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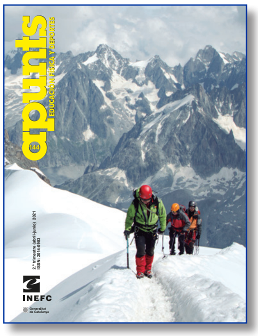

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ATR versus Traditional Periodisation in Adolescent Amateur Tennis Players

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Abstract

The objective of this study was to confirm the most effective periodisation model for improving physical condition in adolescent amateur tennis players: the ATR model or traditional periodisation. Over a period of 38 weeks, 45 amateur tennis players (26 males, 19 females; age: 13.8 (1.09)) were randomly assigned to three different training groups: Control Group (CG), exclusively technical and tactical training; ATR Group (ATRG), technical and tactical training plus physical preparation designed with the ATR model; and Traditional Periodisation Group (TPG), technical and tactical training plus physical preparation designed with traditional periodisation. At the end of the intervention, the CG showed no significant improvements. By contrast, the physical condition of the ATRG and the TPG improved significantly ($p < .05$). Moreover, the ATRG showed a significantly better percentage improvement than the TPG in all the tests performed: 20-m shuttle run test, standing long jump test, medicine ball toss test, spider drill test and sit and reach test. It was concluded that while both periodisation models are useful in improving physical condition, the ATR design is more effective in adolescent amateur tennis players.

Keywords: mesocycle, periodization, physical fitness, training

Introduction

The functional and physiological demands of professional tennis differ from those of the U-18 and U-16 categories. On clay, during competition adolescent male tennis players present a mean heart rate of 135 bpm·min^{-1} and a lactate concentration of 1.54 mmol·l^{-1}. Total match length is approximately 70 minutes, of which only 22.46% is actual playing time. The mean number of shots per point is 3.73 and the mean duration of each point is 5.5 seconds. The total number of points per match is 91.2 (Torres-Luque et al., 2011).

These variables should be taken into account when designing physical training for adolescent tennis players since physical condition is an important performance factor in tennis (Zháněl et al., 2015). In this regard, Ulbricht et al. (2016) observe that adolescent tennis players who obtain better results present higher levels of strength, specific endurance and upper-body power.

Similarly, physical condition plays a significant role in the prevention of injuries in adolescent tennis players due to the convergence of two risk factors that increase the possibilities of sustaining anatomical imbalances: firstly, tennis is an asymmetric sport; secondly, adolescence is a critical period in a human being's life in which accelerated musculoskeletal system growth takes place accompanied by far-reaching physiological changes (Olivera, 2005). Training planning therefore needs to be tailored to each subject's characteristics, particularly bearing in mind the high individual variability at this age (Girard & Millet, 2009).

However, there are additional aspects which largely shape the training planning model to be chosen. They include the variable number of matches and tournaments in which each player participates depending on their wins; the uncertainty of match times; the absence of a reasonable competition-free period of time in the course of the year in which a suitable pre-season stage can be performed and participation in competitions played on different surfaces. Therefore, coaches and physical trainers need to take these factors into consideration to ensure appropriate long-term training for players, avoid over-training and prevent injuries (Colvin & Gladstone, 2016).

In any event, finding a periodisation system that adapts to the characteristics of adolescent tennis players and allows the desired adaptations to be made is difficult. Against this background, the objective of this study was to determine the most effective training planning model to improve physical condition in adolescent amateur tennis players: the ATR (Accumulation, transformation and realization) design or the traditional planning model.

Method

Participants

The study included 45 amateur tennis players (age = 13.8 (1.09); BMI = 18.77 (1.1)), 26 males (regional ranking in the Region of Madrid between positions 71 and 545 and national ranking between positions 382 and 2,647) and 19 females (regional ranking in the Region of Madrid between positions 24 and 239 and national ranking between positions 106 and 1,354). All of them had been playing tennis for at least four years and competed in an average of five tournaments a month between September and June. They had no injuries or health problems preventing them from carrying out the training activities or tests. Attendance was recorded during the study. Of the initial 61-subject sample, 16 players were excluded because they failed to complete 90% of the training sessions. The participants were assigned randomly to one of the following three groups: control group (CG): (*n* = 15; age: 13.87 (1.19) years; weight = 49.73 (4.23) kg; height: 161.31 (8.69) cm; BMI = 19.12 (1.04)); ATR group (ATRG): (*n* = 15; age = 14.06 (1.03) years; weight = 49.26 (4.23) kg; height: 162.21 (8.32) cm; BMI = 18.75 (1.02)); and the traditional periodisation group (TPG): (*n* = 15; age: 13.46 (1.06) years; weight = 48.86 (4.55) kg; height = 163.13 (8.64) cm; BMI = 18.46 (1.23)).

The tennis players and their parents were duly informed about the research objectives, the work methods used and the pre- and post-test tests conducted. The parents also signed an informed consent form giving their approval for their children to be included in this research. The study was performed in compliance with the ethical principles provided for in the Declaration of Helsinki and the approval of the Institutional Review Board of the Bioethics Committee of Prince Sultan University of Riyadh (Saudi Arabia) was secured.

Instruments

The pre-test was conducted in the second week of September and the post-test in the last week of May the following year. Both tests were performed in the same timeslot (between 5.30 pm and 6.30 pm), preceded by a 10-minute warm-up which included an initial five-minute aerobic activation phase and a second active mobility phase. Both the pre-test and post-test were performed following technical and tactical training and after a 24-hour recovery period. The following five tests were used:

20-metre shuttle run test (SRT)
It was used to measure cardiorespiratory endurance on account of its capacity and stability to predict $VO_{2\ max}$ and physical condition, and its reliability and sensitivity for estimating the adaptations accomplished with the training (García & Secchi, 2014). Each subject was asked to run for as long as possible between two lines separated by 20 m in both directions, i.e. there and back, at a pace set by a beep. The speed in the first periods was low but increased every minute. The test ended when the participant stopped because they were tired or because they failed to reach the 20-m mark two consecutive times before the beep went off. The last period or half of it in which the subject managed to complete the drill was recorded. Each participant was allowed to make one attempt.

Standing long jump (SLJ)
This test was used to evaluate explosive leg power on account of its high validity, reliability and applicability (Fernández-Santos et al., 2015). The subject was asked to stand behind a horizontal line with their feet together. From this position, they were to jump as far as possible forwards with both feet together. The rearmost part of the body where the subject landed was taken as the measurement point. Each participant was allowed to make two attempts.

One-handed 3-kg medicine ball toss test (MBTT)
This test was used to evaluate upper-body explosive power on account of its validity, low-risk, ease of performance and the little equipment required (Beckham et al., 2019). The subject was asked to stand behind a straight line, facing the direction of throw, and with the opposite leg to the throwing arm extended in front of them. From this position, they had to try to toss a 3-kg medicine ball as far as possible. The distance measured was between the throw line and the point where the ball hit the ground first. Each participant was allowed to make two attempts.

Spider drill test (SDT)
This test was used to measure agility on account of its ecological validity, reliability and specificity (Huggins et al., 2017). The subject was asked to stand in the centre of the baseline of a tennis court and put their racket on the ground in that same place. At the examiner's signal, they had to place five balls on the racket (one at a time) as fast as possible and do so in the preset order shown in Figure 1. The time was recorded by means of a Casio® HS-80 TW-1EF timer, Japan. Each participant was allowed to make two attempts.

Sit and reach test (S&RT)
This test was used to assess flexibility on account of its high reliability and its validity for estimating hamstring flexibility (Ayala et al., 2012). The participants were asked to sit on the ground with their legs stretched out and their feet upright at a right angle to their legs. Their feet were placed inside a sit-and-reach box. On the top of the box there was a millimetre ruler on a board which the subject had to slowly and progressively move along with their fingers by reaching out as far as possible and holding that position for at least two seconds. At this point the measurement was taken in centimetres. Each participant was allowed to make two attempts.

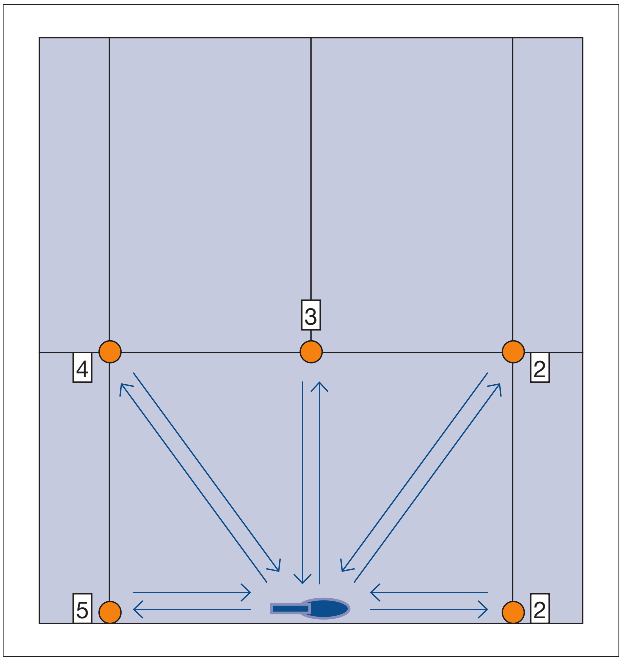

Figure 1
Spider Drill test.

Procedure

Training protocol
The intervention process lasted 38 weeks. The beginning and end coincided with the beginning and end of teaching activities at the subjects' tennis school, or in other words from the second week in September until the last week in May the following year. During this period, the tennis players selected participated in 45 regional tournaments in the Region of Madrid, 41 of them individual and four of them team tournaments. All the participants did five training sessions a week. The technical and tactical training was identical for the three groups and was held from Monday to Friday between 6.30 pm and 8.30 pm. In addition, the ATRG and the TPG did one hour of physical preparation daily (also from Monday to Friday) between 5.30 pm and 6.30 pm. Therefore, the physical training was performed before the technical and tactical training. This sequence was chosen in order to ensure that the presence of neuromuscular fatigue would not negatively impact the adaptations obtained

through the physical conditioning work (Fernandez-Fernandez et al., 2018). Table 1 presents all the parameters pertaining to the volume of training applied to each of the groups during the intervention process.

The physical conditioning work performed by the TPG was designed using traditional periodisation and was produced on the basis of the traditional periodisations provided for in the study performed by Berdejo and González (2008). The ATRG physical preparation was produced using the ATR model. For this purpose, the ATR proposal by Porta and Sanz (2005) was adapted to adolescent amateur tennis players. Figure 2 presents the distribution of the content in the physical preparation of the TPG during the intervention process.

The distribution of the physical work content applied to the ATRG throughout the intervention process and the structure of the macrocycles is shown in Figure 3.

The workload applied to the ATRG and the TPG was identical. To ensure this was the case, the training load components according to Table 2.

Table 1
Volume of work performed by each group.

	GC	TPG	ATRG
Duration of the intervention period	38 weeks	38 weeks	38 weeks
Number of weekly training sessions	5	5	5
Weekly technical and tactical training volume	10 h	10 h	10 h
Weekly physical training volume	0	0	5
Total weekly training volume	10 h	10 h	15 h

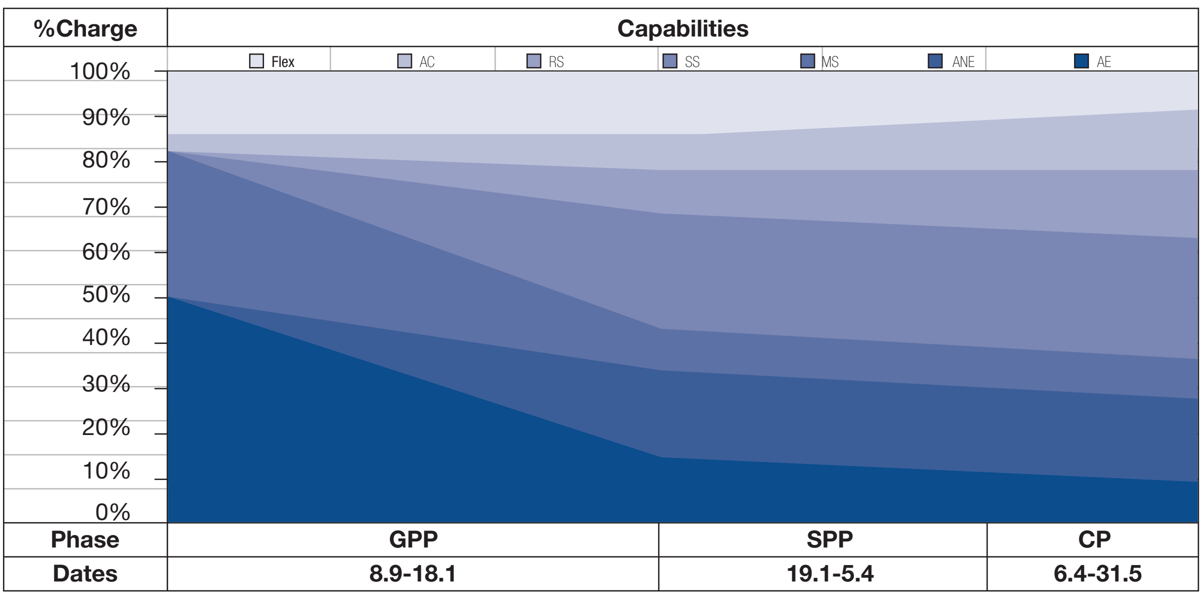

Figure 2
Load dynamics and the distribution of the physical training content in the traditional periodisation model used with the TPG.

Note. Flex: flexibility; AC: acceleration capacity; RS: reaction speed, SS: specific strength; MS: maximum strength; ANE: anaerobic endurance, AE: aerobic endurance; GPP: General preparation period; SPP: Specific preparatory period; CP: Competitive period.

No. microcycles	7	4	2	6	5	2	5	4	3
Mesocycle	A	T	R	A	T	R	A	T	R
Main training content	FM RB III	SS SR	CR RS AC	MS BR III	SS SR	CR RS AC	MS BR III	SS SR	CR RS AC
Macrocycle	I			II			III		
Dates	8 Sep-7 Dec			8 Dec-8 Mar			9 Mar-31 May		

Figure 3
Structure of the training macrocycles used with the ATRG.

Note. A: accumulation; T: transformation; P: performance; MS: maximum strength; BR III: base endurance III; SS: specific strength; SR: specific endurance; CR: competition rate; RS: reaction speed; AC: acceleration capacity.

Table 2
Parameters used to quantify the training load of the ATRG and TPG groups.

Capacity	Parameters used for volume measurement	Parameters used for intensity meas-urement
Strength	Series, repetitions and kilograms	Work percentage with regard to 1RM test
Endurance	Distance travelled, time trained, number of series and repetitions	Heart rate
Speed	Distance travelled, number of series	Percentage with regard to maximum speed or time taken to cover a given distance
Flexibility	Series, seconds maintaining posture	Subject-perceived degree of stress

The training methods used to improve physical condition in both experimental groups were the same and were tailored to the tennis players' characteristics and objectives (Table 3). However, the use of these methods in the course of the training cycle differed depending on the planning model used. The physical preparation of the TPG was structured into a single macrocycle and that of the ATRG into three macrocycles. In both cases, a smaller number of macrocycles was used because the athletes were adolescents and tennis is a sport in which endurance plays an important role in terms of performance (Navarro, 1999).

The physical training time applied to each tennis player was individualised. The 1RM test was used to gauge strength training intensity in the following exercises: sit-up, leg curls, bench press, pullover, pulley triceps, biceps curl with dumbbells and reverse flies. Endurance training intensity was established by means of the information obtained in an incremental exercise test (aerobic and anaerobic threshold, $VO_{2\ max.}$ and $HR_{max.}$). This test was done on a Matrix® Treadmill T70 XIR Minneapolis (United States) and with a Metamax® 3B spiroergometer, Leipzig, (Germany), while heart rate was recorded with a Polar S610i monitor, Kempele (Finland). The protocol was as follows: a 10-minute warm-up at 8 kph followed by a 5-min rest, after which the test began at a speed of 8 kph with a 1% inclination. The speed was increased by 0.5 kph every 30 seconds until the end of the test. The 30-metre test was used to determine work intensity in the speed training. The subjects started from the racing standing position. The time was logged with two Witty-Gate photoelectric cells (Microgate®, Bolzano, Italy) connected to a Microgate Witty Timer receiver. Both experimental groups performed these three tests on three occasions during the intervention, albeit on different dates due to the planning design. More specifically, the ATRG performed them between

Table 3
Training methods and systems used with the TPG and ATRG groups.

Capacity	Training methods and sys-tems	Activities or exercise
Maximum strength	I: 65-80%; S: 3-5; R: 6-12; Rt: 2-3’	Crunches, lower-back on Roman chair, sit-ups, leg curls, bench press, pullover, pulley triceps, biceps curl with dumbbells, reverse flies
Specific strength	Plyometric method (I: Heights of 40-60 cm; S:3-5; R: 5-10; Rt: 3’) Multiple horizontal jumps (S: 3-5; R: 5-10; Rt: 3’) Multiple throws: (I: 30-60%; S: 3-5; R: 5-10; Rt: 3’)	Plyometry: drop from a height of 40-60 cm followed by a quick jump upwards Multiple forward jumps: travel as far as possible with a set number of jumps Multiple tosses of a medicine ball simulating serve, forehand and backhand technique
Base endurance III/ Aerobic endurance	Variable continuous method: (I:65%-75% Max HR; Du: 30-60’)	Aerobic pace run (65-75% Max HR) combined with short (5-20”) high-intensity actions (85-90% Max HR) including changes of pace, direction and accelerations and decelerations
Specific endurance/ Anaerobic endurance	Intensive interval method with short intervals: (I: W 90-100% Max HR, Rt 120 bpm; S: 3-4; R: 3-4; Du: 20”-30”; Rt: 2-3’/5-10’) Intensive interval method with extremely short intervals: (I:W95%-100 Max HR – Rt 120 ppm; S: 3-4; R: 3-4; Du: 8”-15”; Rt: 2-3’/5-10’)	On-court exercises with ball and racket, including specific movements and basic shots (serve, forehand, backhand, volley and smash): Example 1. Serve-forehand-backhand Example 2. Serve-forehand-backhand-forehand volley-backhand volley-smash Example 3. Serve-forehand volley-backhand volley:
Reaction speed	Starts and exercises and reaction games	Example 1. Starts from different positions with visual and auditory stimuli: lying down (face-up, face-down), seated, back turned, standing, racing standing and crouching start. Example 2. Throw a ball at the tennis player, who has to catch it as quickly as possible. Example 3. The tennis player stands inside a square marked out by four numbered cones. The trainer calls out the numbers and the player has to touch them as fast as possible.
Acceleration capacity.	Racing technique exercises Chasing and speed games Slopes and dragging: (I:95-100%, R:4-8; Di: 10-30 m; Rt: 1’-3’)	Racing technique exercises. Examples: Skipping, progressive skipping, heels to buttocks, high and long jumps. Speed and chasing games. Examples: run after some-one placed 2 metres away. In two groups of five tennis players standing opposite each other, one is even and the other odd. The teacher says a number, and if it is even, the even group has to chase the odd group and the other way round. Slopes and dragging: slopes with a 6% off-level. Drag-ging with a speed loss of 10% of their record for the distance.
Flexibility	Active and passive stretching and PNF	General stretching exercises to improve the flexibility of the body’s main joints and muscle groups by means of active and passive stretching. Stretching exercises targeting the short muscles and PNF.

Note. I: intensity: S: series: R: repetitions; Du: duration; Max HR.: Maximum heart rate; bpm: beats per minute; Rt: rest; Di: distance; W: work time.

8 and 14 May, between 8 and 14 December and between 9 and 15 March. The TPG performed them between 8 and 14 May, between 19 and 25 January and between 6 and 12 April.

Statistical analysis

The data were summarised using the arithmetic mean format (standard deviation (SD)). The distribution hypotheses were verified by means of the Shapiro-Francia test and the asymmetry and Kurtosis tests. In order to estimate the effect size of the improvements produced by the different trainings, the percentage of relative change ([post – pre] / pre * 100) was calculated for each group first. The Student t-test for one sample was used to statistically evaluate the effect produced in each group, comparing each mean with regard to zero, as well as the calculation of the 95% confidence interval (CI) for these estimates. The differences between groups were analysed by means of a single-factor analysis of variance (ANOVA) and the subsequent application of Tukey's HSD test. The ANOVA's effect size was estimated by means of the η^2 parameter. The level of statistical significance was set at α =.05. All the analyses were performed in Stata 13.1 (StataCorp, College Station, Texas).

Results

As is shown in Table 4, no statistically significant changes were observed in the CG between the pre-test and the post-test, whereas significant improvements were observed in all the tests in the two experimental groups (TPG and ATRG). According to these results, all the ANOVA presented significant differences between the groups in all the tests, with large effect sizes (S&RT, $F(2.44) = 7.1$, $p = .002$, $\eta^2 = .25$; SLJ, $F(2.44) = 82.71$, $p < .001$, $\eta^2 = .80$; MBTT, $F(2.44) = 13.91$, $p < .001$, $\eta^2 = .36$; SDT, $F(2.44) = 63.73$, $p < .001$, $\eta^2 = .74$; SRT, $F(2.44) = 7.2$, $p < .002$, $\eta^2 = .25$).

After differences were observed in the group effect, the post-hoc analysis of the ANOVA showed that the improvement produced by the TPG was not significantly greater than that which was produced by the CG in any of the tests (S&RT, $p = .994$; SLJ, $p = .135$; MBTT, $p = .061$; SDT, $p = .283$; 20-metre SRT, p = .678). However, the ATRG presented a significantly greater improvement both in comparison with the CG (S&RT, $p = .007$; SLJ, $p = < .001$; MBTT, $p = <.001$; SDT, $p = <.001$; 20-metre SRT, $p = .002$), and in comparison with the TPG (S&RT, $p = .005$; SLJ, $p = <.001$; MBTT, $p = .015$; SDT, $p = <.001$; 20-metre SRT, $p = .022$).

Table 4
Summary of the pre-post intragroup results and differences.

	CG (*n* = 15)				TPG (*n* = 15)				ATR (*n* = 15)			
	Pre	Post	% change [IC 95%]	*p*	Pre	Post	% change [IC 95%]	*p*	Pre	Post	% change [IC 95%]	*p*
S&RT	11.3	11.9	11.1	.118	10	11.1	10.3	.049	10.3	13.5	36.9	<.001
	(4.4)	(4.0)	[-3.2, 25.5]		(3.2)	(3.5)	[0.1, 20.5]		(3.7)	(3.6)	[25.3, 48.6]	
SLJ	176	176.7	0.5	.236	177.5	180.1	1.6	<.001	179	191.1	6.8	<.001
	(25.9)	(24.1)	[-0.4, 1.5]		(26.8)	(25.6)	[0.8, 2.3]		(17.8)	(17.5)	[6.1, 7.5]	
MBTT	717.4	718.5	0.2	.342	720.6	727.9	1	<.001	725.5	739.1	2	<.001
	(155.3)	(154.4)	[-0.2, 0.7]		(144.2)	(146.3)	[0.7, 1.4]		(142.6)	(140.2)	[1.3, 2.7]	
SDT	19.7	19.6	-0.2	.153	19.5	19.3	-0.7	.006	19.4	18.7	-3.4	<.001
	(1.8)	(1.9)	[-0.6, 0.1]		(1.8)	(1.7)	[-1.2, -0.2]		(1.6)	(1.6)	[-4, -2.9]	
SRT	6.8	7	3.4	.188	7	7.4	6.2	.026	7	8.1	15.5	<.001
	(1.2)	(1.2)	[-1.9, 8.7]		(1.2)	(1.2)	[0.8, 11.6]		(1.1)	(1.2)	[11.1, 20]	

Note. The pre- and post-values represent the mean (SD); the CI95% is the confidence interval for the estimated change of percentage value. The *p* values were calculated by comparing the percentage of change with regard to zero by means of the Student t-test for one sample. S&RT: Sit and reach test; SLJ: Standing long jump; MBTT: One-handed 3-kg medicine ball toss test; SDT: Spider drill test; SRT: 20-metre shuttle run test; CG: Control Group; TPG: Traditional Periodization Group; ATRG: ATR Group

Discussion

The results showed that the technical and tactical training performed over 38 weeks at a rate of 10 hours a week did not make it possible to improve physical condition levels, since the CG did not obtain significantly greater scores in the post-test compared with the pre-test. Therefore, it might be thought that the physical improvements achieved by both the ATRG and the TPG may be attributed to the physical preparation done. It was also found that the results obtained by the ATRG were significantly better than those obtained by the TPG, although the workload applied to both experimental groups was identical and the training methods used were the same. Therefore, although some authors consider that from the scientific standpoint the ATR model is no more validated than the traditional periodisation model (Hellard et al., 2017), in view of the results of this research the interpretation must be that load distribution in the ATR design is more effective, at least in the case of physical condition. This might be due to a number of reasons. Firstly, the simultaneous development of several physical capacities might, as a result of their incompatibility, make it difficult to achieve adaptations. By contrast, targeting a smaller number of capacities within each training mesocycle would avoid interferences (Issurin, 2014; Navarro, 1999).

The use of concentrated load models also ensures suitable implementation of training continuity and progression principles since the work stimuli are applied with the frequency and the duration needed to achieve adaptations. Conversely, the use of workloads with multiple objectives would make it difficult for the stimulus to reach the minimum threshold needed for the body to attain a favourable response (Navarro, 1999; Issurin, 2014).

Applying the traditional periodisation model on a prolonged basis has been associated with excess fatigue in view of the increased release of stress hormones and creatine phosphokinase. Under these circumstances, the possibility of obtaining adaptations through the training process would be compromised (Issurin, 2014).

Similarly, the improvement of capacities such as speed and power could be hampered by a high training volume. It should be remembered that in the ATR design, training volume is reduced considerably in the transformation mesocycle and particularly in the performance mesocycle, and it is in the course of these mesocyles when the power and speed work is done due to the low residual effect of both capacities. In contrast, speed and power training in traditional periodisation is combined with capacities such as aerobic endurance and maximum strength, the development of which involves considerable training volume (Navarro, 1999).

Issurin (2014) and Navarro (1999) also contend that the ATR design could be superior to the traditional model due to the fact that the mesocycles are structured according to the residual effects of the training. The general exercises precede the specific ones, and in turn the latter are performed before the competitive exercises. Therefore, the sequencing of the different cycles follows a logical order. Similarly, the duration of each mesocycle is not set only as a function of external aspects such as the competition calendar since the time and the pace of improvement of the capacities to be developed are also factored in (González et al., 2015). In this way, the time structure of the ATR model is tailored to the processes of biological adaptation to physical exercise. However, Verkhoshansky (1998) considers that there is an arbitrary division of training cycles in the traditional periodisation model. Issurin (2016) adds that the ATR model is very useful in sports in which performance depends on several physical capacities and that it is applicable in non-professional sportspeople, in one-against-one and team sports and also in sports that call for high levels of strength or stamina. He also states that the ATR design is an effective alternative to the traditional periodisation model. Moreover, Porta and Sanz (2005) assert that the advantage of the ATR model lies in the fact that the training effects are selective, immediate and accumulative.

With regard to previous studies in which the most efficient methodology for improving physical condition in sports were studied, it should be noted that many of them focus on a small number of physical capacities, particularly strength and speed. Furthermore, the intervention designs used normally lasted less than 16 weeks. In these conditions, it is difficult to draw conclusions in order to determine which model of periodisation is most effective in each sport, since most of the athletes need to improve not only their levels of strength, power and speed but also their other physical capacities and motor qualities (Cissik et al., 2008).

In tennis, the efficacy of different training planning models in non-professional sportspeople has been analysed in another three studies. Vera and Mariño (2013), in research conducted over a period of 16 weeks with university tennis players, concluded that the accentuated multilateral model generated better outcomes than both the ATR approach and traditional periodisation in technique, speed and explosive force.

Polanco and Mariño (2019), following a five-week intervention with university tennis players, found that both the ATR design and tactical periodisation helped to improve technical effectiveness and intermittent endurance. Nevertheless, tactical periodisation generated better technical results, whereas the ATR model yielded superior improvements in intermittent endurance, albeit in out-of-context playing conditions.

Carvajal and Joya (2019), in a 13-week study with adolescent tennis players, observed that the ATR approach delivered significant improvements in levels of strength, cardiovascular endurance and agility, although this research only had one experimental group and no control group, meaning that the true scope of the adaptations achieved could not be verified.

Block models have also been used in team sports, although some authors advise against this on the grounds that integrating methodologies are more effective in sports involving numerous performance factors. These authors argue that training conditional, coordination, socio-affective and cognitive aspects separately is complicated (Martín et al., 2013) and contend that the use of block models such as the ATR design is not appropriate in these sports on account of the high number of competitions held in the course of the year (Krasilshchikov, 2010). Despite these approaches, Castillo Rodríguez (2011), in a study performed with two groups of amateur football players (one junior and one senior), showed the efficacy of the ATR design in the improvement of sports performance. Moreover, Gavanda et al. (2018) found that block versus daily undulating periodisation applied to adolescent American football players yields similar improvements in strength and performance.

Many of these studies analysed therefore prove that block models such as the ATR design make it possible to improve physical condition in different sports. However, this study also confirmed that the ATR approach leads to good results in one-against-one sports such as tennis in which there are socio-motor situations. This system has also been shown to be effective in youth sport (12-16 years) and useful in sports where performance is shaped (among other skills and capacities) by endurance. Nevertheless, due to the small number of articles that have analysed the efficacy of different planning models in tennis, this study's findings need to be confirmed by subsequent research.

Conclusion

Both the traditional periodisation model and the ATR design applied to adolescent amateur tennis players make it possible to improve their levels of flexibility, explosive power, agility and cardiovascular endurance. However, the ATR approach provides significantly better results than traditional periodisation in each of the capacities mentioned.

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