

Topspin's Influence on the Spine in Female Juniors III in Table Tennis

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Abstract: *The consolidation of topspin, the most prolific technical & tactical element in the attack's area, requires, besides the daily training and efficient biomechanics, an optimal health of the osteo-articular and muscular system, due to the fact that the performance of this element requires forceful speed developed throughout the muscle chain. The purpose of the present scientific research is to identify the problems occurred at spine level resulted following to topspin attack and the importance of this technical element in the female junior's performance. The social enquiry-based survey was conducted on a number of 27 coaches and athletes, using a number of 15 questions. Objectives: optimization of topspin attack in 11-12 years old female juniors. Premises: the knowledge on statistics of spine specific areas generating pain at the time of the attack will allow us to create a postural correction program meant to optimize performance. Research methods: The registration method was based on an opinion poll, on a statistical and mathematical method, on computer graphics method. Conclusion: around 78% of the interviewed specialists consider that the lumbar area is the most affected and predisposed to pain in case of topspin, existing a strong correlation between it and the technical element considered to be the most important in the attack phase (topspin – 66.67%) in female juniors, $p = 0.003 < \alpha = 0.05$, $V = 0.620$ and $C = 0.659$.*

Keywords: *postural correction; table tennis; topspin; attack; female juniors.*

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Introduction

As a consequence of high intensity, of strains specific to competitions and long sports training periods, as well as the ball diameter's increase, the risk of a potential accident within competition sports is increasing, according to Kondrič, et al., (2008), the intervention in due time for the treatment and recovery of the affected athletes making the difference between continuity – high performance or interruption – abandon. According to Mocanu (2019), in table tennis, topspin represents a technical – tactical element specific to attack, the execution being initiated by thighs impulse and fast torsion of the trunk, finalized by tangential hitting of the ball with an accelerated movement and an ascending trajectory from bottom to top of the paddle sustained by the active arm, actions meant to imprint to the ball a rotation effect forwardly, in speed mode. The attack-focused professional players and the great majority of the players who participate in international competitions use the forehand topspin attack in order to imprint speed and special effects to the ball, putting the adversary in difficulty and favoring the increase of the chances to win the point (Meghdadi et al., 2019).

According to Yu, Shao, Baker, & Gu (2018), table tennis is a sports which involves the simultaneous contraction of the lower body, upper body and abdomen for an efficient execution of the hit, the muscular unbalances being caused by repetitive unilateral movements which cause stress on tissues, intervertebral discs, spinal ligaments and on other structures, the symptomatology being headaches, cervical-dorso-lumbar pain, fatigue and possible postural deficiencies (Muyor et al., 2013). As part of the multidisciplinary team, the kinesiotherapist's role in high performance sports is to guide and assist the performance athletes with their training, with the purpose of preventing the occurrence of possible accidents, besides the role in assessment – recovery and counseling. The specialists in the area consider that topspin, together with retopspin, are the most important weapons from the technical – tactical arsenal, at the same time being the most spectacular and prolific elements, reason for which it is found in both offensive and defensive athlete's game (Negulescu, Mocanu , & Cristea, 2017). The muscular asymmetry can perturb the rhythm of movement, bone development and it can increase the athlete's injury risk. According to Hjelm, Werner, & Renstrom, (2010), in tennis, the lumbar spine was found to be the most commonly injured localization in girls, and new injuries were mainly found in the knee joint, followed by the ankle joint, while most recurrent injuries were localized to the lumbar spine.

According to Lam, Fan, Zheng, & Lee (2019), during the game, the forehand topspin as technical–tactical procedure is considered to be the most efficient and prolific hit from offensive area, its execution making the difference between performers and amateurs. According to Muyor et al., (2013), table tennis is considered to be an acyclic sport, where the execution is performed through a fast movement of the trunk in flexion – extension and spin, which executed frequently, can lead to the occurrence of lesions after a long play period, aspect which reduces the performance capacity. After the execution of a large number of technical – tactical elements, most athletes practicing table tennis present a hypertrophy on the dominant side, as per Folorunso et al., (2010), aspect which favors in time the occurrence at the spine level of a symptomatology which is materialized in disruptive factors of performance activity, in case no compensation program has been applied.

According to Zhang & Zhou (2019), table tennis is characterized by small balls, fast speed, strong rotation and many changes, their research showing that theoretical research on table tennis is the most common type (243 papers); in China, there had been few studies on sports medicine (9 papers) between 1980-2016; since winning the first table tennis world championship in 1959, China has won 230 gold medals in three major world competitions (the World Championships, the Olympics and the World Cup), aspects highlighting the special interest the world leader has had in this discipline, this interest being shown also by a large volume of specialized scientific articles. According to Pullinger, & Rejeb (2019), most accidents take place in the first quarter of the year (65%) when the training tasks are the greatest, aspect which requires an increased attention in the dosage of the action systems and the constant presence of the kinesiotherapist in the training room. The most prolific attack technical – tactical element voted in proportion of 50% by the technicians of this sports discipline according to Negulescu, Mocanu, & Cristea (2018), creates pain, but also disorders at the spine level for the high performance female junior athletes, one of the reasons of this situation being multiple trunk spins at high speed necessary for the execution of the topspin attack, especially for the forehand execution. Due to the fact that forehand topspin is considered the most used attack hit in competitive table tennis with an usage percentage of 95.23% (Mocanu, Negulescu, Moisescu, 2018), it is omnipresent both in offensive and defensive players, its consolidation at junior level facilitating the performance and the perspectives of female athlete's continuity to a successful career at maturity, in the sense of senior category. Kondrič et al.,

(2011) mention that the most often impairments in the racket sports with are:

- Pain in lumbosacral areas;
- Tendinitis of the rotator cuff shoulder's muscles (dead hand);
- King-Kong arm (overdevelopment of the skilled arm);
- Tennis player's elbow (inflammation of the lateral epicondyle);
- Blocking of the forearm nerve;
- Lesion of the abdominal wall.

Taking into consideration other aspects leading to the occurrence of posture problems, among which we mention the weight of the schoolbags carried by students from primary and middle school (4-7 kg vs. maximum allowed weight 2.5-3 kg), spending long time watching TV or using the mobile telephone in positions favoring various deformations of the spine from young ages, the late intervention by collaborating with a specialty physician or kinesiotherapist for the immediate remediation of the occurred problems, all the above representing a plurality of factors leading to a negative influence on the performance capacity, aspects which must be solved preferably in a correct way and in a time period favoring the successful continuation of the life in table tennis high-performance. In the case of tennis, according to Filipcic, Cuk, & Filipcic (2016), the present results show that the body asymmetry is present in these athletes starting from the smallest age category, reason for the occurrence of the problems related to the spine; in the case of table tennis, the accidents are the result of excessive training of a preparatory part inadequately achieved, of incorrect posture, emotional instability, mental vagabondage, lack of psychical focus and of previous accidents according to Chu, Lin, & Hung (2010), the influence of anthropometric characteristics in sports performance being still unclear (Carrasco, Pradas, & Martínez, 2010); it is also unclear if this influence is in some cases a favoring factor for the occurrence of the accidents in this sports discipline discussed by us.

According to a study performed by Negulescu, Mocanu, & Cristea (2017), on the importance of topspin in the female junior's attack, its consolidation requires daily practice, reason for which the creation of a postural correction program for achieving the performance objectives for the female athletes with spine problems represents a "must have". According to Cao et al., (2020), multi-ball training is one of the common methods used in adolescent table tennis training and it is always used to promote the formation and fixation of players' technical movements, to improve their training effects, in the topspin's consolidation stage being used this highly efficient method named "the Box" which involves a large number

of balls sent by the coach (100-200) with increased speed, the pain occurred in the dorsal side of the trunk limiting both the amplitude of the trunk's rotation necessary to a performance execution, especially with backspin effect ball, as well as the number of repetitions, the pain being a limitative factor for the training volume and the execution speed, especially in the case of the attack's specific elements. As it is desired to continue the high performance tradition at European and world level started by the Multiple World Champion, Angelica-Rozeanu-Edelstein (6 consecutive titles, 1950-1955) and by the national team of Romania, World Champion in 1950 -'60 (winner in all 4 sports tests of the competition during the World Table Tennis Championship in Bucharest, 1953) and continuing with the European Champion, Otilia Badescu (Courtmayour, Italy 2003) and with the latest European Champion, Eliza Samara (Ekaterinsburg, Rusia, 2015), as well as with the actual female team, the Multiple European Champion (2017 Russia and 2019 France), the performance optimization by ensuring the health of the osteo-articular and muscular system, besides other actions specific to this sports discipline, represents a sine-qua-non condition for performances similar to those mentioned above. According to Kondrič et al., (2008), due to the introduction of larger balls, the execution of the technical-tactical elements has become more challenging (sudden) and aggressive, aspect which has created a high accident potential of the main body parts involved in the biomechanics of the hits specific to the attack in juniors, presenting a higher risk. The acceleration of the racket at the time of contact is approximately 180 m/s^2 , whereas the ball flying away from the racket may rotate up to 140 times per second and travel at a speed of 40 m/s, values highlighting the challenge under which the body of the executor is found at the moment of performing the topspin attack (Bańkosz, & Winiarski, 2020).

Research questions

In order to approach this research direction, we have started from the following existing aspects:

- The inexistence of a postural correction model program in youth table tennis;
- No knowledge on the percentage of players having pain and spine disorders;
- The importance of knowing the most affected specific spine region resulting from the topspin attack;

- No knowledge on the existence of a relationship between the topspin attack and the health of the spine in female juniors;
- Do the junior female athletes trained by you have spine pain, resulting from practicing high-performance table tennis?
- Are the junior female athletes trained by you involved in a compensation-recovery program (regarding spinal disorders resulting from the specificity of the technical-tactical attack elements or from the fundamental position adopted at the tennis table)?
- Which of the five regions of the spine do you think are most likely to cause pain in the case of topspin attack in female juniors?
- When do you think that exercises are useful for increasing muscle-joint mobility (postural improvement program), before or after training?
- Is there a kinesiotherapist in the sports club you work for who can evaluate the health of the musculoskeletal system?
- Following the execution of a certain technical procedure, specific to the attack, can there be pain in the spine?
- On a scale of 1-10, how much do you consider that a poor posture of the female athlete (improper position of the torso) can negatively influence the biomechanics of topspin execution?
- How important is the technical-tactical topspin element in attack (on a scale from 1-10) at the level of performance?
- Do you think that a program to evaluate and improve incorrect body positions would be useful and could it be beneficial in optimizing (improving) the playing technique in attack?

Table 1. List of interviewed table tennis specialists

NO.	NAME OF THE SPECIALIST	SPORTS CLUBS
1.	A. B.	C.S. STIROM BUCUREȘTI
2.	A. F.-K.	C.S. FITFEEL ODORHEIU-SECUIESC
3.	B. D.	C.S.M. BUZĂU
4.	B. A.	C.S. VIITORUL PANTELIMON
5.	B. L.	A.C.S.O.V. PANTELIMON
6.	B. A.	C.S. STIROM BUCUREȘTI

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7.	C. M.	C.S.M. MOINEȘTI
8.	C. G.	C.S.M. IAȘI
9.		S.C.M. DUNĂREA 2020
	C. A.	GIURGIU
10.	D. G. A.	L.P.S. BISTRIȚA
11.		C.S.S. ODORHEIU
	G. I.	SECUIESC
12.	H. N.	A.C.S. DÂMBOVIȚA
13.		C.N. VLĂHUTĂ
	I. D.	RÂMNICU SĂRAT
14.	K.-G. B.	L.T.N.M TG. SECUIESC
15.		C.S.S. SFÂNTU
	K. B.	GHEORGHE
16.	M. V.	C.S.M. VATRA DORNEI
17.	M. V.	C.S.M. BUZĂU
18.		FORMER COACH OF
	M. M.	SPORT TEAM C.S
		VOINȚA GALAȚI
19.		Athlete of Post SV
		Mühlhausen-Germany &
		SCM Gloria Buzău-
		Romania clubs
	O. I.	
20.	P. A.	A.S.D. T.T. BIELLA
21.		C.S.M. VICTORIA
	P. M.	CAREI
22.		NAȚIONAL CADETS
		TEAM and
		C.S. PRISTAVU
	P. G.	CÂMPULUNG club
23.	P. C.	F.C. ARGES
24.	Ș. R.	C.S.M. BUZĂU
25.	S. C.	L.P.S. SLATINA
26.	S. I. I.	C.S.S. SLATINA
27.	V.S.	A.C.S. ACTIV GALAȚI

Source: authors'own contribution

Note. Most specialists participating to the scientific research are former players in A Division or Super League, being at present involved in the training of juniors participating to the national championship of the specialty federation. *Source of this table is from SPSS Statistisc. vers. 23.*

Purpose of the study

By collecting the information from the specialists in the area on the importance of creating a model for postural correction program, we will be able to choose the most adequate action systems and modern evaluation methods specific to kinesiotherapy, meant to optimize the topspin attack and the performance of female junior players with age comprised between 11 and 12 years old.



Figure 1. Execution of side rever topspin

Equations

For this research, we have used the following methods for recording and analyzing the data presented in this paper:

- Bibliography study;
- Observation method;
- Method of recording based on opinion poll;
- Statistical-mathematical method;
- Computerized graphics method.

The social enquiry-based survey was issued on a printed format of A4 type, but also in on-line variant, comprising 15 questions addressed to a number of 27 specialists comprising top coaches and athletes, a part of the interviewed specialists achieving notable performances at national and international level. Most used items have had the purpose of identifying the postural problems of the spine and the importance of topspin attack in order to improve the game at the above mentioned age category.

For the analysis of the relations and existing correlations between the topspin attack and posture, we have calculated the values of the correlation

coefficients, C and V contingency coefficients (Cramer) for nominal-type data, as well as the associated probabilities (p), Cronbach's Alpha, using IBM SPSS Statistics, Version 23 statistical – mathematical analysis program. The significance threshold taken into consideration was $\alpha = 0.05$.

For the theoretical substantiation of our research, we have consulted and interpreted scientific materials from the national and international area specific to our field and research interest, which would facilitate a better understanding of the chosen direction.

Our presence at the most important competitions such as the national team championship and the individual national championship has allowed us to observe the execution (biomechanics) of the topspin attack in the female junior III category, as well as the direct discussion with the specialists of this sport regarding the female athlete's postural problems resulting from the frequent use of the technical and tactical element subject to our research. Through the data obtained from coaches, the computer graphics provides an overview of the spinal problems, the importance of topspin during attack and the connection between the two variables, frequency and level of correlation.

The item's property of correlating with the final test score calculated by Cronbach's Alpha coefficient shows an acceptable value of the test's consistency, $\alpha = 0,598$.

Eq. (1)

$$\rho_T = \frac{k}{k-1} \left(1 - \frac{\sum_{i=1}^k \sigma_i^2}{\sigma_X^2} \right)$$

Calculation formula for Cronbach's Alpha coefficient

Eq. (2)

$$V = \sqrt{\frac{\chi^2}{n \cdot (q-1)}}$$

Calculation formula for the contingency coefficient V

Eq. (3)

$$C = \sqrt{\frac{\chi^2}{n + \chi^2}}.$$

Calculation formula for the contingency coefficient C

Eq. (4)

$$\chi^2 = \sum_{i=1}^{L-C} \frac{(f_i^o - f_i^t)^2}{f_i^t}.$$

Calculation formula for Test χ^2 (chi-square)

Results

The coach-addressed social enquiry-based survey highlights important aspects for the optimization of the topspin attack and of the problems generated by the deficient posture of athletes.

1. Do you consider that a program for assessing and ameliorating the incorrect body positions would be useful and could bring benefits to the improvement of attacking technique?

R: 100% of the coaches answered with “Yes” to this question, aspect highlighting the necessity of involving a kinesiotherapist for the athlete’s performance and life improvements.

2. What technical element do you consider to be important in the attack phase?

R: Topspin was designated in proportion of almost 56% as being the most important element used in attack.

3. At what age do you think you can take action in sports training and find the topspin in the game?

R: 8 years old is indicated as being optimum for the implementation of topspin in the game, being selected by the specialists in a percentage of 40.7%.

4. Which of the following aspects do you believe to influence the most topspin's success?
R: Biomechanics was designated in proportion of 44.4% as being the aspect with the greatest influence in topspin's success.
5. Which of the 5 regions of the spine do you consider to be predisposed to generate pain, in the case of the topspin attack, in female juniors?
R: The lumbar area is the most predisposed to generate disorders and implicitly pain, with a percentage of almost 78%.
6. Is a kinesiotherapist performing evaluations on the muscular and articular system's health present within your club?
R: 85% of the sports clubs do not have a kinesiotherapist in the multidisciplinary team necessary for high-performance.
7. Do junior female athletes trained by you present pain at the spine level, resulting from practicing high-performance table tennis?
R: Almost 26% answered in the affirmative, while 67% in the negative.
8. Are the junior female athletes trained by you involved in compensation – recovery programs?
R: 37% of the interviewed coaches have female athletes involved in compensation – recovery programs, while 59.3% do not have.
9. In your opinion, which is the technical procedure with the highest efficiency, forehand or backhand topspin?
R: 92.6% voted forehand topspin and only 3.7% for backhand topspin.

Table 2. The answers to Question no. 10 from the Opinion Poll

On a scale from 1 to 10, how much do you consider that a deficient posture of the female athlete can negatively influence the biomechanics of the topspin's execution?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7	2	7.4	7.4	7.4
	8	8	29.6	29.6	37.0
	9	9	33.3	33.3	70.4
	10	8	29.6	29.6	
Total		27	100.0	100.0	100.0

Source: results from the statistical processing of data arising from original research

Note: As per the highest percentage of 33.3 % corresponding to Grade 9 granted by the coaches to the deficient posture, we conclude that it affects significantly the biomechanics of the most important element from the attack area. *Source of this table is SPSS Statistisc. vers. 23.*

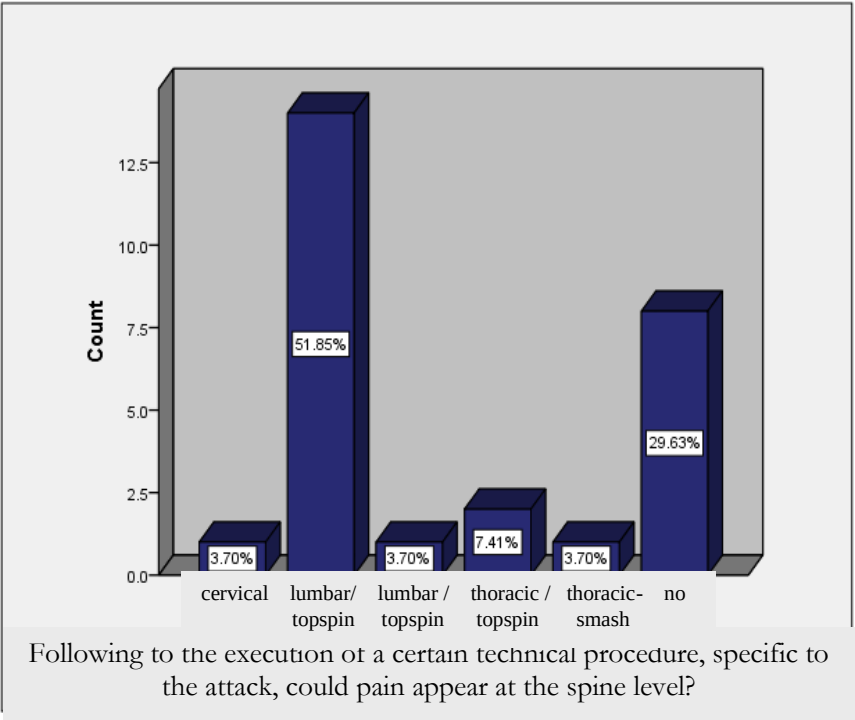


Figure 2. Image with answers to Question no. 11

Source: figure arising from the original research activity

Note: Topspin technical - tactical element is the one favoring the occurrence of pain in lumbar area in time
Source of this figure is from and involve our research dates. Source of this figure is from Excel Worksheet.

Table 3. The answers to Question no. 12

Do you consider that a program for assessing and ameliorating the incorrect positions of the body would be useful and could it bring benefits to the improvement of attacking technique?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	27	100.0	100.0	100.0

Source: table resulting from own research

Note: The necessity of performing a postural assessing and ameliorating program is validated by all coaches questioned, considering that the kinesiotherapeutic endeavor would favor the optimization of table tennis attack. Source of this table is from SPSS Statistisc. vers. 23.

Table 4. The answers to Question no. 13

Which technical element do you believe to be the most important in attack?

	Frequency	Percent	Valid Percent	Cumulative Percent
Position at the play table	8	29.6	29.6	29.6
Topspin	15	55.6	55.6	85.2
Smash (ball hit in force, without effect imprint)	2	7.4	7.4	92.6
Service	2	7.4	7.4	
Total	27	100.0	100.0	100.0

Source: *data resulting from own research*

Note: *in the attack, the most important technical – tactical element is considered to be topspin with a percentage of 55.6% followed by the position at the play table in a percentage of 29%. Source of this table is from SPSS Statistisc. vers. 23.*

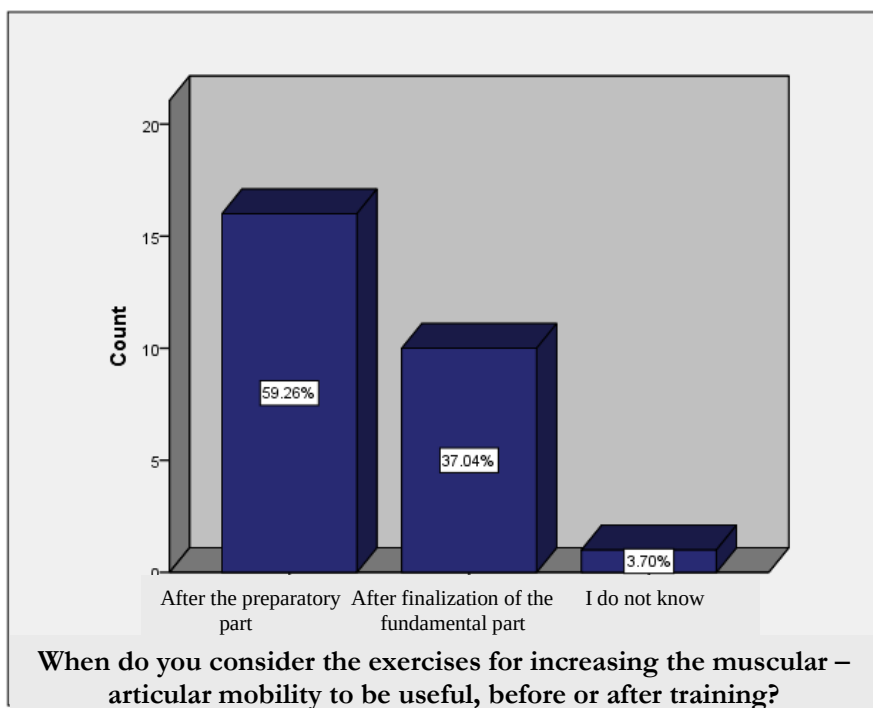


Figure 3. Image of the answers in percentages to Question no. 14

Source: *figure arising from the original research activity*

Note: *The postural amelioration program is indicated by the technicians to be implemented after the preparatory part, i.e. at the beginning of the fundamental part, while 37% see it as pertinent at the end of the fundamental part. Source of this figure is from Excel Worksheet.*

Table 5. Answers to Question no. 15 from the Opinion Poll

How important is the topspin element in the attack phase (on a scale from 1 to 10) at performance level?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7	1	3.7	3.7	3.7
	8	6	22.2	22.2	25.9
	9	5	18.5	18.5	44.4
	10	15	55.6	55.6	
	Total	27	100.0	100.0	100.0

Source: *original data resulting from research*

Note: 55.6 % of the interviewed subjects offered Grade 10 to the importance of topspin in high-performance table tennis, being the greatest percentage granted as compared to the other elements graded. Source of this table is from SPSS Statistisc. vers. 23.

Conclusions

The obtained results on the influence of topspin attack at spine level resulting from the social enquiry-based survey favor the conclusion that the performance of female juniors is optimized by the amelioration of the postural problems having a negative impact on the biomechanics in the execution of the most important technical and tactical attack element and by diminishing the pain in the lumbar area, all favoring the improvement of the sports performance and the athlete's life quality.

For the achievement of the performance objectives, we recommend the following specific actions:

- Cooptation of a kinesiotherapist in the multidisciplinary team;
- Somatometric evaluation and creation of special programs for remediating the disorders identified in order to stop the boosting of postural problems which generate discomfort at the moment of the execution of attack specific technical – tactical elements;
- Performance of a preparative part taking into consideration the movements advised against the disorders of the female athlete at spine level;
- The implementation and performance of the postural improvement program at the beginning or at the end of the fundamental part according to the recommendations made by the interviewed coaches;
- Performing stretching exercises after each workout for a period of 20-40 seconds for each adopted action system;
- Wearing heel cushions modeled according to the evaluation and the results of the analysis of the plantar pressures made with the help of the baropodometer;

- Paying more attention to the most prolific technical element specific to the attack (topspin) by daily training, optimizing the execution technique and hitting the ball in front of the torso.



Figure 4. Antropometric evaluation



Figure 5. Postural analysis performed with the help of images

Source: figure arising from the original research activity

Measurements	
Results	Angle °
Shoulder tilt	14° LF
Ground distance left shoulder mm	140
Ground distance right shoulder mm	141
Scapulae tilt	2° LF
Sips tilt	0°
Angle varus/valgus knee rg	169°
Angle varus/valgus rearfoot rf	173°
Angle varus/valgus knee lf	166°
Angle varus/valgus rearfoot lf	173°

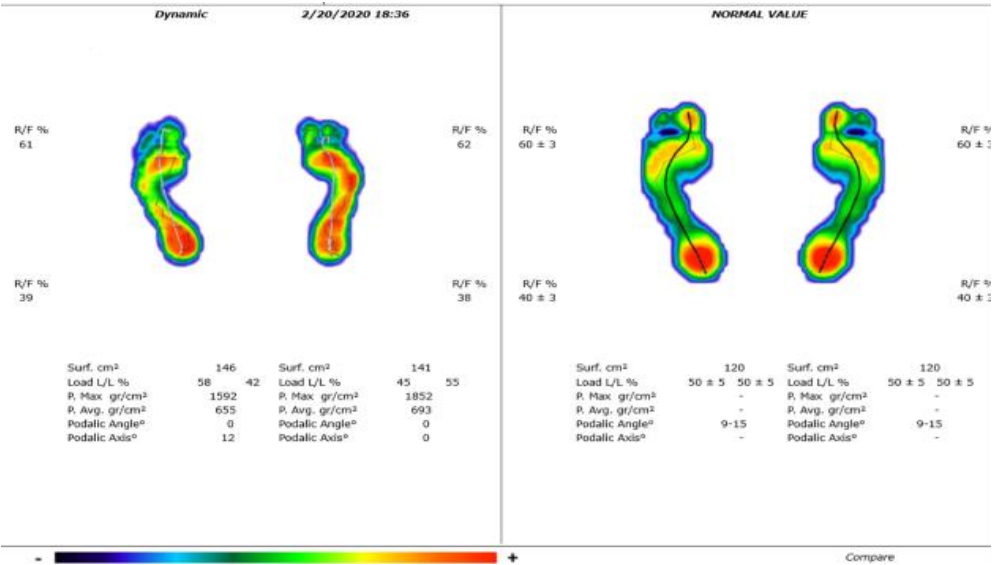


Figure 6. Comparison between the values of the plantar pressure of a subject in the dynamic phase vs. a normal value at the sole level, performed with the help of platform Freemede - SensorMedica (posturotest) device, evaluation performed to achieve the heel cushions necessary for postural correction.

Source: figure arising from the original research activity

Table 6. Existing correlations on the influence of attack's specific technical elements on the spine in table tennis

		Which of the 5 regions of the spine do you consider to be predisposed to generate pain, in the case of the topspin attack, in female juniors?			
		cervical	thoracic	lumbar	Total
Which technical element do you believe to be the most important in the attack phase?	Position at the play table	3	0	5	8
	Topspin	0	0	15	15
	Smash (ball hit in force, without effect imprint)	1	0	1	2
	Service	0	1	1	2
Total		4	1	22	27

Source: *results from the statistical processing of data arising from original research*

Note: 22 coaches (81.48%) consider that the lumbar area is the most affected area. A number of 8 coaches have chosen the position at the play table (22.72%) and 15 (68.18%) have chosen topspin. Source of this table is from SPSS Statistisc. vers. 23.

Another strong correlation shows the fact that most coaches (15 of 27, i.e. 55.56%) indicate that topspin is the main element in attack phase and among them, 93.33% prefer forehand topspin. Because the probability associated to the correlation tests is $p = 0.033 < \alpha = 0.05$, it results that there is a connection between the technical element considered to be the most important in the attack phase and the technical procedure with higher efficiency, forehand or backhand topspin. The coefficient values $V = 0.505$ and $C = 0.581$ show a good correlation.

Table 7. Level of correlations between the most important technical attack element and the spine areas predisposed to generate pain

		Value	Approximate Significance
Nominal by Nominal	Phi	0.881	0.002
	Cramer's V	0.623	0.002
	Contingency Coefficient	0.661	0.002
N of Valid Cases		27	

Source: results from the statistical processing of data arising from original research

Note: The technical element considered to be the most important in the attack phase and the regions of the spine predisposed to generate pain in the case of topspin attack in juniors, are correlated ($p = 0.002 < \alpha = 0.05$, $V = 0.623$ and $C = 0.661$, it results a strong correlation). Source of this table is from SPSS Statistisc. vers. 23.

We intend to assess them in the future and we will create customized programs and postural amelioration means (heel cushions) for a number of 10 junior female athletes from a group of 20 subjects, using somatometry, posturotest, baropodometer and heel cushions.

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