POWER-UP Trial
Performance Output With Haptics—Evaluating Athlete Response and Unrealized Potential

Jason Taporco, MD, MPH; Alex Adelman, MD; Ryan Donovan-Schager; John Konhilas, PhD; Peter Hurwitz; Mark Sakr, DO

University of Arizona College of Medicine

Abstract

Elite athletes are consistently seeking efficient and ethical methods to achieve greater performance. In this double-blinded, randomized, crossover trial, we explored the effect of a drug-free skin patch (VICTORY patch) on several markers of strength and performance. In 70 NCAA Division 1 athletes, our data shows that this technology produced a statistically significant force increase in both isolated and compound movement in participants when wearing the VICTORY patch. Additionally, our secondary analysis identified statistically significant correlation with force production and length of time wearing a patch, which raises consideration of a dose-response relationship.

Purpose

Vibrotactile technology, which utilizes the principles of dermatologic afferent pathways to provide sensory feedback, is increasingly being explored for its potential to enhance athletic performance. This technology leverages wearable devices to deliver real-time haptic feedback, theoretically helping athletes refine movement patterns, improve posture, and enhance proprioception. By providing immediate, non-visual cues, vibrotactile feedback can assist in correcting form, optimizing biomechanics, and reducing the risk of injury.

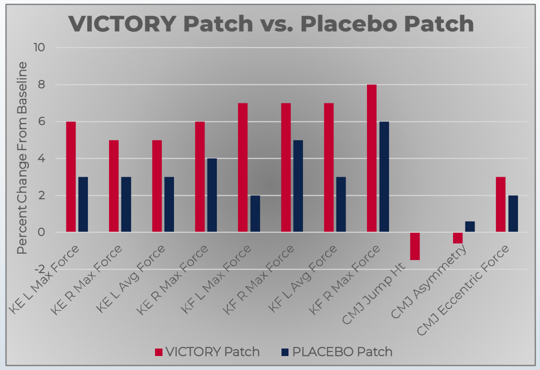
Research suggests that it can be particularly effective in sports requiring precision and coordination, such as gymnastics, golf, and running. Additionally, vibrotactile stimulation has been studied for its role in improving reaction times and muscle activation, making it a valuable tool for both training and rehabilitation. As advancements in wearable technology continue, vibrotactile systems are likely to become more integrated into athletic training programs, offering a new dimension of performance enhancement.

This double-blind, crossover randomized control trial was used to evaluate athletic performance benchmarks in NCAA Division 1 varsity athletes after use of a drug-free, non-invasive patch (VICTORY Patch; The Super Patch Company Inc.) to determine the impact of vibrotactile technology on complex athletic function.

Methods and Study Design

This double-blinded, randomized, crossover trial involved 70 athletes who wore either a VICTORY or placebo patch on the dominant thigh. Participants were tested prior to patch placement and then no sooner than 1 hour after patch placement. Each participant then underwent a 7 to 10-day washout period and was re-tested later with the alternate patch. Primary outcome measures for the three movements are listed in the comparative tables.

Table 1	Demographics	
Gender	Female 40 (57.1%), Male 30 (42.9%)	
Sport Type	Power 44 (62.9%) • Gymnastics 6 • T&F Sprinter 6 • T&F Hurdler 4 • T&F Thrower 4 • T&F High Jump 1 • T&F Pole Vault 1 • Baseball 4	• Beach VB 4 • Swim Sprinter 4 • Softball 3 • Diver 2 • Tennis 2 • Women's Golf 2 • Volleyball 1
	Endurance 26 (37.1%) • Swim Distance 15 • T&F Cross Country 7	• Women's Soccer 4
Dominant Side	Right 65 (92.9%), Left 5 (7.1%)	
Time Wearing Patch (min)	VICTORY Patch: 227.2 Placebo Patch: 222.4	



Knee Extension	VICTORY Patch	Statistical Analysis
Left Max Force [N]	11.6N (+6%)	**p=0.007, r=0.32**
Right Max Force [N]	10.3N (+5%)	**p=0.037, r=0.25**
Left Average Force [N]	11.3N (+5%)	**p=0.002, r=0.38**
Right Average Force [N]	10.2N (+6%)	**p=0.001, r=0.42**

Knee Flexion	VICTORY Patch	Statistical Analysis
Left Max Force [N]	19.8N (+7%)	**p<0.001, r=0.58**
Right Max Force [N]	17.9N (+7%)	**p<0.001, r=0.61**
Left Average Force [N]	17.5N (+7%)	**p<0.001, r=0.57**
Right Average Force [N]	19.9N (+8%)	**p<0.001, r=0.61**

Counter Movement Jump (Force Plate)	VICTORY Patch	Statistical Analysis
Jump Height [in]	-0.2in (-1.5%)	p=0.086, r=0.21
Concentric Peak Force Asymmetry [%]	-0.6%	**p=0.026, r=0.27**
Eccentric Peak Force [N]	44.8N (+3%)	**p=0.005, r=0.34**

Results

70 total division 1 athletes were consented and randomized to participate in this trial, all of whom completed the testing sessions (Table 1). On average, athletes wore the patches for 225 minutes. Participants were 40 females and 30 males, as well as 44 power athletes and 26 endurance athletes. One athlete was inadvertently assigned the VICTORY patch for both pairs of testing sessions, and their data was subsequently removed leading to a modified intention-to-treat analysis.

For both knee extension and flexion, the VICTORY patch produced statistically significant ($p<0.05$) increase in both maximum and average force in both legs. Additionally, small ($r<0.30$) correlations were seen across multiple measurements between greater force generation and longer times of patches being worn. The placebo patch was only significant for right knee flexion maximum and average force.

For counter movement jump, neither VICTORY patch nor placebo produced statistically significant changes in peak power, peak power by body mass, or jump height. The VICTORY patch produced a statistically significant decrease is concentric peak force asymmetry and increase in eccentric peak force. There was a small negative correlation between jump height and longer times of patches being worn.

When comparing VICTORY patch and placebo magnitude of change using Mann-Whitney U testing, a statistically significant greater maximum ($p=0.005$) and average ($p=0.009$) force production was noted with the VICTORY patch in left knee flexion.

Conclusions

In NCAA Division 1 athletes, vibrotactile stimulation of the dominant leg with the VICTORY patch showed statistically significant increases in maximum force, average force, and right-to-left imbalance for isolated movement. The VICTORY patch also showed statistically significant increases in concentric peak force asymmetry and eccentric peak force for counter movement jump. Placebo testing showed fewer statistically significant changes, and the VICTORY patch had a statistically greater effect in left knee flexion testing.

This study implies that patch-based vibrotactile strategies may improve strength and performance outcomes in elite athletes. This was most strongly noted in isolated strength testing and asymmetry. However, there were numerous correlations noted between magnitude of improvement and length of time wearing either patch which raises the possibility that a dose-response relationship exist.

Knee Extension	Placebo Patch	Statistical Analysis
Left Max Force [N]	7.3N (+3%)	p=0.867, r=0.02
Right Max Force [N]	6.6N (+3%)	p=0.247, r=0.14
Left Average Force [N]	7.0N (+3%)	p=0.317, r=0.12
Right Average Force [N]	8.0N (+4%)	p=0.076, r=0.21

Knee Flexion	Placebo Patch	Statistical Analysis
Left Max Force [N]	5.8N (+2%)	p=0.130, r=0.18
Right Max Force [N]	12.8N (+5%)	**p=0.002, r=0.38**
Left Average Force [N]	6.7N (+3%)	p=0.165, r=0.17
Right Average Force [N]	15.1N (+6%)	**p<0.001, r=0.44**

Counter Movement Jump (Force Plate)	Placebo Patch	Statistical Analysis
Jump Height [in]	0.0in (0%)	p=0.737, r=0.04
Concentric Peak Force Asymmetry [%]	0.6%	p=0.175, r=0.16
Eccentric Peak Force [N]	31.7N (+2%)	**p=0.017, r=0.28**

Conclusion

The findings of this study support wearable, vibrotactile technology as a promising and low-risk intervention to improve athletic performance. Additional research is needed to evaluate these findings in sport-specific activities and outside of the elite athlete population. Additional interest also exists in exploring the dose-response relationship between patch-based technology and increases in athletic performance.

Limitations

This study took place at a single institution with NCAA Division 1 athletes only, reducing generalizability. One athlete was inadvertently assigned the intervention patch during both testing sessions and was therefore excluded from analysis.

Citations

1. Sigrist, R., Rauter, G., Riener, R., & Wolf, P. (2013). "Augmented Visual, Auditory, Haptic, and Multimodal Feedback in Motor Learning: A Review." Psychonomic Bulletin & Review, 20(1), 21-53.
2. Kosmas, P., Munih, M., & Pišot, R. (2018). "Haptic Motor Learning through Wearable Vibrotactile Feedback: A Systematic Review." Sensors, 18(11), 3894.
3. Chi, W., Heinen, T., & Shea, C. H. (2020). "Vibrotactile Feedback Enhances Postural Control and Motor Learning in Athletes." Journal of Sports Sciences, 38(18), 2128-2138.

Acknowledgements

Nicholas McIntee, MA; Jaime Fernandez, MS; UA Athletic Dept