' balance under various conditions—eyes open and closed, on stable and unstable surfaces—before and after engaging with the test.

Under the condition of eyes open on a stable surface, the standard deviation (Std) for x-axis deviation decreased notably from 9.01 to 5.02, and for y-axis deviation, it decreased from 3.39 to 1.05 post-assessment. This indicates an improvement in balance and reduced deviation from the central position after the test. When participants performed the test with closed eyes on an unstable surface, both x-axis and y-axis deviations decreased from 4.04 to 3.08 and from 5.79 to 4.19, respectively. This suggests a moderate improvement in balance control despite the more challenging test conditions.
Under the eyes open condition on an unstable surface, the deviation decreased from 2.76 to 1.16 on the x-axis and from 4.09 to 3.04 on the y-axis. This significant reduction in both deviations signifies enhanced balance control despite the surface instability. Lastly, during the eyes closed phase on an unstable surface, the deviations decreased from 5.88 to 4.58 on the x-axis and remained constant at 5.88 on the y-axis. This shows a reduction in lateral deviation despite the challenging condition, indicating some improvement in maintaining balance without visual cues.

DISCUSSION

Reis et al. advocated in their study that they focused on game adaptation, particularly for dynamic difficulty change, to achieve game balance. Instead of focusing on computational techniques and game balancing methodologies, they neglected the quality of the balance objective in terms of good game design.[8] In the other study of Kirk et al. advocated as the tempo, command combinations, and difficulty of video games rise along with the level of play, which speeds up metabolism and creates general and targeted body weariness, leading to an improvement in balance..[9] Chivers et al in his Study suggested that after meniscal repair, a reduction in postural stability may be anticipated. In the case of meniscal injuries, proprioception training should be a crucial component of the postoperative regimen.[10] Park et al indicated Because patients with combined ACL tears as opposed to solitary ACL tears do not require lowering the objective of regaining proprioception.[11] In our study we focused on improving balance of the patient with the medial meniscus tear using i-Premium Balance Master. We trained the athlete and monitored the progressive improvement in the static and dynamic balance. The meniscus participates in the reception of proprioceptive impulses operating on the knee joint and the feeling of joint placement, which is indicated by the existence of mechanoreceptors.

CONCLUSION

Meniscus tear with the ACL partial tear is a common condition that required proper physiotherapy treatment for its early recovery. Balance master proprioceptive training shows early recovery in the patient’s daily activities, it will improve his quality of life and improves the stability of the knee joint. Thus, balance training program using Balance Master is effective in rehabilitation protocol for meniscus tear.

PATIENT CONSENT

Informed consent of patient was taken.

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