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CAP Pilot Study: The Effect of a 3 Week Resisted Sprint Interval Training Protocol on Recovery Heart Rate, VO2 Max and Speed.

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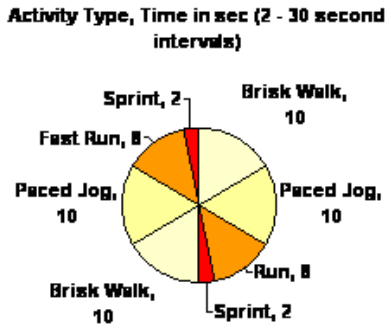
Introduction

Over the last few years we have struggled with the question, "How do you condition soccer players before the season?" Too much emphasis on endurance based exercises seem to cause declines in speed and agility as well as vertical power. Too much emphasis on speed and agility and they loose their ability to last an entire game let alone ability to play strong in multi day tournaments. In this pilot study we took 1 subject who was already in excellent shape and ran him through a 3 week training protocol on the Woodway Force Treadmill and Landis Treadmill. During this time the subject did not participate in any strength training. The goal was to improve Heart Rate (HR) Recovery, Max HR, VO2 Max, Resisted Sprint Speed, etc.

Training Protocol:

The protocol consisted of sport specific interval runs on the Woodway Force Treadmill and timed runs on a Landis Treadmill and tracked HR with a Polar RS800 Heart Rate Monitor and Watch. The sport specific interval runs on the Force Treadmill were run with a 0 Load, and based on a 30 second interval that would repeat to give you the desired amount work to rest ratio for that day. Below is a graph depicting this interval:



- Brisk Walk/Jog – 10 seconds
- Paced Jog/Run – 10 seconds
- Strong Run – 8 seconds
- Max Sprint – 2 seconds

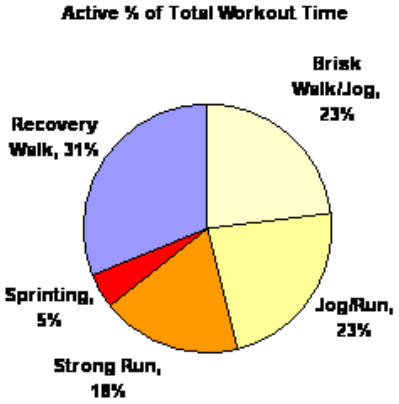
This interval was repeated 4 times in a row during the pre and post-test then the subject would walk at a slow, but steady pace for 1 minute. Then this ratio of 2 minutes working to 1 minute resting would repeat 10 times for a total of 30 minutes. The reason we chose the 30 second interval rather than the 60 or 90 second interval that we have used in the past was based on the adaptability of the 30 second time frame and the ability of the subject to attack it more intensely rather than saving up and pacing themselves as we have seen in the 90 second interval.

The times spent in each activity are loosely based on the time spent in each activity of a soccer match as described in the graphics below. We have tried to establish an intense bout of soccer specific activity that could adequately prepare them for the demands of the sport. In the 2:1 Work : Rest Interval Pre and Post-Test the time spent in each activity closely resembled the activity breakdown over a 90 minute game.

Activity Breakdown Over a 90 Minute Game

Activity/Position	Defenders	Midfielders	Forwards
Walk	36%	31%	29%
(Walk Backwards)	(4-8%)	(4-8%)	(4-8%)
Jog	41%	38%	35%
Strong Run	17%	20%	23%
Sprint	6%	11%	13%

Figure 5: Courtesy of www.TotalSoccerFitness.com



The training protocol for the 3 week study went as follows:

Week 1:

Day 1: **Pre-Test on the Force 30s interval** **2:1 x 10**

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Day 2: **Pre-Test on the Landis**	12min warm up run – 10min rest – **12min run**
Day 3: Rest	
Day 4: Force 30s interval	3:1 x 7 *(building a base)*
Day 5: Landis Run	10min run -5min rest x 2 *(quickening the pace)*
Day 6: Rest	
Day 7: Landis Run	20min paced run at 8.0 *(recovery run)*
Week 2:	
Day 1: Force 30s interval	4:1 x 5 *(building a base)*
Day 2: Pre-Test on the Landis	8min run – 2min rest x 3 *(quickening the pace)*
Day 3: Rest	
Day 4: Force 30s interval	1min:30sec x 20 *(quickening the pace)*
Day 5: Landis Run	8min run – 2min rest x 3 *(quickening the pace)*
Day 6: Rest	
Day 7: Landis Run	20min paced run at 8.0 *(recovery run)*
Week 3:	
Day 1: Force 30s interval	1min:45sec x 17 *(quickening the pace)*
Day 2: Pre-Test on the Landis	10min run – 5min rest x 2 *(maintaining speed, endurance)*
Day 3: Rest	
Day 4: Force 30s interval	1:1 x 15 *(focusing on speed)*
Day 5: Landis Run	12min run – 6min rest x 2 *(maintaining speed, endurance)*
Day 6: Rest	
Day 7: **Post-Test on the Landis**	12minute warm up run – 5min rest – **12min run**
Week 4:	
Day 1: **Post-Test on the Force 30s interval**	**2:1 x 10**

Figure 1: This graphic is of the Woodway Force Treadmill which uses a harness attached to a post behind the treadmill and a resisted belt system that allows the athlete to move the belt as opposed to a motorized system where the athlete simply has to keep up with the speed of the belt.

Figure 2: This graphic shows the display panel of the Woodway Force Treadmill that was used for the Interval Runs. This display allows us to monitor HR, Speed, Distance, Load and Time.

The training protocol was designed to establish baselines, then focus on either quickening the speed during shorter intervals, or maintaining the pace over longer intervals. In week 3, the Force workouts put much more emphasis on sprinting speed and covering large amounts of distance in the running portions of the 30 second interval. During this time the runs on the Landis Treadmill were focused on maintaining speeds for longer periods of time to continue to push the long term energy system (aerobic conditioning) while the Force workouts started to push the intermediate energy system (anaerobic / aerobic conditioning).

Testing and Results:

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Over the 3 week period the subject noticed greatly improved ability to maintain higher sprint speeds on the Force 30 second interval workouts which we believe would translate into the ability to maintain speed during repeated bouts of sprinting on the field in a game. Each week the speeds got faster starting out averaging 10.6 and maxing out at an 11.9 average during the 1:1 week (last workout of week 3) where the interval distance also maxed out at 100 yards per interval as opposed to 81 yard per interval in the Pre-Test.

In looking at heart rate changes over the 3 week period we noticed that the subjects HR was not recovering as fast in the post test as it did in the pre-test (Figure 3) , but this could be attributed to the fact that the athlete was covering more distance, and sprinting at a much faster pace right before each recovery period. What was interesting though is that on the very last run when the subject came to a complete stop the heart rate started off at 192 and recovered to 149r within 1 minute. During the Pre-Test the subjects heart rate ended at 191 and could only recover to 159 within 1 minute. This seems to meet the design of the study – push the body harder and recover faster!

When you compare this information with the % of Max HR (Figure 4) you see another interesting bit of information. The subject was working harder at each interval (running faster and covering more distance), but the % of max HR was lower until the very end where the athlete was able to push themselves to peak out (29 minutes into the workout), and still recover quickly enough within 1 minute.

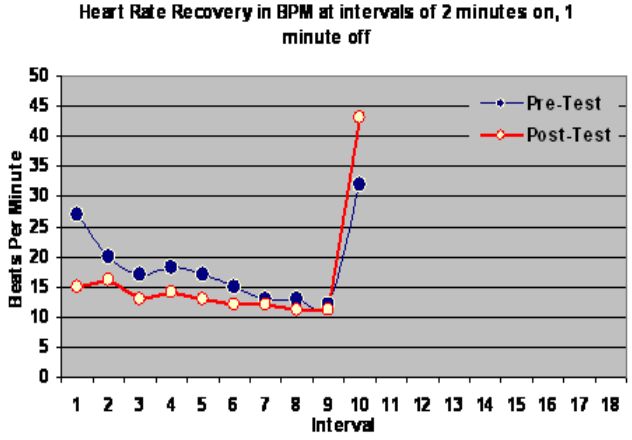

Figure 3: This graph shows the HR recovery during the 1 minute walk after each 2 minute interval. On the 10th interval the subject was instructed to sit down and allow HR to recover as quickly as possible. The results of this graph is only impressive when you compare with Figure 4 and 5 and notice that the % of max HR never got as high during the posttest, even though the subject was covering more distance and sprinting at a much faster pace.

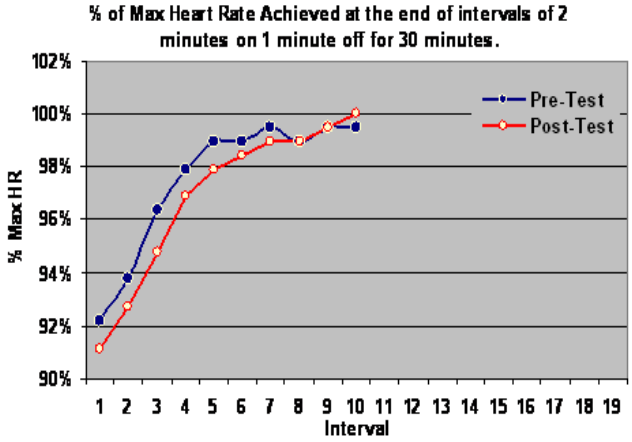

Figure 4: This graphs shows the % of max HR achieved during the 2 minute interval (based on a Max HR of 192). This graph shows significant improvement in conditioning Pre-Test to Post-Test when compared to Figure 5 which shows that the subject was covering more distance and sprinting at a much faster pace in the Post-Test.

As you can see in the graphs below (Figures 5 and 6) that show the improvements in yards per interval and sprint speed per interval show that the subject was improving in both categories.

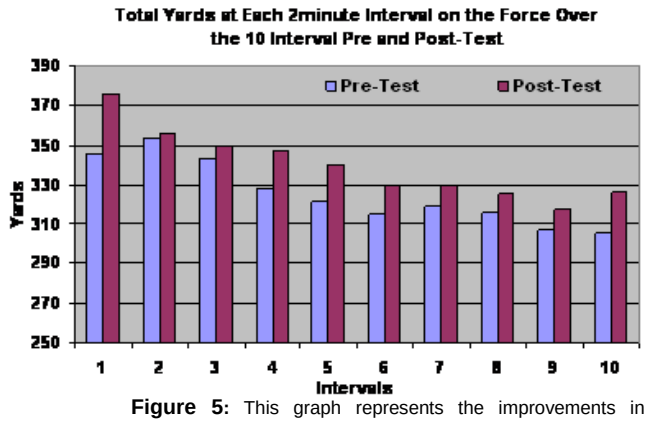

Figure 5: This graph represents the improvements in distance at each interval from Pre-Test to Post-Test

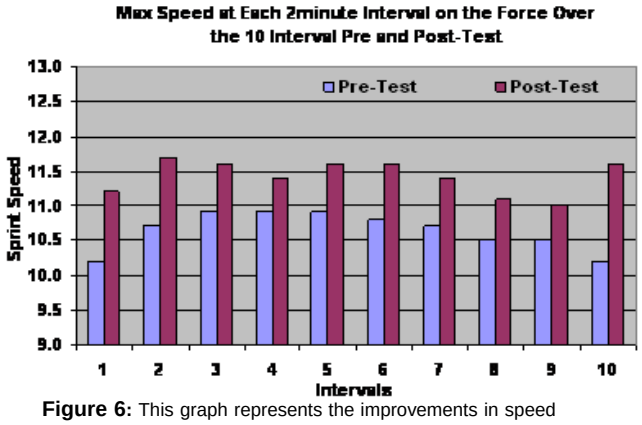

Figure 6: This graph represents the improvements in speed at each interval from Pre-Test to Post-Test

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Overall the pilot study showed exactly what we had anticipated and this is represented in the graphs below. Figure 7 shows the improvement in Pre and Post-Test Force 30 second interval 2:1 Protocol and Figure 8 shows the improvements in 12 minute run distance and its correlated VO2 max score.

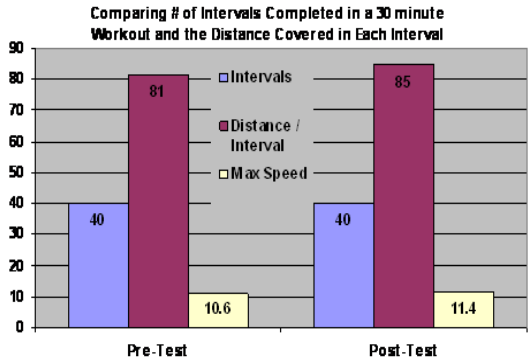

Figure 7: This chart shows the comparison of Pre-Test to Post-Test intervals, distance achieved per 30 second interval, and the average sprint speed in each interval. The improvements in distance per interval seem modest, but it represents an overall improvement of 160 yards over the 40 intervals.

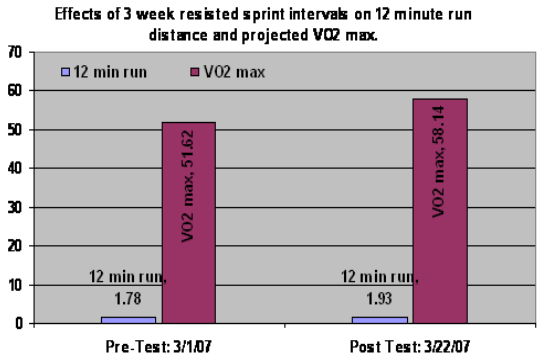

Figure 8: This graph represents the change in 12 minute run distance and it's correlated value of VO2 max over the course of the 3 week training phase. The test was done on a treadmill and the subject was asked to manually adjust the speed based on fatigue. There was no coaching or markers that would pace the subject for this test, it was entirely up to the subject.

Practical Applications and Comparisons:

Over the last few years we have been searching for a protocol that not only helped develop VO2 max, but also helped develop the powerful acceleration type sprint speeds. This protocol has proved to us that we are on the right track with the Woodway Force 30 second interval test. Training time was always set at 30 minutes and the subject went through 4 workouts per week plus 1 recover jog that was set at 20 minutes. Based on the improvements in HR Recovery, VO2 Max, Resisted Sprint Speed, and Distance Covered in 30 seconds we feel that this protocol could be a good Pre-Season Program Conditioning Program for soccer players as well as basketball players. We also feel that shorter variations of this program would be great during the season to maintain dynamic leg strength, sprint endurance, and VO2 max.