Comparing the Muscle Activity between the Pommel Torso Exercise Machine and Standard Floor Exercises

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SUMMARY

Introduction

The aim of the study was to investigate the biomechanical effects and muscle activity of the back and abdominal region when using the Pommel Torso Exercise Machine before and after a 6 week training programme.

Method

16 participants (5 females and 11 males) underwent a biomechanical and muscle activity assessment. They were asked to perform 6 exercises on the Pommel Torso Machine and 4 standard 'floor' and swiss ball abdominal exercises for comparison. This data was collected using a 10 camera Oqus motion analysis system and the Delsys EMG System for surface electromyography.

Anthropometric measurements were also taken including, height, weight, BMI, a sum of four skinfold for body fat measurement, hip to waist circumferences and additionally each participant filled out a body shape questionnaire.

9 participants completed a 6 week training programme. This entailed using the Pommel Torso Exercise Machine 3 times per week. Post biomechanical and muscle activity assessments were re-measured and the anthropometric measurements were also taken to establish any changes which might have occurred as a result of training on the Pommel Torso Exercise Machine.

Results

Pre training, the Pommel Torso Machine produced significantly greater muscle activity in the back muscles when compared to the abdominal exercises. No significant difference was found in the External Obliques between the Pommel Torso and abdominal exercises. The abdominal exercises, however, did produce significantly greater muscle activity for the Rectus Abdominis.

Post training, the abdominal exercises produced significantly greater muscle activity in the Rectus Abdominis and External Obliques. No significant differences were found in Latissimus Dorsi with exception of the 'plank' exercise. The Pommel Torso produced significantly greater muscle activity in the Erector spinae similar to pre training results.

When comparing pre and post EMG results, no significant changes were found in Erector Spinae. The ‘front to back’ and ‘spin’ exercises did not show any significant differences in muscle activity. The overall muscle activity had significantly reduced in the External Obliques and Latissimus Dorsi in all the ‘circle’ exercises.

The anthropometric measurements show a significant reduction in body fat percentage with an overall loss of 15%. Hip and waist circumference also showed a significant reduction, however, there was no change in body weight.

Conclusion

The pre training results suggest that the Pommel Torso Exercise Machine produces greater overall muscle activity of the back and abdominal muscles compared to the standard abdominal exercises. The standard abdominal exercises predominantly target the Rectus Abdominis muscles; however, there was a much lower amount of activity of the back muscles. Therefore, these results suggest the Pommel Torso Machine appears to target front and back muscle groups in a more balanced manner, which could reduce risks of muscle imbalances and low back pain. .

From the biomechanical results, the Pommel Torso produced a range of movements at the spine including; flexion/extension, lateral trunk flexion and internal and external rotation. Therefore, the Pommel Torso can be considered as a functional exercise for the back and abdominal muscles, providing a more beneficial workout. In all cases the standard abdominal exercises provided a limited range of movements mainly working in the sagittal plane, therefore, predominantly targeting the Rectus Abdominis.

The anthropometric measurements showed a reduction in body fat percentage and hip and waist circumferences, however, there was no change in body mass. This would suggest that participant’s increased lean muscle mass and decreased their fat mass.

Background Information

Low back pain is a global problem and many prevention strategies are available to reduce the prevalence of this musculoskeletal disorder (Frymoyer & Cats-baril 1991). Numerous clinicians and athletic trainers often adopt training programmes to improve the strength of the abdominal muscles due to its positive effects on spinal stabilization (Richardson *et al.* 1999).

Many exercise machines have been designed to try and seek the best possible benefits for improving abdominal strength whilst reducing the risk of back pain. This has led to various companies manufacturing a range of new abdominal machines such as the more well-known AbRoller and FitBall (also known as swiss ball) (Hildenbrand & Noble 2004). The biomechanical evidence behind their effectiveness is limited, however, the few devices which have been tested, found to produce greater abdominal contractions of the Rectus Abdominis and External Obliques when compared to a traditional crunch (Francis *et al.* 2001; Sternlicht & Rugg 2003; Warden *et al.* 1999).

The Pommel Torso Exercise Machine is a new exercise machine designed to improve muscle strength of the entire abdominal and lower back region by providing rotation, flexion/extension and side flexion exercises, figure 1. The machine claims to work these muscles harder than standard abdominal 'floor' and swiss ball exercises and therefore claims to provide an overall, more beneficial workout.

Figure 1: The Pommel Torso Exercise Machine

The aim of the study is to investigate the biomechanical effects and muscle activity of the back and abdominal region whilst using the Pommel Torso Exercise Machine. Consequently, this report provides the evidence for levels of muscle activity and the physiological and biomechanical effectiveness when using the Pommel Torso Exercise Machine before and after a 6 week training programme.

Method

16 participants (5 females and 11 males) underwent a biomechanical and muscle activity assessment. They were asked to perform 6 exercises on the Pommel Torso Machine; rotation in big circles, medium circles, small circles, about a single point (spin), flexion/extension (front to back) and side flexion (side to side). To provide a comparison, the participants were asked to perform 4 standard 'floor' and swiss ball abdominal exercises (plank, swiss ball crunch with rotations to the left and right). Data was collected using a 10 camera Oqus motion analysis system (Qualisys Medical, Sweden) (figure 2a). Small retro-reflective spherical markers and clusters of markers were placed on specific anatomical landmarks of the thigh, pelvis and lumbar spine of all participants. These markers determine the position of the thigh, pelvis and lumbar spine and provide segmental analysis of the sagittal, coronal and transverse planes. Additionally, surface electromyography (EMG) data was collected using the Delsys EMG System (figure 2b) to record and evaluate the electrical activity produced by muscles. The sensors were positioned in accordance with Hermans *et al*. (1993) recommendations for surface electromyography.

Anthropometric measurements were also taken including, height, weight, BMI, a sum of four skinfold for body fat measurement, hip to waist circumferences and additionally each participant filled out a body shape questionnaire. Body fat measurements were taken using a skinfold caliper. Measurements were taken from biceps, triceps, scapular and abdominal region which allowed a body fat percentage to be calculated (Durnin and Womersley 1974).

After the initial testing, 9 participants completed a 6 week training programme. This entailed using the Pommel Torso Exercise Machine 3 times per week, spending at least 3 minutes on each of the 6 exercises. Once the participants completed the 6 week training programme, biomechanical and muscle activity assessments were re-measured and the anthropometric measurements were also taken to establish any changes which may have occurred as a result of training on the Pommel Torso Exercise Machine.

Figure 2 (a) 10 Camera Oqus Camera Set Up in the Movement Laboratory, Brook Building, UCLan (b) Delsys Surface EMG Results

Pre-training EMG

From the pre-training data, all 16 participant's EMG results are presented below (Figures 3-6). From these results, it is possible to make a comparison of muscle activity between the exercises using the Pommel Torso Machine and standard abdominal exercises. The big circles, medium circles and small circles exercises were performed clockwise and anti-clockwise on the exercise machine and therefore, an average for each of these exercises is shown.

Figure 3 shows the muscle activity of the left and right External Oblique. All circle and 'side to side' exercises create a similar amount of muscle activity as the standard abdominal exercises with no significant differences found. The 'front to back' and 'spin' exercises on the machine show significantly lower muscle activity and when compared to the all the abdominal exercises and other exercises on the Pommel Torso machine ($p<0.05$).

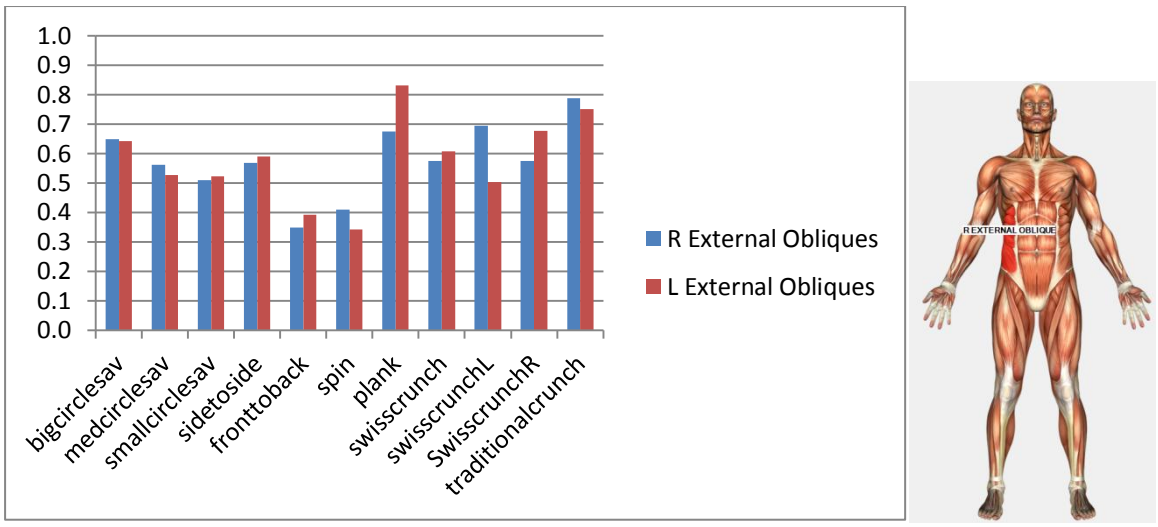

Figure 3: The average, pre training muscle activity of the left and right External Oblique for all 16 participants.

Figure 4 shows significantly greater muscle activity in Rectus Abdominis during the standard abdominal exercises than all exercises on the Pommel Torso Exercise Machine ($p<0.05$).

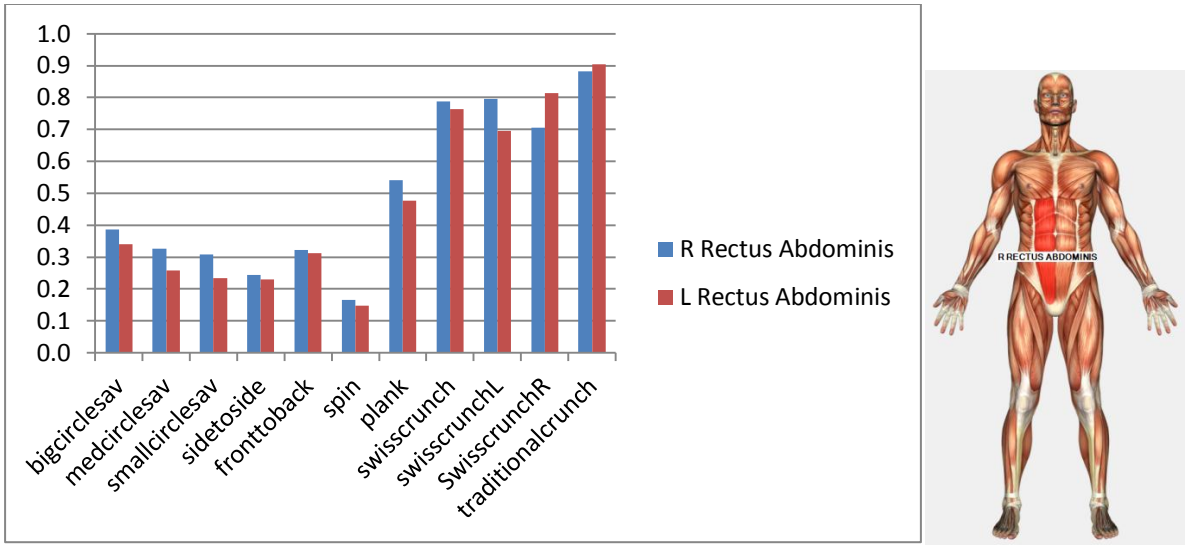

Figure 4: The average, pre training muscle activity of the left and right Rectus Abdominis for all 16 participants.

Figure 5 shows significantly greater muscle activity in Latissimus Dorsi during the exercises on the Pommel Torso Machine ($p<0.05$) compared to the standard abdominal exercises, with the exception of the 'plank' exercise. The greatest amount of muscle activity was seen on the Pommel Torso during the 'Big Circles' exercise.

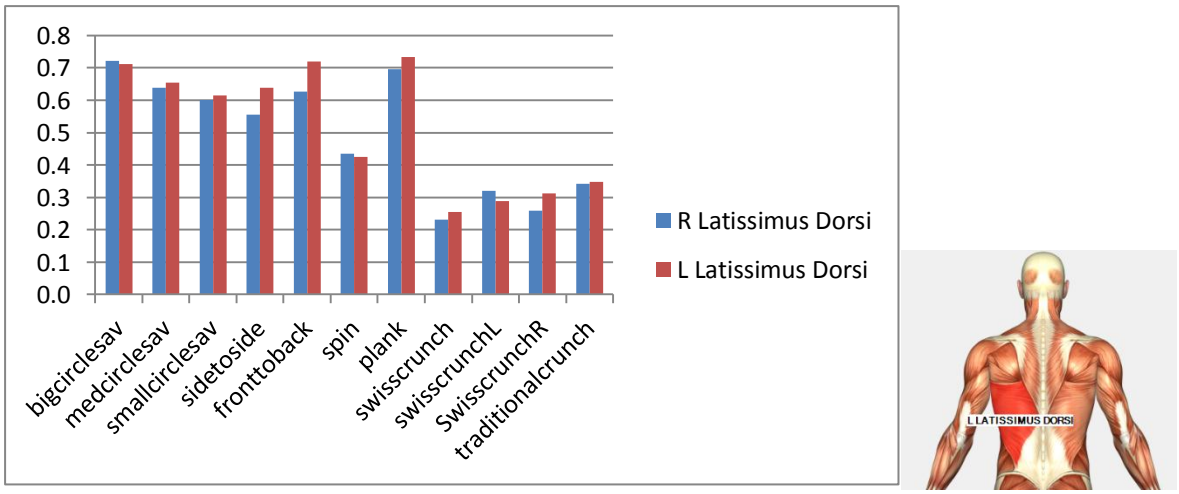

Figure 5: The average, pre training muscle activity of the left and right Latissimus Dorsi for all 16 participants.

Figure 6 shows significantly greater muscle activity of the Erector Spinae is during exercises on the Pommel Torso Machine than during the standard abdominal exercises, with the circle exercises showing the greatest amount of muscle activity. Interestingly, the ‘plank’ exercise shows a significantly lower amount of muscle activity in Erector Spinae than the other exercises.

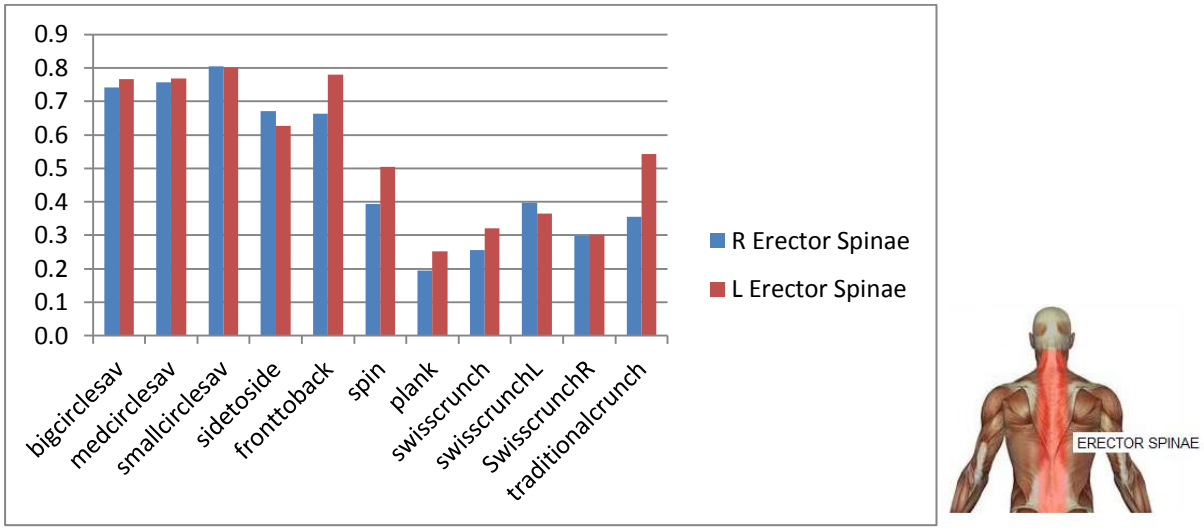

Figure 6: The average, pre training muscle activity of the left and right Erector Spinae for all 16 participants.

Biomechanical Measurements

Figure 7 shows the amount of flexion and extension occurring at the lumbar spine during each of the exercises on the Pommel Torso Machine. ‘Big circles’ shows the greatest movement in flexion and extension and the ‘side to side’ exercise produces the least movement.

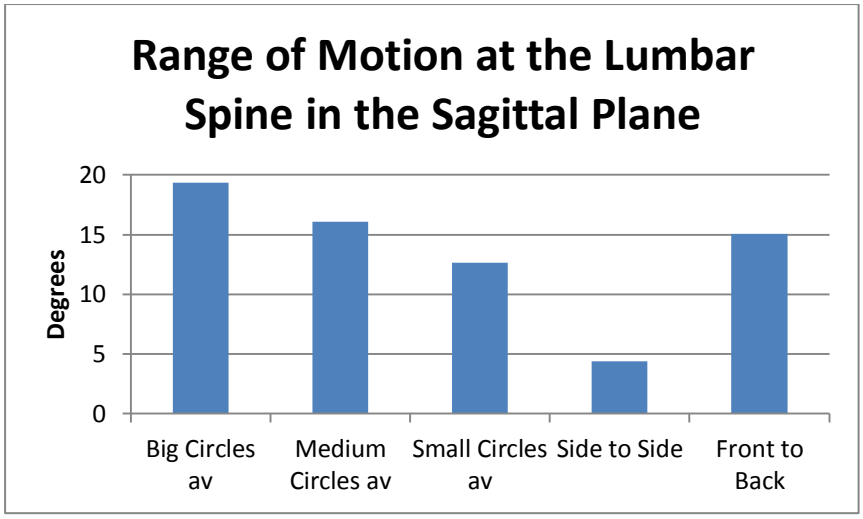

Figure 7: Range of motion at the spine in the sagittal plane.

Figure 8 shows the amount of lateral trunk flexion occurring at the lumbar spine during each of the exercises on the Pommel Torso Machine. The ‘front to back’ exercise has the least amount of lateral trunk flexion with ‘big circles’ showing the largest amount of movement.

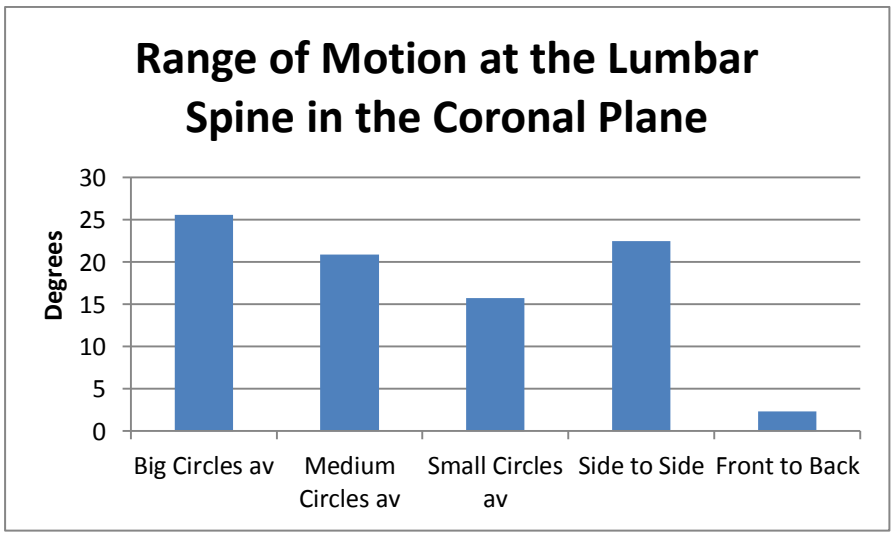

Figure 8: Range of motion at the spine in the coronal plane.

Figure 9 shows the amount of external and internal rotation occurring at the lumbar spine during each of the exercises on the Pommel Torso Machine. Again, 'Big circles' produces the greatest range of movement when compared to the other exercises. A trend is seen in all movement planes between the circles exercises showing a gradual decrease from 'big circles' to 'medium circles' to 'small circles'.

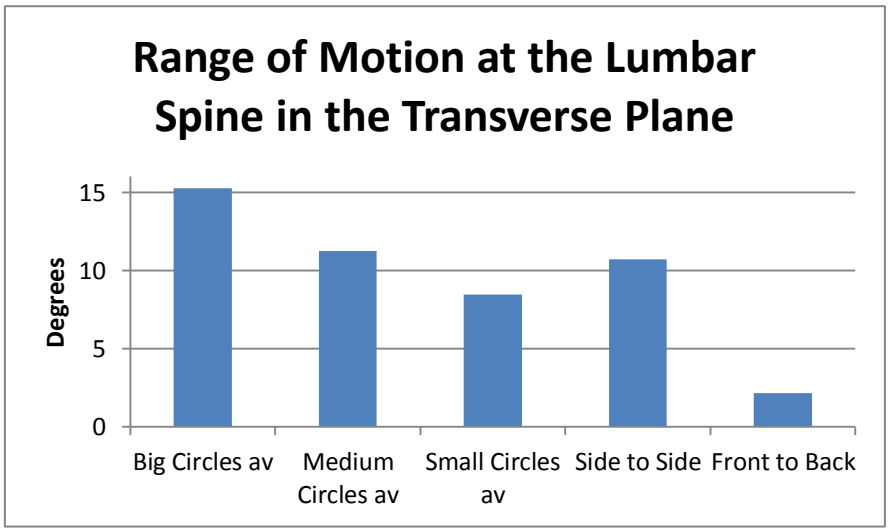

Figure 9: Range of motion at the spine in the transverse plane.

Post training EMG

The post exercise EMG results allow a comparison of muscle activity between the exercises using the Pommel Torso Machine and standard abdominal exercises and between pre and post 6 week training programme.

Figure 10 shows the standard abdominal exercises produce a significantly greater muscle activity in the External Oblique than the exercises on the Pommel Torso Machine with the greatest activity seen during the 'side to side' exercise. This is in contrast to the results pre training where no differences were seen between the standard abdominal exercises and the Pommel Torso Machine.

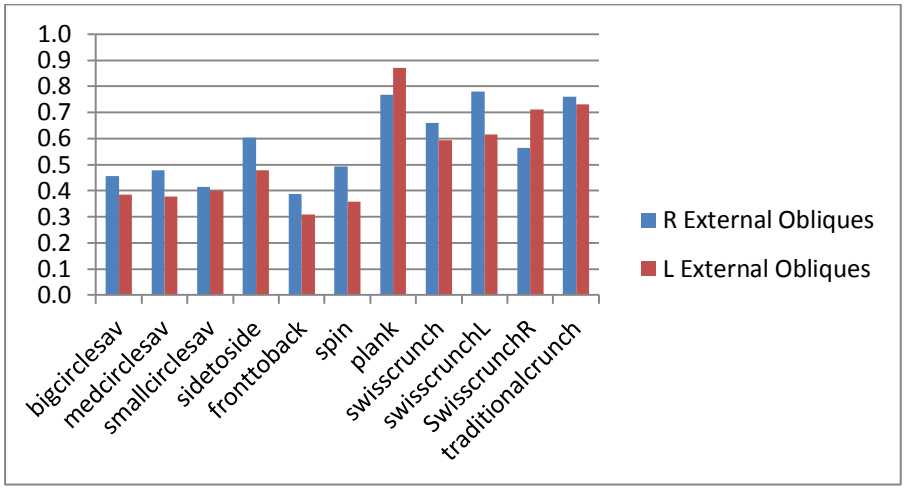

Figure 10: The average, post training muscle activity of the left and right External Oblique for all 9 participants.

Figure 11 shows the post training results for the left and right Rectus Abdominis. Similar to the pre training results, the Rectus Abdominis shows significantly greater muscle activity for the abdominal exercises than the Pommel Torso exercises.

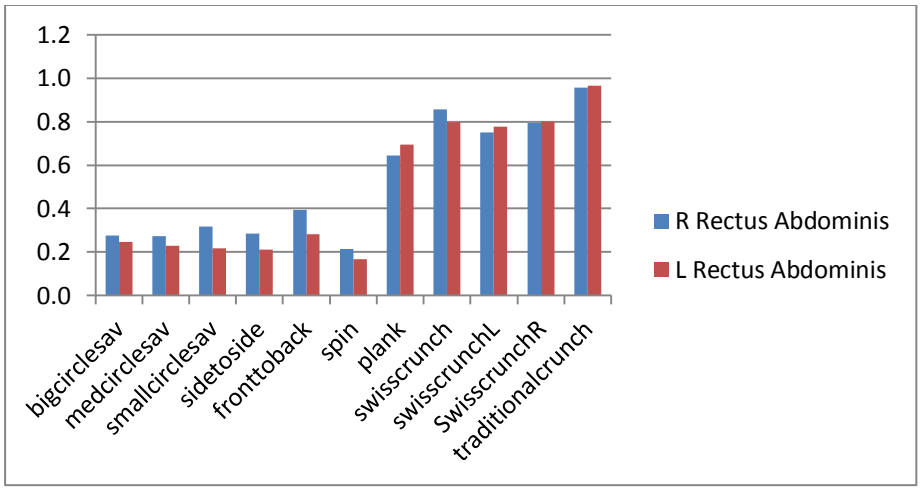

Figure 11: The average, post training muscle activity of the left and right Rectus Abdominis for all 9 participants

Figure 12 shows the post training results for the left and right Latissimus Dorsi. The ‘plank’ exercise has a significantly greater muscle activity when compared to all other exercises. The ‘front to back’ exercise also shows significantly greater muscle activity than the remaining exercises.

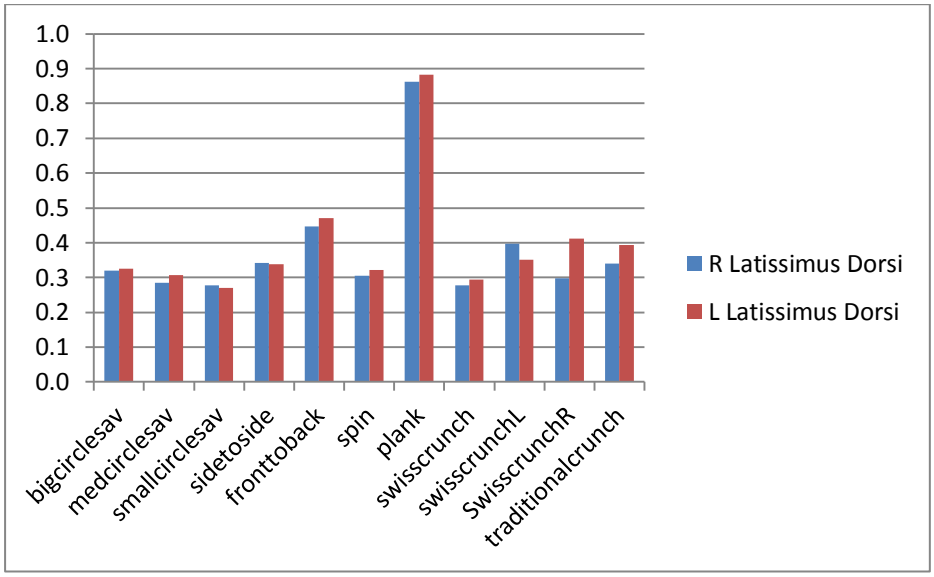

Figure 12: The average, post training muscle activity of the left and right Latissimus Dorsi for all 9 participants

Figure 13 shows the post training results of the left and right Erector Spinae. All circle exercises, the ‘side to side’ and ‘front to back’ exercises have a significantly greater muscle activity than the standard abdominal exercises, similar to the pre training results. The ‘plank’ exercise produces the lowest amount of muscle activity in the Erector Spinae.

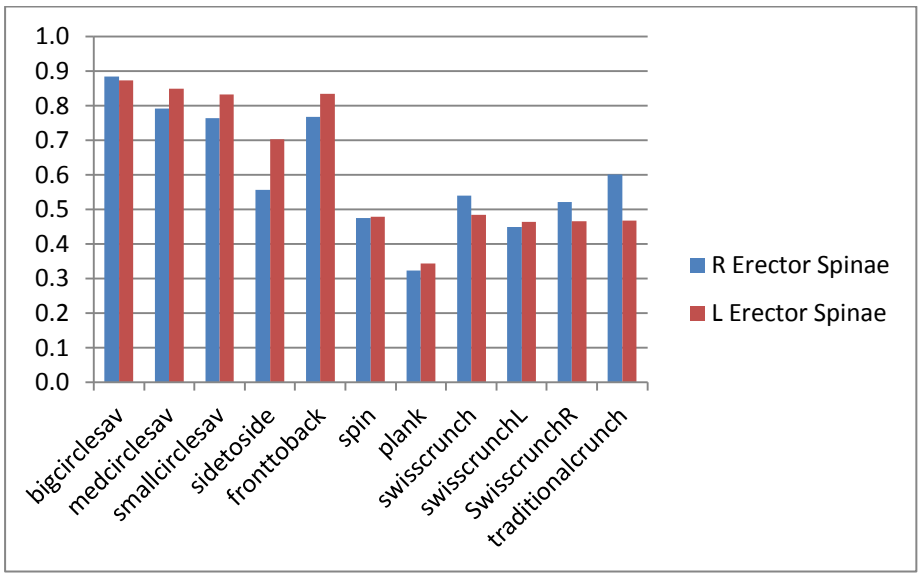

Figure 13: The average, post training muscle activity of the left and right Erector Spinae for all 9 participants

Table 1 shows the comparison between pre and post training EMG results. Post training, the overall muscle activity had significantly reduced in the External Obliques and Latissimus Dorsi in the circle exercises. The 'side to side' exercise showed a reduction in Latissimus Dorsi activity post training, but was greater in Rectus Abdominis. The 'front to back' and 'spin' exercise did not show any significant differences between pre and post training EMG results. No significant differences were seen in the Erector Spinae.

Table 1: P-Values for pre and post EMG comparison.

	Big	med	small	Side	Front	spin
External Oblique	**0.034**	**0.035**	**0.031**	0.176	0.305	0.860
Rectus Abdominis	0.074	0.117	0.058	**0.048**	0.431	0.590
Erector Spinae	0.223	0.159	0.221	0.161	0.317	0.241
Latissimus Dorsi	**0.001**	**0.000**	**0.000**	**0.004**	0.065	0.470

Post Biomechanical Measurements

In figure 14 the ‘side to side’ exercise showed the least range of movement in flexion and extension.

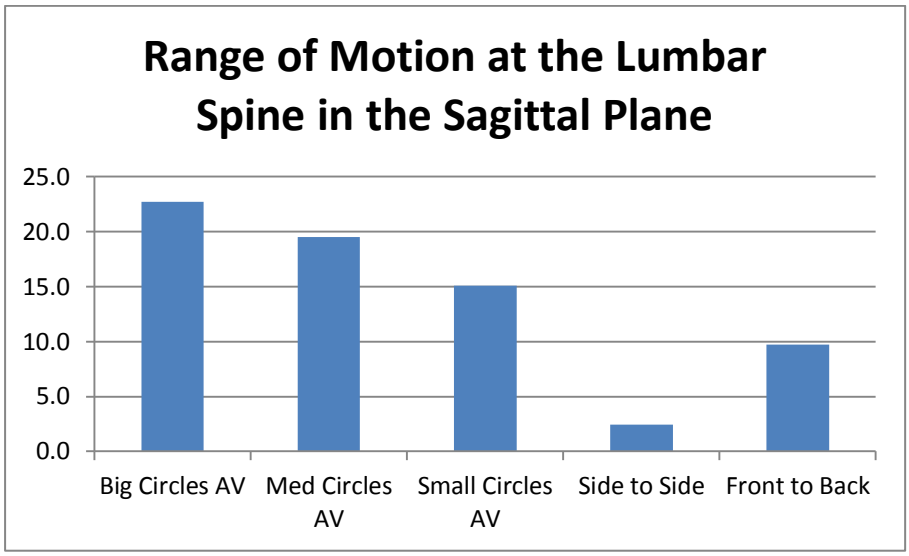

Figure 14: Range of motion at the Lumbar spine in the sagittal plane.

Figure 15 shows the amount of lateral trunk flexion occurring at the lumbar spine during each of the exercises on the Pommel Torso Machine. The ‘front to back’ exercise had the least amount of lateral trunk flexion with ‘big circles’ showing the largest amount of movement, again very similar to the pre biomechanical results. Although, there was an increase of about 5 degrees of lateral trunk flexion in each of the circles exercises but a 10 degree decrease in the ‘side to side’ exercise when comparing the pre and post results.

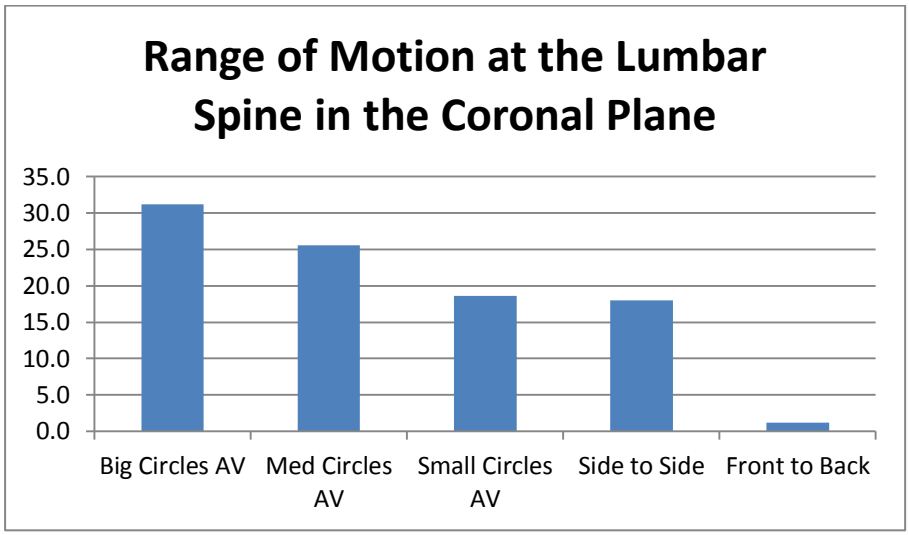

Figure 15: Range of motion at the Lumbar spine in the coronal plane.

Figure 16 shows the amount of external and internal rotation occurring at the lumbar spine during each of the exercises on the Pommel Torso Machine. Again, 'Big circles' produces the greatest range of movement when compared to the other exercises and 'front to back' produces the least amount of movement. When compared to the pre biomechanical measurements the amount of external and internal rotation has decreased almost by half for each exercise. The post biomechanical effects of the Pommel Torso Machine show that the 'big circles' exercise produced the largest range of movement in flexion/extension, rotation and lateral trunk flexion, which was the same for the pre measurements. Again, there was a trend between the circle exercises showing a gradual decrease from 'big circles' to 'medium circles' to 'small circles'.

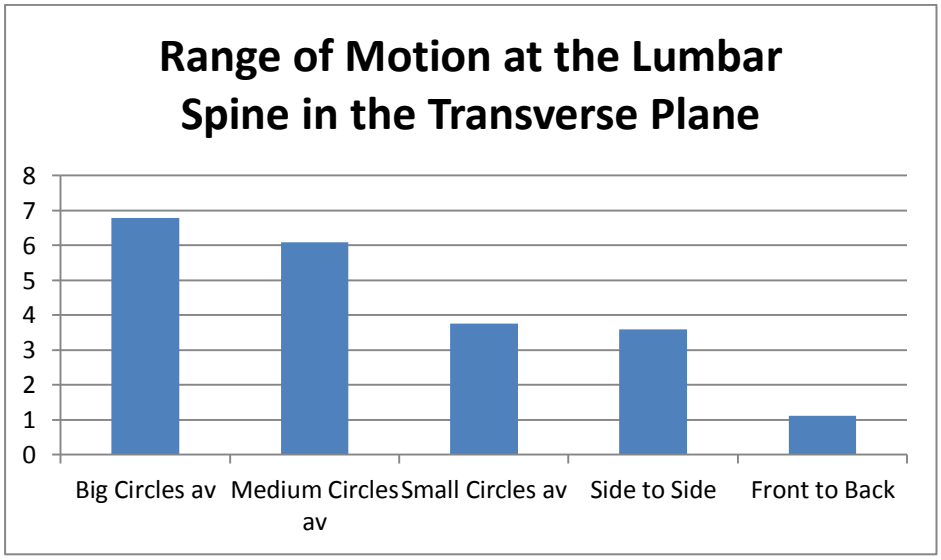

Figure 16: Range of motion at the Lumbar spine in the transverse plane.

Anthropometric Measurements

Figure 17 shows the pre and post training results of the sum of four skinfold measurement for the biceps, triceps, scapular and abdominal region for each participant. The skinfold measurements significantly decreased post training ($p<0.05$) in each region with an overall reduction in body fat of 15% (Table 2)

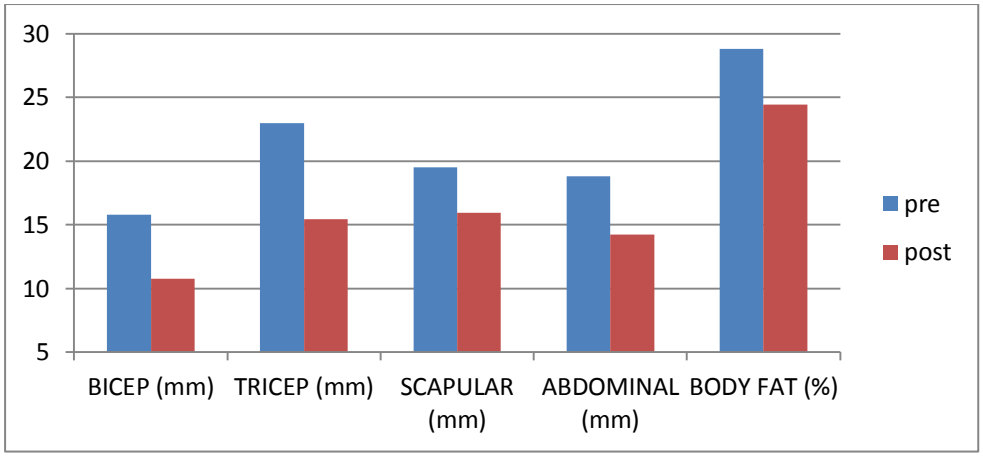

Figure 17: Pre and post training sum of four skinfold measurements for the biceps, triceps, scapular and abdomen, including a body fat percentage.

Table 2: Percentage decrease and P-values for skinfold measurements.

	BICEP	TRICEP	SCAPULAR	ABDOMINAL	BODY FAT %
% decrease	33.72183	32.8318109	14.92628993	22.60273973	15.10942761
p-value	**0.000506**	**0.00084131**	**0.00830915**	**0.021285674**	**0.001580266**

Additionally, for the hip and waist circumference measurements, a further percentage decrease was discovered and a significant difference (<0.05) between the pre and post training measurements (Table 3).

Table 3: Percentage decrease and P-values for hip and waist circumferences.

	HIP	WAIST
% decrease	1.13	1.59
p-value	**0.032**	**0.025**

However, no significant changes were found between the pre and post weight and height measurements and subjectively, no significant changes were discovered in perceived body shape from the body shape questionnaire.

Discussion

The pre training results suggest that the Pommel Torso Exercise Machine produces a greater overall muscle activity of the back and abdominal muscles compared to the standard abdominal exercises. The data shows that the standard abdominal exercises predominantly target the Rectus Abdominis muscles but produced a significantly lower amount of activity of the back muscles (Erector Spinae and Latissimus Dorsi).

Clinically, it is not recommended for people to perform exercises which predominantly target the Rectus Abdominis muscles, since this can create a muscle imbalance. It is advised that people should perform exercises which target both front and back muscle groups to enhance overall back and abdominal strength and stabilization. Therefore, from the pre training results of the standard abdominal exercises, it could be postulated that these exercises may cause muscle imbalance and potential risks of lower back pain. However, the Pommel Torso Machine appears to target front and back muscle groups in a more balanced manner, reducing risk of muscle imbalances and low back pain.

When comparing the pre and post training EMG results it was found that there was a significant reduction in muscle activity in the External Obliques and Latissimus Dorsi. This could be due to the training effect on Pommel Torso Machine over the 6 weeks.

The evidence for the biomechanical effectiveness of new abdominal training devices is limited. However, from the biomechanical results found in this study, the Pommel Torso has shown to produce a range of movements at the spine including; flexion/extension, lateral trunk flexion and internal and external rotation. As a result, the Pommel Torso can be considered as a functional exercise and therefore, the back and abdominal muscles are working functionally in conjunction with each other, providing a more beneficial workout. The standard abdominal exercises provide a limited range of movement, mainly working in the sagittal plane, which could suggest why they predominantly target the Rectus Abdominis.

The anthropometric measurements showed a reduction in body fat percentage and hip to waist circumferences, however, there was no change in height and weight suggesting that the participant's increased lean muscle mass and decreased their fat mass.

Conclusion

In conclusion the Pommel Torso appears to provide a balanced muscle workout for the core muscles and can be used to reduce body fat and improve muscle tone.

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