Evaluating Return to Sports Following Total Hip Arthoplasty With Custom Stems in Professional and Recreational Table Tennis Players

Cyril Courtin,* MD, Idriss Tourabaly,[†‡] MSc, MD, Ankitha Kumble,[§] BSc, Sonia Ramos-Pascual,[§] MEng, PhD, Elodie Baraduc,[‡] DC, Camille Rose,[‖] MD, Mo Saffarini,[§¶] MEng, MBA, and Alexis Nogier,*[†‡] MSc, MD
Investigation performed at Clinique Trénel, Sainte-Colombe, Auvergne-Rhône-Alpes, France

Background: Table tennis players execute short explosive movements, along with continuous hip flexion, abduction, and rotation, increasing their risk of injury. Previous studies reported a rate of return to sports (RTS) of 20% to 80% in athletes following total hip arthroplasty (THA). There are no studies reporting RTS in table tennis players following THA.

Purpose: To evaluate the clinical outcomes and RTS following custom THA in professional, ex-professional, and recreational table tennis players.

Study design: Case series; Level of evidence, 4.

Methods: Patients who underwent primary THA between April 2013 and January 2022 were retrospectively reviewed (n = 2977). Table tennis players of any level that received a custom femoral stem were included in the study (N = 17). At a minimum follow-up of 2 years, all players were assessed using the Oxford Hip Score (OHS), Forgotten Joint Score (FJS), and the University of California Los Angeles (UCLA) activity score, as well as with a sports-specific questionnaire that included questions related to their table tennis practice. Descriptive statistics, including medians and interquartile ranges, were used to summarize the data.

Results: All 17 players (22 hips) were available at $\geq$2 years, of which 3 were professional (5 hips), 4 were ex-professional (6 hips), and 10 were recreational (11 hips). The median OHS was 44.0 (IQR, 44.0-48.0) in professional, 48.0 (IQR, 48.0-48.0) in ex-professional, and 48.0 (IQR, 45.0-48.0) in recreational players. The median FJS was 92.0 (IQR, 88.0-98.0) in professional, 98.0 (IQR, 98.0-98.0) in ex-professional, and 100.0 (IQR, 93.0-100.0) in recreational players. The median UCLA activity score was 10.0 (IQR, 9.0-10.0) in professional, 9.0 (IQR, 9.0-9.8) in ex-professional, and 8.0 (IQR, 5.5-9.0) in recreational players. The rate of RTS was 100% for professional and ex-professional players, and 80% for recreational players. The hours played before onset of symptoms was higher than following surgery for professional (30.0 [IQR, 25.0-30.0] vs 20.0 [IQR, 16.0-22.5] h/week) and ex-professional players (19.5 [IQR, 11.0-29.3] vs 3.0 [IQR, 2.0-5.5] h/week), while it was constant for recreational players (4.0 [IQR, 2.3-4.0] vs 4.0 [IQR, 3.8-4.5] h/week).

Conclusion: Our retrospective analysis demonstrated that at a minimum follow-up of 2 years THA using custom stems provided good to excellent clinical outcomes in professional, ex-professional, and recreational table tennis players. All professional and ex-professional players, as well as 80% of recreational players, were able to return to play table tennis, although both professional and ex-professional players reduced their number of hours of play compared with before surgery. These findings could be used to help set expectations for table tennis players who are scheduled to undergo THA.

Keywords: hip replacement; return to sports; table tennis; professional player; total hip arthroplasty; athlete

High-level athletes often start their career at a young age and must perform repetitive movements to progress.[25,41] More specifically, table tennis players frequently execute short explosive movements,[29] in addition to continuous hip flexion, abduction, and rotation. This results in high

The Orthopaedic Journal of Sports Medicine, 13(3), 23259671241311604
DOI: 10.1177/23259671241311604

strains applied on their lower limb joints, which can lead to hip and groin injuries.[19,56]

The incidence of hip and groin injuries has been reported to vary between 5% and 72% in athletes that play soccer, hockey, rugby, and cycling,[9,15,18,26,42,43,49] which may result in various hip pathologies, such as femoroacetabular impingement (FAI). The incidence of FAI in athletes ranges from 17% to 79%.[5,7,23,52] Furthermore, FAI may lead to secondary osteoarthritis (OA),[1,17] which could require surgical interventions, such as total hip arthroplasty (THA).

A recent systematic review showed a pooled proportion of return to sports (RTS) following THA of 56% (range, 20%-80%) in athletes that practiced high-intensity sports including hiking, running, tennis, and skiing,[40] although none of the included studies reported on table tennis players. Another systematic review[47] found that return to table tennis following THA was considered safe in one of the included studies,[51] but was allowed only with experience in another included study.[10]

There are no studies reporting outcomes of custom THA in table tennis players. Therefore, the purpose of the present study was to evaluate the clinical outcomes and RTS following THA in professional, ex-professional, and recreational table tennis players at a minimum follow-up of 2 years. Our null hypothesis was that there would be no differences in RTS across the 3 groups.

METHODS

Study Design and Participants

All patients that underwent primary THA between April 2013 and January 2022 by 1 of 2 surgeons (A.N. and I.T.) were retrospectively reviewed (n = 2977). Patients that played table tennis at any level before surgery and received a custom (also termed individualized) femoral stem were included in the present study (N = 17). None of the patients had previous hip surgeries (arthroscopy, osteotomy, or arthroplasty). All custom stems were metaphyseal-engaging, conventional length, made of titanium alloy, and coated with hydroxyapatite in the proximal two-thirds. The surgeons systematically implanted custom stems in active patients to restore both the intra- and the extra- medullary femoral architecture, including reproducing the native femoral offset and anteversion, which has been shown to provide excellent clinical outcomes and high rates of RTS in athletic populations (Figure 1).[35,36,53] One recreational player had surgery via the lateral approach because the patient had a gluteal muscle enthesopathy and required reattachment of the gluteal muscles. All other players had surgery via direct anterior approach (modified Hueter).[44] Immediately after surgery, partial weightbearing with the use of crutches was allowed. Within the first 4 weeks, passive rehabilitation was started progressively. After 4 to 6 weeks, active progressive weightbearing rehabilitation was started, and after 8 weeks, functional training specific to table tennis could be initiated. All patients provided informed consent for their data to be used for research and publication purposes, and institutional review board approval was obtained.

Definitions

Professional players were defined as table tennis players who competed at national and/or international competitions prior to THA. Ex-professional players were defined as table tennis players that had retired from competing at national and/or international competitions but were coaches or playing recreationally before THA. Recreational players were defined as table tennis players who did not compete at national and/or international competitions before THA, but practiced the sport $\geq$2 hours per week, before the onset of symptoms.

Postoperative Assessment

At a minimum follow-up of 2 years, all players were assessed using the Oxford Hip Score (OHS),[13] Forgotten Joint Score (FJS),[27] 12-item Short Form Health Survey (SF-12) Quality of Life subscore,[16] and University of California Los Angeles (UCLA) activity score[57] per operated hip, as well as with a sports-specific questionnaire that included questions related to their table tennis practice per player (see Supplemental Material Figure S1, available separately).

Statistical Analysis

Descriptive statistics were used to summarize the data. Due to the small cohort size, continuous variables were presented as medians and interquartile ranges, while categorical variables were presented as proportions. Comparisons between groups were not conducted due to the small cohort size. Statistical analyses were conducted using R Version 4.3.1 (R Foundation for Statistical Computing).

¶Address correspondence to Mo Saffarini, MEng, MBA, ReSurg SA, Rue Saint-Jean 22, Nyon, Vaud 1260, Switzerland. (email: journals@resurg.com).
*Service de Chirurgie Orthopédique, Clinique Trenel, Sainte-Colombe, Auvergne-Rhône-Alpes, France.
†Service de Chirurgie Orthopédique, Clinique Maussins-Nollet, Ramsay Santé, Paris, Île-de-France, France.
‡Clinique Nollet, Paris, Île-de-France, France.
§ReSurg SA, Nyon, Vaud, Switzerland.
‖Institut National du Sport de l'Expertise et de la Performance, Paris, Île-de-France, France.
Final revision submitted August 6, 2024; accepted August 30, 2024.
One or more of the authors has declared the following potential conflict of interest or source of funding: Clinique Trenel provided funding for manuscript writing and data analysis. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.
Ethical approval for this study was obtained from Ramsay Sante (IRB No. 00010835).

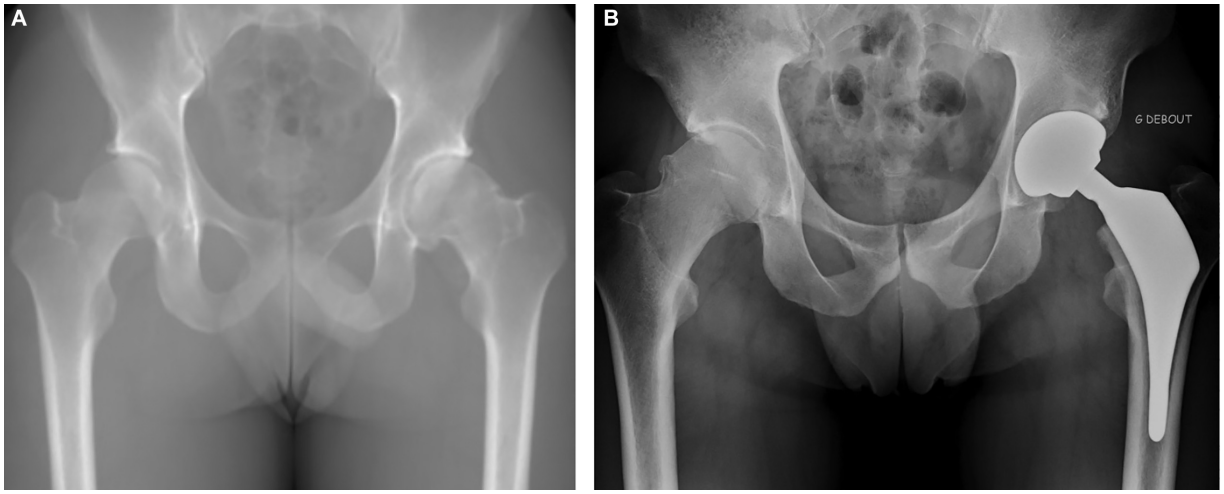

Figure 1. Preoperative (A) and postoperative (B) pelvic radiographs of a professional male table tennis player, aged 26 years.

RESULTS

Patient Characteristics

Seventeen table tennis players (22 hips) were included in the study, of which 3 were professional (5 hips), 4 were ex-professional (6 hips), and 10 were recreational (11 hips). The proportion of male patients was 100% in professional players, 67% in ex-professional players, and 73% in recreational players (Table 1). The median age was considerably lower for professional players (median, 25.8; IQR, 23.3-42.9), compared with ex-professional (median, 47.3; IQR, 45.2-57.0) and recreational players (median, 57.3; IQR, 53.7-62.7). The most common indication for THA was secondary OA due to dysplasia for professional players (60%), and primary OA for ex-professional (83%) and recreational (73%) players.

Preoperative Data

The median waiting period between the onset of symptoms and surgery was 24.0 months (IQR, 24.0-60.0) in professional, 66.0 months (IQR, 33.0-96.0) in ex-professional, and 18.0 months (IQR, 10.5-33.0) in recreational players (Table 2). The number of hours of play before surgery was partially or completely reduced in all 3 of 3 (100%) professional players, 4 of 4 (100%) ex-professional players, and 6 of 10 (60%) recreational players.

Postoperative Assessment

All 17 table tennis players were available at a minimum follow-up of 24 months. The OHS tended to be lower in professional players (median, 44.0; IQR, 44.0-48.0) compared with ex-professional (median, 48.0; IQR, 48.0-48.0) and recreational (median, 48.0; IQR, 45.0-48.0) players (Table 3). The FJS tended to be lower in professional players (median, 92.0; IQR, 88.0-98.0), compared with ex-professional (median, 98.0; IQR, 98.0-98.0) and recreational (median, 100.0; IQR, 93.0-100.0) players. The SF-12 Physical component was higher in professional (median, 90.0; IQR, 70.0-95.0) and ex-professional (median, 95.0; IQR, 91.3-95.0) players compared with recreational (median, 70.0; IQR, 47.5-92.0) players. The SF-12 Mental component tended to be lower for professional (median, 83.3; IQR, 70.8-87.5) and recreational (median, 79.2; IQR, 75.0-93.8) players compared with ex-professional (median, 91.7; IQR, 76.0-91.7) players. The UCLA activity score tended to be higher in professional (median, 10.0; IQR, 9.0-10.0) players compared with ex-professional (median, 9.0; IQR, 9.0-9.8) and recreational (median, 8.0; IQR, 5.5-9.0) players. Satisfaction with surgery tended to be lower in professional (median, 9.0 points; IQR, 8.0-9.5) players compared with ex-professional (median, 10.0 points; IQR, 9.8-10.0) and recreational (median, 10.0 points; IQR, 10.0-10.0) players (Table 2).

Professional players reported slight pain on visual analog scale in the operated hip (1.0; IQR, 0.5-1.5) and the spine (1.0; IQR, 0.5-2.0), ex-professional players reported slight pain in the spine (1.0; IQR, 0.0-2.5), and recreational players reported slight pain in the spine (1.5; IQR, 0.0-4.5) and left knee (2.0; IQR, 0.0-2.8) (Table 2).

Return to Sports

The proportion of players who returned to play table tennis was 100% (n = 3) in the professional group, 100% (n = 4) in the ex-professional group, and 80% (n = 8) in the recreational group (Table 2). Of note, all bilateral patients returned to sports, and they were able to RTS between their 2 surgeries.

Of the 3 professional players who returned to table tennis, all (100%) resumed playing at a professional level, though only 1 (33%) was at his best level since surgery. Two (67%) professional players reported that the time taken to reach best level following surgery was “shorter than expected” or “as expected,” and these same players

TABLE 1
Characteristics and Surgical Data for Hips in Initial Cohort (n = 22)[a]

	Professional (n = 5 hips)		Ex-Professional (n = 6 hips)[b]		Recreational (n = 11 hips)	
Age, y	25.8	(23.3-42.9)	47.3	(45.2-57.0)	57.3	(53.7-62.7)
BMI, kg/m^2	22.9	(21.7-25.2)	26.1	(24.0-26.8)	25.4	(24.7-28.7)
Sex, male	5	(100)	4	(67)	8	(73)
Bilateral	2	(40)	2	(33)	1	(9)
Etiology						
Primary OA			5	(83)	8	(73)
Secondary OA due to dysplasia	3	(60)			2	(18)
Secondary OA due to dysplasia and FAI	1	(20)	1	(17)		
Severe chondropathy with dysplasia	1	(20)				
Avascular necrosis					1	(9)
Dysplastic acetabular morphology	3	(60)			1	(9)
Acetabular cup diameter						
46-48			3	(50)	4	(36)
50-52	2	(40)	3	(50)	5	(45)
54-56	3	(60)			2	(18)
Femoral head diameter						
28 M					1	(9)
32 M			2	(33)	5	(45)
36 M	5	(100)	4	(67)	5	(45)

[a]Data are presented as median (IQR) or n (%). BMI, body mass index; FAI, femoral acetabular impingement; M, medium offset; OA, osteoarthritis.
[b]Five of the 6 hips belonged to ex-professional players who were table tennis coaches.

TABLE 2
Table Tennis Questionnaire for Each Player in the Final Cohort (N = 17)[a]

	Professional (n = 3 players)		Ex-Professional (n = 4 players)[b]		Recreational (n = 10 players)	
Time between onset of symptoms and surgery, mo	24.0	(24.0-60.0)	66.0	(33.0-96.0)	18.0	(10.5-33.0)
Years played before surgery	15.0	(12.5-23.5)	38.0	(34.8-41.8)	14.0	(6.5-37.5)
Hours played per week before onset of symptoms	30.0	(25.0-30.0)	19.5	(11.0-29.3)	4.0	(2.3-4.0)
In the waiting period immediately before surgery, were you able to play table tennis at your usual pace?						
Yes, there was no change in my ability to play	0	(0)	0	(0)	4	(40)
No, I had to reduce my pace/number of hours of play	3	(100)	1	(25)	4	(40)
No, I had to completely stop playing	0	(0)	3	(75)	2	(20)
Return to play table tennis following surgery	3	(100)	4	(100)	8	(80)
Pain on VAS (0, no pain; 10, extreme pain)						
Right hip	1.0	(0.5-1.5)	0.0	(0.0-0.3)	0.0	(0.0-1.0)
Left hip	1.0	(0.5-1.5)	0.0	(0.0-0.0)	0.0	(0.0-0.0)
Spine	1.0	(0.5-2.0)	1.0	(0.0-2.5)	1.5	(0.0-4.5)
Right knee	0.0	(0.0-2.0)	0.0	(0.0-0.3)	0.0	(0.0-2.3)
Left knee	0.0	(0.0-0.5)	0.0	(0.0-0.3)	2.0	(0.0-2.8)
Right ankle	0.0	(0.0-1.5)	0.0	(0.0-0.3)	0.0	(0.0-0.0)
Left ankle	0.0	(0.0-0.0)	0.0	(0.0-0.0)	0.0	(0.0-0.0)
Right foot	0.0	(0.0-1.5)	0.0	(0.0-0.0)	0.0	(0.0-0.0)
Left foot	0.0	(0.0-1.0)	0.0	(0.0-0.0)	0.0	(0.0-0.0)
Satisfaction with surgery (1, not at all satisfied; 10, extremely satisfied)	9.0	(8.0-9.5)	10.0	(9.8-10.0)	10.0	(10.0-10.0)

[a]Data are presented as median (IQR) or n (%). VAS, visual analog scale.
[b]Three of the 4 ex-professional players were table tennis coaches.

TABLE 3
Clinical Outcomes for Hips in Final Cohort (n = 22)[a]

	Professional (n = 5 hips)		Ex-Professional (n = 6 hips)[b]		Recreational (n = 11 hips)	
Follow-up, y	4.9	(3.4-5.4)	6.2	(4.6-8.4)	6.0	(3.9-7.7)
OHS	44.0	(44.0-48.0)	48.0	(48.0-48.0)	48.0	(45.0-48.0)
FJS	92.0	(88.0-98.0)	98.0	(98.0-98.0)	100.0	(93.0-100.0)
SF-12 Physical	90.0	(70.0-95.0)	95.0	(91.3-95.0)	70.0	(47.5-92.5)
SF-12 Mental	83.3	(70.8-87.5)	91.7	(76.0-91.7)	79.2	(75.0-93.8)
UCLA activity score	10.0	(9.0-10.0)	9.0	(9.0-9.8)	8.0	(5.5-9.0)

[a]Data are presented as median (IQR). One patient had an SF-12 Physical component of 20 and a UCLA score of 2.0 because of an issue with the knee. This patient had an OHS of 48 and FJS of 100. FJS, Forgotten Joint Score; OHS, Oxford Hip Score; SF-12, 12-item Short Form Health Survey; UCLA, University of California Los Angeles.
[b]Five of the 6 ex-professional players were table tennis coaches.

TABLE 4
Players that Returned to Play Table Tennis Following Surgery (n = 15)

	Professional (n = 3 players)		Ex-Professional (n = 4 players)[a]		Recreational (n = 8 players)	
After surgery, you were able to resume playing table tennis …						
Recreationally			3	(75)	7	(88)
Professionally	3	(100)			1	(13)
Recreationally and as a coach			1	(25)		
Are you currently at your best level since surgery?						
Yes	1	(33)	1	(25)	7	(88)
No	2	(67)	3	(75)	1	(13)
After surgery, the time it took you to reach your best level was…						
Much shorter/faster than expected	1	(33)			2	(25)
Somewhat shorter/faster than expected					1	(13)
As expected	1	(33)	3	(75)	5	(63)
Somewhat longer/slower than expected	1	(33)	1	(25)		
Your best level is/was…						
Much better/higher than expected					1	(13)
Somewhat better/higher than expected	1	(33)			1	(13)
As expected	1	(33)	4	(100)	4	(50)
Somewhat worse/lower than expected	1	(33)			2	(25)
Time to return to best level of table tennis postoperatively, mo	15.0	(8.5-16.5)	11.0	(10.5-11.5)	4.5	(3.0-6.0)
Hours per week played when at best level postoperatively, hr	20.0	(16.0-22.5)	3.0	(2.0-5.5)	4.0	(3.8-4.5)

[a]Data are presented as median (IQR) or n (%). Three of the 4 ex-professional players were table tennis coaches.

reported the best level achieved was "somewhat better than expected" or "as expected." For the 3 professional players, the time taken to reach the player's best level following surgery was 15.0 months (IQR, 8.5-16.5) (Table 4). Furthermore, the hours played before onset of symptoms was greater than following surgery (30.0 vs 20.0 hours/week) (Tables 2 and 4).

Of the 4 ex-professional players who returned to table tennis, all (100%) resumed playing at a recreational level, with only 1 (25%) at best level since surgery, and another (25%) also returning as a coach. Three (75%) ex-professional players reported that the time taken to reach their best level following surgery was "as expected" and all 4 (100%) reported their best level achieved was "as expected." The time taken to reach their best level following surgery was 11.0 months (IQR, 10.5-11.5). Furthermore, the hours played before onset of symptoms was lower than following surgery (19.5 vs 3.0 hours/week) (Table 4).

Of the 8 recreational players who returned to sports, 1 (13%) resumed playing as a professional and 7 (88%) were at their best level since surgery. All eight (100%) recreational players reported that the time taken to reach their best level following surgery was "shorter than expected" or "as expected" and 6 (75%) reported their

best level achieved was "better than expected" or "as expected." The time taken to reach their best level following surgery was 4.5 months (IQR, 3.0-6.0). Furthermore, the hours played before onset of symptoms was the same as following surgery (4.0 vs 4.0 h/week) (Table 4). Of note, professional players (median, 25.8; IQR, 23.3-42.9) were considerably younger than ex-professional (median, 47.3; IQR, 45.2-57.0) and recreational players (median, 57.3; IQR, 53.7-62.7) (Table 1), which may have affected their ability to RTS.

DISCUSSION

The most important findings of the present study were that THA using custom stems provided good to excellent short-term clinical outcomes in table tennis players, regardless of their level. Furthermore, all professional and ex-professional players, as well as 80% of recreational players, were able to return to play table tennis following THA, although both professional and ex-professional players reduced their number of hours of play compared with before surgery, thus only partially confirming our null hypothesis. These findings could be used to help set expectations for table tennis players that are scheduled to undergo THA with custom stems.

Several studies[11,21,30,34,54] have reported on RTS following THA in professional and recreational players; however, none has focused on table tennis players. A systematic review reporting on sports participation following THA pooled data from 14 studies that included players of various levels and sports and found that RTS to presymptomatic level was 82%.[40] The systematic review also reported a tendency for patients to shift from high-impact sports to low-impact sports following THA.[20] Another systematic review summarizing athletic activity following THA in patients who participated in sports such as swimming, skiing, and biking at various levels found an RTS rate ranging from 54% to 98%.[22] Last, a systematic review reporting on RTS following THA in 250 golfers found that the rate of return to golf was 90% at a mean time of 4.5 months.[45] The present study reported an RTS rate in the high end of those in previous publications, with all (100%) professional and ex-professional players returning to table tennis and 80% of recreational players returning to table tennis.

Interestingly, a recent survey of 510 European Hip Society members revealed that 65% of surgeons allowed unrestricted table tennis participation between 3 and 6 months following THA, 19% of surgeons allowed table tennis participation with experience, 10% did not allow it, and 6% had no opinion.[48] The consensus of the survey stated that table tennis should be allowed at 3 months following THA. The authors of the present study believe that return to table tennis can be allowed without restriction at 3 months following THA, if the 3-dimensional architecture of the hip has been accurately restored by the implants.

Navas et al[34] found that athletes significantly increased the number of sports sessions per week following THA compared with before the onset of symptoms (3 days/week vs 1 day/week; $P < .0001$). Additionally, they reported a significant increase in the minimum session length following THA compared with before the onset of symptoms (82 ± 40.8 minutes vs 23 ± 31.6 minutes; $P < .0001$).[34] In contrast, the present study found that professional and ex-professional players reduced the number of hours played per week following THA compared with before THA (professional players, 20 vs 30 h/week; ex-professional players, 3.0 vs 19.5 h/week), while the number of hours played per week stayed constant for recreational players (4.0 vs 4.0 h/week). This could be due to professional and ex-professional players' nearing the end of their career or due to their older age. Nonetheless, all players in the present study were very satisfied with surgery (range, 8.0-10.0 points). Furthermore, 5[4,6,24,30,33] of the 37 studies included in the systematic review by Hoorntje et al[20] reported that time to RTS ranged from 4 to 7 months, while the present study reported a similar median time to return to best level of 4.5 months in recreational players, but a higher median time to return to their best level of 15 and 11 months, respectively, in professional and ex-professional players. Of note, the present study only recorded the time it took for players to return to their best level of play, and not the time it took for players to RTS. Additionally, the time to return to best level of play may have been higher for professional players, due to the high volume of hours and intensity of play. It is also important to note that all professional and ex-professional players returned to play, while only 80% of recreational players returned to play.

A study investigating sports activity following THA with short stems in 68 patients who participated in high-, intermediate-, and low-impact sports found that at a mean follow-up of 2.7 years, the UCLA activity score was 7.6 ± 1.9.[46] Another study reporting on outcomes and sports activity following THA in 36 patients <40 years old found that at a follow-up of 3.9 ± 1.3 years, UCLA activity score was 7.6 ± 1.5 and modified Harris Hip Score was 92.6 ± 12.3.[34] The present study found that at a minimum follow-up of 2 years, median UCLA activity scores were 10.0 in professional, 9.0 in ex-professional, and 8.0 in recreational table tennis players. Additionally, FJS (median, 92-100) and OHS (median, 44-48) scores were good to excellent following THA, regardless of player level.

Twenty of the 22 hips included in the present study underwent THA for primary or secondary OA. Of these, 5 table tennis players presented with secondary OA due to dysplasia, while 2 presented with secondary OA due to dysplasia and FAI. An alternative treatment for dysplasia is periacetabular osteotomy (PAO)[2,8]; however, PAO is not recommended in cases with OA.[39] A recent systematic review on outcomes of PAO in competitive athletes found that postoperative sports participation ranged from 63.7% to 85.7% in low-impact sports, 4.3% to 25.4% in moderate impact sports, and 5.1% to 10.8% in high-impact sports, and time to RTS ranged from 8.8 to 12.8 months.[12] An alternative treatment for FAI is hip arthroscopy[14]; however, arthroscopy is not recommended in cases with OA.[3,28,31] A systematic review on RTS following hip arthroscopy in patients participating in various sports such as football, rowing, biking, and swimming reported

a pooled rate of RTS to the patients' preoperative level of 82% at 5.7 months.[32] Although arthroscopy can provide good outcomes in patients with FAI, it should not be performed on patients with severe dysplasia.[38,50,55]

All players in the present study underwent THA with custom stems, which allows accurate restoration of the native hip anatomy, including femoral anteversion, femoral offset, and limb length.[37] A recent systematic review[37] has shown that custom stems grant good clinical outcomes, low complication rates, and excellent survival. Additionally, custom stems have been shown to provide excellent clinical outcomes and high rates of RTS in athletic populations, such as ballet dancers.[35,36,53] We believe that when custom stems are implanted by a minimally invasive muscle-sparing direct anterior approach, they can provide the best outcomes in high-demanding athletic patients, such as table tennis players, because this combination can allow optimal balance of the muscles through restoration of the extramedullary anatomy. Furthermore, it could be interesting to compare outcomes and rate of RTS of robotic-assisted THA versus manual THA.

Limitations

The present retrospective study has several limitations. First, the cohort size was small, as it focused only on table tennis players who underwent THA. In addition, all patients were operated on by 1 of 2 experienced orthopaedic surgeons; thus, outcomes may not have been generalizable to any surgeon. Furthermore, post hoc comparison tests between groups were not performed due to the limited cohort size. Second, the present study reported only short-term outcomes, and it is therefore not possible to extrapolate these results to the long term. Third, 29% of the cohort underwent bilateral THA, which could have influenced the mean age of the cohort and clinical outcomes. Additionally, the presence of bilateral THA further reduces the size of the cohort; hence, further studies on larger cohorts are needed to confirm these findings. Fourth, the present study only recorded the time it took for players to return to their best level of play, and not the time it took for players simply to return to play, which makes it more difficult to compare with other studies in the literature. Fifth, there was no comparative group of table tennis players who underwent surgery with off-the-shelf stems or using another surgical approach.

CONCLUSION

Our retrospective analysis demonstrated that at a minimum follow-up of 2 years, THA using custom stems provided good to excellent clinical outcomes in professional, ex-professional, and recreational table tennis players. All professional and ex-professional players, as well as 80% of recreational players, were able to return to play table tennis; although both professional and ex-professional players reduced their number of hours of play compared with before surgery. These findings could be used to help set expectations for table tennis players who are scheduled to undergo THA.

Supplemental material for this article is available at https://journals.sagepub.com/doi/full/10.1177/23259671241311604#supplementary-materials

REFERENCES

1. Agricola R, Heijboer MP, Ginai AZ, et al. A cam deformity is gradually acquired during skeletal maturation in adolescent and young male soccer players: a prospective study with minimum 2-year follow-up. *Am J Sports Med*. 2014;42(4):798-806.
2. Alrashdi NZ, Motl RW, Aguiar EJ, Ryan MK, Perumean-Chaney SE, Ithurburn MP. Mobility-related outcomes for periacetabular osteotomy in persons with acetabular dysplasia: setting the stage for measurement of real-world outcomes. *J Hip Preserv Surg*. 2021;8(4):367-381.
3. Arakawa H, Kobayashi N, Kamono E, et al. Prior hip arthroscopy increases the risk of dislocation, reoperation, and revision after hip arthroplasty: an updated meta-analysis and systematic review. *J Orthop Sci*. 2024;29(1):157-164.
4. Arbuthnot JE, McNicholas MJ, Dashti H, Hadden WA. Total hip arthroplasty and the golfer: a study of participation and performance before and after surgery for osteoarthritis. *J Arthroplasty*. 2007;22(4):549-552.
5. Arriaza R, Saavedra-García M, Arriaza A, et al. Prevalence of hip femoroacetabular impingement deformities in high-level (La Liga) male professional football players. *BMC Musculoskelet Disord*. 2024;25(1):166.
6. Atkinson HD, Bailey CA, Willis-Owen CA, Oakeshott RD. Bilateral hip arthroplasty: is 1-week staging the optimum strategy? *J Orthop Surg Res*. 2010;5:84.
7. Ayeni OR, Banga K, Bhandari M, et al. Femoroacetabular impingement in elite ice hockey players. *Knee Surg Sports Traumatol Arthrosc*. 2014;22(4):920-925.
8. Beck EC, Gowd AK, Paul K, et al. Pelvic osteotomies for acetabular dysplasia: Are there outcomes, survivorship and complication differences between different osteotomy techniques? *J Hip Preserv Surg*. 2020;7(4):764-776.
9. Chen AW, Craig MJ, Mu BH, et al. Return to basketball after hip arthroscopy: minimum 2-year follow-up. *Arthroscopy*. 2019;35(10):2834-2844.
10. Clifford PE, Mallon WJ. Sports after total joint replacement. *Clin Sports Med*. 2005;24(1):175-186.
11. Cowie JG, Turnbull GS, Ker AM, Breusch SJ. Return to work and sports after total hip replacement. *Arch Orthop Trauma Surg*. 2013;133(5):695-700.
12. Curley AJ, Padmanabhan S, Chishti Z, Parsa A, Jimenez AE, Domb BG. Periacetabular osteotomy in athletes with symptomatic hip dysplasia allows for participation in low-, moderate-, and high-impact sports, with greater than 70% return to sport for competitive athletes: a systematic review. *Arthroscopy*. 2023;39(3):868-880.
13. Delaunay C, Epinette J-A, Dawson J, Murray D, Jolles BM. Validation de la version française du score de hanche Oxford12. *Rev Chir Orthop Traumatol*. 2009;95:107-116.
14. Dukas AG, Gupta AS, Peters CL, Aoki SK. Surgical treatment for FAI: arthroscopic and open techniques for osteoplasty. *Curr Rev Musculoskelet Med*. 2019;12(3):281-290.
15. Edouard P, Dandrieux PE, Hollander K, Zyskowski M. Injuries and illnesses at the Munich 2022 European Championships: a prospective study of 5419 athletes from 52 countries involved in 9 sports. *BMJ Open Sport Exerc Med*. 2024;10(1):e001737.
16. Gandek B, Ware JE, Aaronson NK, et al. Cross-validation of item selection and scoring for the SF-12 Health Survey in nine countries: results from the IQOLA Project. International Quality of Life Assessment. *J Clin Epidemiol*. 1998;51(11):1171-1178.
17. Ganz R, Parvizi J, Beck M, Leunig M, Nötzli H., Siebenrock KA. Femoroacetabular impingement: a cause for osteoarthritis of the hip. *Clin Orthop Relat Res*. 2003;417:112-120.

18. Gerhardt MB, Romero AA, Silvers HJ, Harris DJ, Watanabe D, Mandelbaum BR. The prevalence of radiographic hip abnormalities in elite soccer players. *Am J Sports Med*. 2012;40(3):584-588.
19. Giordano BD. Assessment and treatment of hip pain in the adolescent athlete. *Pediatr Clin North Am*. 2014;61(6):1137-1154.
20. Hoorntje A, Janssen KY, Bolder SBT, et al. The effect of total hip arthroplasty on sports and work participation: a systematic review and meta-analysis. *Sports Med*. 2018;48(7):1695-1726.
21. Innmann MM, Weiss S, Andreas F, Merle C, Streit MR. Sports and physical activity after cementless total hip arthroplasty with a minimum follow-up of 10 years. *Scand J Med Sci Sports*. 2016;26(5):550-556.
22. Jassim SS, Douglas SL, Haddad FS. Athletic activity after lower limb arthroplasty. *Bone Joint J*. 2014;96-B(7):923-927.
23. Kapron AL, Peters CL, Aoki SK, et al. The prevalence of radiographic findings of structural hip deformities in female collegiate athletes. *Am J Sports Med*. 2015;43(6):1324-1330.
24. Karampinas PK, Papadelis EG, Vlamis JA, Basiliadis H, Pneumaticos SG. Comparing return to sport activities after short metaphyseal femoral arthroplasty with resurfacing and big femoral head arthroplasties. *Eur J Orthop Surg Traumatol*. 2017;27(5):617-622.
25. Kerbel YE, Smith CM, Prodromo JP, Nzeogu MI, Mulcahey MK. Epidemiology of hip and groin injuries in collegiate athletes in the United States. *Orthop J Sports Med*. 2018;6(5):2325967118771676.
26. Klingenstein GG, Martin R, Kivlan B, Kelly BT. Hip injuries in the overhead athlete. *Clin Orthop Relat Res*. 2012;470(6):1579-1585.
27. Klouche S, Giesinger JM, Sariali EH. Translation, cross-cultural adaption and validation of the French version of the Forgotten Joint Score in total hip arthroplasty. *Orthop Traumatol Surg Res*. 2018;104(5):657-661.
28. Lamo-Espinosa JM, Gómez-Álvarez J, Pascual Roquet-Jalmar E, et al. Femoroacetabular impingement and the effect of osteochondroplasty on hip osteoarthritis prevention: the Pandora's Box Opening Process. *Cartilage*. 2024;15(2):120-129.
29. Le Mansec Y, Dorel S, Hug F, Jubeau M. Lower limb muscle activity during table tennis strokes. *Sports Biomech*. 2018;17(4):442-452.
30. Lefevre N, Rousseau D, Bohu Y, Klouche S, Herman S. Return to judo after joint replacement. *Knee Surg Sports Traumatol Arthrosc*. 2013;21(12):2889-2894.
31. Malahias M-A, Gu A, Richardson SS, De Martino I, Sculco PK, McLawhorn AS. Hip arthroscopy for hip osteoarthritis is associated with increased risk for revision after total hip arthroplasty. *Hip Int*. 2020;31(5):656-662.
32. Memon M, Kay J, Hache P, et al. Athletes experience a high rate of return to sport following hip arthroscopy. *Knee Surg Sports Traumatol Arthrosc*. 2019;27(10):3066-3104.
33. Mont MA, LaPorte DM, Mullick T, Silberstein CE, Hungerford DS. Tennis after total hip arthroplasty. *Am J Sports Med*. 1999;27(1):60-64.
34. Navas L, Faller J, Schmidt S, Streit M, Hauschild M, Zimmerer A. Sports activity and patient-related outcomes after cementless total hip arthroplasty in patients younger than 40 years. *J Clin Med*. 2021;10(20):4644.
35. Nogier A, Tourabaly I, Ramos-Pascual S, et al. Excellent clinical outcomes and return to dance of 6 active, professional ballet dancers aged younger than 40 years at total hip arthroplasty through direct anterior approach with a custom stem: a case report. *Clin J Sport Med*. 2023;33(6):573-578.
36. Nogier A, Tourabaly I, Ramos-Pascual S, et al. High rates of satisfaction and return to dance in current or former professional ballet dancers after total hip arthroplasty with a muscle-sparing direct anterior approach using custom femoral stems. *Orthop J Sports Med*. 2023;11(3):23259671231155143.
37. Nogier A, Tourabaly I, Ramos-Pascual S, Müller JH, Saffarini M, Courtin C. Outcomes of primary total hip arthroplasty using 3D image-based custom stems in unselected patients: a systematic review. *EFORT Open Rev*. 2021;6(12):1166-1180.
38. Novais EN, Carry PM, Kestel LA, Ketterman B, Brusalis CM, Sankar WN. Does surgeon experience impact the risk of complications after Bernese periacetabular osteotomy? *Clin Orthop Relat Res*. 2017;475(4):1110-1117.
39. Novais EN, Ferraro SL, Miller P, Kim Y-J, Millis MB, Clohisy JC. Periacetabular osteotomy for symptomatic acetabular dysplasia in patients $\geq$40 years old: intermediate and long-term outcomes and predictors of failure. *J Bone Joint Surg Am*. 2023;105(15):1175-1181.
40. Pasqualini I, Emara AK, Rullan PJ, et al. Return to sports and return to work after total hip arthroplasty: a systematic review and meta-analysis. *JBJS Rev*. 2023;11(8):e22.00249.
41. Pulici L, Certa D, Zago M, Volpi P, Esposito F. Injury burden in professional European football (soccer): systematic review, meta-analysis, and economic considerations. *Clin J Sport Med*. 2023;33(4):450-457.
42. Quintana-Cepedal M, Roces-Vila I, Del Valle M, Olmedillas H. Epidemiology of injuries in elite female rink hockey players: a two season observational study. *Phys Ther Sport*. 2024;67:7-12.
43. Rankin AT, Bleakley CM, Cullen M. Hip joint pathology as a leading cause of groin pain in the sporting population: a 6-year review of 894 cases. *Am J Sports Med*. 2015;43(7):1698-1703.
44. Rathi R, Tourabaly I, Nogier A. Two-incisions direct anterior approach for THR: surgical technique and early outcome. *J Orthop*. 2017;14(3):398-402.
45. Robinson PG, Williamson TR, Creighton AP, et al. Rate and timing of return to golf after hip, knee, or shoulder arthroplasty: a systematic review and meta-analysis. *Am J Sports Med*. 2023;51(6):1644-1651.
46. Schmidutz F, Grote S, Pietschmann M, et al. Sports activity after short-term hip arthroplasty. *Am J Sports Med*. 2011;40(2):425-432.
47. Sowers CB, Carrero AC, Cyrus JW, Ross JA, Golladay GJ, Patel NK. Return to sports after total hip arthroplasty: an umbrella review for consensus guidelines. *Am J Sports Med*. 2023;51(1):271-278.
48. Thaler M, Khosravi I, Putzer D, Siebenrock KA, Zagra L. Return to sports after total hip arthroplasty: a survey among members of the European Hip Society. *J Arthroplasty*. 2021;36(5):1645-1654.
49. Tramer JS, Castle JP, Gaudiani MA, et al. Upper-extremity injuries have the poorest return to play and most time lost in professional baseball: a systematic review of injuries in Major League Baseball. *Arthroscopy*. 2023;39(8):1905-1935.
50. Troelsen A, Elmengaard B, Søballe K. Medium-term outcome of periacetabular osteotomy and predictors of conversion to total hip replacement. *J Bone Joint Surg Am*. 2009;91(9):2169-2179.
51. Vail TP, Mallon WJ, Liebelt RA. Athletic activities after joint arthroplasty. *Sports Med Arthrosc Rev*. 1996;4:298.
52. Vasavada KD, Shankar DS, Ross KA, et al. Patient-reported hip pain and function are worse among elite Nordic ski athletes competing in ski jumping versus Nordic combined: a cross-sectional analysis. *J ISAKOS*. 2024;9(3):283-289.
53. Winter P, Kurz K, Jung A, Roch J, Wolf M, Siebel T. The clinical outcome of custom-made implants in primary and revision hip arthroplasty. *Acta Chir Orthop Traumatol Cech*. 2022;89(6):423-428.
54. Wylde V, Blom A, Dieppe P, Hewlett S, Learmonth I. Return to sport after joint replacement. *J Bone Joint Surg Br*. 2008;90(7):920-923.
55. Yamada K, Matsuda DK, Suzuki H, Sakai A, Uchida S. Endoscopic shelf acetabuloplasty for treating acetabular large bone cyst in patient with dysplasia. *Arthrosc Tech*. 2018;7(7):e691-e697.
56. Yu C, Shao S, Awrejcewicz J, Baker JS, Gu Y. Lower limb maneuver investigation of chasse steps among male elite table tennis players. *Medicina (Kaunas)*. 2019;55(4):97.
57. Zahiri CA, Schmalzried TP, Szuszczewicz ES, Amstutz HC. Assessing activity in joint replacement patients. *J Arthroplasty*. 1998;13(8):890-895.