

## **Maximize Your Performance with Respiratory Muscle Training (RMT) MAXIMUS Device**

### **Introduction: What is Respiratory Muscle Training - RMT?**

Respiratory Muscle Training (RMT) is a method that uses resistance breathing exercises to enhance the respiratory muscles' function for breathing. Particularly, inspiratory muscle training (IMT) has been proven to improve respiratory muscle performance and may lessen shortness of breath (dyspnea) after exercise (Oliveira, 2021).

**Summary:** In this RMT device white paper, we will share the multitude of research articles and describe our hypothesis for the development of an advanced RMT device that provides both inspiratory/expiratory resistance and has a profound impact on athletic performance improvement via our hypothesis that by using a device designed for use during exercise, elicits powerful impact on both lactate threshold and VO<sub>2</sub> Max, thus, significantly improving strength and endurance. This is primarily due to the intensity of adding RMT designed for exercise, which has a variable impact depending on the intensity, frequency, and duration of the exercise while using the RMT device. In this paper, we discuss the impact on overall health and sports performance impact MAXIMUS is having on both athletes and non-athletes, looking to improve cardio-respiratory fitness and sports-specific strength and endurance, as well as stress/anxiety relief, better sleep and overall sense of well-being. This research outlined below led to the design and development of Maximus, specifically for improving sports performance; first and foremost, however, the health benefits are equally impressive. Early research on the MAXIMUS RMT device shows significant improvements in strength and endurance; one must experience to believe the results. Both from an overall health perspective, stress relief, better sleep, etc. It reminds us of the early days of strength training with free weights when pundits said training with weights would make you less flexible and muscle-bound. Now we know strength training with weights, bands, etc., is critical to a well-balanced routine that includes regular stretching, strength training, nutrition, etc.

Early research participant in prototype development and research with college athletes indicates a significant increase in strength and endurance in athletes and the average health enthusiast. Prototype users saw an average increase of 43% in strength and a 24% improvement in endurance. In a collegiate study of women's lacrosse, participants in the Maximus device group saw an average increase in strength of 44% Vs. Standard of care, no device used during exercise. The lacrosse player used the device for six weeks doing the same exercises as the control group.

This is the next frontier to taking athletic performance to the next level of human performance. Both lactate threshold and VO<sub>2</sub> Max are improved, as well as many metrics involving lung efficiencies, maximum inspiratory pressures, maximum expiratory pressures, increased lung volume, intercostal muscle strength improvement, and more. Thus, early research backs all the reported benefits of RMT seen in athletes, mainly due to the accelerated impact of using the device during exercise, thus rapidly acting as a force multiplier on any exercise and maximally increasing all benefits.

### **Profound Benefits for Athletes employing RMT: Research Studies**

Haj Ghanbari *et al.* (2013) depicted that competition drives athletes to find new ways to gain an edge over their competitors. Historically, full- or partial-body workouts that target the peripheral muscles and heart have been the mainstays of high-performance training. To surpass the plateau achieved by such training, respiratory muscle training (RMT) and particularly

inspiratory muscle training (IMT) have been investigated as a method through which athletes could improve their performance.

According to Shei (2018), there has been much interest in the function of the respiratory muscles during exercise, particularly their vulnerability to fatigue both during and immediately after exercise.

According to recent research, RMT may 1) reduce the motor drive of the inspiratory muscles while preserving pressure production, 2) encourage diaphragm hypertrophy and raise the proportion of type I fibers and the size of type II fibers in the muscles of the external intercostals. 3) reduce the sympathetically induced vasoconstriction known as the respiratory muscle metaboreflex, which may divert blood away from the leg locomotor muscles 4) lessen the perceived breathlessness or shortness of breath ratings 5) make respiratory muscle economy better; 6) lessen the difficulty of breathing and 7) increase the capacity of respiratory muscles (Sales *et al.*, 2016; St Croix *et al.*, 2007; Downey *et al.*, 2007; Ledd *et al.*, 2007; Held *et al.*, 2014) For instance, These possible mechanisms are probably connected. Delaying respiratory muscle exhaustion and the respiratory muscle metaboreflex may be aided by increasing the number of type I fibers (Shei, R. J. (2018).

It has been demonstrated that respiratory muscle training (RMT) is a valuable ergogenic aid for athletic performance. Running, cycling, swimming, and rowing are just a few exercise modalities where RMT has been shown to enhance performance. The physiological effects of RMT have been hypothesized to include diaphragm hypertrophy, muscle fiber type switching, enhanced neural control of the respiratory muscles, enhanced respiratory muscle economy, attenuation of the respiratory muscle metaboreflex, and reductions in perceived exertion and breathlessness. These physiological effects may account for performance improvements by improving respiratory muscle endurance.

Over the last several decades, much research has been done on how exercising the respiratory muscles, particularly the inspiratory muscles, might increase exercise capacity and performance.

### **Historical Finding of Meta-Analysis Study Done By HajGhanbari *et al.* 2013**

HajGhanbari *et al.* 2013 conducted a systematic review with a meta-analysis study to determine whether RMT can enhance sports performance in athletes; They carried out a systematic review that included meta-analyses to evaluate (a) the effect of RMT on sports performance (b) the effect of RMT on respiratory muscle strength and endurance in athletes who participate in various sports (c) the types of athletes or sports that show the most solid progress from RMT and whether elite or recreational athletes gain the most from RMT, and (d) to identify the most effective mode of RMT.

Their meta-analyses showed that RMT had a substantial favorable impact on time trials, exercising endurance duration, and the number of repetitions in Yo-Yo testing. Most studies showed an increase in the strength and endurance of the inspiratory muscles, which partly depended on the RMT technique used.

They concluded that RMT could enhance athletic performance, they determined. Future research may provide even more considerable benefits if more effort is put into aligning the ventilatory demands of RMT to those needed during athletic activities.

### **Benefits of Inspiratory Muscle Training (IMT) By Rożek-Piechura *et al.* (2020)**

IMT, or inspiratory muscle training, can be used to reduce fatigue. The advantages of IMT are connected to increased oxygen delivery to the tissues, which improves physical performance. Exercise is known to cause respiratory muscles to get fatigued, which reduces their capacity and causes a poorer delivery of oxygen to the active muscles. The oxygen (O<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>), generated at more significant levels during power or endurance exercises, are controlled by the respiratory system and its central regulating unit.

Recent research suggests that athletes' physical performance may be impacted by their inspiratory muscles. The sympathetic peripheral vasoconstriction reflex is activated in physically demanding situations when the creation of free radicals exceeds the elimination capacity, which causes early skeletal muscle exhaustion and, as a result, a drastic decline in performance.

Inspiratory muscle training is a therapeutic modality that overcomes resistance against the muscles responsible for expanding the rib cage. The application of IMT has been demonstrated to be a viable strategy for optimizing respiratory capacity. IMT makes it possible to achieve better physiological functioning of the body, which can improve athletic results (Rożek-Piechura *et al.*, 2020).

### **How do RMT trainers work?**

#### **Threshold Trainers**

No substantial flow is obtained below the threshold in a threshold RMT device; once the threshold pressure is overcome, a valve is opened, and the inspiratory flow is unfettered. Usually, the threshold pressure is surpassed during the first 20 percent of inspiratory volumes. As a result, the breathing rhythm features a quick and short pressure peak followed by a neutral period with little effort.

#### **Resistive trainers**

Resistive trainers either feature several tiny holes with a decreasing number of opening holes as the device's dial is turned, or they contain tiny orifices for breathing that get increasingly smaller as the training progresses. Airflow rate, or breathing pattern, affects resistive trainers as well. Inspiratory flow is forced through a variable orifice using resistive RMT devices. To use the complete inspiratory volume for muscle training, the pressure applied to create inspiratory flow must be maintained throughout the entire breath (Sapienza, C. M. (2008).

The respiratory pattern that goes along with it displays modest but persistent pressure exertion. Some devices, like the MAXIMUS, focus RMT on the inspiratory and expiratory muscles by applying the same theory to the expiratory flows.

### **The Physiology of RMT Benefits**

When the work of breathing increases, blood flow to the legs is reduced. If the breathing rate is decreased, cardiac output reduces. Thus, blood flow to the legs can increase. It is thought that these changes can be explained by the metaboreflex (Kaur *et al.*, 2015). Simple nerve terminals may be found in all muscles, including respiratory muscles. These nerve fibers

are stimulated when metabolites build up, providing signals to the cardiovascular controllers. This, in turn, sets off a reflex increase in sympathetic outflow, constricting the blood vessels in the limbs and the airways.

As a result, the blood supply to the limbs alters, which raises blood pressure and lowers blood flow. Since training increases the effort that must be done before the reflex is triggered, it may be able to sustain blood flow to the limbs for a more extended period and improve performance (McConnell, 2013).

### **RMT Enhances Hypoxic training of Athletes**

There is proof that RMT improves sports performance and has many other positive impacts on healthy individuals. The research findings conclusively demonstrate that IMT results in statistically significant performance improvements (Oliveira, 2021). A more recent evaluation investigated the application of RMT in hypoxic circumstances. Although hypoxic training has grown in popularity among athletes, it can have unfavorable effects, such as respiratory muscle exhaustion after an extended activity has been shown to enhance breathing patterns, increase the effectiveness of respiration, lessen the sensation of dyspnea, and enhance performance in hypoxic situations (Álvarez-Herms, 2019).

### **RMT Relieves Stress, Anxiety, and Depression Validated by Various Studies**

You may be amazed that it is not a new scientific breakthrough study that found that Diaphragmatic breathing has also been studied in conjunction with meditation, old eastern religions, and martial arts. It is an essential component of yoga and Tai Chi Chuan (TCC), and it helps with emotional balance, social adaption, and distinctive rhythmic motions and positions (Lehrer et al., 2010)

Breathing exercises, commonly called "deep breathing" or "diaphragmatic breathing," are effectively integrated body-mind training for managing stress and psychosomatic illnesses. Diaphragmatic breathing deepens inhalations and exhalations, contracts the diaphragm, and expands the abdomen. This reduces the frequency of breathing while increasing the number of blood gases in the body, lessening stress and anxiety in individuals.

Recently, Nuez-Flores et al. (2021) examined how a high-intensity home-based RMT program affects the quality of life, lung function, psychological state, and a healthy mind. They found that RMT interventions can reduce stress and enhance the quality of life.

In another psychological research Brown (2005) found that anxiety, melancholy, and stress may all be reduced with breathing exercises, which are very effective non-pharmacological interventions. Additionally, Yu and Song (2010) showed similar advantages on anxiety in a 3-day intervention study where subjects who practiced breathing exercises three times each day reported much less anxiety.

Breathing exercises are often used in therapeutic settings to treat mental illnesses such as depression, anxiety, and stress, including post-traumatic stress disorder (PTSD) ( Goldin & Gross, 2010).

### **A study by Ma et al. (2017) Showed How RMT Relieves Stress, Anxiety, and Depression,**

In reaction to stress, the glucocorticoid steroid hormone cortisol is produced. The release of cortisol is linked to depression, anxiety, and other unpleasant feelings. The hypothalamic-pituitary-adrenal (HPA) axis, which controls metabolic reactions, immunity, and specific mental processes, including memories and emotional evaluation, may be the basis of the underlying

mechanism because of its sensitivity to its activity. . Salivary cortisol levels have been linked to anxiety and depression. In contrast, plasma cortisol levels reflect variations in the activation of the HPA axis with changes in CO2 inhalation (Clow et al., 2010; Ma et al. (2017).

To determine if RMT can significantly enhance cognitive function and decrease negative affect and stress, Ma et al. (2017) undertook an 8-week breathing training course.

Ma et al. (2017) found that in their study that the breathing intervention group (BIG) demonstrated considerably greater sustained attention following training than the control group. In the diaphragmatic breathing condition, there was a highly significant impact of group and time on cortisol levels, with the BIG having a considerably lower cortisol level after training and the control group (CG) having no significant change in cortisol levels.

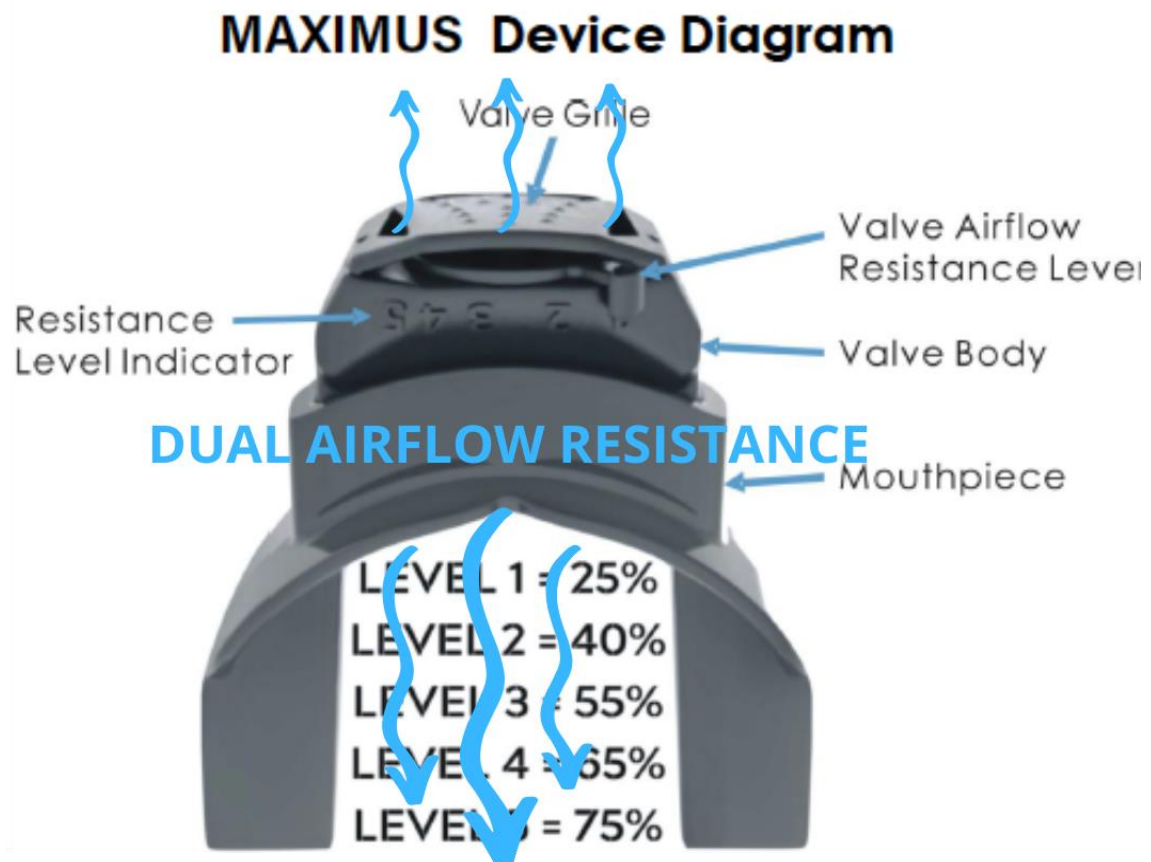
They concluded that RMT had been shown to promote sustained attention, emotion, and cortisol levels. From a health psychology standpoint, this study produced data proving the influence of RMT, a mind-body activity, on mental function, which has crucial implications for stress relief.

**Inspired by advanced and innovative evidenced-based scientific studies, we have designed a new device MAXIMUS Fitness Accelerator.** MAXIMUS Fitness Accelerator was designed and built in accordance with the abovementioned two historical research was done by HajGhanbari et al. (2013) and Rożek-Piechura *et al.* (2020).ed

Early data confirms that we can aggressively titrate the progression of training intensity because the device is designed for use during exercise where the intensity of training and advancement of two-way airflow resistance affords all users maximal results for maximal performance.

Until now, there were no devices designed with two-way resistance breathing, both inspiratory and expiratory resistance, designed for use during exercise for maximum intensity, that maximizes both strengths via improving lactate threshold and improved endurance by way of Vo2 max via overall improved breathing efficiencies, increased lung volume, increased inspiratory and expiratory max flow pressures. While an athlete would rarely consider performing quadriceps exercises without balancing leg strength with hamstring exercises, nor vice versa, or biceps, not triceps. We train for balance in our muscles for the best overall athletic performance. When looking at the RMT device, MAXIMUS is the first device with Dual Resistance Technology, designed for use during all exercises, except swimming, for maximum gains in performance.

**MAXIMUS Fitness Accelerator is Designed for MAXIMUM RESULTS when used during exercises for athletes and health enthusiasts looking to live a healthy Lifestyle.**



#### **Prototype User Study Revealed MAXIMUM Performance Improvement**

It is what we have seen with both prototype users, helping to develop the product and significantly increasing endurance and strength performance.

#### **Prototype User Protocol Study:**

Early prototype users signed a confidentiality agreement and agreed to the following stipulations.

1. Users agreed to perform baseline testing to gain a baseline in strength and endurance performance. No device was used during the baseline testing.
2. At least one endurance exercise was chosen, and two or three strength exercises were chosen. The most common strength exercise chosen as pushups and pull-ups.
3. Users agreed not to alter nutrition habits from what they usually consume during the 8-week trial.
4. Users agreed to not add any new supplements to their routine during the 8-week trial.
5. After eight weeks of using the device, users again performed the same baseline test with no device.

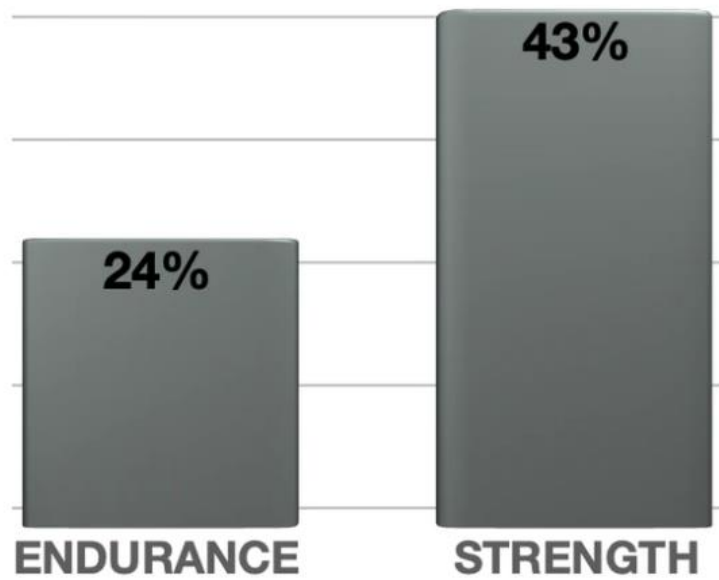
Comparison from the original baseline to week-9 baseline numbers was calculated for the numbers as seen above for strength increase.

**Increased Strength + Endurance**

On average, MAXIMUS prototype users saw a 24% Increase in Endurance & 43% in strength after eight weeks.

\*Prototype users were not high-level athletes, thus more likely for significant gains.

**The only change made was adding a MAXIMUS device during their training routine.**



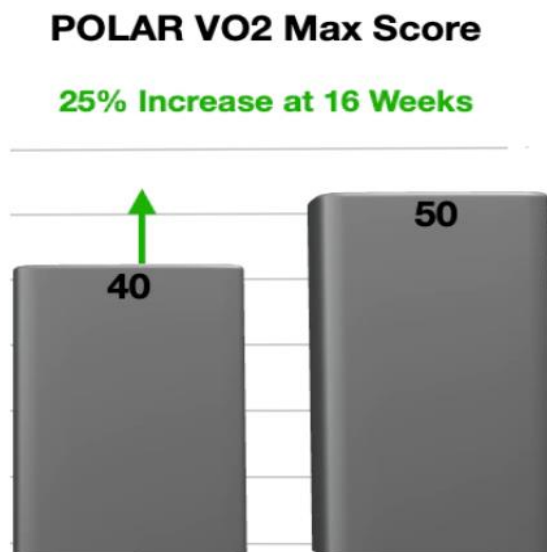
**\*Results are variable and dependent on baseline fitness, frequency of device use, resistance levels employed, duration of training sessions, and intensity of exercise.**

**Increased VO2 Max Score**

After 16 weeks of using MAXIMUS during exercise, my Endurance and VO2 Max score improved by 25%.

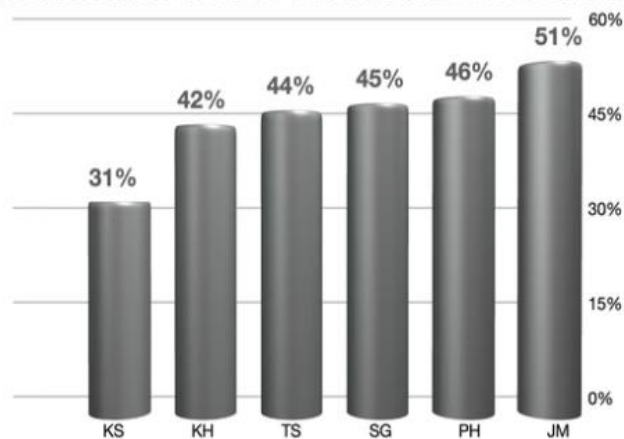
This is one prototype user's experience using MAXIMUS over 16 weeks with VO2 testing using Polar Technology.

Results are variable and dependent on baseline fitness, frequency of device use, resistance levels employed, duration of training sessions, and intensity.



**Prototype Users Increased STRENGTH ranging from 31% to 51%.**

**STRENGTH INCREASES AFTER MAXIMUS USE FOR 8 WEEKS**



\*Results are variable and dependent on baseline fitness, frequency of device use, resistance levels employed, duration, and intensity of training sessions.



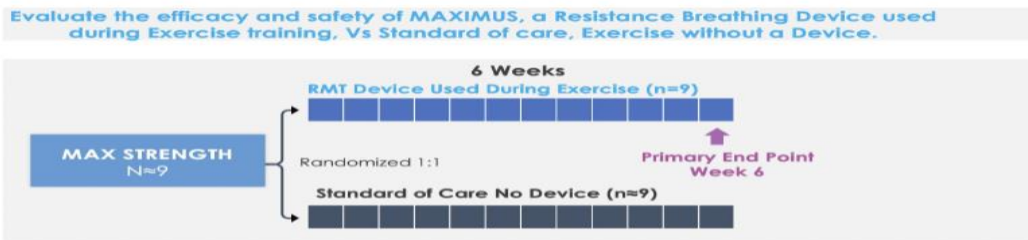
**STUDY #2**    [MAXIMUS DEVICE](#)

**Evaluating the Performance of College lacrosse teams using MAXIMUS Device Fitness Accelerator**

**Study design and Inclusion Criteria:** It is a single-center, randomized, active control study randomized to one of two age-matched, healthy women's college lacrosse teams—a minimum of two in each group of freshmen, sophomores, Juniors, and Seniors. The active control group performed the same workouts as the Maximus device group.

**Exclusion criteria:** Any athlete with a respiratory illness, chronic or otherwise, were excluded from participation. Any athletes with a cardio-respiratory illness of any type were excluded from this study.

Single-center Randomized study of RMT added to Exercise Vs. Standard of care exercise no device, same exercise routine. J Francis et al. (2022)



**STRENGTH RESULTS**

MAXIMUS Group				MAXIMUS Group				
Name	Squat/Time	Squat/Time	Avg. % Difference	22%	Push up/Time	Push up/Time	Avg. % Difference	71%
Robbie	51/1:29	64/1:35	13	25%	1/0:08	2/0:07	1	100%
Kaylen	125/3:45	93/2:30			6/0:23	12/2:28	6	100%
Becka	50/1:23	INJ			10/0:28	INJ		
Sophia H.	15/1:39	INJ			8/0:21	INJ		
Kierra	60/2:24	80/1:52	20	33%	20/0:35	30/0:43	10	50%
Grace	46/1:34	45/1:59			6/0:15	7/1:33	1	14%
Courtney	78/2:47	84/2:38	6	8%	6/0:17	10/0:40	4	66%
Sarah	80/2:50	90/2:37	10	20%	4/0:26	8/0:40	4	100%
Molly	111/3:32				1/0:07	1/0:08		0%
			<b>Total %</b>	<b>86%</b>			<b>Total %</b>	<b>430%</b>
Control Group				Control Group				
Name	Squat/Time	Squat/Time	Avg. % Difference	16%	Push up/Time	Push up/Time	Avg. % Difference	47%
Gemma	38/1:02	41/1:55	3	8%	14/0:43	17/0:42	3	21%
Regan	34/1:04	INJ			0/0:02	INJ		
Solei	60/1:43	47/1:26			5/0:12	8/0:31	3	60%
Gianna	38/1:58	INJ			0/0:02	INJ		
Sloan	85/2:21	80/1:41			17/0:37	30/0:38	13	76%
Christen	48/1:26	55/1:10	7	14.50%	4/0:20	7/0:30	3	75%
Sophia J.	70/2:06	82/1:48	12	17%	12/0:35	5/0:20		0%
Terra	93/3:12	53/1:26			20/0:33	30/0:53	10	50%
Claudia	145/3:32	180/3:53	35	24%	19/0:30	20/0:30	1	5%
Shannon	?	22/1:32				0/0:03		0%
			<b>Total %</b>	<b>64%</b>			<b>Total %</b>	<b>287%</b>

**SQUATS      38%      improvement over standard exercise control group/no device**  
**PUSHUPS    51%      improvement over standard exercise control group/no device**  
**\*\*Overall Strength gains averaged 44.5% increase in strength for both squats and push ups Vs. the control group. Calculations performed on those athletes that had a positive gain, improvement over previous baseline in both groups**

***This randomized study of a woman's college lacrosse team showed a similar increase in strength, to that of the prototype user study, of 44%, in the device group, over an active control group consisting of training with no device and the same exercises and cadence as the device group.*** This is consistent with prototype users looking at the intensity of RMT training and the associated increases in lactate threshold. We hypothesize that, regardless of exercise, the lactate threshold increases dramatically with use over time because the resistance and intensity are greatest using a device during exercise.

**Current RMT Devices Available In The Market For Medical and Sports Purposes**

**MAXIMUS is the only device with DUAL RESISTANCE Designed to use during EXERCISE resulting in**

<b>Device</b>	<b>Manufacturer/distributor</b>	<b>Inspiratory</b>	<b>Expiratory</b>	<b>Combination</b>
<b>Breather</b>	PNMedical (Orlando, FL, USA)	Yes	Yes	Resistive
<b>Threshold PEP</b>	Philips ResporonKs (Murrysville, PA, USA)	Yes	Yes	Resistive and Threshold
<b>Eolos</b>	Aleas Europe (Miami, FL, USA)	Yes	Yes	Resistive
<b>Threshold IMT</b>	Philips Respiroics (Murrysville, PA, USA)	Yes		Threshold
<b>Pflex</b>	Philips Respiroics (Murrysville, PA, USA)	Yes		Resistive
<b>POWERbreathe</b>	POWERbreathe ( Southam, UK)	Yes		Threshold
<b>Trainer</b>	Project Electronics Ltd (Erith, UK)	Yes		Resistive
<b>Respifit S</b>	Biegler GmbH (Mauerbach, Australia)	Yes		Resistive
<b>Ultrabreathe</b>	Tangent Healthcare Ltd. (Basingstoke, UK)	Yes		Resistive
<b>Protex IMT</b>	Smiths Medical (St Paul, MN, USA)	Yes		Resistive
<b>EMST-150</b>	Aspire Products (Atlanta, GA, USA)		Yes	Threshold
<b>MAXIMUS</b>	<b>Neo-Ventures LLC (Overland Park, KS)</b>	<b>Yes</b>	<b>Yes</b>	<b>Resistive</b>

**MAXIMAL PERFORMANCE GAINS.**

*MAXIMUS is the first and only Resistance Breathing Trainer Device designed with PATENTED DART Technology - Dual Airflow Resistance Technology allowing users to dial up airflow resistance equally, inhaling and exhaling, to increase cardio-respiratory fitness rapidly and maximally allowing users to do more with less wear and tear on joints and muscles, acting as a FORCE Multiplier, regardless of your workout.*

**Achieve Your General Health and Wellness Goals with MAXIMUS**

There are many potential benefits elicited from this two-way resistance breathing device, including prototype user-reported benefits, lower blood pressure, better sleep, stress management, reduced snoring, and an improved sense of well-being.

**Prototype Users Reported Benefits**

**Maximize Energy** - The Maximus device is designed based on the most advanced research that can reduce the respiratory rate by increasing lung volume, thus preserving your energy and maximizing your endurance and performance.

**Increasing Focus** - MAXIMUS helps in deep Diaphragmatic Breathing, which enhances your focus.

**During EXERCISE Use Benefits** - MAXIMUS is used during exercise for Maximal Gains in strength, speed, and endurance.

**Lower Resting Heart Rate** - Using MAXIMUS during training or a workout helps the lungs increase in volume, reducing respiratory rate, and ultimately lowering your heart rate.

**Better Sleep** - Various research studies have proven that deep diaphragmatic breathing relieves stress.

**Better Fitness** - MAXIMAL helps you by enhancing fitness, making you better, faster, and stronger by going harder and longer. It also allows you to maximize your workouts by doing more with less wear and tear on your body, joints, and muscles.

**The goal of MAXIMUS** - The MAXIMUS aims to help athletes achieve their goals by preserving energy and maximizing endurance. MAXIMUS is continuously working and participating in research studies to give you better experiences and make you stand out from the rest.

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