White Paper:

FORCE MEETS ADAPTATION

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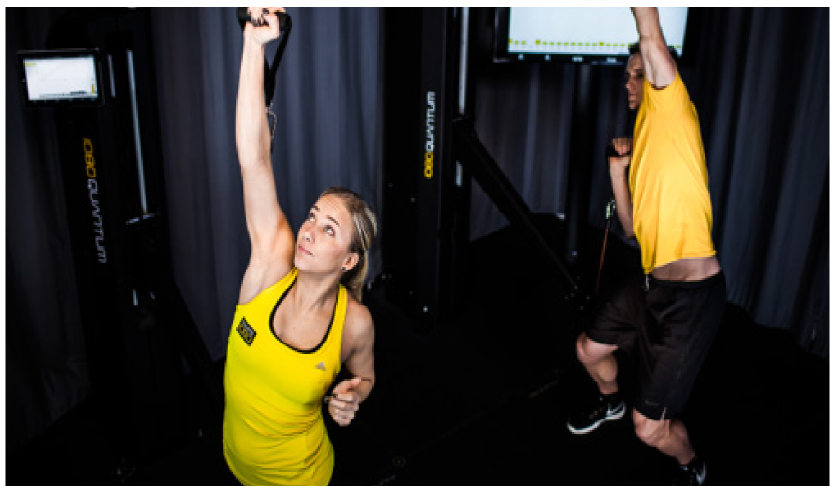
1080 Motion is a Swedish company revolutionizing strength training. We are the leader in robotic technology solutions for neuromuscular testing and training in sports and rehabilitation. Early work began in 2005 to develop technology in a device to outperform existing training equipment. The intelligence in our solutions resides in the software and algorithms designed to train, test and analyze physical factors of performance. As a pioneer in pushing the boundaries in performance training and rehabilitation, our development efforts are always focused on bringing professional users the best and most efficient ways of working with athletes and patients.

FORCE MEETS ADAPTATION

Practical applications and sequencing methods for the multiple resistance modes featured in the 1080 Motion technology: supramaximal eccentrics, eccentric overload, isokinetic, isotonic, ballistic, and assisted.

The crack of the bat. The rocket struck on frame. The blitz hit in the A-gap and the body check into the boards. The monster jam, the "roof." The block start. The jumps.



Whatever the name of the game, sports are defined by impact plays: Expressions of explosive force that change both the physical and intangible forms of momentum. In the fraction of a second, a ball, an opponent, or the athlete's own body are propelled in an alternate, game-changing direction. Coaches covet, recruit, and game plan for the ability to deliver match-breaking force... but what are the **best methods** to further develop that quality in athletes?

Like most questions rooted in training speed, power, and strength, the answer is... "It depends."

An **athlete-centered training model**—one that identifies *the athlete* as the primary object of control rather than a fixed *training plan*—understands that each individual athlete has unique deficiencies and limiting factors, *and that individual athletes can respond completely differently to an identical bout of training.*

To center athletes as the object of control, the best professionals in the world utilize precise data and the principle of specificity to train essential movement patterns. Traditionally, these best efforts have been limited by the fixed physical properties of the available training tools and implements, whether that be mass, inertia, air pressure, or elasticity.

1080 Motion technology provides the dexterity to freely advance and individualize athlete preparation by delivering crucial data and multi-mode resistance training. The user can control speed, load and inertia independently in both the concentric and eccentric phases of any movement. Given the ability to manipulate the laws of physics with 1080, coaches, athletes, and rehab professionals can achieve a new standard in training that is simultaneously effective, efficient, and safe.

When the answer to the question posed is inevitably it depends, the most effective training tools will be those with the versatility to offer a range of functional testing and training solutions and the ingenuity to quantify the resulting trends and progressions.

I. THE SPECIFICITY PRINCIPLE

Modern training and rehabilitation are guided by centuries of practical experience, culture, and an ever-increasing body of science. Trends come and go, but over time, common practice relies on well-known truths and an understanding of the complexities of human performance. While detailed philosophies and approaches to training vary between practitioners, major divergences that literally change the game are far and few between.

The specificity principle is a fundamental precept for developing strength, rooted in the ideas that:

- Each different sport features unique movement skills to target in training, from isolated joint movements to continuous athletic tasks.
- Each different athlete, in turn, demonstrates unique force-velocity relationships within those sport-specific movements.

Training systems that target these individual variables will be the most effective tools and create a competitive advantage.

Applying Specificity—Movement

To improve athletic performance, the movement patterns being tested and trained should resemble the overall movement (kinetic chain) and/or its significant component parts (partial kinetic chain to isolated joint movements). In practical terms, we can separate movements into:

- *Discrete athletic tasks*—Those having a clear start and finish, such as striking, swinging, or kicking.
- *Continuous (or cyclical) athletic tasks*—Those with unique, ongoing locomotion patterns such as sprinting, skating, or swimming.

For discrete athletic tasks, there are sport-specific movement patterns that contribute to performance. Take, for example, a serve in tennis. From handheld toss to racquet impact, a sequence of actions all contribute to the ultimate speed of the serve. In fact, testing has found isolated shoulder internal rotation, squat (lower extremity), and the unilateral overhead press (lower extremity, trunk, and upper extremity) all to contribute to serve speed. Cyclical athletic tasks, meanwhile, are fundamental to athletic performance; consequently, isolated kinetic chain and continuous movement patterns should be targeted for both testing and training purposes.

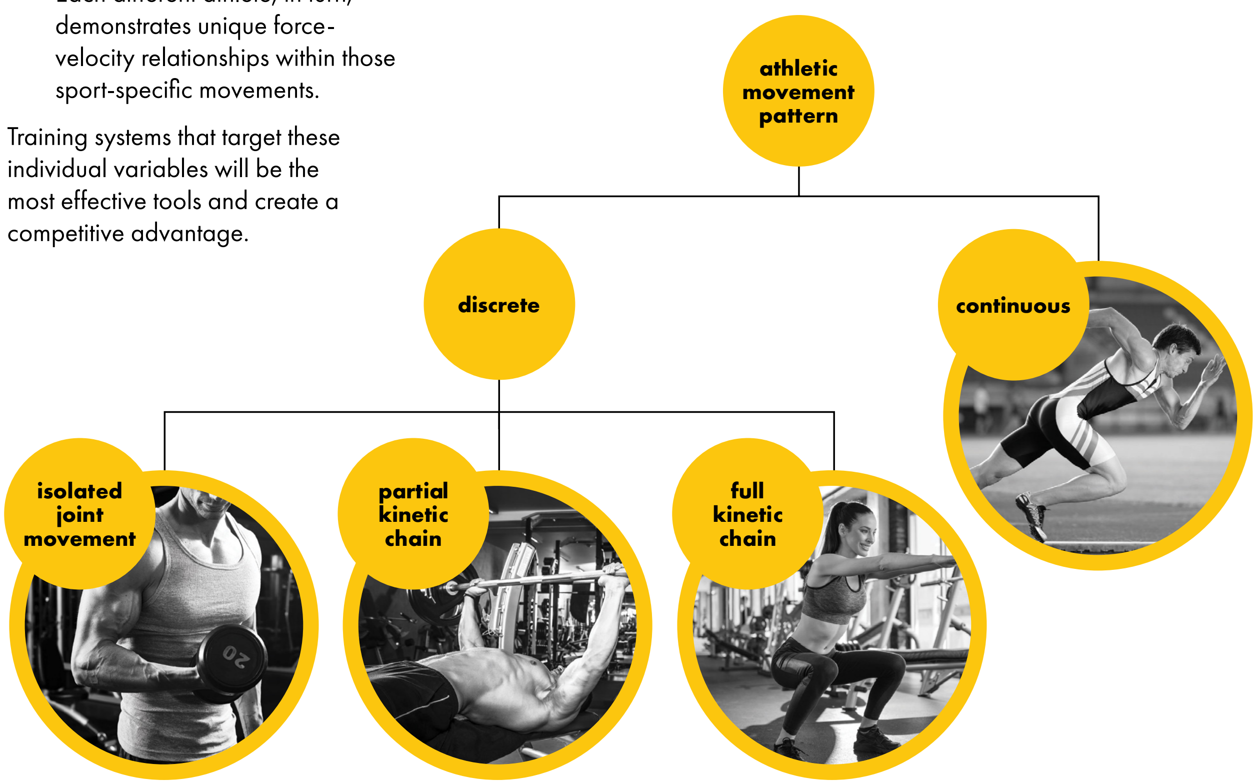


Figure 1: *Describes the relationship of training capability utilizing the 1080 Motion system within the force-velocity curve and movement desired.*

Applying Specificity—Force-Velocity Curve

As we stated earlier, sports are defined by impact plays—the ability to generate force and speed are fundamental qualities that should be targeted to optimize athletic performance. The relationship between force and velocity (the force-velocity curve) was first described by A.V. Hill in 1938 and guides our understanding of basic neuromuscular function as it relates to physical performance. Throughout the past century, the interconnection between force and velocity has been used to depict neuromuscular function ranging from single muscle fibers to continuous movements such as sprinting.

Specifically, single muscle fibers and isolated joint movements have hyperbolic force-velocity curves, while linear relationships are observed for discrete, multi-joint movements and continuous movement patterns. Regardless of the nature of their relationship, human skeletal muscle has the capacity to generate greater force eccentrically than concentrically, and force and velocity is inversely related in the concentric phase. From these observations, it becomes apparent that human muscles have the ability to generate force (eccentric and concentric) over a range of different velocities in order to meet different functional and athletic demands.

Force-velocity curves have frequently been used to guide training and rehabilitation, with different portions targeted for different purposes. Based on the specificity principle, training at a specific movement's speed will result in greater strength gains at similar speeds. Different portions of the force-velocity curve can be targeted by manipulating not only speed and load, but also the type of external resistance: normal mass in gravity, isotonic, isokinetic, or ballistic.

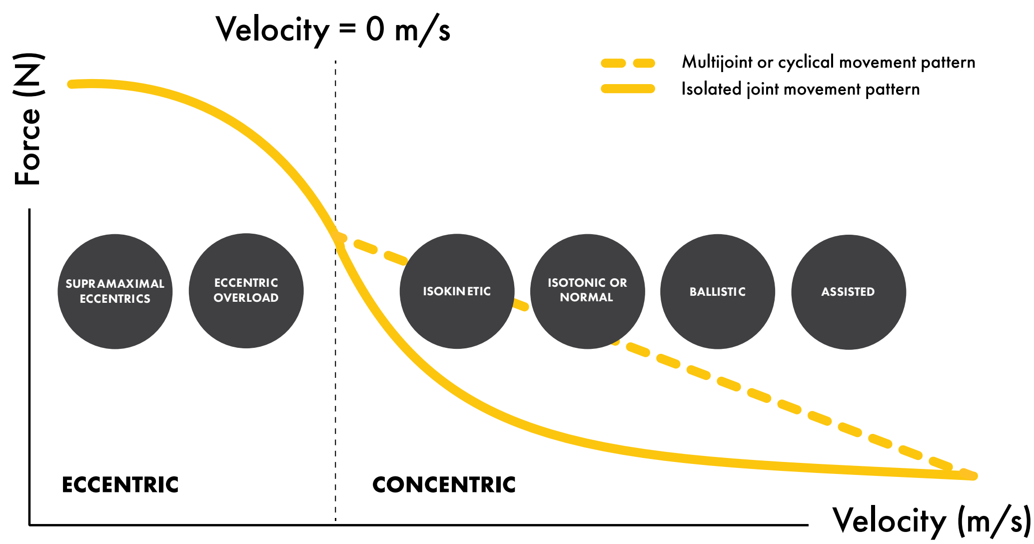


Figure 2: *Resistance modes of the 1080 Quantum and Sprint and where they belong on the force velocity curve*

This leads to a number of questions:

1. **How can force and speed be measured for a wide variety of movement patterns?**
2. **Which variable—force or speed—should be targeted in training?**
3. **Once identified, how do I specifically target these qualities in training?**
4. **Would different equipment be needed for testing and training purposes?**

In the performance and rehabilitation field, answers to these questions are often incomplete due to the inherent limitations of the equipment and training implements at hand. The 1080 Quantum and 1080 Sprint offer multiple modes of resistance and the ability to manipulate both load and speed of the concentric and eccentric phases—independent of each other. In combination, this allows users to effectively target different portions of the force-velocity curve, from isolated to kinetic chain movement patterns, while using a single piece of equipment.

II. 1080 MOTION TECHNOLOGY

1080 Motion delivers a motorized, electrical resistance system that precisely captures an athlete's key variables of force, speed, and power in all planes of motion. Simultaneously, the system provides options for independently controlling resistance, speed and inertia in both the concentric (muscle contraction) and eccentric (muscle elongation) phases of a movement.   The sophistication of the 1080 technology—unmatched in simplicity and effectiveness—eliminates the inherent barriers of other training methods and allows coaches, athletes, and performance professionals to maximize results.

1080 Quantum

The 1080 Quantum can be used alone as a single-station cable column, or paired with another unit to form a 1080 Syncro, which enables different exercises and increased resistance load. Both Quantum and Syncro feature an intuitive, engaging user interface that generates real-time feedback from every rep and every set. The multitude of resistance types and the range of speed settings make the1080 Quantum gentle enough to assist the elderly post-surgery, yet powerful enough to challenge elite athletes. The 1080 Quantum system offers all the necessary accessories to provide the total testing, training, and rehabilitation experience.

1080 Sprint

The 1080 Sprint is a portable resistance and assistance training and testing device for continuous actions such as sprinting, skating, and swimming. The 1080 Sprint features intelligent, variable resistance technology that allows for change of direction movements to be performed smoothly under load or with measured assistance. Data recorded by the 1080 Sprint provides coaches and performance professionals the ability to measure the power of force, speed, and acceleration with a high degree of accuracy. From there, users can apply the data to big picture trends in training or drill down and dissect a sprint profile into meaningful pieces of information.

III. 1080 MOTION RESISTANCE MODES

The 1080 Motion system replicates the external load features of barbells, flywheels, cable systems, and pneumatic air devices, while adding numerous options to specialize resistance training. Users can apply the specificity principle to effectively target isolated, partial or full kinetic chain, and continuous movement patterns and improve the capacity to generate force, speed, or both.

Within an athlete-centered training model, an advantage of these separate resistance modes is the ability to target different portions of the force-velocity curve that are specific to the desired movement pattern. In precise terms, force demands can be imposed by an increased load or by a restriction on speed. From there, a progression toward greater speed of a given exercise can be done by continuing on to lighter loads or by employing different resistance modes before assisting the movement to maximize speed.

In this manner, different portions of the force-velocity continuum can be systematically and separately targeted for any movement pattern specific to an athletic task. The relationship between the different types of resistance that can be applied to a specific movement is defined by the desired adaptation.

Supramaximal eccentrics

For any movement pattern, a load greater than maximum eccentric strength can be imposed. This is safely done using the eccentric boost mode, with the athlete maximally resisting the pull of the cable through the calibrated physiological range. Each repetition produces maximum eccentric force-generating capacity. As great forces are involved, safety of the athlete is ensured by calibrating the end point of the pull from the machine within the physiological range of the movement, as well as via safety bars and the use of low speeds.

Eccentric overload

This mode allows the user to program true eccentric overload in training and rehabilitation, capturing increased strength and power. The traditional benefits of eccentric overload via inertia (using flywheels, gravity, etc.) are amplified and precisely controlled with 1080 up to three times the difference between eccentric and concentric load. This enhances specificity, adding greater eccentric force generating capacity to any movement pattern.

Isokinetic resistance

The isokinetic resistance of 1080 allows for the limitation of speed providing the athlete the opportunity to generate maximum concentric force in kinetic chain movement patterns. This is important, since traditional single joint exercises performed with isokinetic resistance can be limiting to performance and rehabilitation goals, as kinetic chain movement patterns cannot be targeted.

Specifically, users can target the capacity to generate maximum concentric force in the lower extremities in both bilateral and unilateral exercises such as squats and lunges. In addition, upper extremity press, pull, and trunk rotation patterns can be performed, targeting single or multiple planes of motion. Applying a speed restriction allows for the set load to be low, with the maximum force effort through the exercise motion entirely controlled by the user. In rehabilitation, this is an effective way for the patient to control the load within a desired pain threshold.

Normal mass resistance

This resistance mode simulates the inertial properties of a normal mass (i.e. cable driven weight stack) in gravity. To target force generation capacity of the concentric phase of any movement pattern, greater loads can be imposed with similar characteristics as those experienced in the "real world." With a progression toward lighter loads, both acceleration and velocity of the movement pattern will increase. As lighter loads are used, the athlete will reach peak acceleration of a given movement pattern, after which normal mass resistance will not provide resistance to the movement. Thus, with lower velocities and heavier loads, normal mass resistance is available as a precise and desirable choice.

Isotonic resistance

Isotonic loading—which provides constant resistance without inertia—remains common in resistance training. The advantages of this mode are that isotonic resistance provides the same resistance regardless of the speed and acceleration within a movement pattern and allow for high speed movements. This is in contrast to normal mass loading, where the resistance is dependent on the acceleration of the movement: Specifically, as acceleration decreases, so does the resistance. By contrast, isotonic external loading might provide a more robust training stimulus as the concentric speed increases in comparison to normal mass load.

Ballistic resistance

In any explosive athletic task, the human body must overcome inertia to create movement. This quality is not available with isotonic resistance; furthermore, normal mass resistance (which has inertia) will not provide resistance when the load is no longer being accelerated. Consequently, a combination of the two can be optimal for targeting movement patterns at greater speeds. Ballistic resistance brings this combination to life by providing both inertia during acceleration and constant resistance during deceleration. Using ballistic resistance to train explosive movements, users can bypass the individual barriers of both isotonic and normal mass resistance.

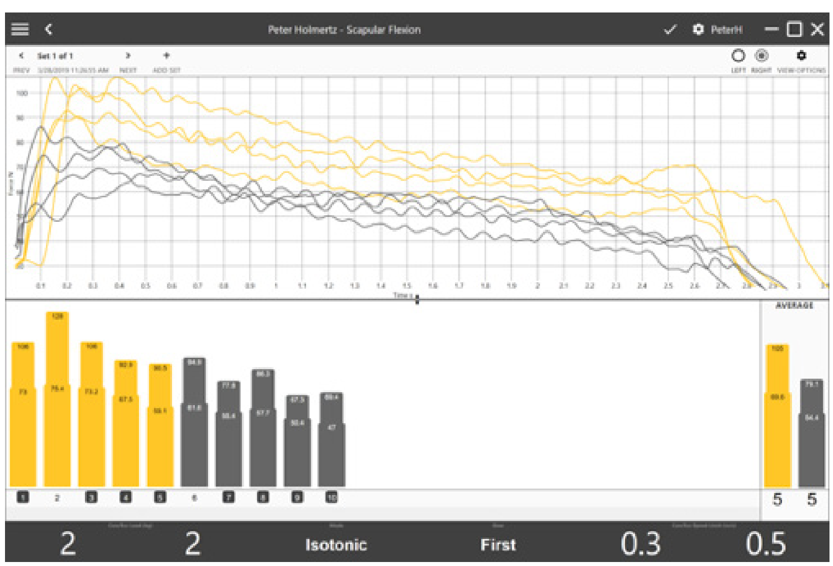
A broad jump, for example, can be safely trained with ballistic resistance by overcoming inertia at initial concentric acceleration, and during the deceleration phase the load will not fly away and create a slack in the line, which is what traditionally causes the subsequent "impact" experienced when using normal resistance. This means that explosive jumps, pushes, or pulls can be performed without unnecessary impacts upon completion of the movement's concentric phase. In addition, setting a low eccentric speed can also ensure no harmful impacts upon completion of the concentric phase.

Assissted

In order to target velocities beyond the level which an athlete can reach under normal conditions, assisted movement patterns can be performed. One example is jumping: A pre-set pulling force/external load can be attached to an athlete by means of a harness or vest. This will decrease the inertia of the bodyweight that must be overcome during the jump. Another application is "unloading" body weight in vertical eccentric movements similar to lunges and Nordic hamstring curls.

IV. ACTIONABLE OUTPUT

With the athlete at the center of the decision-making process, the access to meaningful information is imperative. Technology continues to advance in the athletic performance domain, but when so many choices and devices are available, how do we distinguish between the data we need to know versus the data that is simply nice to know? The testing of athletes must be simple, precise, and meaningful to support critical decisions in program design and execution.



Data Metrics

Motorized, electrical resistance eliminates the burden of excessive, esoteric metrics and simplifies testing with every repetition. Straightforward and precise, the 1080 data allows users to quickly examine measurements of any movement pattern, including presses, squats, pushes, pulls, rotational work, or jumps. With a sampling frequency of 333 Hz both the maximum and the average of force, speed, power, and acceleration of these movement patterns are instantly displayed as bar graphs. Beyond that, with the touch of button, users can view a full graphical display of how these variables develop during a given movement pattern. This data and display provides invaluable information to the athlete, coach, and other members of the performance team for documentation, biofeedback, decision-making, workload monitoring, and fatigue management. Not to mention the possible intra- and inter-athlete comparisons over time.

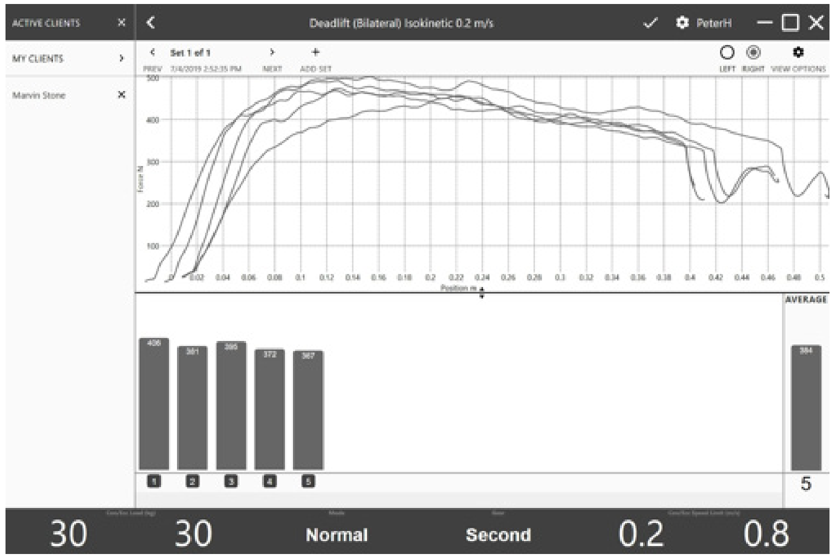


__Figure 3:__ 1080 Quantum with average force produced of 384 N over 5 repetitions of isokinetic bilateral leg deadlift.

Force Velocity Profiling

The advancement of robotic resistance, the ability to set load, and the capacity to measure both force and speed allow users to generate force-velocity relationships from any movement pattern. At the individual level, comparisons can be made between the left side of the body and the right; at the group level, users can analyze an entire population to provide documentation for whether force, speed, or both should be targeted in training.

Symmetry

Continuous, linear movements such as running can also be assessed for asymmetries in the right and left lower extremities. Comparisons using force output might identify asymmetries that limit performance or increase the possible risk of injury, and this information offers a valuable tool for those making decisions in the return to play process.

Sprint

The ability to sprint is an essential component of numerous sports. Data from resisted sprints (i.e. running, swimming, and skating) can be used to determine speed development (acceleration) and the maximum speed phase. Also, data can be presented in different split times (5 m is most common), and subsequently used in force-velocity profiles. Analysis of this data can be used to evaluate and compare acceleration, maximum speed, and force-velocity insights. In fact, force-velocity profiles from 5m split intervals can be used to determine if force or speed should be targeted to enhance performance.

Cloud Technology

Data is stored on a cloud-based server, which allows further processing and analysis of data that can be accessed across platforms.

V. 1080 IN MOTION

Field Case: Linear Speed for Team Sports

Speed kills, or so the saying goes. But what exactly is fast? How relevant is a 40-time for players in sports or position groups that rarely sprint more than 5-10 yards on a given play? How limiting is an electric "burst" if the player cannot then reach and maintain a game-breaking maximum mph level?

Charged with developing bigger, stronger, and faster athletes, Matt Rhea—Athletic Performance Coach for the Indiana University football team—helped guide the squad from having 6 players capable of sprinting 21 mph to 34 players hitting that mark in just over a year's time.

Max speed, however, is just one element of Rhea's training goals. He tests his athletes running on the 1080 Sprint with virtually imperceptible resistance to see what each different player's speed looks like. Meaning:

- How do key force and velocity benchmarks compare to others in their position group across the first 5 yards of a sprint?
- Are there asymmetries that could limit performance or increase injury risk?
- After the initial acceleration phase, how does the athlete achieve and hold their max speed at different splits?

"The most effective speed development will happen when you take one athlete and identify his or her limitations and you address those limitations," Rhea said, speaking at the 2019 1080 Summit in Stockholm, Sweden. "My ultimate goal is to eventually try to figure out what's limiting their performance. Is it a force issue? Is it a power issue? Is it a coordination issue?"

Those are not rhetorical questions, as once Rhea identifies each athlete's limiting factors, he individualizes that player's programming to target those specific needs. For players who may be deficient in power production and need to improve their acceleration, Rhea tilts their programming to include more heavy resisted running with the 1080 Sprint, often beginning from a three-point stance to replicate a football play's explosion off the snap.

For athletes who are quick off the line but struggle to either transition to top speed or reach an elite max speed, Rhea programs more assisted sprinting with the 1080.

"My purpose is to give them a stimulus that causes something to happen that I know eventually is going to improve speed," Rhea said at the 1080 Summit. "My goal with assisted sprinting is to help allow the brain to feel what a faster speed feels like."

That stimulus for the brain and central nervous system is critical—while recognizing that few team sports involve extended acts of pure linear sprinting, Rhea believes the components of linear speed transfer across disciplines and apply to the dynamic movement challenges of different sports.

"Football is generally a curvilinear speed sport, so very rarely are you sprinting in a straight line," Rhea says. "But, there are what I call wiring components on how the brain coordinates speed—and whether it's applied in a linear fashion or curved running or field-based pursuit or evasion, a lot of those wiring elements are the same. You can train them in different ways—for instance, resisted or assisted sprinting."

Field Case: Power Development for Rotational Sports

You name the object, World Long Drive Tour pro Ryan Steenberg has hit it. Hard. Crushing baseballs as a Little Leaguer, leveling ball carriers as a college linebacker, slamming weight stacks as a bodybuilder, and stinging nuclear drives as a weekend golfer.

All of which left Steenberg with a role on the business side of sports—working the PGA trade show circuit not as an athlete but as an entrepreneur marketing a unique training device. To make the shift to the performance side as a competing professional, Steenberg needed to add distance to his already prodigious swing.

"From my competitive background, the athlete was already within," Steenberg says. "So it was just a matter of getting some barriers out of the way to allow that athlete to take over and produce fire and produce force and produce speed."

Given his advanced training age, with over 20 years of weightlifting experience, Steenberg recognized that the 1-3% improvements he needed to achieve his goals on the Long Drive Tour were going to require a unique and highly specific stimulus.

"I've taken those traditional movement patterns from the gym, which you would do with a weight stack or with bands, and I've applied those to the 1080," Steenberg says, describing the sessions he performs with the 1080 Quantum. "With the various and extremely diverse ways of loading those, you have an infinite amount of ways to load those patterns with the 1080. That's really where, for me, I think the benefit has come. So I can work in sequence, I can work in pattern, I can work in rotation, I can work in lateral drive, and I can load rotation."

That rotational loading involves adding variable resistance to the swing pattern and component movements, loading:

- Rotational hip thrusters
- Rotational chops & punches
- Explosive lateral jumps and plyos

Across sessions, or sometimes within a single session, Steenberg changes the tension and parameters to target different key outcomes: max strength, striking power, and club head speed. Manipulating resistance with 1080's Isokinetic mode, eccentric speed limits, and No Flying Weight setting, Steenberg also uses the 1080 platform to guide and motivate his progress, using the trend views to track his progress on the force-velocity curve.

"That old training attitude and methodology of the gym and stacks of plates, bands, and chains... the 1080 has basically made all that obsolete," Steenberg says. "This is the next wave. So as I reach for the next 1-3%, there is no doubt that 1080 will get me there."

Field Case: In-Season Strength Training for Ice Hockey

Matt Price had a problem. Kicking off his 5th season as the head strength and conditioning coach for the LA Kings ice hockey team, Coach Price had once again successfully executed an off-season training program to build greater speed, strength, and power with his athletes. But with the onset of the competitive season and a grueling schedule of 82 games packed into just over 160 days, the Kings' players had limited time and energy to maintain those gains and stave off detraining effects in those crucial qualities.

Choices needed to be made.

Go heavy on off days? Recovery needs, travel demands, and contractually-required non-training days limited the viability of periodizing such a program. Post-game lifts? Ice hockey is an aggressive, physically taxing contact sport—while post-game strength training has become a normal practice in the NHL, Price found that the following the stress, adrenaline, and exertion of a full game, his players were not physiologically prepared to adapt to a traditional strength or power stimulus.

Price laid out his method for addressing this challenge during a presentation at the inaugural LA Galaxy Sports Science Conference in 2018, during which he outlined his 4 "M's" for In-Season Training:

1. Manage—Using an n=1 approach, manage the training loads for each individual athlete.
2. Measure—"The more you know, the less you fear," Price said, describing a decision-making process supported by actionable data.
3. Microdose—Provide small "doses" of high-stimulus exercises, targeting the maintenance of key physical qualities without the imposition of fatigue.
4. Mimic—Even if both volume and intensity are reduced, continue movements and exercises that resemble prior training.

To deliver this microdose for strength maintenance, Price programmed high force isokinetic exercises on the 1080 Quantum Syncro. This athlete-driven stimulus allowed the Kings players to push against a form of resistance that wasn't externally imposed by a stack of iron, but rather by their own capacity and motivation within every rep and every set.

"We were finding that we were getting a much better strength maintenance—or in some cases improved strength qualities—during the competitive season," Price said, further elaborating on his program of in-season microdosing during an interview with Martin Bingisser and Nick Garcia of the HMMR Media podcast. "We did that through the use of some advanced equipment. We were very fortunate to work with the 1080 Quantum Syncro machine, so we are using very dynamic isokinetic loading now, which is an unbelievable stimulus for our athletes in a concentric-only action."

Field Case: Return to Play—From Pain to Performance

During a stretch of several months in 2016, WTA player Rebecca Peterson saw a slight pain in her arm worsen to the point she was unable to hit a forehand or serve. As the pain increased, she tried the usual range of therapies, tests, and treatments. None reversed the trend, and compounding her frustration, nothing pointed towards an accurate diagnosis.

Using the 1080 Quantum, her trainer, Ali Ghelem, initiated shoulder strength tests at very low loads with isokinetic resistance. The analysis showed that her pain was highly localized and very specific to a tennis player's biomechanics. The most painful movement occurred amidst internal rotation with the shoulder abducted. Furthermore, her range of motion was very limited, or about 1/3 of the range measured on her healthy side. Force production was also extremely low on the injured side.

Peterson hit backhands throughout her rehab, but only in May 2017 could she resume striking forehands and serves. She played her first competitive match post-injury in June and later performed at US Open.

	Left Side - Healthy				Right Side - Injured			
Test Date mm|dd	Range cm	Force N	Range Gain %	Force Gain %	Range cm	Force N	Range Gain %	Force Gain %
02 | 03	62	48	100	100	16	16	100	100
02 | 17	69	65	111	135	56	19	350	117
03 | 10	62	61	100	127	61	40	381	251
04 | 16	50	81	81	169	58	74	363	469
05 | 16	79	82	127	172	92	91	575	575
07 | 02	80	73	129	152	92	77	575	487
08 | 17	94	78	152	162	87	100	544	633

Table 1: *Summary of progression of range of motion and force improvements.*

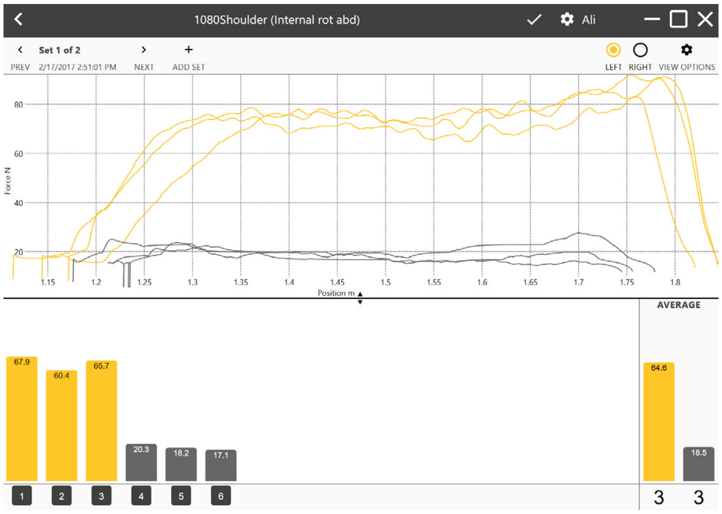


Figure 4: *Screenshot from 1080 Quantum force testing in the early stage of intervention. It shows the difference in the affected side (gray) compared to the uninjured side (yellow). The bars show average force in Newtons (right and left) while the graphs show how force develops throughout the movement and range of motion.*

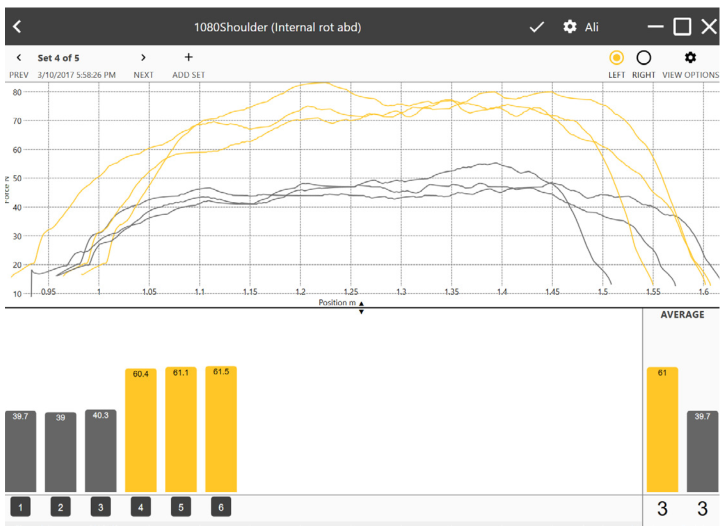


Figure 5: *Screenshot following a few weeks of rehabilitation, which shows significant progress in force production compared to the uninjured side.*

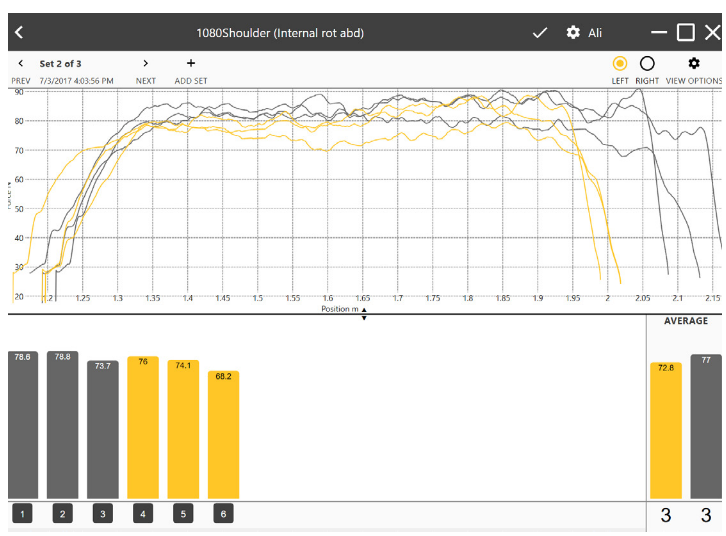


Figure 6: *Screenshot of follow up tests that show force production on the injured side (gray) has recovered.*

VI. PUBLISHED RESEARCH

1080 Sprint

Acute Kinematic Effects of Sprinting With Motorized Assistance (2019)

Force–velocity profiling of sprinting athletes: single-run vs. multiple-run methods. European Journal of Applied Physiology (2019)

Training at maximal power in resisted sprinting: Optimal load determination methodology and pilot results in team sport athletes. PLOS ONE (2018)

Validation of force-, velocity-, and acceleration-time curves and temporal characteristics as output data from the 1080 Sprint. Masters' thesis, Norwegian School of Sport Sciences (2018)

A Resisted Sprint Improves Rate Of Force Development During A 20-Meter Sprint In Athletes. Journal of Strength and Conditioning Research (2018)

The Potentiating Effect of Resisted Sprint Training in Varsity Level Sprinters. Journal of Strength & Conditioning Research (2018)

The effect of individualized sprint training in elite female team sport athletes. Journal of Sports Sciences (2018)

Effects of a 4 Week Very Heavy Resisted Sprinting Intervention on Acceleration Sprint and Jump Performance in Youth Soccer Players. Masters' thesis, The Swedish School of Sport and Health Sciences (2018)

A training intervention on acceleration sprint and jump performance in late pubertal adolescent athletes. Masters' thesis, The Swedish School of Sport and Health Sciences (2018)

1080 Quantum

Isokinetic strength training of kinetic chain exercises of a professional tennis player with a minor partial internal abdominal oblique muscle tear – a case report (2019)

Isokinetic resistance training combined with eccentric overload improves athletic performance and induces muscle hypertrophy in young ice hockey players. Journal of Science and Medicine in Sport (2019)

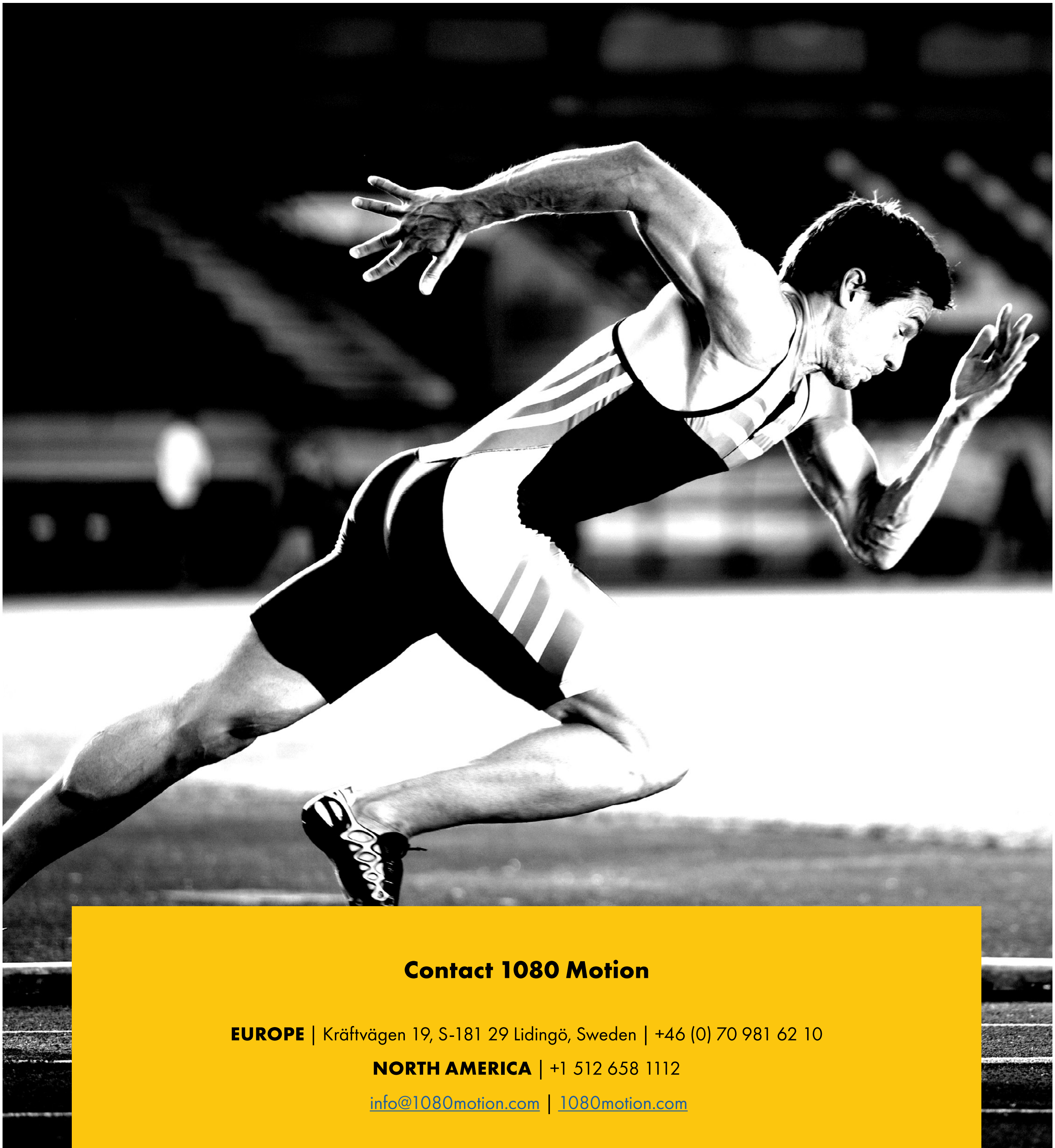
Upper and lower body power tests predict serve performance in national and international level male tennis players. Sport Performance & Science Reports (2019)

Testing a novel isokinetic dynamometer constructed using a 1080 Quantum. PLOS ONE (2018)

Effects of nine weeks isokinetic training on power, golf kinematics, and driver performance in pre-elite golfers. BMC Sports Science, Medicine and Rehabilitation (2017)

Construct validity and test-retest reliability of the force-velocity profile in a golf specific rotation movement. Conference paper, 22nd Annual Congress of the European College of Sports Science (2017)

Training Strategies to Improve Muscle Power: Is Olympic-style Weightlifting Relevant? Medicine and Science in Sports and Exercise (2016)



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