Open Access Journal of Sports Medicine

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ORIGINAL RESEARCH

Prevalence of Hip Pain in Elite Badminton Players: Observational Study

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Purpose: To report the prevalence of hip pain in elite badminton players, describe their hip pathologies, and evaluate expectations regarding hip pain.

Patients and Methods: All badminton players registered at the national sports institute (Institut national du sport, de l'expertise et de la performance; INSEP) in France on 01/09/2023 were contacted by the medical team to complete a questionnaire comprising training information, prevalence of hip pain, and expectations regarding hip pain. The medical database was reviewed to identify all hip pathologies recorded.

Results: Of the 20 elite badminton players registered at the national sports institute (10 females and 10 males, aged 23.8±3.9 years), 9 (45%) reported experiencing hip pain while registered at the institute, 4 at their dominant side only and 5 bilaterally. Six players had cam-type femoroacetabular impingement (FAI), concomitant with coxofemoral chondropathy and/or muscle tears in 3 athletes (requiring femoroplasty in 3). Furthermore, 3 more players had coxofemoral chondropathy and/or muscle tears. Before playing badminton at a high-level, 12 (60%) thought that becoming elite players could cause joint pain; however, none (0%) thought that it would cause pain specifically at their hip joint.

Conclusion: Nine of 20 elite badminton players have experienced hip pain while registered at a national sports institute, with the most common hip pathologies being cam-type FAI (n=6; 30%) and muscle tears (n=4; 20%). Although before playing badminton at a high-level, none of the athletes thought that becoming an elite badminton player could cause pain specifically at the hip joint, at the time of the questionnaire, 19 athletes (95%) thought this was common. These findings could allow coaches and medical staff to align expectations regarding the likelihood of hip pain and hip pathologies in badminton players training at an elite level, by adjusting training regimens or implementing early screening.

Keywords: racquet sports, hip, femoroacetabular impingement, pathology

Introduction

Competitive athletes are increasingly experiencing hip and groin injuries,[1–5] which can lead to the development of hip pathologies. Hip pathologies may develop from traumatic injuries that result in fractures or tears, as well as from repetitive events, such as abnormal joint contact,[2,6–8] which can lead to femoroacetabular impingement (FAI). These pathologies can cause chronic pain that can hinder or even end professional careers.[9–12]

Several studies have investigated hip pathologies in athletes, and have found cam-type FAI to be one of the most common hip pathologies in this population, with prevalences as high as 70%.[13–16] There is minimal literature on hip pathologies in racket sports, although several studies have published on injuries in tennis players[17,18] and badminton athletes,[19–21] and found injuries in up to 50% of athletes.

Badminton is an asymmetric overhead racket sport, that requires continuous repetitions of high intensity jumps, landings, and changes of direction, which place high stresses and ranges of motion on the lower limbs.[22] Thus, badminton players may be prone to develop specific hip pathologies. A number of studies have investigated injuries in badminton players,[23–26] but none have focused on investigating hip pathologies in this population. Therefore, the purpose

Received: 2 April 2025
Accepted: 27 June 2025
Published: 23 July 2025

of the present study is to (i) report the prevalence of hip pain in elite badminton players currently registered at the national sports institute (Institut national du sport, de l'expertise et de la performance; INSEP) in France, (ii) describe their hip pathologies, and (iii) evaluate expectations regarding hip pain before and after becoming elite athletes.

Materials and Methods

All badminton players registered at the national sports institute (Institut national du sport, de l'expertise et de la performance; INSEP) in France in September 2023 were contacted by the medical team to complete a questionnaire consisting of six sections (Supplementary Appendix 1). The institute is a high-level training center for more than 700 top-level athletes in 24 sports, including badminton, and is dedicated to excellence in sports. All badminton players registered at the institute compete nationally and/or internationally. Furthermore, the medical database at the institute was retrospectively reviewed to identify all hip joint injuries and pathologies recorded by the medical team. Athletes provided informed consent for their data to be used for research and publication purposes, and research was carried out in accordance with the Declaration of Helsinki.

Data Analysis

Due to the small cohort size, only descriptive statistics were used to summarise the data. No sample size calculation was performed, as all badminton players currently registered were enrolled.

Results

In September 2023, there were 20 elite badminton players registered at a national sports institute (Figure 1), comprising 10 females and 10 males, with a mean age of 23.8±3.9 years (range, 18–31) and body mass index (BMI) of 22.8±1.7 kg/m^2 (range, 20–26) (Table 1). The right side was dominant for 19 of the 20 athletes (95%). The athletes had been playing badminton at a club for 16.9±4.0 years (range, 10–24) and played badminton for 18.7±4.0 hours per week (range, 8–25) while in good shape. The UCLA activity score was 10 for all 20 athletes. Their national ranking ranged from 1–36 (including both singles and doubles), while their international ranking ranged from 7–356 (including both singles and doubles).

Nine of the 20 athletes (45%) reported experiencing hip pain while registered at the institute, with 5 of these athletes (25%) currently experiencing hip pain at the time of the questionnaire (Table 1). Four athletes had hip pain at their dominant side only, while 5 had bilateral hip pain; interestingly, none had hip pain at their non-dominant side only (Table 2). The onset of pain was sudden in 4 athletes and incremental in 5. While hip pain was at maximum intensity, the

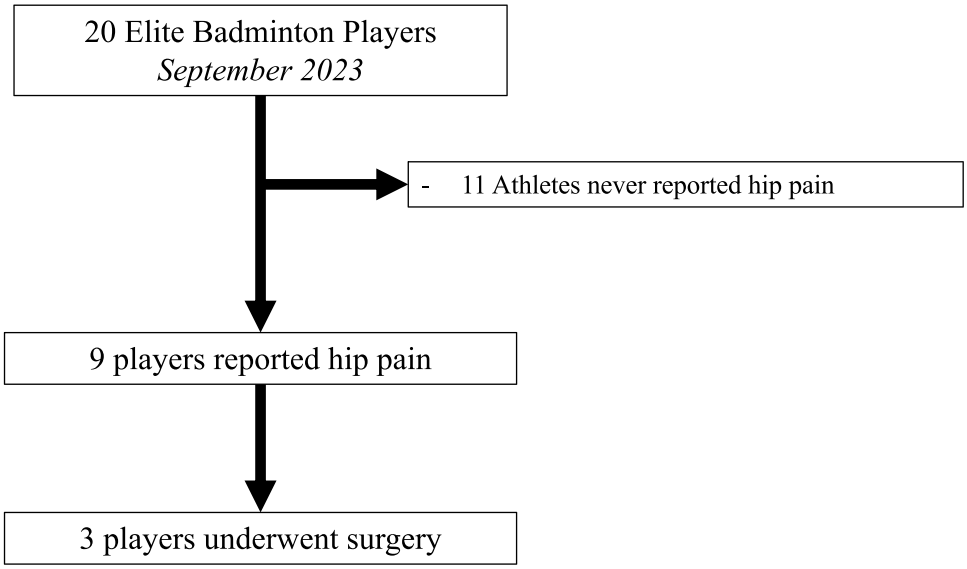

Figure 1 Flowchart of the study cohort.

Table 1 Demographics, Training Information, and Prevalence of Pain for Professional Badminton Players Registered at a National Sports Institute (n=20)

	Mean ± SD (Range)	Median (IQR)
	n (%)	
Age (years)	23.8 ± 3.9 (18–31)	23.5 (21–25)
Weight (kg)	71.0 ± 8.3 (58–92)	70.4 (66–75)
Height (m)	1.8 ± 0.1 (1.6–1.9)	1.8 (1.7–1.8)
Body mass index (kg/m^2)	22.8 ± 1.7 (20–26)	23 (22–23)
Female sex	10 (50.0%)	
Right dominant side	19 (95.0%)	
Participate in other sports	4 (20.0%)	
Years playing at a club	16.9 ± 4.0 (10–24)	16.5 (14–20)
Years registered at the national sports institute	4.7 ± 3.7 (0–11)	4.5 (2–7)
Hours per weeek playing badminton (when in good shape)	18.7 ± 4.0 (8–25)	20 (16–20)
Hours per weeek of physical preparation (when in good shape)	6.9 ± 2.1 (3–10)	6 (6–9)
National ranking - singles (n=4)	2.5 ± 1.3 (1–4)	3 (2–3)
National ranking - doubles* (n=14)	8.1 ± 11.7 (1–36)	3 (1–8)
International ranking - singles (n=4)	53.8 ± 15.3 (41–73)	51 (42–63)
International ranking - doubles* (n=15)	86.5 ± 82.8 (7–356)	78 (29–108)
Number of national (Interclubs) competitions per year (when in good shape)	9.8 ± 2.5 (5–16)	10 (9–10)
Number of national (Tournaments) competitions per year (when in good shape)	1.1 ± 0.4 (0–2)	1 (1–1)
Number of international competitions per year (when in good shape)	16.9 ± 4.5 (12–25)	15 (15–20)
Experienced hip pain before registering at the national sports institute	2 (10.0%)	
Experienced hip pain while registered at the national sports institute	9 (45.0%)	
Currently experiencing hip pain	5 (25.0%)	

Note: *Of note, ranking in doubles includes all categories (men's, women's, mixed).
Abbreviations: SD, standard deviation; n, number of athletes; IQR, interquartile range.

Table 2 Data for Badminton Players Experiencing Hip Pain While Registered at the National Sports Institute (n=9)

	Mean ± SD (Range)	Median (IQR)
	n (%)	
Painful side		
Dominant	4 (44.4%)	
Non-dominant	0 (0.0%)	
Bilateral	5 (55.6%)	

(*Continued*)

https://doi.org/10.2147/OAJSM.S527933

Table 2 (Continued).

	Mean ± SD (Range)	Median (IQR)
	n (%)	
Onset of hip pain		
Sudden*	4 (44.4%)	
Incremental	5 (55.6%)	
Maximum intensity of hip pain on VAS**		
At rest		
Dominant side	3.1 ± 3.7 (0.0–10.0)	1.0 (0.0–4.0)
Non-dominant side	0.7 ± 1.7 (0.0–5.0)	0.0 (0.0–0.0)
While performing ADL (excluding sports)		
Dominant side	2.9 ± 3.1 (0.0–10.0)	2.0 (2.0–3.0)
Non-dominant side	1.7 ± 1.8 (0.0–5.0)	2.0 (0.0–3.0)
While playing badminton		
Dominant side	5.8 ± 4.0 (0.0–10.0)	8.0 (3.0–8.0)
Non-dominant side	3.4 ± 4.4 (0.0–10.0)	0.0 (0.0–6.0)
Hip pain concomitant with		
Reduction in ROM at the hip	7 (77.8%)	
Night pain / morning stiffness at the hip	6 (66.7%)	
Cracking noises / sensations at the hip	6 (66.7%)	
Change in play due to hip pain		
Reduced the number of hours of play	3 (33.3%)	
Stop playing	3 (33.3%)	
No change	3 (33.3%)	
Hip pain affected quality of life	5 (55.6%)	

Note: *Only one athlete remembered the specific event that initiated hip pain. **The athletes that experienced no pain at the dominant side during badminton, experienced pain during activities of daily living, and viceversa.
Abbreviations: SD, standard deviation; n, number of athletes; IQR, interquartile range; VAS, visual analogue scale; ROM, range of motion; ADL, activities of daily living.

average pain on VAS while playing badminton was 5.8±4.0 (range, 0–10) at the dominant side and 3.4±4.4 (range, 0–10) at the non-dominant side. Hip pain was concomitant with reduction in range of motion in 7 athletes, night pain and/or morning stiffness in 6 athletes, and cracking and/or snapping at the hip in 6 athletes. Five athletes reported that their hip pain affected their quality of life. While hip pain was at maximum intensity, 3 athletes had to completely stop playing, 3 had to reduce the number of hours of play, and 3 had no change in their ability to play.

A review of the medical database revealed that, of the 9 athletes who reported experiencing hip pain, 6 had radiologically confirmed cam-type FAI, which was bilateral in 2, on the dominant side in 3, and on the non-dominant side in 1. Cam-type FAI was concomitant with coxofemoral chondropathy only in 2 athletes, and coxofemoral chondropathy and sartorius muscle tear in 1 athlete (Table 3). Regarding the 3 athletes without FAI, 1 had bilateral coxofemoral chondropathy with adductor magnus muscle tear and labral tear in the dominant side, another had coxofemoral chondropathy with adductor magnus muscle tear in the dominant side, and the other had gracilis muscle tear in the

Table 3 Hip Pathologies and Treatments for Badminton Players Experiencing Hip Pain While Registered at the National Sports Institute (n=9)

	Athlete 1	Athlete 2	Athlete 3	Athlete 4	Athlete 5	Athlete 6	Athlete 7	Athlete 8	Athlete 9
Age (years)	24	23	31	19	24	19	24	23	24
Body mass index (kg/m2)	22.2	22.6	20.7	22.6	25.0	20.4	23.2	25.9	26.0
Sex	M	M	F	M	M	M	M	F	F
Dominant side	Left	Right	Right	Right	Right	Right	Right	Right	Right
Painful side	Bilateral	Dominant	Bilateral	Bilateral	Dominant	Bilateral	Dominant	Dominant	Bilateral
Hip pathology									
FAI (Cam-type)	Non-dominant	Dominant		Bilateral	Dominant	Bilateral		Dominant	
Chondropathy		Dominant	Bilateral		Dominant		Dominant		
Muscle tear		Sartorius (dominant)	Adductor magnus (dominant)				Adductor magnus (dominant)		Adductor magnus (non-dominant) and gracilis (dominant)
Other	Adductor tendinopathy (dominant)		Labral tear (dominant)						
Treatment									
Physical rehabilitation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Training modification	Yes	Yes	Yes		Yes				Yes
NSAID	Yes		Yes		Yes			Yes	Yes
Pain killer					Yes				
Corticosteroid injection	Non-dominant				Dominant				
Hyaluronic acid injection					Dominant				
Arthroscopic femoroplasty	Non-dominant @ 19y	Dominant @ 22y			Dominant @ 22y				
Pain reduction following treatment									
Dominant side	0%	50%	100%	0%	95%	100%	100%	90%	100%
Non-dominant side	100%		100%	0%		100%			100%
Level following treatment*	Higher	Same	Lower	Same	Higher	Same	Higher	Same	Same
Hours of play following treatment*	More	Same	Less	Same	More	Same	More	Same	Same

Note: *Compared to before hip pain started.
Abbreviations: FAI, femoroacetabular impingement; NSAID, non-steroidal anti-inflammatory drugs M, male; F, female.

https://doi.org/10.2147/OAJSM.S527933

dominant side and adductor magnus tear in the non-dominant side. Physical rehabilitation was prescribed for all 9 athletes, training modification for 5, non-steroidal anti-inflammatory drug (NSAID) for 5, corticosteroid injection for 2, pain killers for 1, and hyaluronic acid injection for 1. Furthermore, 3 athletes underwent primary unilateral arthroscopic femoroplasty of the right hip for cam-type FAI.

Regarding the 3 athletes that underwent femoroplasty, 1 reported that hip pain at their operated side had reduced by 100% following surgery (Athlete #1), 1 reported it had reduced by 95% (Athlete #5), while 1 reported that it had reduced by 50% (Athlete #2). All 3 athletes were able to return to play badminton following femoroplasty, 2 athletes (Athletes #1 and #5) returned to play at a better level than before hip pain started and played more hours per week than before hip pain started, while 1 athlete (Athlete #2) returned to play at the same level and played the same number of hours per week than before hip pain started.

Before playing badminton at a high-level, 12 athletes (60%) thought that becoming an elite badminton player could cause joint pain; however, none (0%) thought that becoming an elite badminton player could cause pain specifically at the hip joint. Interestingly, at the time of the questionnaire, 19 athletes (95%) thought it was common for elite badminton players to have hip pain. Furthermore, 9 athletes (45%) were concerned that a hip pathology may affect their future career, and 9 (45%) were concerned that a hip pathology may affect their future quality of life.

Discussion

The most important finding of this study on hip pathologies in elite badminton players at a national sports institute was that 9 of the 20 athletes have experienced hip pain while registered at the institute. Furthermore, the most common hip pathologies were cam-type FAI (n=6; 30%), which required arthroscopic femoroplasty in 3 athletes, and muscle tears (n=4; 20%). Before playing badminton at a high-level, 12 athletes (60%) thought that becoming an elite badminton player could cause joint pain; however, none (0%) thought that becoming an elite badminton player could cause pain specifically at the hip joint. Interestingly, at the time of the questionnaire, 19 athletes (95%) thought it was common for elite badminton players to have hip pain. Finally, 9 athletes (45%) were concerned that a hip pathology may affect their future career, and 9 (45%) were concerned that it may affect their future quality of life. These findings could allow coaches and medical staff to align expectations regarding the likelihood of hip pain and hip pathologies in badminton players training at an elite level, by adjusting training regimens or implementing early screening. It is worth noting that as the study was performed on a small sample of elite badminton players, the findings are exploratory and should not be overgeneralized.

A study by Reeves et al[25] investigated the epidemiological incidence of injuries in badminton players between 2006 and 2011, and found that lower extremity injuries account for 44% of the total. Miyake et al[24] only investigated injured tournament-level athletes and found that most injuries occurred during practice compared to during matches. Finally, an older study by Yung et al[26] investigated the epidemiology of injuries in Hong Kong elite badminton athletes and found an injury incidence of 5.04 per 1000 player-hours. Furthermore, the study by Yung et al found that most injuries were strains, followed by sprains, and, interestingly, spinal facet injuries. Although these studies have reported on the injury incidence in badminton players, none of the published literature has focused on the type of hip pathologies in this specific patient population. The present study found that 6 athletes (30%) had cam-type FAI, of which 2 had bilateral, 3 had on their dominant side only, and 1 had on their non-dominant side only. Furthermore, FAI was sometimes concomitant with coxofemoral chondropathy, muscle tears, and adductor tendinopathy. Additionally, 2 athletes (20%) had coxofemoral chondropathy, in both cases with concomitant muscle tears, and 1 athlete (5%) had adductor magnus and gracilis muscle tears. It is interesting to note that most hip pathologies occurred in the dominant side, which is to be expected in an asymmetric sport such as badminton. Finally, footwear is one of the most important aspects that can be controlled by the athlete, and has demonstrated the improve badminton performance.[27–30]

Badminton is a fast-paced game where athletes need quick reaction times to anticipate the direction and speed of the shuttle, movements that are comparable to cutting in other sports. Besier et al[31] investigated the forces on the knee during badminton, and found some evidence that unanticipated movements result in greater varus/valgus and internal/external rotation moments at the knee compared to anticipated ones. Greater forces increase the strain through the joint which could amplify the potential for injury. Even though the study of Besier et al[31] was specifically on the knee, this could

imply that a similar effect would occur at the hip joint. Xie et al[32] investigated lower limb biomechanics, and found that the backhand lunge showed a larger internal rotation moment at the hip, while the forehand lunge revealed greater internal rotation moments at the hip. It is worth noting that the majority of studies focus on knee and ankle injuries or pathologies, and the authors believe that more research should focus on hip injuries and pathologies, as there is only minimal literature on this topic.

Hip and groin injuries are a recognised and important problem in competitive athletes, as they can lead to chronic pain that can hinder or even end professional careers.[9–12] A recent systematic review by Cruz et al[9] on National Collegiate Athletic Association (NCAA) athletes found that hip pain is highest in impingement-type sports such as ice hockey (97%), followed by contact sports, such as football and wrestling (60%). Cruz et al[9] also investigated asymmetric/overhead sports, which include tennis, baseball, softball and volleyball, and found a rate of hip injuries of 31%; however none of the included studies reported on badminton, which is an asymmetric sport.[24–30]

The most important question for elite athletes is when they can return to sport following an injury, and in the authors' opinion this is closely related to the timing of the treatment. In cases that require only an infiltration, there might be quick pain decrease which allows the athlete to return to play. However, in severe cases, hip pathologies in high-level athletes may require surgery. In the present study, 3 of the 9 athletes with hip pain required primary unilateral arthroscopic femoroplasty for cam-type FAI, after which all (100%) were able to return to play, 2 at a higher level and 1 at the same level. This data is promising, as it shows that the rate of return to play is high in this specific patient population. These findings are corroborated by a recent meta-analysis, which has shown that hip arthroscopy is a successful treatment for FAI, resulting in a high rate of postoperative patient satisfaction and an improvement in patient-reported outcomes, including pain, with a low rate of complications and reoperations.[33] Maldonado et al[34] investigated return to play after hip arthroscopy for the treatment of FAI with labral tears in tennis players, and found that 75% returned to play, most of which returned at the same or higher level. In a systematic review by Nicola et al[35] 87% of athletes with symptomatic FAI returned to their sport after hip arthroscopy, and 82% returned to preinjury level. Additionally, a more recent meta-analysis by Lovett-Carter et al[36] reported that 88% of athletes with symptomatic FAI returned to their sport after hip arthroscopy, and 85% returned to preinjury level. Furthermore, as preventing is better than treating, the use of screening could enhance preventive programs, as pathologies may be diagnosed at an earlier stage, before becoming symptomatic.

The results of this study should be interpreted with the following limitations in mind. First, athletes were asked retrospectively about their playing capabilities and hip pain, which may affect the accuracy of this data, resulting in athletes over- or under-estimating their pain scores. Second, the present study only considered the time frame while athletes were registered at the institute, and does not include any follow-up assessment. Third, the present study evaluated a small cohort of professional badminton players registered at a single elite institute at one time point, thus these findings cannot be generalised or extrapolated to badminton players at other institutes or the general population. Finally, due to the small cohort size, it was not possible to perform uni- and multi-variable analyses to identify which athlete characteristics could be risk factors for hip pain or hip pathologies.

Conclusion

Nine of 20 elite badminton players have experienced hip pain while registered at a national sports institute, with the most common hip pathologies being cam-type FAI (n=6; 30%) and muscle tears (n=4; 20%). Although before playing badminton at a high-level, none of the athletes thought that becoming an elite badminton player could cause pain specifically at the hip joint, at the time of the questionnaire, 19 athletes (95%) thought this was common. These findings could allow coaches and medical staff to align expectations regarding the likelihood of hip pain and hip pathologies in badminton players training at an elite level, by adjusting training regimens or implementing early screening.

Ethical Approval

Athletes provided informed consent for their data to be used for research and publication purposes. Review Board approval was obtained from "GCS Ramsay Santé pour l'Enseignement et la Recherche" (#COS-RGDS-2023-05-005-NOGIER-A).

Acknowledgments

The authors are grateful to Adrien Revault for his assistance with data collection and project management. This paper has been uploaded to ResearchSquare as a preprint: https://www.researchsquare.com/article/rs-4842945/v1.

Funding

Clinique Trenel provided funding for data analysis and manuscript writing.

Disclosure

None of the authors declare any conflict of interest in the authorship or publication of this contribution.

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