

Strength and Conditioning for Fencing

Anthony Turner, MSc, CSCS*D,¹ Stuart Miller, BSc (Hons),¹ Perry Stewart, MSc,¹ Jon Cree, MSc,¹ Rhys Ingram, MSc,² Lygeri Dimitriou, PhD,¹ Jeremy Moody, PhD,³ and Liam Kilduff, PhD⁴

¹London Sport Institute, Middlesex University, Wales, United Kingdom; ²English Institute of Sport, Manchester, United Kingdom; ³Sport Science, Cardiff Metropolitan University, Cardiff, United Kingdom; and ⁴Sport and Exercise Science, Swansea University, Wales, United Kingdom

SUMMARY

SCIENTIFIC RESEARCH INTO FENCING IS SPARSE AND LITTLE RELATES TO STRENGTH AND CONDITIONING. IN OUR EXPERIENCE OF WORKING WITHIN FENCING, IT IS A PREDOMINATELY ANAEROBIC SPORT CHARACTERISED BY EXPLOSIVE HIGH-POWER MOVEMENTS. CONSEQUENTLY, FENCERS SHOULD BE CAUTIOUS OF SOME OF THE TRADITIONAL TRAINING METHODS CURRENTLY USED SUCH AS LONG SLOW DISTANCE RUNNING BECAUSE THIS IS LIKELY TO BE COUNTERPRODUCTIVE TO PERFORMANCE. INSTEAD, EXERCISES AND CONDITIONING DRILLS THAT DEVELOP REPEAT LUNGE ABILITY, STRENGTH, AND POWER SHOULD BE USED. THE HIGH PROPORTION OF LUNGING ALSO DICTATES THE NEED FOR ECCENTRIC STRENGTH AND CONTROL AND THE ABILITY TO REDUCE MUSCLE DAMAGE.

INTRODUCTION

Fencing is one of only a few sports that has been featured at every one of the modern Olympic Games. It takes place on a 14 × 2 m strip called a “piste,” with all scoring judged electronically as a result of the high pace of competition. The winner is the first fencer to score 5 hits during the preliminary pool bouts, or 15 hits should they reach the direct elimination bouts. During the preliminary pools, bouts last up to 5 minutes,

whereas during elimination, each bout consists of 3 rounds of 3 minutes, with 1-minute rest between the rounds. There are 3 types of swords used in Olympic fencing, and these are briefly described in Table 1. The sword with which a fencer chooses to specialize in is likely based on what is offered at their local club or the coach who first introduced them to the sport.

In general, fencing involves a series of explosive attacks, spaced by low-intensity movements and recovery periods, whereby perceptual and psychomotor skills prevail (i.e., the ability to quickly and appropriately respond to an opponent’s actions). There is a great need to repeatedly defend and attack and to often engage in a seamless transition between the two (counterattack). This can be facilitated by an appropriate strength and conditioning (S&C) program in which strength, power, and power-endurance qualities (including economy of movement) can be enhanced. However, one common practice is that coaches favor the more “traditional” low-intensity, high-volume training, which is often contradictory to the scientific literature describing the development of these skills.

The aim of this article is to rationalize the use of S&C. A significant challenge stems from the lack of primary research conducted within fencing. Therefore, a combination of anecdotal observations (which include personal communications with the Great Britain coaching team) and evidence derived from empirically similar sports will need to be used.

To complete this article, a fencing-specific S&C program will be suggested.

NEEDS ANALYSIS

As with any sport to which S&C interventions are to be implemented, the S&C coach must first undergo a needs analysis to identify the biomechanical and physiological requirements of the sport and its time-motion characteristics (TMC). After this, the S&C coach must construct an appropriate test battery to measure the strengths and weaknesses of the athlete against these variables. In addition, it is fundamental to identify the mechanisms of injury and rehabilitative strategies.

TIME-MOTION CHARACTERISTICS OF ELITE FENCERS

Fencing tournaments take place over an entire day (often lasting around 10 hours) and consist of approximately 10 bouts (the majority of which do not require the full bout time) with a break of anywhere between 15 and 300 minutes between each (20). Roi and Bianchedi (20) have reported the TMC of the winners of the men’s and women’s epee and men’s foil during the elimination bouts of an international competition (Table 2). In general, results reveal that bouts and actual fight time consist of only 13 and 5% of actual competition time, respectively, with a bout work to rest ratio of 1 to 1 in men’s epee and 1 to 3 in men’s foil.

KEY WORDS:

fencing; combat; strength; power

Table 1
Brief description of the 3 types of swords used in Olympic fencing

Foil	Target area is restricted to the torso, including the back but not the arms. Hits are scored only with the tip of the sword
Epee	Target area is the entire body. Like the foil, hits must be scored with the tip of the blade. Unlike either sabre or foil, epee allows simultaneous hits to be scored by both fencers at the same time (the other 2 swords involve priority scoring whereby the point is awarded to the fencer who made the first hit)
Sabre	Target area is everything above the waist, except for the hands. Hits with the side of the blade and the tip are scored as valid; the sabre is primarily used to slash

On average, a foil fencer will work for 5 seconds, whereas an epee fencer will work for 15 seconds (much of which is at a submaximal intensity) before each rest period or interruption. During the elimination bouts, a fencer may cover between 250 and 1000 m, attack 140 times, and change direction approximately 200 times. Also of interest, Roi and Pittaluga (21) reported a significantly greater number of directional changes when comparing female fencers of high- and low-technical abilities (133 ± 62 versus 85 ± 25 , respectively; $p < 0.05$), which is to be suggestive of different tactical levels.

Although TMC within sabre have not been reported, anecdotal observations suggest that the average work phases are shorter (approximately 3 seconds), with a bout work to rest ratio of 1 to 5, covering a distance closer to the 250

m end of range, with significantly fewer changes in directions and attacks.

BIOMECHANICAL ANALYSIS OF FENCING

THE “ON GUARD” POSITION

Fencing uses an “on guard” position (Figure 1a) in which the fencer “bounces” in preparation for action. This position enables rapid manipulation of the base of support relative to the center of mass, whereby the fencer can quickly transition from attack to defense and vice versa. This ability is fundamental because to cope with an opponent’s attack, a fencer must be able to quickly move from a current or intended action to a new one that can accommodate this attack. Although this is determined largely by perceptual and psychomotor skills, a fencer must have the physical requisites to capitalize on this. Current

concepts within S&C would relate these to factors such as rate of force development (RFD) and stretch-shortening cycle (SSC) augmentation, which to some degree are both dependent on muscular strength (2,15).

THE LUNGE

The lunge (Figure 1a–c) is the most common form of attack. Others include those derived from in-stance counterattacks (following a parry/block for example) and the fleche. With around 140 attacks in the elimination bouts alone (Table 2), the significance of the lunge and the need to optimally execute this repeatedly is evident. Quantitative data describing the kinetics and kinematics of the lunge are yet to be determined. However, qualitative observations reveal that the rear leg must produce a powerful concentric action

Table 2
Time-motion characteristics of 6 direct elimination bouts from an international competition

	Women’s epee	Men’s epee	Men’s foil
Total bout time (min)	47–81	48–98	77–122
Effective fight time (min)	28–48	22–39	17–34
Effective interruption time (min)	19–33	26–59	60–89
Bout time relative to competition time (%)	11	12	17
Effective fight time relative to competition time (%)	6	5	4
Effective fight time relative to bout time (%)	59	42	26
Interruptions (n)	126–150	96–180	246–318
Attacks (n)	66–138	96–180	138–210
Changes of direction (n)	210–582	102–294	120–180

The data pertain to the winners of the men’s and women’s epee and men’s foil only. Adapted with permission from Roi and Bianchedi (20).

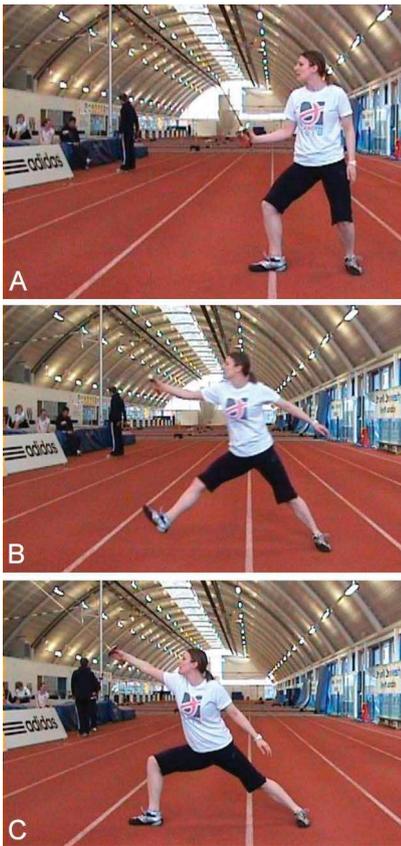


Figure 1. (a–c) (right to left). The lunge: commencing from the on guard position.

(Figure 1b), whereas the knee extensors of the front leg must produce a rapid braking action at landing to stabilize and prepare the fencer for subsequent actions (Figure 1c). Generally, the back

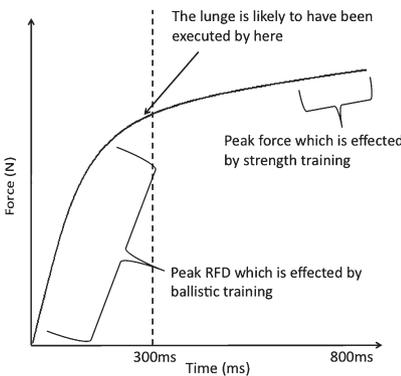


Figure 2. The F-T curve. Ballistic training improves the initial slope of the curve and is therefore more specific to fencing-specific skills, such as the lunge.

foot maintains its position while the front foot moves forward. Of note, the braking forces experienced by the lead leg are likely to be very high. Therefore, the lunge dictates the need for both concentric strength and braking strength (eccentric and isometric strength).

Because the lunge is an attacking movement, its success is largely dictated by the speed of execution, which emphasizes the importance of having an enhanced RFD and the ability to generate high power outputs. Finally, because this movement is often initiated after the “bounce” of the on guard position, it is likely to use the SSC

mechanism, so this also needs to be targeted.

THE KINETICS AND KINEMATICS OF ATTACK

To attack, fencers will use their leg musculature to explosively push against the ground and strike their opponent from an out of range position. Unlike other upper-body combat strikes that use the same method (26), the striking arm is first to move in the attacking sequence. Therefore, the power generated by pushing against the floor is used to reach and strike their opponent as quickly as possible, rather than to strike them with force. When

Table 3
The effects of AET on power athletes as concluded by the review of Elliott et al. (8)

AET compromises gains in power by reducing the ability to produce force at the high-velocity, low-frequency region of the F-V curve, where the highest rates of power are produced (see Figure 4)

Concurrent strength and AET compromises gains in RFD when compared with strength training only and thus leads to interference with explosive strength development (see Figure 5)

RFD is influenced by the rate at which ATPase splits ATP into ADP + P. Because ATPase activity is a function of myosin heavy chain composition, whereby type IIx is faster than type IIa and type IIa is faster than type I, training programs that emphasize strength and power training will see the greatest improvements in RFD

Fast-twitch muscle fibers (i.e., type IIx and IIa) are required to produce high power outputs. Although these are recruited and trained in strength and power training (resulting in an increased percentage of fast-twitch cross-sectional area), AET actually causes transformations of these fibers to accommodate an increased proportion of slow-twitch fibers

Although the proportions of muscle fiber types are largely governed by genetics, strength and hypertrophy training can alter the absolute content of fast myosin heavy chains

AET produces a net catabolic effect on muscle tissue. This is consequent to an increased release of cortisol (catabolic hormone) and a decreased release of testosterone (anabolic hormone)

AET can induce unnecessary fatigue, which may reduce the capacity to produce power and thus compromise skill acquisition by reducing the quality of execution and therefore motor learning

It is often assumed that AET is most beneficial to fat loss. However, HIIT produces significantly ($p < 0.05$) greater postexercise energy expenditure. Furthermore, although both modalities increased the rate of fatty acid oxidation, it is significantly greater in the HIIT

ADP = adenosine diphosphate; AET = aerobic endurance training; ATP = adenosine triphosphate; F-V = force-velocity; HIIT = high-intensity interval training; RFD = rate of force development.

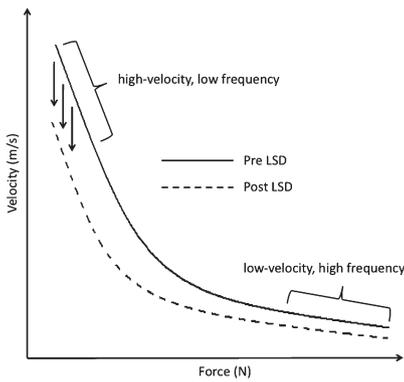


Figure 3. Changes to the F-V curve consequent to aerobic endurance training in the form of long slow distance running.

lunging, because it is generally desirable to keep the back foot in contact with the ground, and perpendicular to the plane of attack, extension at the ankle and hip is limited. Despite these differences, leg (especially knee) extension force (or rather power as this move is time dependent) appears paramount to a successful hit in fencing.

FORCE GENERATION CHARACTERISTICS AND TRAINING INTERVENTIONS

Assuming a fencing lunge occurs as quickly as a punch (e.g., in boxing or Tae Kwon Do), total movement time may be approximately 300 milliseconds (1). This duration does not provide the opportunity to develop peak force, which may require up to 600 to 800 milliseconds (7). This emphasizes the need for these athletes to train power and RFD. Both of these qualities are a function of neuromuscular activation (4,22), leading many authors to recommend ballistic (explosive) training to improve them (22,10,27). Although heavy resistance training improves the final height of the force-time (F-T) curve (Figure 2), ballistic training improves the slope of the initial portion of the F-T curve, specifically within the first 200 (11) to 300 milliseconds (17) when the strike of a lunge is most likely to occur.

Plyometrics and Olympic-style lifts are some of the most effective forms of ballistic training because in

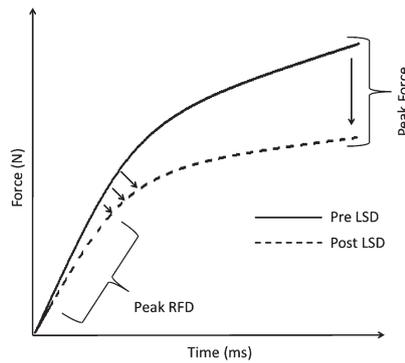


Figure 4. Changes to the F-T curve consequent to aerobic endurance training in the form of long slow distance running. Adapted with permission from Bompa and Haff (5).

addition to their ability to be adapted to the specifics of the sport, they encourage full acceleration through the entire movement. In addition, Olympic-style lifts produce some of the highest power outputs of any exercise modality. It should also be noted that a high and positive correlation exists between power and maximum strength ($r = 0.77-0.94$) (2), illustrating the significance of strength training as a prerequisite to power development.

PHYSIOLOGICAL DEMANDS OF FENCING

AEROBIC POWER

Roi and Bianchedi (20) reported that although the aerobic capacity of fencers (52.9 mL/kg per minute) is greater than that of the sedentary population (approximately 42 mL/kg per minute), it is clearly lower than that of aerobic endurance-based athletes and may be suggestive of the relatively small role a high $\dot{V}O_2\text{max}$ has to fencing. Further support may be gleaned from the existing data within empirically similar sports, such as wrestling, boxing, and mixed martial arts (19). It appears that fencing relies predominantly on anaerobic metabolism; aerobic energy system contribution may be small and predominately involved in the submaximal movements of the “on guard” position and during recovery periods (interbout and intrabout). Furthermore, although the energy system requirements of each sword will inevitably differ (see Table 2), it is in the opinion of the authors that none will significantly tax the aerobic system to the extent that training need directly target its development through the traditional methods of long slow distance (LSD) running.

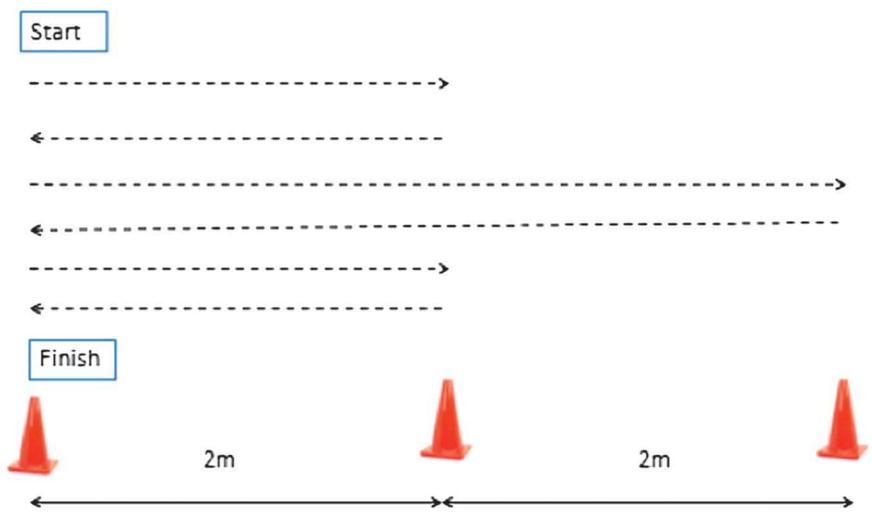


Figure 5. 2-4-2 m shuttle. The test/drill should be completed using fencing footwork with the fencer facing forward at all times. The fencer must ensure that they start behind the 0-m line and ensure that both feet return back behind the line following each shuttle. Furthermore, some part of the lead foot must cross the 2 and 4 m lines with each shuttle.

Table 4
High-intensity interval training for fencing using a 2-4-2 m shuttle

Sword	Gender	Work:rest	Work (s)	Rest (s)	Repetitions × Sets ^a	COD (n)	Total distance (m) ^b	Attacks (n) ^c
Epee	Male	1:1	15	15	7 × 3	210	672	126
Foil		1:3	5	15	9 × 3	135	432	81
Sabre ^d		1:5	3	15	9 × 3	81	324	54
Epee	Female	2:1	15	8	5 × 3	150	480	90
Foil ^e		1:3	5	15	8 × 3	120	384	72
Sabre ^e		1:5	3	15	8 × 3	72	288	48

COD = change of direction.

^aOne-minute rest between sets.

^bTotal distance covered assumes 0.75 revolutions (12 m) per 3 seconds (sabre), 1 revolution (16 m) per 5 seconds (foil), and 2 revolutions (32 m) per 15 seconds (epee).

^cThis statistic is applicable if each shuttle ends with an attacking lunge.

^dValues are based on anecdotal observations of sabre bouts where it is hypothesized that less work, distance, and attacks are performed relative to foil.

^eFor female foilests and sabreurs, it is hypothesized that less distance and attacks are performed relative to male equivalents, as noted when comparing actual competition data of male and female epeeists'. However, work to rest ratios across gender have not changed because this would incur highly speculative inferences.

Further support for this notion, as well as defining the predominant anaerobic system, originates from reports quantifying the blood lactate concentrations of fencing bouts. In men's foil,

for example, blood lactate concentrations (measured 5 minutes after bout) averaged 2.5 mmol/L during the preliminary pools and then were consistently above 4 mmol/L (and as high

as 15.3 mmol/L in the winner) during the elimination bouts (6). Therefore, although foil fencing is undoubtedly an anaerobic-type sport, it appears that the preliminary bouts rely more

Table 5
Incidence and characteristics of TLI, as reported by Harmer (12)

184 TLI among 78,223 fencers over 5 years
Overall TLI rate of 0.3/1,000 AE (95% confidence interval: 0.26–0.35)
There were greater TLI in males than in females (61 versus 39%)
TLI of foil and epee were similar (0.26/1,000 AE) and highest in saber (0.42/1,000 AE)
First- or second-degree strains and sprains accounted for 52% of TLI (26% each) with third-degree strains and sprains (i.e., ruptures) accounting for 3% of TLI
Contusions accounted for 12% of TLI
Puncture (i.e., penetrating) wounds accounted for 2.7% (<i>n</i> = 5) with 2 classed as serious (1 penetrated the forearm and 1 penetrated the lateral neck)
The lower extremities accounted for most injuries (63%) and mostly involved the knee (20%), thigh (15%), and ankle (13%)
Although the knee was the most common site for injury, thigh strains (<i>n</i> = 26; 14%) and ankle sprains (<i>n</i> = 23; 12.5%) were the most frequent injury types
A greater incidence of thigh strains involved the hamstrings versus the quadriceps (<i>n</i> = 19; 73% versus <i>n</i> = 7; 27%)
Above the hip, TLI of the lumbar spine (9%) and fingers (7%) predominated
AE = aerobic exercise; TLI = time-loss injuries.

Table 6
Battery of fitness tests suitable for fencing athletes

Performance tests and supporting comments (with reference literature where relevant)
Skinfold assessment: Identifies body fat percentage, which across combat sports (such as wrestling and kung fu) averages as 9% (Turner (25)). However, because combat sports are weight regulated, values above this would be expected. This assessment is to enable the regulation of nonfunctional mass, which would impede performance by reducing propulsion and exercise economy by virtue of the muscular system having to continuously overcome the body's inertia
Squat jump: Measure of lower-body strength
Countermovement jump: Measure of lower-body power (speed strength)
Reactive strength index (height jumped/GCT): As described by Flanagan and Comyns (9) and Newton and Dugan (16), this test can provide strength and conditioning coaches with a good indication of an athletes' SSC ability. Efficient SSC mechanics should result in greater jump heights from greater drop heights (also reflected by the reactive strength index score). If equipment is not available to measure GCT, the coaches can simply monitor the drop height that produces the greatest vertical displacement
Muscle balance: Because of the profound asymmetries of fencers, whereby the lead leg is significantly more developed in strength and girth than the trail leg, a test to monitor (and correct) muscle imbalance is vital. A difference of 15% (Impellizzeri et al. (14)) is generally used as a clinical marker of bilateral strength asymmetry and a significant risk of injury. For this, a single-leg countermovement jump test is advised, comparing the difference between the legs as a percentage
Agility: Assesses the athlete's ability to change direction. The 2-4-2 m shuttle is recommended (see Figure 5) and must be conducted in a fencing stance (preferably judged throughout by a fencing coach) with the fencer facing forward at all times. The fencer should start behind the 0-m line and ensure that both feet return back behind the line following each shuttle. Furthermore, some part of the lead foot must cross the 2 and 4 m lines with each shuttle
1RM power clean: This test evaluates the athlete's strength speed (power under heavy loading) but should only be included once the athlete's technique is of sufficient standard
1RM back squat: Evaluation of maximum muscular strength, which as described, is significantly correlated with peak power. Like above, this should only be included once the athlete's technique is of sufficient standard
Anaerobic tests: As aforementioned, power endurance is an important part of fencing, and thus, this is an important variable to test. Because there are no current tests available for this within fencing and because biomechanical specificity must be ensured, a repeated sprint tests format, using the 2-4-2 m shuttle may be best advised. The following guidelines are purely speculative of how this test could be conducted and as such require further investigation to assess its validity and reliability. The drill should be conducted as described within the agility test and following the guidelines presented in Table 5. Only 1 set need be performed with mean or total time recorded. Other available measures include performance decrement and fatigue index, but these are associated with poor reliability (coefficient of variance, 11–50%) and should not be used (Oliver (18); Spencer (23))
1RM = 1 repetition maximum; GCT = ground contact time; SSC = stretch-shortening cycle.

on the alactic system, whereas the elimination bouts rely more on the lactate system. Currently, no data are available for the other 2 swords but following what is reported herein, sabre is likely to predominately tax the alactic system across both types of bout, whereas epee may use more of the lactic acid system during the elimination bouts (similar to foil).

In summary, LSD running is likely to be disadvantageous to the fencer. The article by Elliott et al. (8), summarized in Table 3, and the schematics of Bompa and Haff (5) (see Figures 3 and 4) support this argument.

FENCING-SPECIFIC CONDITIONING TRAINING

In the authors' opinion, low-intensity aerobic endurance training is detrimental to fencing performance and unfavorably alters energy system adaptations and muscle physiology. Consequently, metabolic conditioning may be best derived from high-intensity interval training. Anecdotally, sparring provides the most specificity and optimally adapts the energy systems for the purposes of competition. However, it is not always reasonable to call on this intervention, and oftentimes, athletes need to engage in less sport-specific activities

to appropriately and consistently increase and manipulate the intensity. Therefore, again anecdotally, it is suggested that coaches use work to rest ratio and average work duration specific to their sword. For example, in men's foil (work to rest 1:3, average work duration of 5 seconds), fencers can complete a 2-4-2 m shuttle (to encourage multiple changes in direction across varying and fundamental lengths; Figure 5) over a 5-second period (speed/fatigue will determine how much of the shuttle is completed) before resting for 15 seconds. Because the TMC reported by Roi and

Table 7
Competition schedule for men's foil in the lead up to the London 2012 Olympics (calendar available at www.FIE.ch)

Paris	FRA	Challenge International de paris	27.01.12/28.01.12
Paris	FRA	Challenge International de paris	29.01.12/29.01.12
La coruña	ESP	Tournoi Ciudad de A Coruña	17.02.12/18.02.12
La coruña	ESP	Coupe du Monde par équipes	19.02.12/19.02.12
Venise	ITA	Coupe Ville de Venise	03.03.12/04.03.12
Bonn	GER	Löwe von Bonn	16.03.12/17.03.12
Bonn	GER	Coupe du Monde par équipes	18.03.12/18.03.12
Wakayama	JPN	prince takamado WC	28.04.12/29.04.12
Séoul	KOR	SK Trophée Séoul	18.05.12/19.05.12
Séoul	KOR	Coupe du Monde par équipes	20.05.12/20.05.12
St-Petersbourg	RUS	Fleuret de St-Petersbourg	01.06.12/02.06.12
La Havane	CUB	Copa Villa La Habana	29.06.12/30.06.12
La Havane	CUB	Coupe du Monde Par équipes	01.07.12/01.07.12

Bianchedi (20) were recorded over 6 elimination bouts, adding approximately 174 attacks (Table 2), the repetitions of the proposed drill can be arranged in 1 of 2 ways: The drill can (a) be carried out over 3 sets of 3 minutes with 1-minute rest between sets or (b) be completed ≈ 29 times (174 divided by 6) split into 3 sets of approximately 9 repetitions, again with 1-minute rest between the sets.

Of course, it should be noted that these data were collected from an international competition, and therefore, these athletes were of a high standard (and presumably fit) and were adult. When applying these guidelines to novice, intermediate, and younger fencers, both intensity and repetitions should be adjusted accordingly. Table 4 suggests training drills appropriate to

all fencing disciplines including across gender and are based on the data of Roi and Bianchedi (20). These guidelines should be treated with caution until similar data are collected across multiple competitions of all abilities, gender, and age. It should also be noted that although men's epee contains average work periods of 15 seconds, this is not all performed at maximum intensity.

High-intensity interval training additions such as these may be a beneficial to training as Hoch et al. (13) reported that fencing training sessions rarely evoke blood lactate concentrations above the anaerobic threshold and thus do not always replicate competition bouts. Finally, anecdotal experience reveals that also completing these drills using their nondominant stance will help fend off the highly prevalent (and visually obvious) muscular imbalances between legs.

RISK OF INJURY

Perhaps the most insightful research to investigate injuries in fencing was conducted by Harmer (12), who collected data from all national events organized by the U.S. Fencing Association over a 5-year period (2001–2006). In total, more than 78,000 fencers (both genders) between 8 and 70 years of

Table 8
Strength and conditioning program for fencers: 4 example strength sessions and 4 example power sessions

Strength session 1	Strength session 2	Strength session 3	Strength session 4
Back squats (can also focus on eccentrics i.e., using loads > concentric 1 repetition maximum)	Split squats	Bench press	Deadlift
Bent-over row	Stiff leg dead lift	Pull-ups	Nordics
Technical (i.e., learning a new exercise or those that focus on the recruitment of a specific muscle) and then conditioning (e.g., medicine ball slams and throw) drills should be performed after workout			
Power session 1	Power session 2	Power session 3	Power session 4
Low load power clean (60–80% 1 repetition maximum; focus on high velocity)	High load power clean (>80% 1 repetition maximum)	Split snatch ^a	Jump squats
Plyometrics should be performed after workout. Example drills include box jumps, drop lands, drop jumps, and single-leg and lateral versions of each. After this, metabolic conditioning can be performed using the 2-4-2 drills and focusing on using the reverse stance, fencers should change their lead leg to help reduce imbalances			
^a Train both sides i.e., don't always land dominant leg forward.			
Power = 4 sets \times 3 repetitions at various loads; strength = 4 sets \times 4 repetitions at 4–5 repetition maximum loads.			

age and across all swords were investigated. Throughout this period, all incidents that resulted in withdrawal from the competition (i.e., a time-loss injury) were documented from which the incidence and characteristics of injuries were calculated. This value was determined as the rate of time-loss injuries per 1,000 hours of athlete exposures, with 1 athlete exposure equaling 1 bout. The results of this study are summarized in Table 5.

Harmer (12) concluded that the risk of injury in fencing is very low with the chance of injury in football and basketball being 50 and 31 times greater, respectively. Furthermore, the authors are of the assumption that many of the fencers from which this data was gathered were not undertaking efficacious S&C programs. With this assumption in mind, strength training may have reduced the incidence of these injuries through its positive adaptations on the structural integrity of all involved (3).

PERFORMANCE TESTING

Testing enables coaches to identify the physical capabilities of their athletes, monitor the efficacy of their S&C programs (and adjust accordingly), and makes predictions on competition performance. Based on the needs analysis conducted above, a suggested battery of tests has been identified (Table 6). It is important to conduct the tests in the order described above because this will reduce the negative effects of accumulated fatigue as the athlete progresses through the testing battery. Also, despite agility being defined as the ability to change direction in response to a sport-specific stimulus, agility is largely tested via closed skills; the reactive element is difficult to test without compromising reliability and incurring significant expense (24).

PERIODIZATION

Periodization may be defined as a training plan, whereby peak performance is brought about through the potentiation of biomotors and the management of fatigue and accommodation. The traditional periodization strategies such

as implementing a biomotor emphasis (e.g., strength and power) for approximately 4 weeks and using a 3:1 loading paradigm should be adopted for fencers during the off-season. During the in-season, competitions occur every 2–4 weeks (Table 7), and thus, this approach may not always be possible. Here, it may be advisable to use a nontraditional approach, which alternates between strength and power training on a session-to-session basis; in this context, it may be possible to perform 2–4 sessions of each before changing. Table 8 provides examples of 4 strength sessions and 4 power sessions, which may be appropriate to fencers.

CONCLUSION

It is highly recommended that fencers use strength and power training because it is likely to increase both the speed and (energy) efficiency of striking. Athletes should be critical of some traditional training methods such as LSD running because of their counterproductive effects on performance. Instead, exercises and conditioning drills, such as those identified herein, that focus on the physiological and biomechanical prerequisites of competition bouts should be used. In summary, a more scientific approach to performance training is required for these athletes, and more objective data are required within the sport of fencing.



Anthony Turner is a strength and conditioning coach and the program leader for the MSc in Strength and Conditioning at

the London Sport Institute, Middlesex University and the lead strength and conditioning coach for the British Fencing National Academy.



Stuart Miller is the head of Biomechanics at the London Sport Institute.



Perry Stewart is a lecturer and coach for the London Sport Institute.



Jon Cree is a strength and Conditioning coach and a lecturer in Sport Science and Sport and Exercise

Rehabilitation at Middlesex University.



Rhys Ingram is a strength and conditioning coach with the EIS where he leads the British Fencing program.



Lygeri Dimitriou is a senior lecturer in Sport and Exercise Physiology in the London Sports Institute, Middlesex University.



Jeremy Moody is program director for the MSc Strength and Conditioning at the Cardiff School of Sport, Cardiff Metropolitan University and Director for Judo, Sport Wales.



Liam Kilduff is a senior lecturer at Swansea University.

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