

iNCREDIWEAR

EMPOWERING RECOVERY

Surface Electromyography Shows how Incrediwear Helps Professional Athletes Recover

RESEARCH AIM:

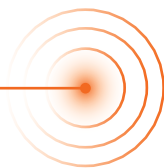
Identify and understand changes in muscular load and fatigue in elite athletes who used iNCREDIWEAR for recovery following training sessions.

6 HOCKEY PLAYERS 14 SOCCER PLAYERS

STUDY DESIGN:

Twenty (20) subjects, six (6) professional hockey players and fourteen (14) professional soccer players, were enrolled in a double blinded, placebo-controlled three arm study. Following informed consent, subjects were asked to perform a cycling or running test, then recover by sleeping overnight wearing Incrediwear leg sleeves, and then perform the same cycling or running test again the following day. Real-time measurements were taken with surface electromyography (sEMG) to record muscular loading and recovery using the Myontec Ltd. EMG-embedded textile shorts.

sEMG



TECHNOLOGY BACKGROUND:

sEMG is a non-invasive technique used to measure and analyze the electrical activity of muscles. The sEMG shorts enable accurate, validated measurement of gluteal, hamstring and quadriceps muscle activity.

KEY FINDINGS:

DRAMATIC IMPROVEMENT

The subjects wearing the Incrediwear leg sleeves demonstrated dramatically improved recovery compared to placebo subjects and the subjects who did not receive any recovery garment.

REDUCED MUSCLE LOAD

In the study, we observed reduced muscle load which is positively correlated with recovery.

31% IMPROVED RECOVERY

In hockey players (n=6), normalized improvement in recovery was 31.0% compared to -1.1% for subjects who received placebo sleeves and in soccer players (n=14), normalized improvement in recovery was 16.8% compared to 6.9% for subjects who received placebo sleeves.

INCREASED BLOODFLOW

Mechanism of improved recovery is the Incrediwear technology, which reduces inflammation and increases blood flow.

UNEQUIVOCAL TRAINING BENEFIT

CONCLUSION:

The evidence from this double blinded, placebo controlled experimental research trial demonstrates substantial improvement in muscular recovery among professional athletes. Subjects who wore Incrediwear to recover improved by an average of 21.1% overall, an unequivocal benefit to athletic recovery and therefore performance.



ADDITIONAL INFO:

Real-time, accurate surface electromyography (sEMG) data was gathered using Myontec technology, whose sEMG embedded shorts are changing sports research capabilities by enabling non-invasive measurements of muscle signaling and load during strenuous activity. The Myontec sEMG shorts measure the load of each muscle and muscle group separately, meaning an athlete's musculoskeletal status be analyzed specifically to look for injury propensity and imbalance. In combination with Incrediwear, Myontec shorts should be implemented as a valuable tool for muscle evaluation and monitoring during activity, while using Incrediwear to drastically improve the ability of each athlete to...

recover optimally every day, train harder, and achieve the greatest training benefit.

Empowering Recovery: Surface Electromyography Shows how Incrediwear Helps Professional Athletes Recover

Abstract

The aim of this research was to identify and understand changes in muscular load and recovery in elite athletes who used semiconductor embedded leg sleeves made by Incrediwear Inc. following training sessions.

Twenty (20) subjects, six (6) professional hockey players and fourteen (14) professional soccer players, were enrolled in a double blinded, placebo-controlled three arm study. Following informed consent, subjects were asked to perform a cycling or running test, then recover by sleeping overnight wearing Incrediwear leg sleeves, and then perform the same cycling or running test again the following day. Real-time measurements were taken with surface electromyography (sEMG) to record muscular loading and recovery using the Myontec Ltd. EMG-embedded textile shorts. sEMG is a non-invasive technique used to measure and analyze the electrical activity of muscles. The sEMG shorts enable accurate, validated measurement of gluteal, hamstring and quadriceps muscle activity.

The subjects wearing the Incrediwear leg sleeves demonstrated dramatically improved recovery compared to placebo subjects and the subjects who did not receive any recovery garment. In hockey players (n=6), normalized improvement in recovery was 31.0% compared to -1.1% for subjects who received placebo sleeves and in soccer players (n=14), normalized improvement in recovery was 16.8% compared to 6.9% for subjects who received placebo sleeves. In the study, we observed reduced muscle load which is positively correlated with recovery. We hypothesize that the mechanism of improved recovery is the ability of Incrediwear to reduce inflammation and increase blood flow, which are proven aspects of the technology.

Introduction

The use of Incrediwear to reduce muscular load and improve recovery in professional athletes is of great interest across professional sporting disciplines, as the ability to recover and maintain optimal training load and musculoskeletal readiness is correlated with reduced days lost to injury and overall superior athletic performance.

Incrediwear technology incorporates semiconductor nanoparticles into the fabric of wearable apparel, including leg sleeves. Their use to reduce pain, inflammation and improve recovery is widely acknowledged by athletes, coaches, doctors and clinicians who implement Incrediwear into their sports and medical practices around the world.

Applications of Surface Electromyograph (sEMG) Testing

Surface electromyography (sEMG) testing is valued for its diverse applications. Clinical applications include muscle function assessment, neuromuscular disorders, rehabilitation monitoring. Sports and performance applications include muscle activation patterns, biomechanical analysis, training optimization. Research applications include injury prediction and prevention, workload analysis, muscle physiology studies, movement analysis, injury prevention and ergonomics.

Myontec sEMG Technology

Myontec's sEMG capability enables revolutionized real-time muscle data collection. EMG data is traditionally gathered via small needle insertion of sensors directly into the muscle tissue. Desire for more practical EMG testing has led to the development of surface EMGs, by which sensors are affixed to the surface of the skin, however this is a difficult and time-consuming preparation that poses significant reliability challenges that have hindered the applicability of surface EMG testing, particularly in strenuous activities and exercise settings. The Myontec shorts are a validated sEMG system with the benefits of convenience, accuracy, and applicability to testing of athletes in strenuous settings.

The wearable Myontec sEMG system is validated for uses including evaluating muscle function, capacity, fatigue, force production, and to analyze activation patterns, biomechanics of movement, and to detect abnormalities or neuromuscular deviations by obtaining continuous biofeedback.

Study Design and Methodology – Randomized, Double blinded, Experimental Trial

The studies were carried out in December 2021 on two separate cohorts of subjects.

Studies were randomized, double blinded, and placebo-controlled and were designed to test recovery of professional male hockey players (n=6), and professional male soccer players (n=14). The aim was to assess the impact of the Incrediwear product on muscle load using surface EMG testing, to indicate muscle recovery. Surface EMG testing has demonstrated applications for predicting injury predisposition and readiness for athletic performance.

This research was carried out in collaboration with Myontec Ltd., maker of shorts with embedded EMG textile sensors to obtain real-time surface EMG data on the athlete's gluteal, hamstring and quadriceps muscles.

Professional hockey athletes completed a cycling test pedaling at an easy perceived rate of exertion for twenty (20) minutes after a three-hour training session. Following completion of the test, subjects were provided with recovery product based on their randomly assigned group (real, placebo or none), and instructed to wear it overnight. The following day, after 16-22 hours, subjects returned and performed an identical cycling test. EMG data was collected during both cycling tests, and the muscle loading following overnight recovery in real Incrediwear, placebo Incrediwear, or no recovery product was compared to pre-recovery values.

Professional soccer athletes completed an incremental running test on a treadmill, including an easy intensity standardized warm-up and cool down where EMG, VO₂max and lactate recordings were taken. Following the run session, athletes were given recovery product based on their randomly assigned group (real, placebo, or none) and instructed to wear it overnight. The athletes returned after 16-22 hours for another session (identical warm up and cool down protocol to the previous day) and their EMGs were recorded for comparison to pre-recovery values.

Participants

Professional athletes with no known musculoskeletal conditions, systemic pathologies or cognitive impediments to providing protocol consent were included in the studies. Participants were consented and randomly assigned to three groups: Incrediwear recovery products, sham recovery product, or no recovery product.

Study Results & Discussion

Studies in this experimental research trial were performed in December, 2021.

Recovery was between sixteen and twenty-two (16-22) hours, with median recovery time of eighteen (18) hours and average recovery time equal to nineteen (19) hours.

Data Analysis

Surface Electromyography (sEMG) data was collected throughout each test (cycling or running) for each subject. The results were averaged and normalized by the average reduction in muscle load observed in participants who received no recovery product (negative control). Average pre-recovery muscular load was calculated by averaging the hamstring, gluteal and quadriceps loading for the warm-up and cool down portion of the cycling or running tests. Average post-recovery (after wearing real, sham or no product) muscular load was calculated by averaging the hamstring, gluteal and quadriceps loading for the warm-up and cool down portion of the cycling or running test when the subject returned the following day. The percent difference in muscular load from pre-recovery to post-recovery was normalized by the baseline average values from subjects who did not receive any leg sleeves for recovery (negative control). Normalized values indicate the percent improvement in recovery for each group.

Table 1 – sEMG Data for Muscular Recovery Using Incrediwear in Hockey Players (n=6)

	Real Incrediwear		Placebo Incrediwear		No leg sleeves	
	Subject 2	Subject 3	Subject 1	Subject 4	Subject 5	Subject 6
Avg. pre-recovery load (mA/min)	42.5	26.5	38	42.5	39.5	40.5
Avg. post-recovery load (mA/min)	34	20	45	43	41	46
Change in load	8.5	6.5	-7	-0.5	-1.5	-5.5
Percent change in muscular recovery	20%	25%	-18%	-1%	-4%	-14%
Average change in muscular recovery	22.3 %		-9.8 %		-8.7 %	
Normalized % improvement in recovery	31.0%		-1.1%		0.0%	

Table 2 – sEMG Data for Muscular Recovery using Incrediwear in Soccer Players (n=14)

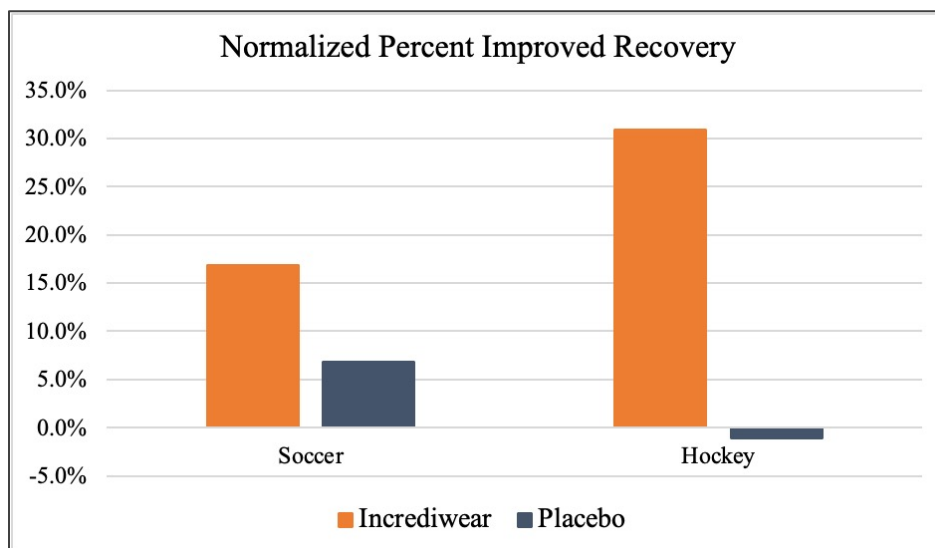
	Real Incrediwear						Placebo Incrediwear					No leg sleeves		
Subject #	1	4	7	9	11	14	3	5	8	10	12	2	6	13
Avg. pre-recovery load (mA/min)	64.5	75.5	68.5	63.0	56.5	45.5	46.5	59.0	51.5	74.0	50.5	63.5	46.5	51.0
Avg. post-recovery load (mA/min)	67.0	65.0	81.0	62.0	61.0	33.0	53.0	68.0	53.0	74.0	54.0	65.0	65.0	52.0
Change in load	-2.5	10.5	-12.5	1.0	-4.5	12.5	-6.5	-9.0	-1.5	0.0	-3.5	-1.5	-18.5	-1.0
Percent change in muscular recovery	-4%	14%	-18%	2%	-8%	27%	-14%	-15%	-3%	0%	-7%	-2%	-40%	-2%
Average change in muscular recovery	2.1 %						-7.8 %					-14.7 %		
Normalized % improvement in recovery	16.8 %						6.9 %					0%		

Data Summary

The sEMG data for professional hockey players and soccer players demonstrate superior recovery in subjects who wore Incrediwear. Normalized improvement in recovery was 31% and 16.8%, respectively.

The reduction from pre-recovery muscular load to post-recovery muscular load in the subjects who wore Incrediwear for recovery indicates that **Incrediwear helped the athletes recover 21.1% better** on average than with placebo leg sleeves, or no leg sleeves at all.

Figure 1 – Normalized Improved Recovery in Hockey and Soccer Athletes



Data Summary – Hockey and Soccer

Normalized percent improved recovery in hockey players:

Incrediwear: 31.0%

Sham: -1.1%

Negative control: 0.0%

Normalized percent improved recovery in soccer players:

Incrediwear: 16.8%

Sham: 6.9% improved recovery

Negative control: 0.0%

Normalized percent improved recovery across all subjects in experimental research trial including hockey and soccer players:

Incrediwear: 21.1%

Sham: 4.5% improved recovery

(Normalized by Negative control: 0.0%)

Conclusion

The evidence from this double blinded, placebo controlled experimental research trial demonstrate substantial improvement in muscular recovery among professional athletes. Subjects who wore Incrediwear to recover improved by 21.1%, an unequivocal benefit to athletic recovery and therefore performance.

Real-time, accurate surface electromyography (sEMG) data was able to be gathered using Myontec technology, whose sEMG embedded shorts are changing sports research capabilities by enabling non-invasive measurements of muscle signaling and load during strenuous activity. The Myontec sEMG shorts measure the load of each muscle and muscle group separately, meaning an athlete's musculoskeletal status can now be analyzed with greater specificity and definition. In combination with Incrediwear, Myontec shorts should be implemented as a valuable tool for muscle evaluation and monitoring, to assess performance status and injury propensity at any time while using Incrediwear to drastically improve the ability of each athlete to recover optimally every day and achieve greater training benefit.

List of Tables and Figures

Table 1 – sEMG Data for Muscular Recovery using Incrediwear in Hockey Players (n=6)

Table 2 – sEMG Data for Muscular Recovery using Incrediwear in Soccer Players (n=14)

Figure 1 – Normalized Improved Recovery in Hockey and Soccer Athletes



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Appendix 1: Running VO₂ max test with sEMG Study Schedule

Groups: Incrediwear, Sham Incrediwear, None (negative control)

1. Subjects execute an incremental running test on treadmill
 - Warm up up with sEMG
 - Speed 7.1 km/h, pace 6:10 min/km
 - Record sEMG, VO₂max, lactate, Heart Rate data
 - Speed starting with 6.5 km/h, increase every 90 sec. until anaerobic threshold after which speed remains the same but surface incline increases every minute
2. After completion of test, subjects receive product as assigned for recovery overnight
 - Wear product 16-22 hours against skin, no other recovery activities done
3. Following day
 - Muscle load test running on treadmill
 - Identical warm up with sEMG
 - speed 7.1 km/h, pace 6:10

Appendix 2: Products – Incrediwear Recovery Leg sleeves and Myontec sEMG Shorts



Incrediwear Recovery Leg Sleeves

iNCREDIWEAR



Myontec sEMG Shorts

Appendix 3: Sample sEMG Real-time Data for Experimental Research Trial

Professional Hockey

Hockey Player 1 – Sham Incrediwear Sleeves

Reference after training



Recovery overnight



Muscle load changes from 41mA/min (reference after training) to 45 mA/min (recovery overnight). Charts in lower right corner show loading on left quad, right quad, left hamstring, right hamstring, left glute, and right glute (moving from L to R).

Hockey Player 2 – Incrediwear Leg Sleeves

Reference after training



Recovery overnight



Hockey Player 6 – No sleeves (negative control)

Reference after training



Recovery overnight



Professional Soccer

Soccer Player 1 – Incrediwear sleeves

Yellow arrows show warmup period that was compared pre and post-recovery

Reference warmup before VO2 max test



Same warm up after overnight recovery



Soccer Player 5 – Sham Incrediwear

Yellow arrows show warmup period that was compared pre and post-recovery

Reference warmup before VO2 max test



Same warm up after overnight recovery



Soccer Player 6 – No sleeves (negative control)

Yellow arrows show warmup period that was compared pre and post-recovery

Reference warmup before VO₂ max test



Same warm up after overnight recovery

