

Prevalence of Musculoskeletal Conditions in Tennis-Teaching Professionals

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Background: Tennis-teaching professionals represent a significant proportion of all avid tennis players worldwide, with 15,000 belonging to the largest professional organization, the United States Professional Tennis Association (USPTA). However, there is no epidemiologic study to date reporting the prevalence of musculoskeletal conditions in these tennis-teaching professionals.

Purpose: To investigate the prevalence of musculoskeletal conditions in tennis-teaching professionals following the International Tennis Federation's (ITF) guidelines for epidemiologic studies.

Study Design: Descriptive epidemiology study.

Methods: Electronic surveys were distributed to 13,500 American members of the USPTA. The prevalence of musculoskeletal conditions was calculated.

Results: A total of 1176 USPTA members completed the survey. Most participants reported teaching more than 5 days per week and more than 2 hours per day. The prevalence of musculoskeletal injury secondary to teaching tennis was 42%. The most affected area was the lower extremities (43% of all injuries) followed by the upper extremities (37%). The most commonly injured structures were muscles or tendons (36% of all injuries) and joints or ligaments (28%). The majority of injuries did not cause participants to miss more than 24 hours of teaching (57%).

Conclusion: This is the first epidemiologic study on the occupational risk of musculoskeletal injuries and conditions in tennis-teaching professionals. Tennis-teaching professionals have a significant risk of musculoskeletal injuries or conditions related to their occupation. The prevalence of injury is consistent with previously published studies of injury prevalence among other tennis-playing populations. The proportions of upper and lower extremity injuries were fairly equitable.

Keywords: epidemiology; International Tennis Federation; tennis; USPTA; occupational injury

Tennis is the most popular racquet sport in the world with over 75 million participants, 15,000 of whom are certified teaching professionals registered with the world's largest tennis-teaching organization, the United States Professional Tennis Association (USPTA).^{23,28} In 2003, more than 36,000 people were treated in an emergency department for racquet and volley sport injuries, resulting in a total health care cost of \$1.79 billion according to the US Consumer Product Safety Commission.¹⁹ Tennis-teaching professionals are at risk of various occupational injuries related to teaching the

sport.^{2,15,21} However, despite these studies indicating that tennis-teaching professionals are at risk of injury, there have been no studies published on the incidence or prevalence of injuries in the tennis-teaching professional community.

In recreational and competitive tennis players, musculoskeletal injuries are the most frequent reason to obtain medical advice and lose time off the court.⁶ A systematic review of 119 studies related to tennis injuries since 1966 noted a large variability in the data and suggested that lower extremity injuries occurred with the highest incidence.²⁴ Lower extremity injuries have been reported to occur twice as often as upper extremity injuries, accounting for 39% to 59% of all injuries.^{3,10,11,13} Another study noted that 91% of 376 tournament players had sustained a lower extremity injury at some point in their career.⁸ Furthermore, a prospective cohort study noted an incidence of lower extremity stress fractures of 13% in 139 elite, junior, and professional players.¹⁷

In contrast to the distribution of the incidence of musculoskeletal injuries, it appears that the prevalence of gradual-onset musculoskeletal conditions secondary to playing tennis is higher for upper extremity injuries.²⁴ A prospective study and 2 cross-sectional studies on elite tennis players reported that shoulder injuries were most

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prevalent.^{14,30,32} A study of boys and girls in the “16 and under” and “18 and under” United States Tennis Association (USTA) junior levels demonstrated that the prevalence of upper extremity injuries was greatest in that population as well (Safran MR, Hutchinson MR, Moss R, Albrandt J. “A comparison of injuries in elite boys and girls tennis players.” Presented at Society for Tennis Medicine and Science, 1999). However, another prospective study at the USTA Boys National Championship reported that the incidence of back and thigh injuries was greatest.¹¹ These contrasts display the immense variability in the incidence and prevalence of injuries at each body region reported in the existing literature.

To address this variability in study findings resulting from methodological inconsistencies within the tennis epidemiology literature, the International Tennis Federation (ITF) coordinated a meeting of international experts with vast experience managing tennis injuries with the goal of reducing the variability in epidemiological studies on tennis injuries. This variability was determined to be a result of significant differences in the studies’ definitions of injuries, methodologies for collecting and analyzing data, and their sample populations. These experts published a consensus statement in which they proposed a list of medical conditions that needed to be monitored in all tennis-playing populations, criteria for categorizing the severity of each condition, and the methods in which the data should be analyzed and reported. The proposal intended to create consistency among future studies so that the data could be compared and subsequently utilized by other researchers and clinicians.²² The consensus statement has only been cited twice in literature reviews and twice in retrospective studies.^{1,7,9,24} Since publication 4 years ago, there has been only 1 epidemiologic study that has followed the ITF guidelines, a study conducted on collegiate tennis players.⁵

Even though numerous studies exist on the nature of injuries sustained by junior, collegiate, and elite tennis players, no study could be found regarding the incidence or prevalence of their injuries secondary to occupational exposure by tennis-teaching professionals. Despite being at the forefront of the education of future elite tennis players, these tennis-teaching professionals have been overlooked thus far by the epidemiologic and scientific community in terms of defining their true injury rates and risks. This risk may in fact be higher for overuse injuries than in junior and elite players since tennis-teaching professionals have greater exposure time, at times spending 8 hours a day teaching tennis. Therefore, the objective of this study was to investigate the prevalence of musculoskeletal conditions in tennis-teaching professionals based on the ITF guidelines outlined in the consensus statement and to determine the relationship between occupational activities of tennis-teaching professionals and injury risk.

METHODS

This was a cross-sectional survey of the prevalence of musculoskeletal conditions in the tennis-teaching professional population at the time of the survey. The entire USPTA–United States membership was invited to

participate in the study. Approximately 13,500 of those 15,000 members hold membership in the United States. Study approval was obtained from the USPTA and the Institutional Review Board of St Vincent’s Health System.

All active members of the USPTA currently registered in their email list were contacted and provided a consent form explaining the risks and benefits of the study. Male and female tennis-teaching professionals aged 21 years and older who were currently registered with the USPTA were included in the study. This age was used as the cutoff because it is the highest age of majority for all of the 50 states in the United States. Once the tennis-teaching professional agreed to participate, a surveillance questionnaire was provided to capture data on the type and nature of each injury, defined by the guidelines set forth in the ITF consensus statement as “any physical or psychological complaint or manifestation sustained by a player that results from a tennis match or tennis training, irrespective of the need for medical attention or time loss from tennis activities.”²²

The primary outcome measurements were the prevalence of current injuries and the prevalence of individual body parts injured. Other variables included demographic and anthropometric information, playing hand, USPTA certification level,²⁹ forehand and backhand stroke type, typical teaching workload, and specific type of injury. Furthermore, respondents were queried about their most severe current injury and asked to describe the location and type of injury, the laterality of the injury location, the cause of the injury and its severity as measured by a visual analog scale—the Nirschl Pain Phase Scale of Athletic Overuse Injuries^{18,20}—and the amount of time lost from teaching due to the injury.

Data were analyzed using JMP 10 (SAS Institute Inc). An a priori sample size analysis determined that results would be generalizable to the total population of USPTA members in the United States ($N = 13,500$) with 95% confidence with a $\pm 5\%$ CI if 374 subjects completed the survey. Descriptive statistics were prepared for all variables (mean, standard deviation, count, and proportion). All variables were compared between males and females using Student *t* tests, analyses of variance, Fisher exact tests, or chi-square tests as appropriate at a significance level of $P = .05$. Odds of dominant side injury were compared using nominal logistic regression and odds ratios, and their 95% CIs were calculated. Prevalence of injury according to body location was compared using prevalence ratios (PRs) and 95% CIs.

RESULTS

The current study included 1176 teaching professionals (8.7%) of all 13,500 tennis-teaching professionals registered with the USPTA in the United States. This sample size allows for results to be generalized to all active USPTA members with a $\pm 2.7\%$ CI. The respondents were, on average, male, middle-aged, right-handed, and slightly overweight (Table 1). Males had a significantly greater body mass index (BMI) than females ($P < .001$). The majority of USPTA members held the elite professional (P1) certification (52%), and males were more likely to hold a higher certification than females ($P < .001$).

TABLE 1
Tennis-Teaching Professional Demographics Stratified by Sex^a

	Males	Females	P Value	Overall
Age, y	53 ± 13	53.4 ± 11.4	.65	53.1 ± 12.7
Height, m	1.79 ± 0.07	1.66 ± 0.07	<.001	1.77 ± 0.09
Weight, kg	84.5 ± 13.9	64.9 ± 11.2	<.001	80.7 ± 15.5
BMI, kg/m ²	26.2 ± 3.8	23.6 ± 3.6	<.001	25.7 ± 3.9
Dominant hand			.90	
Right	91 (864/950)	92 (207/226)		91 (1071/1176)
Left	9 (86/950)	8 (19/226)		9 (105/1176)
Most recent teaching day			.006	
Today	57 (539/950)	46 (104/226)		55 (643/1176)
This week	27 (258/950)	29 (66/226)		28 (324/1176)
Past 2 mo	9 (81/950)	12 (27/226)		9 (108/1176)
> 2 mo	8 (72/950)	13 (29/226)		9 (101/1176)
USPTA certification ³¹			<.001	
Recreational coach	8 (77/950)	10 (22/226)		8 (99/1176)
Professional (P2 and P3)	33 (311/950)	46 (105/226)		35 (416/1176)
Elite professional (P1)	54 (513/950)	42 (94/226)		52 (607/1176)
Master professional	5 (49/950)	2 (5/226)		5 (54/1176)
Days of teaching per week			.040	
<1	10 (96/950)	11 (24/226)		10 (120/1176)
1-2	11 (100/950)	17 (38/226)		12 (138/1176)
3-4	24 (226/950)	25 (56/226)		24 (282/1176)
5-7	56 (528/950)	48 (108/226)		54 (636/1176)
Hours of teaching per day			.73	
<1	4 (39/950)	5 (12/226)		4 (51/1176)
1-2	23 (222/950)	23 (52/226)		23 (274/1176)
>2	73 (689/950)	72 (162/226)		72 (851/1176)

^aData are presented as mean ± SD or % (n/total). BMI, body mass index; USPTA, United States Professional Tennis Association.

The majority of respondents had taught tennis the same day they completed the study survey (55%), and males were more likely to have last taught tennis more recently ($P = .006$). Most teaching professionals (54%) reported teaching 5 to 7 days in a typical week and for longer than 2 hours per day (72%). Male respondents reported teaching more days in a typical week than females ($P = .040$). Tennis-teaching professionals who were more active in a typical week also reported spending more time teaching per day ($P < .001$) (Figure 1). Additionally, respondents certified as elite professionals were more likely to teach more often in a typical week ($P < .001$) and for longer during a typical teaching day ($P < .001$) (Table 2).

A total of 1517 current injuries were reported by 497 tennis-teaching professionals at the time of survey (3.1 injuries per injured subject), yielding an injury prevalence of 42% (Table 3). Overall, injuries to the lower extremities were the most prevalent (31%). Both upper extremity injuries (PR, 1.9; 95% CI, 1.6-2.2) and lower extremity injuries (PR, 2.3; 95% CI, 2.0-2.6) were significantly more prevalent than trunk injuries. Additionally, lower extremity injuries were 1.2 times more prevalent than upper extremity injuries (95% CI, 1.1-1.3). The most commonly injured location per individual body part was the shoulder (17% of all injuries) (Table 4). Specifically looking at anatomical structures injured in each body part, the most commonly injured structures were knee ligaments (9% of all injuries), shoulder muscles (6%), elbow tendons (4%), and shoulder joints

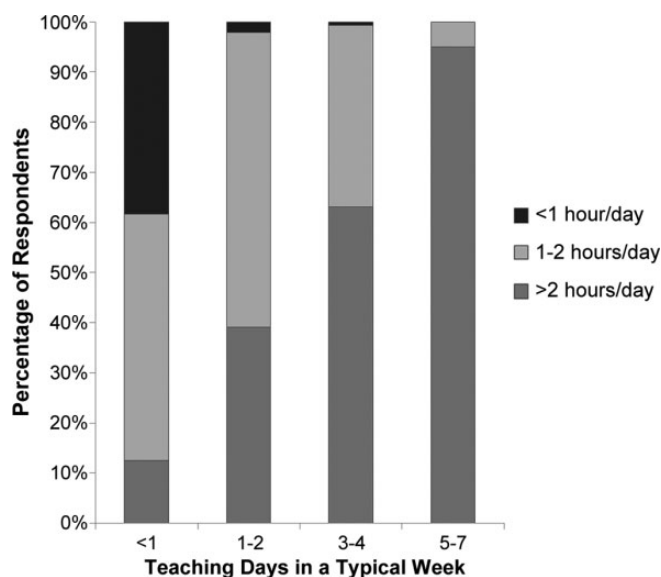


Figure 1. Active hours among tennis-teaching professionals.

(4%). Participants were also asked to describe in detail their most severe currently ongoing injury (Table 5). The majority reported their most severe injury or musculoskeletal condition in the lower extremities (53%), with 36% to joints

TABLE 2
Typical Time Spent Teaching^a

	Level 1 (Recreational)	Level 2 (Professional)	Level 3 (Elite Professional)	Level 4 (Master Professional)	P Value	Overall
Days teaching in a typical week					<.001	
<1	15 (15/99)	11 (47/416)	8 (49/607)	17 (9/54)		10 (120/1176)
1-2	25 (25/99)	14 (59/416)	8 (48/607)	11 (6/54)		12 (138/1176)
3-4	35 (35/99)	25 (102/416)	21 (128/607)	31 (17/54)		24 (282/1176)
5-7	24 (24/99)	50 (208/416)	63 (382/607)	41 (22/54)		54 (636/1176)
Hours teaching in a typical day					<.001	
<1	5 (5/99)	4 (16/416)	4 (25/607)	9 (5/54)		4 (51/1176)
1-2	45 (45/99)	28 (117/416)	15 (93/607)	35 (19/54)		23 (274/1176)
>2	49 (49/99)	68 (283/416)	81 (489/607)	56 (30/54)		72 (851/1176)

^aData are presented as % (n/total).

TABLE 3
Prevalence of Injury Among
Tennis-Teaching Professionals^a

Currently injured	42 (497/1176)
Injury location	
Upper body	25 (299/1176)
Trunk	14 (163/1176)
Lower body	31 (367/1176)
Injured structure	
Bone	9 (109/1176)
Joint or ligament	23 (267/1176)
Muscle or tendon	26 (308/1176)
Nerve	6 (66/1176)
Don't know/not sure	8 (98/1176)

^aData are presented as % (n/total).

or ligaments and 36% to muscles or tendons. Overall, most injuries were attributed to either overuse or teaching too much (49%) or a sudden movement or change of direction (22%). The severity of this injury was classified on average at a Nirschl phase 3 (16%), phase 4 (23%), or phase 5 (23%) (Table 6).

Teaching professionals were also asked to describe the severity of this injury in terms of how much it affected their ability to teach using a visual analog scale from 0 to 10 (0 = not affected, still able to teach at 100%; 10 = completely unable to teach). The mean severity of injury was self-described as a 3.5 ± 3.0 . Severity of injury was significantly different according to the affected structure, with the Tukey honestly significant difference test showing bone injuries to be significantly more severe than injuries to muscles or tendons ($P = .042$). Most injuries resulted in

TABLE 4
Injured Locations and Structures^a

Injured Location	Injured Structure					Total
	Bone	Joint or Ligament	Muscle or Tendon	Nerve	Don't Know	
Head or face	0 (0/16)	6 (1/16)	6 (1/16)	19 (3/16)	69 (11/16)	1 (16/1517)
Neck	9 (6/66)	14 (9/66)	30 (20/66)	20 (13/66)	27 (18/66)	4 (66/1517)
Shoulder or clavicle	6 (12/206)	33 (68/206)	45 (92/206)	1 (3/206)	15 (31/206)	14 (206/1517)
Upper arm	3 (1/36)	6 (2/36)	53 (19/36)	6 (2/36)	33 (12/36)	2 (36/1517)
Elbow	1 (1/128)	25 (32/128)	53 (68/128)	9 (11/128)	13 (16/128)	8 (128/1517)
Forearm	0 (0/37)	8 (3/37)	51 (19/37)	5 (2/37)	35 (13/37)	2 (37/1517)
Wrist	6 (6/108)	34 (37/108)	36 (39/108)	8 (9/108)	16 (17/108)	7 (108/1517)
Hand, finger, or thumb	4 (2/52)	31 (16/52)	23 (12/52)	13 (7/52)	29 (15/52)	3 (52/1517)
Sternum, ribs, or upper back	7 (2/28)	7 (2/28)	32 (9/28)	14 (4/28)	39 (11/28)	2 (28/1517)
Abdomen	0 (0/18)	0 (0/18)	39 (7/18)	11 (2/18)	50 (9/18)	1 (18/1517)
Lower back, pelvis, or sacrum	14 (23/163)	19 (31/163)	35 (57/163)	17 (28/163)	15 (24/163)	11 (163/1517)
Hip or groin	19 (20/106)	27 (29/106)	30 (32/106)	4 (4/106)	20 (21/106)	7 (106/1517)
Thigh	0 (0/26)	4 (1/26)	46 (12/26)	12 (3/26)	38 (10/26)	2 (26/1517)
Knee	13 (33/257)	53 (135/257)	23 (60/257)	2 (6/257)	9 (23/257)	17 (257/1517)
Lower leg or Achilles tendon	5 (3/66)	12 (8/66)	58 (38/66)	8 (5/66)	18 (12/66)	4 (66/1517)
Ankle	15 (10/66)	29 (19/66)	33 (22/66)	8 (5/66)	15 (10/66)	4 (66/1517)
Foot or toe	12 (16/138)	25 (34/138)	33 (45/138)	11 (15/138)	20 (28/138)	9 (138/1517)
Total	9 (135/1517)	28 (427/1517)	36 (552/1517)	8 (122/1517)	19 (281/1517)	

^aData are presented as % (n/total).

TABLE 5
Most Severe Current Injury^a

Most severely injured area	
Head or neck	4 (22/496)
Shoulder or clavicle	13 (64/496)
Arm, elbow, wrist, or hand	17 (84/496)
Trunk	12 (61/496)
Hip, groin, or thigh	8 (38/496)
Knee	29 (143/496)
Lower leg, ankle, or foot	17 (84/496)
Most severely injured structure	
Bone	8 (42/496)
Joint or ligament	36 (181/496)
Muscle or tendon	36 (178/496)
Nerve	4 (22/496)
Don't know/not sure	15 (73/496)
Affected side	
Dominant	68 (250/485)
Nondominant	32 (117/485)
Bilateral	21 (104/485)
Not applicable	3 (14/485)
Cause of injury	
Overuse/teaching too much	49 (240/485)
Sudden movement or change of direction	22 (106/485)
Court surface	4 (20/485)
Fitness level	2 (8/485)
Racquet (weight, stiffness, grip size, head size, etc)	1 (4/485)
Type of strings	1 (6/485)
Poor technique	0 (1/485)
String tension	0 (1/485)
Other	20 (99/485)

^aData are presented as % (n/total).

fewer than 24 hours of teaching time lost, but the amount of time lost from teaching depended on the type of injury. The majority of injuries occurred to a teaching professional's playing hand (dominant) side (68%). Upper extremity injuries were 17.2 times more likely to occur to the dominant side than lower extremity injuries ($P < .001$; 95% CI, 8.1-42.3) (Table 7).

DISCUSSION

The purpose of the current study was to document the prevalence of musculoskeletal injuries and conditions among tennis-teaching professionals. This study accomplished that purpose, and furthermore serves as the first instance of an epidemiologic study on occupational injuries in tennis-teaching professionals using the guidelines proposed by the ITF consensus statement.²² The existing literature reports a prevalence ranging from 21.5% to 52.9%.^{11,12} The current study found that the cross-sectional prevalence of tennis-teaching professionals in the United States was 42%. Furthermore, the prevalence of upper extremity, lower extremity, and trunk injuries was found to be 25%, 31%, and 14%, respectively, among the 1176 survey respondents. Since many athletes reported multiple injuries, when all injuries were examined, upper extremity injuries were found to comprise 37%, lower extremity injuries 43%, and trunk injuries 19% of the

1517 injuries reported in this study. A comparison of this distribution by injury location to the results of a number of existing studies¹¹ can be found in Table 8. It is important, however, to interpret this comparison within the context of understanding that there may be significant differences in the age of participants in this study compared with previously conducted work. Injuries to the lower extremities remained the most common, followed by upper extremity and trunk injuries, a pattern that is consistent with previously published work; however, the current study population experienced a more even distribution of injuries across the body compared with the existing literature. In the current study, lower extremity injuries were 1.2 times more frequent than upper extremity injuries (95% CI, 1.1-1.3), while in the pooled existing literature, lower extremity injuries were 2.1 times more frequent (95% CI, 2.0-2.2). The relative decrease in the prevalence of lower extremity injuries among tennis-teaching professionals may be due to the more stationary activities involved with coaching compared with playing. However, a greater proportion of tennis-teaching professionals in the current study were shown to sustain upper extremity or trunk injuries compared with tennis players, which can possibly be explained by high volumes of repetitive hitting during instruction periods with athletes.

In terms of the types and subtypes of tissue, muscles and tendons were the most commonly injured structures. A similar prospective study that followed competitive athletes for 6 months reported muscle cramps and tendon strains as the 2 most common musculoskeletal conditions reported.¹⁵ Muscle cramps were also reported to be the most common injury reported in junior players and in club players in 2 other prospective studies.^{26,31} In a retrospective cohort study, ankle sprains were the most commonly reported diagnosis, followed by calf and quadriceps strains.²⁵ In this particular study, patients' information was obtained from medical records of visits to a physician or physiotherapist, which may skew the results toward more severe injuries and leave out milder muscle and tendon injuries that were managed by athletic trainers with good outcomes and did not require additional evaluation.

The majority of participants had taught within the past week before completing the survey, most of whom taught 5 or more days of lessons per week, indicating a study population active in teaching tennis even if currently injured. The vast majority spent more than 2 hours per day teaching tennis. Furthermore, those respondents who reported teaching more often per week were significantly more likely to teach for a longer duration per day. These findings suggest that most participants are probably working as tennis-teaching professionals as a full-time career, and as such, any significant injury could present a significant hindrance to their capacity to fulfill their work requirements. Fortunately, two-thirds of the tennis-teaching professionals in this study were not significantly affected by their injuries to such a degree that their activities of daily living were limited.

^{||}References 4, 11, 12, 14-16, 24, 25, 27, 30-32.

TABLE 6
Severity of Most Severe Current Injury^a

	Injured Structure					P Value	Overall
	Bone	Joint or Ligament	Muscle or Tendon	Nerve	Don't Know		
VAS severity	4.7 ± 3.3	3.8 ± 2.9	3.3 ± 2.9	5.0 ± 3.1	2.4 ± 2.5	<.001	3.5 ± 3.0
Nirschl phase ^b						.002	
0	17 (7/42)	1 (2/175)	3 (5/175)	0 (0/22)	4 (3/71)		4 (17/485)
1	12 (5/42)	11 (20/175)	15 (26/175)	5 (1/22)	15 (11/71)		13 (63/485)
2	5 (2/42)	13 (23/175)	11 (19/175)	9 (2/22)	14 (10/71)		12 (56/485)
3	7 (3/42)	22 (39/175)	15 (26/175)	9 (2/22)	11 (8/71)		16 (78/485)
4	24 (10/42)	18 (31/175)	29 (50/175)	36 (8/22)	20 (14/71)		23 (113/485)
5	24 (10/42)	26 (45/175)	20 (35/175)	23 (5/22)	21 (15/71)		23 (110/485)
6	2 (1/42)	5 (9/175)	5 (8/175)	5 (1/22)	8 (6/71)		5 (25/485)
7	10 (4/42)	3 (6/175)	3 (6/175)	14 (3/22)	6 (4/71)		5 (23/485)
Time lost						<.001	
No time lost	21 (9/42)	37 (64/175)	38 (66/175)	23 (5/22)	55 (39/71)		38 (183/485)
Slight (0-23 hours)	7 (3/42)	14 (25/175)	25 (44/175)	14 (3/22)	25 (18/71)		19 (93/485)
Minimal (1-3 days)	10 (4/42)	9 (16/175)	6 (10/175)	5 (1/22)	6 (4/71)		7 (35/485)
Mild (4-7 days)	17 (7/42)	10 (17/175)	6 (11/175)	14 (3/22)	4 (3/71)		8 (41/485)
Moderate (8-28 days)	7 (3/42)	10 (17/175)	11 (20/175)	9 (2/22)	4 (3/71)		9 (45/485)
Severe (1-6 mo)	24 (10/42)	9 (16/175)	9 (15/175)	18 (4/22)	1 (1/71)		9 (46/485)
Long term (>6 mo)	14 (6/42)	11 (20/175)	5 (9/175)	18 (4/22)	4 (3/71)		9 (42/485)

^aData are presented as mean ± SD or % (n/total). VAS, visual analog scale.

^bNirschl Pain Phase Scale of Athletic Overuse Injuries¹⁸: phase 0 = no pain with activity. Phase 1 = stiffness or mild soreness after activity; pain usually gone within 24 hours. Phase 2 = stiffness or mild soreness before activity that is relieved by warm-up; symptoms not present during activity but return afterward, lasting up to 48 hours. Phase 3 = stiffness or mild soreness before specific sport or occupational activity; pain partially relieved by warm-up and is minimally present during activity but does not cause the athlete to alter activity. Phase 4 = similar to phase 3 pain but more intense, causing the athlete to alter performance of the activity; mild pain occurs with activities of daily living but does not cause a major change in them. Phase 5 = significant (moderate or greater) pain before, during, and after activity, causing alteration of activity; pain occurs with activities of daily living but does not cause a major change in them. Phase 6 = phase 5 pain that persists even with complete rest; pain disrupts simple activities of daily living and prohibits doing household chores. Phase 7 = phase 6 pain that also disrupts sleep consistently; pain is aching in nature and intensifies with activity.

TABLE 7
Odds of Dominant Side Injury

	Odds Ratio (95% CI)	P Value
Lower limbs	1.00 (—)	—
Trunk	1.63 (0.9-3.1)	.13
Upper limbs	17.15 (8.1-42.3)	<.001

It appears that overuse injuries due to inadequate rest may be the biggest contributing factor to injury in this population. This finding was consistent with similar findings in an epidemiologic study on musculoskeletal injuries in collegiate tennis athletes.⁵ The majority of the coaches reported teaching almost every day for greater than 2 hours per day. This presents an occupational risk directly linked to the nature of their profession. The American Medical Society for Sports Medicine recently published a statement on overuse injuries, stating that inadequate rest in athletes was common and led to overuse injuries.⁷ Limiting court time would seem to be the simple solution to this problem; however, it is complicated as it is evident that many of these tennis-teaching professionals rely on court time to provide their income. Limiting the amount of teaching past the point of fatigue is a more reasonable option that each coach could tailor to his or her individual physical condition.

TABLE 8
Injury Location Compared With Existing Literature^a

Study	Proportion of All Injuries, %		
	Upper Extremity	Lower Extremity	Trunk
Jayanthi et al ¹²	41	49	3
Kühne et al ¹⁵	25	64	11
Letsel Informatie Systeem ¹⁶	28	59	13
Steinbrück ²⁷	21	60	19
Weijermans et al ³¹	NR	67	NR
Hutchinson et al ¹¹	26	51	22
Winge et al ³²	45.7	39.0	11.0
Krause and Pöttinger ¹⁴	36.4	44.3	19.3
Chard and Lachmann ⁴	35	45	20
Reece et al ²⁵	20	59	21
von Krämer and Schmitz-Beuting ³⁰	47.5	31.1	16.6
Weighted average of existing studies	27.2	57.3	14.6
Current study	37	43	19

^aNR, not reported.

This study was subject to numerous limitations. As with all cross-sectional epidemiologic studies, this study could have suffered from selection bias. Despite the fact that a

significant portion of members voluntarily completed the survey, our study population could have been biased toward a more injured population, as a noninjured teaching professional would not be motivated to complete a study on current injuries. Another limitation in this study is the self-report of injury by the study participants. It is unknown whether the reported diagnosis was confirmed by a health care professional, which could potentially lead to mislabeled diagnoses. Furthermore, there was not a clearly defined classification of an injury (in accordance with the USPTA consensus statement), which could have led some participants to over- or underreport the presence of injury.

CONCLUSION

This study provides the USPTA, its members, and health care professionals with baseline data on demographics of tennis-teaching professionals and the prevalence of musculoskeletal conditions that could affect those involved in this occupation. In accordance with the guidelines set forth by the ITF in its 2009 consensus statement,²² the prevalence of musculoskeletal injuries among tennis-teaching professionals was 42%, most of which occurred to the lower extremities and soft tissues. The majority of tennis-teaching professionals were active in teaching at least 5 days per week and at least 2 hours per day, and the most commonly cited cause of injury was overuse. Most injuries were mild and resulted in fewer than 24 hours of teaching time lost.

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