RESEARCH ARTICLE

Current Occupational Perspective of Total Hip Joint Surgeons in China: A Survey of Members of the Chinese Orthopedic Association

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Objectives: To explore the basic occupational information and the preferences of surgical techniques in Chinese joint surgeons.

Methods: A survey study was conducted during the Chinese Hip Society (CHS) conference of 2020. Participants from hospitals all over the country were included as the potential respondents. The questions were asked for respondents' basic information, overviews of total hip arthroplasty (THA), surgical techniques, and prosthesis selection. After data collection and filtration, analysis was conducted using chi-square test or Fisher's exact test.

Results: Only 8.31% of joint surgeons used robotics or navigation systems to assisted their total hip arthroplasty. For the approach preference, posterolateral approaches were generally favored, being used commonly by 75.36% of respondents while the direct anterior approach was considered the preferred choice by 8.31% of Chinese joint surgeons. 24.36% of the respondents choose to use domestic prosthesis in over 80% of their patients.

Conclusions: The intelligent THA is in the early stage at present but developing rapidly in China. The composition of surgical approach is simple at present and the continuing education should aim at increasing the diversity of approach selection in the following years. Domestic prosthesis is playing significant role in the prosthesis market. Joint registration system is urgently needed for Chinese joint surgery.

Key words: China; Hip joint surgeons; Occupational perspectives; Survey; Total hip arthroplasty

Introduction

Total hip arthroplasty (THA), previously hailed as the operation of the 20th century,[1] has a history of more than 80 years since it was first successfully performed in 1938. During the past eight decades, the design and fabrication of prostheses, as well as the philosophy and surgical techniques of arthroplasty, have dramatically improved due to the constructive contributions of orthopedic surgeons and medical engineers. The development has subsequently been substantial though there was a time lag of approximately 20 years in China compared with the developed countries until the first THA was performed. Several essential factors contributed to this phenomenon. On the one hand, China has a large population and there is considerable demand for THA. Chinese joint surgeons made great progress *via* theoretical study and practice. On the other hand, not only international enterprises but also domestic manufacturers provide excellent facilities and tools, such as orthopedic robots and navigation equipment which substantially optimize the surgical outcomes.[2–4] Nevertheless, there remain many problems to date. Nowadays, some THA complications, including prosthesis loosening,[5,6] implant dislocation,[7,8] periprosthetic

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joint infection (PJI),[9] etc., are confusing both the surgeons and the patients. Some are caused by accidents while others represent inherent drawbacks of the surgical technologies. For example, the direct anterior approach (DAA) performs well in avoiding the dislocation of the prosthesis although the duration of surgery is increased[10] due to the inherent characteristics of the technique. Different surgical approaches or different prostheses could make a difference in preventing certain complications.[11,12] Hence, it is of great significance for a joint surgeon to master and choose proper surgical techniques and prostheses when dealing with different cases. As we all know, continuing education, including standardized resident training (SRT) and various fellowship programs, is of great significance for hip joint surgeons, in which they can learn different surgical techniques and participate in the surgery personally.[13] However, the existing National Health Commission-guided SRT has only a short 10-year history since 2010[14] and more augmentations are needed in orthopedic specialty training. Though the progress of total hip arthroplasty was obvious, there is limited accurate information on the occupational perspectives of Chinese joint surgeons due to the lack of a joint register system or other nationwide databases,[15] making it difficult to launch continuing education among Chinese joint surgeons according to their actual demands.

As one of the goals of the Chinese Hip Society (CHS) is to provide the high-quality and most advanced continuing education, including theoretical lessons and opportunity to practice, in this context, we designed a questionnaire of basic information and professional issues to explore the current occupational situation of Chinese joint surgeons. The study has three main goals: (i) to explore what surgical techniques and prostheses Chinese hip joint surgeons usually use in their operations; (ii) to learn the application of high-tech facilities in Chinese total hip arthroplasty; and (iii) to acquire the how Chinese hip joint surgeons deal with controversial problems. The results could provide a reference for the further academic conference and continuing education for Chinese hip joint surgeons.

Methods

Questionnaire Design

A questionnaire including four basic and 26 professional questions was designed and launched as an online version. The survey contained choice and yes or no questions. Basic questions were asked, including age, educational levels, professional titles and the types of hospital in which the surgeon worked. Professional questions are divided into three parts generally. The first part is a total hip arthroplasty overview of the respondents, such as the yearly amount of total hip arthroplasty and the application of robots/navigation systems. The second part focused on surgical techniques, including the surgical approaches and several controversial issues in particular. The last section aims to learn about the preference in prosthesis selection of the respondents. (Table 1).

TABLE 1 Questionnaire design

Basic information	Age in years?
	Professional titles?
	Educational levels?
	Hospital types?
THA overview	What kind of arthroplasty do you perform?
	How many total hip arthroplasties do you perform per year?
	What kind of revision surgery do you perform?
	What is the proportion of revisions for all total hip arthroplasties you perform each year?
	What is the most common cause of primary total hip arthroplasty?
	Do you perform total hip arthroplasty using surgical robots or computer navigation system?
	What is the ratio of robot or computer navigation-assisted arthroplasty?
	What is the most common complication after total hip arthroplasty?
	What is the proportion of patients undergoing professional rehabilitation training after discharge?
Surgical technique	What is your most commonly used approach in primary total hip arthroplasty?
	How do you deal with the capsule and external rotator muscle when using a posterolateral approach?
	How do you usually reconstruct external rotator muscles?
	What proportion of primary total hip arthroplasties is a direct anterior approach?
	What approach do you most commonly use in revision total hip arthroplasty?
	What is your preference for prostheses selection in elderly patients without strength in their gluteus medius?
	What proportion of your total hip arthroplasties uses adductor release?
	What is your frequency of usage of pulse irrigation systems in total hip arthroplasty?
	What is your preference for tranexamic acid usage in total hip arthroplasty?
Prosthesis selection	In what proportion of arthroplasties do you use domestic prostheses?
	What is your preference for friction interface?
	What is your preference for processing technique of acetabular prosthesis?
	What is your preference for prosthesis fixation?
	What proportion of cemented acetabular cups do you use in total hip arthroplasty?
	What proportion of cemented femoral stems do you use in total hip arthroplasty?
	What is your preference for cement?
	What is your preference for antibiotics in cement fixation?

Data Collection

Respondents were surveyed with the questionnaire *via* the online questionnaire system during the Chinese Hip Society (CHS) conference of 2020. Collected questionnaires were excluded according to the following exclusion criteria: (i) incomplete answers; (ii) unduly short answering time (less than 180 seconds); (iii) illogical answers; and (iv) repeat answers.

Statistical Analysis

Data were analyzed using SPSS software (v24.0, IBM, Armonk, NY, USA) and visualized using Graphpad (8.0.2, GraphPad Software, San Diego, CA, USA). Subgroup analysis was made using the following rules: if no more than 20% of the expected counts are less than 5, the chi-square test was performed; otherwise, Fisher's exact test was applied. Differences were considered significant at $P < 0.05$.

Results

General Information

From the survey, a total of 698 valid questionnaires were included in the analysis. The numbers of joint surgeons aged from 35 to 45 years and 45 to 55 were 278 (39.83%) and 292 (41.83%), respectively. There were 110 (15.76%) surgeons older than 55 years of age while there were only 18 (2.58%) under 35 years of age. A total of 343 (49.14%) had senior titles and 310 (44.41%) had deputy senior designations. Of the remaining respondents, 45 (6.45%) were attending physicians. Based on hospital classification, 258 (36.96%) of the respondents originated from medical school-affiliated hospitals. In terms of the level of education, 337 (48.28%) respondents had only an undergraduate degree while 172 (24.64%) and 187 (26.79%) had a Master's degree or doctorate, respectively. Two (0.29%) respondents did not disclose their level of education (Table 2).

TABLE 2 General information of respondents

Questions	Variable, n (%)	N
Q1. Age in years		
<35	18 (2.58)	698
35–45	278 (39.83)	
45–55	292 (41.83)	
≥55	110 (15.76)	
Q2. Professional titles		
Senior	343 (49.14)	698
Deputy senior	310 (44.41)	
Attending	45 (6.45)	
Q3. Education levels		
Bachelor	337 (48.28)	698
Master	172 (24.64)	
Doctor	187 (26.79)	
Not disclosed	2 (0.29)	
Q4. Hospital types		
Medical school-affiliated hospitals	258 (36.96)	698
Provincial hospitals	58 (8.31)	
Municipal hospitals in provincial capitals	38 (5.44)	
Municipal hospitals in non-provincial capitals	128 (18.34)	
County-level hospitals	126 (18.05)	
Private hospitals	60 (8.60)	
Traditional Chinese medicine (TCM) hospitals	30 (4.30)	

Total Hip Arthroplasty Overview

In China, the majority of hospitals have a department for the reconstruction of joints, rather than sub-specialized departments for hips and knees. Accordingly, 662 (94.84%) respondents performed both THA and total knee arthroplasty (TKA) procedures. A total of 161 (23.07%) respondents performed fewer than 30 THA every year, very similar to the numbers performing 50 to 100 per year (23.64%) or 100 to 200 per year (20.77%). A total of 101 (14.47%) and 99 (14.18%) respondents performed 30 to 50 and 200 to 400 THA per year, respectively, while only 27 (3.87%) performed more than 400 THA annually which is a challenging task for a hip joint surgeon. A total of 256 (36.68%) respondents performed both THA and TKA revision surgery while 66 (9.46%) performed THA revision only. The remaining 376 (53.87%) respondents answered that they do not perform THA revision surgery. The two most common reasons for THA were reported by 378 (54.15%) and 178 (25.50%) surgeons to be avascular necrosis of the femoral head and femoral neck fracture, respectively. Only 58 (8.31%) respondents used robots or navigation in surgery while 37 (63.80%) of them reported that the proportion of operations in which robots or navigation assistance was used in fewer than 5% cases. Further analysis revealed that the application of robots or navigation is closely related to age ($P = 1.080\text{E-}4$, $\chi^2 = 25.503$), professional titles ($P = 0.012$, $\chi^2 = 8.935$), education levels ($P = 3.739\text{E-}9$, $\chi^2 = 40.658$) and hospital types ($P = 3.754\text{E-}9$, $\chi^2 = 33.807$), with municipal hospitals in provincial capitals and TCM hospitals were excluded due to the absence of robots or navigation in these hospitals (Fig. Fig. 1A–D). According to the survey, 275 (39.40%) respondents reported that dislocation of prostheses was the most frequent complication following THA. Prosthesis loosening and infection were regarded by 143 (20.49%) and 102 (14.61%) respondents as the most commonly observed complication, respectively. However, 136 (19.48%) respondents considered instead that other symptoms, such as postoperative pain or decreased range of motion were the most common complication. In China, rehabilitation therapy is not as popular as in many developed countries, as demonstrated by 258 (36.96%) respondents reporting that fewer than 10% of discharged patients seek professional rehabilitation therapy after THA (Table 3).

Surgical Techniques

In terms of surgical approach, 526 (75.36%) respondents most commonly use a posterolateral approach (PLA) and a lateral approach in 65 (9.31%) respondents. Direct anterior approach (DAA), which has been dramatically promoted in recent years is most commonly used in only 58 (8.31%) respondents while 28 (4.01%) respondents use DAA in no less than 80% of their procedures. Generally, the selection of

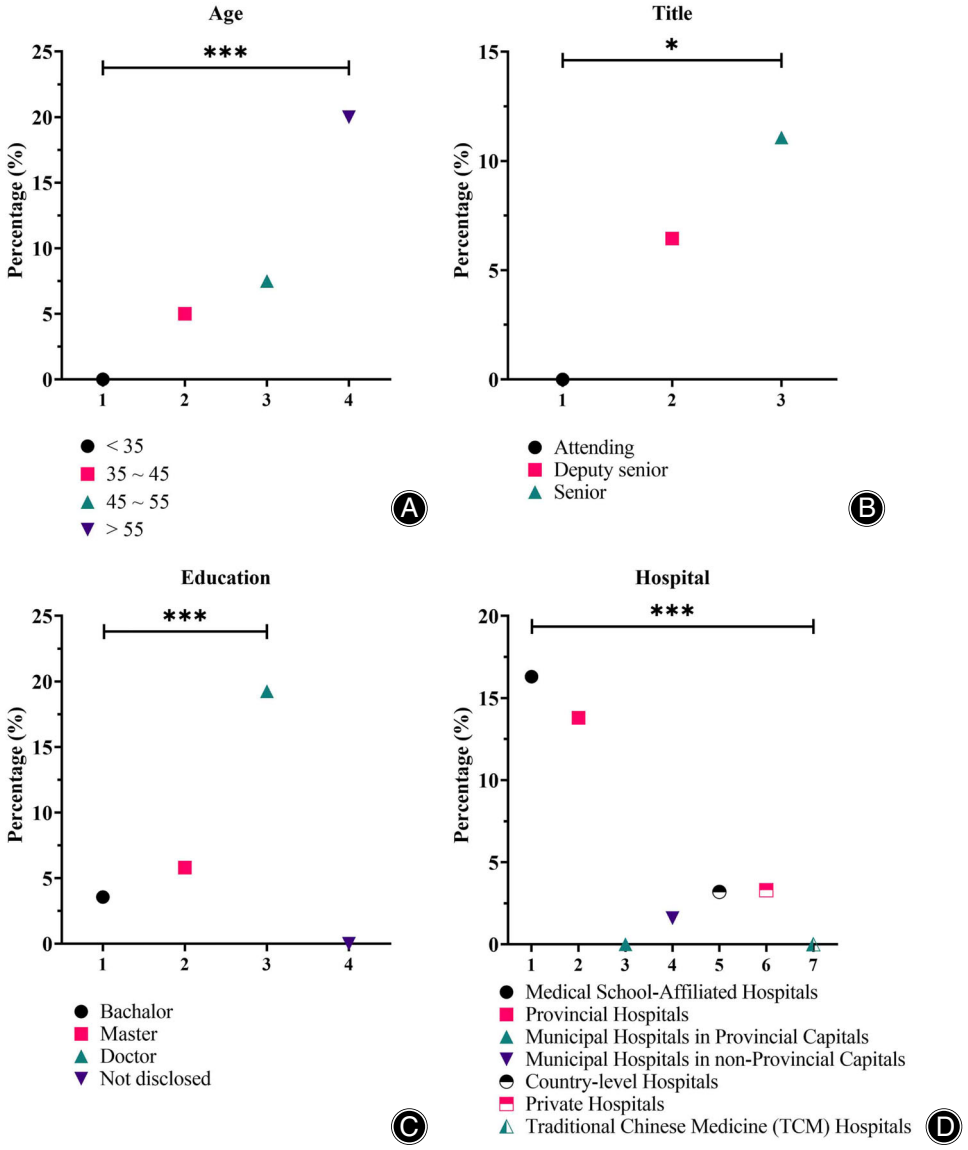

Fig. 1 (A) The application percentage of robot/navigation in different age groups; (B) the application percentage of robot/navigation in different professional title groups. (C) the application percentage of robot/navigation in different education level groups; and (D) the application percentage of robot/navigation in different hospital types. The differences were considered significant at * $P < 0.05$, ** $P < 0.01$ and *** $P < 0.005$

preferred surgical approach is independent of professional titles ($p = 0.656$) and educational levels ($P = 0.092$). (Fig. 2). In further analysis, results showed that the choice of PLA is significantly different in respondents with different educational levels ($P = 6.210E\text{-}4$, $\chi^2 = 14.678$) and hospital types ($P = 0.016$, $\chi^2 = 15.673$) while ages and professional titles appear to have little influence on the selection of PLA (Fig. 3). Moreover, the DAA related subgroup analysis revealed that the preference for DAA is significantly higher in doctorates compared to those with the Master's or Bachelor's degree ($P = 0.034$, $\chi^2 = 6.809$). However, the ages ($P = 0.440$, $\chi^2 = 2.659$), professional titles ($P = 0.249$, $\chi^2 = 2.681$) and or hospital types ($P = 0.197$) appear to have little influence on DAA preference (Fig. 4). In revision THA, a posterolateral approach was favored by 274 (85.09%) joint surgeons. When using a posterolateral approach, 372 (53.30%) respondents choose to reconstruct both the articular capsule and external rotators in every case to prevent early dislocation. Conversely, 22 (3.15%) respondents prefer to reconstruct neither the capsule nor external rotators when performing THA. Additionally, 120 (17.19%) respondents perform selective reconstruction. There were different opinions for some regarding inconclusive issues, for example how to treat elderly patients who were weak or had a loss of strength of the gluteus medius muscle, for which 244 (34.96%) respondents generally perform THA with a large diameter femoral head prostheses while 232 (33.24%) prefer the use of hemiarthroplasty. In addition, dual-mobility cups and constrained acetabular liners are favored by 152 (21.78%) and 70 (10.03%) respondents, respectively. The proportions of respondents choosing "Sometimes" or "Never" for the application of pulse irrigation systems in

TABLE 3 Total hip arthroplasty overview

Questions	Variable, n (%)	N
Q1. What kind of arthroplasty do you perform?		
Total hip arthroplasty only	36 (5.16)	698
Total hip arthroplasty and total knee arthroplasty	662 (94.84)	
Q2. How many total hip arthroplasties do you perform per year?		
<30	161 (23.07)	698
30–50	101 (14.47)	
50–100	165 (23.64)	
100–200	145 (20.77)	
200–400	99 (14.18)	
≥400	27 (3.87)	
Q3. What kind of revision surgery do you perform?		
Do not perform any total hip arthroplasty revision	376 (53.87)	
Total hip arthroplasty revision only	66 (9.46)	
Revisions of total hip arthroplasty and total knee arthroplasty	256 (36.68)	
Q4. What is the proportion of revisions for all total hip arthroplasties you perform each year?		
<1%	66 (20.50)	322
1%–5%	115 (35.71)	
5%–10%	88 (27.33)	
10%–15%	39 (12.11)	
15%–20%	8 (2.48)	
≥ 20%	6 (1.86)	
Q5. What is the most common cause of primary total hip arthroplasty?		
Avascular necrosis of femoral head	378 (54.15)	698
Developmental dysplasia of the hip and related osteoarthritis	137 (19.63)	
Femoral neck fracture	178 (25.50)	
Post-traumatic osteoarthritis of the hip	4 (0.57)	
Rheumatoid arthritis	1 (0.14)	
Q6. Do you perform total hip arthroplasty using surgical robots or computer navigation system?		
Yes	58 (8.31)	698
No	640 (91.69)	
Q7. What is the ratio of robot or computer navigation-assisted arthroplasty?		
<1%	16 (27.59)	58
1%–5%	21 (36.21)	
5%–10%	8 (13.79)	
10%–20%	4 (6.90)	
20%–40%	2 (3.45)	
≥40%	7 (12.07)	
Q8. What is the most common complication after total hip arthroplasty?		
Infection	102 (14.61)	698
Dislocation	275 (39.40)	
Prosthesis loosening	143 (20.49)	
Abnormal wear	42 (6.02)	
Others	136 (19.48)	
Q9. What is the proportion of patients undergoing professional rehabilitation training after discharge?		
<10%	258 (36.96)	698
10%–20%	104 (14.90)	
20%–40%	84 (12.03)	
40%–80%	78 (11.17)	
≥80%	174 (24.93)	

THA were 268 (38.40%) and 122 (17.48%), respectively, while 164 (23.50%) chose "Always," suggesting that Chinese joint surgeons do not regard it as essential for performing THA. A total of 373 (53.44%) respondents prefer venous administration of tranexamic acid in combination with topical application compared with the single venous injection or other routes (Table 4).

Prosthesis Selection

When selecting a brand of the prosthesis, 212 (30.37%) respondents declared that fewer than 10% of devices they use are Chinese brands, while 170 (24.36%) use prostheses that are domestic in more than 80% of cases, highlighting two opposing attitudes toward home-made products. When selecting a bearing surface, the ceramic head on ultra-high molecular weight polyethylene (UHMWPE) acetabular cup lining was favored by 306 (43.84%) respondents, followed by ceramic on ceramic, favored by 238 (34.10%) respondents. Metal prostheses did not appear as popular as ceramics, with only 129 (18.48%) and 24 (3.44%) respondents choosing metal on UHMWPE or ceramicized metal on UHMWPE, respectively, as a primary choice when selecting a bearing

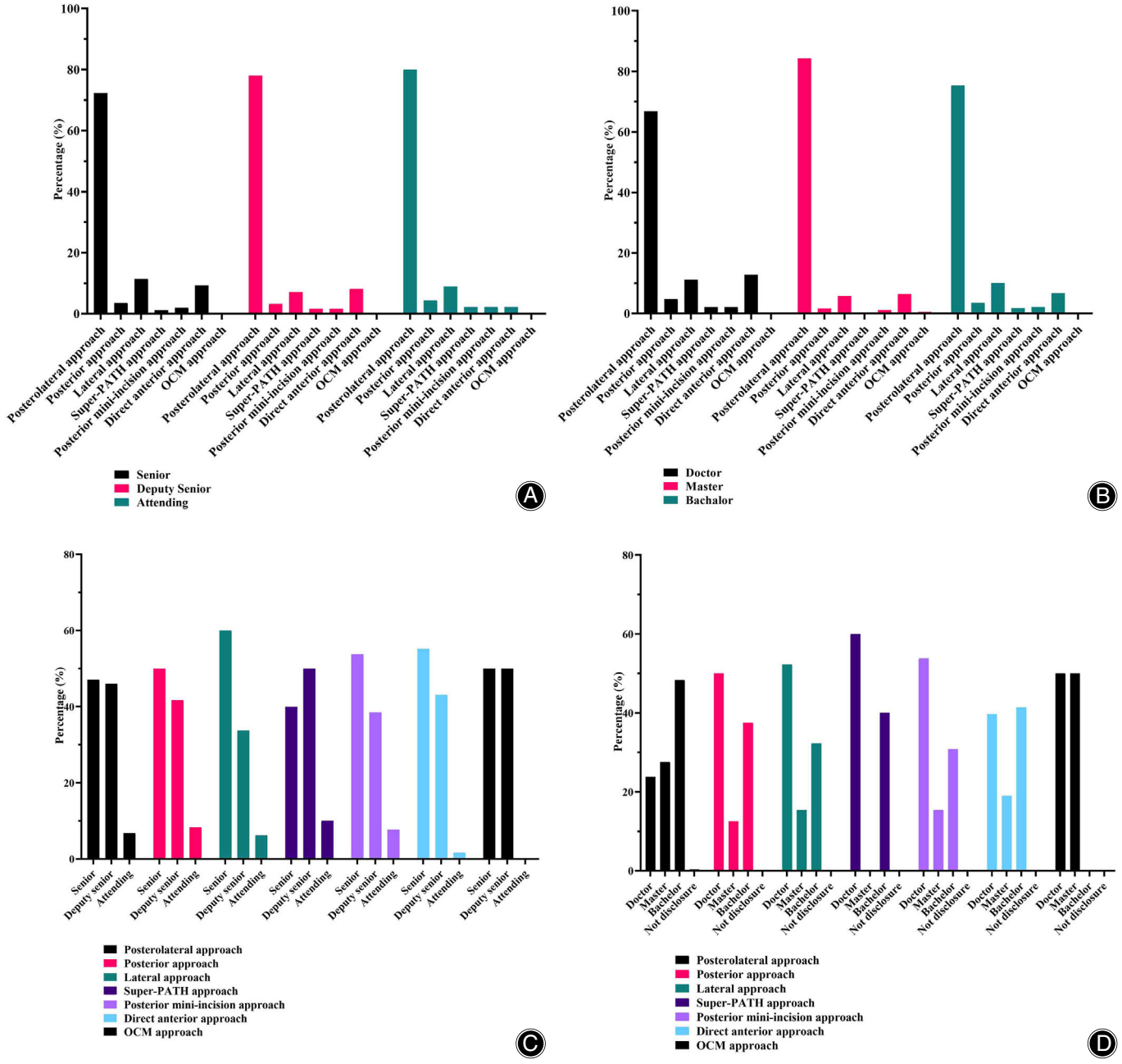

Fig. 2 (A) Subgroup analysis of the prefered surgical approach in different professional title groups; (B) subgroup analysis of the prefered surgical approach in different education level groups; (C) subgroup analysis of the professional title in different surgical approaches; and (D) subgroup analysis of the education level in different surgical approaches. The differences were considered significant at * $P < 0.05$, ** $P < 0.01$ and *** $P < 0.005$

interface. 658 (94.27%) of respondents preferred an uncemented acetabular cup and uncemented stem fixation as their primary choice. Cemented acetabular cups and femoral stems were rarely used. A total of 650 (93.12%) and 588 (84.24%) respondents reported that they use cemented cups or cemented stems, respectively, in fewer than 10% of their operations. When using the cement, a medium or high viscosity variety was preferred by 300 (42.98%) and 282 (40.40%) respondents, respectively. In addition, 350 (50.14%) respondents use antibiotic-containing cement to prevent infection. A total of 86 (12.32%) respondents were more cautious about infection when using cement fixation

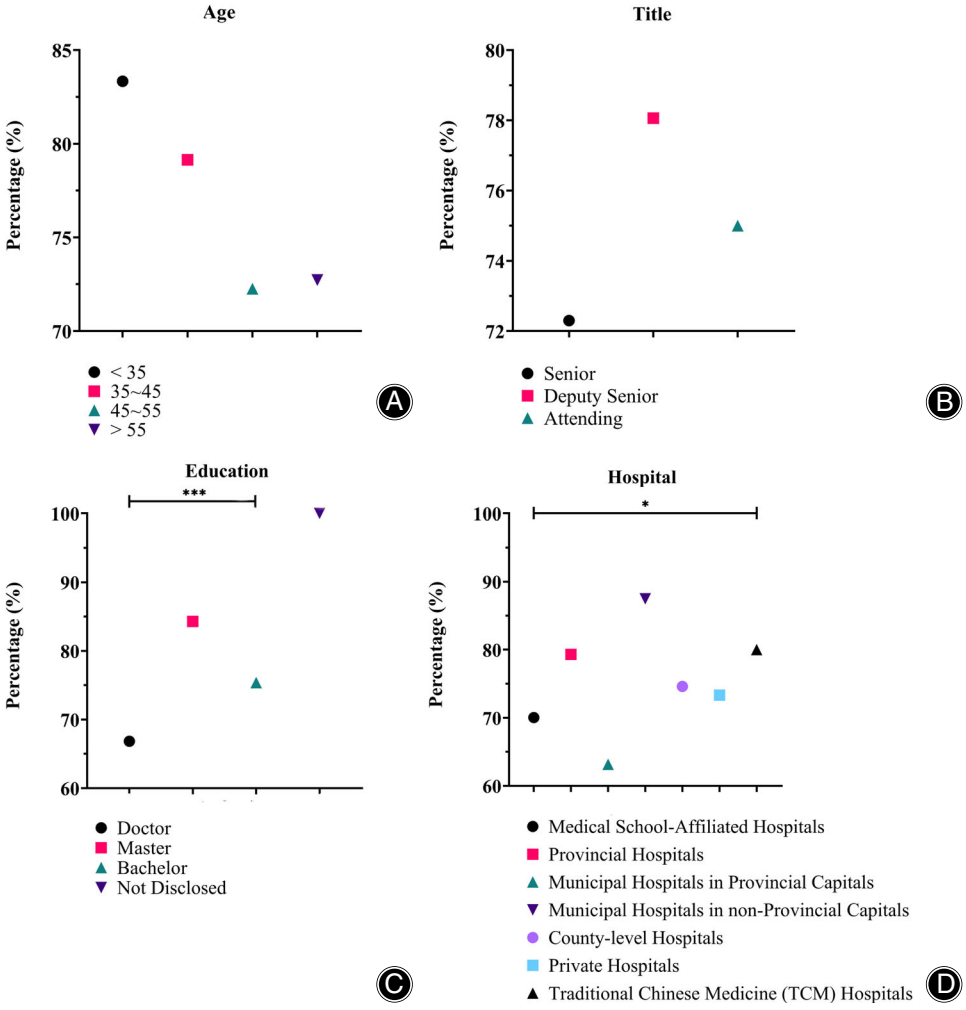

Fig. 3 (A) The percentage of posterolateral approach in different age groups; (B) the percentage of posterolateral approach in different professional title groups; (C) the percentage of posterolateral approach in different education level groups; and (D) the percentage of posterolateral approach in different hospital types. The differences were considered significant at * $P < 0.05$, ** $P < 0.01$ and *** $P < 0.005$

because they prefer to use antibiotic-containing cement in combination with supplementary administration of antibiotics (Table 5).

Discussion

Choices of the Surgical Approaches and Prostheses in Total Hip Arthroplasty

THA, classified as having the greatest level of complexity in joint surgery, is a challenge for joint surgeons to master. Almost all joint surgeons have to be surgical assistants for several years before they can operate themselves under the guidance of a superior in China. Such long-term training creates a "mentor-apprentice relationship" in which the apprentices follow everything the instructors do. For example, if the mentor only uses the posterolateral approach, the learner is likely to choose this technique in their THA cases. Although doctors and patients aim to ensure safety for an operation, a drawback is that individuality and diversity become weaker. In our opinion, diversity is important for the development of THA, both in terms of surgical technique and products. Therefore, a variety of short or middle-term exchange programs should be promoted in the health systems or official academic organizations in China. Only in this way will young joint surgeons become acquainted with knowledge and identify more suitable surgical techniques by themselves.

When selecting a surgical technique and prostheses, Chinese joint surgeons exhibit similar preferences to those in the international mainstream on most issues. The use of metal on metal prostheses has gradually decreased due to the higher rate of revision surgery and many other problems[16] while ceramics have become increasingly popular. In China, hip joint surgeons seem to have a special preference for ceramic on ceramic bearings compared with surgeons in the United States, New Zealand, Australia and some European countries.[17] Ceramic on ceramic bearings display superior performance over metal on metal bearings because they reduce wear-induced osteolysis, aseptic loosening, cumulative long-term risk of dislocation and corrosion of the head–neck

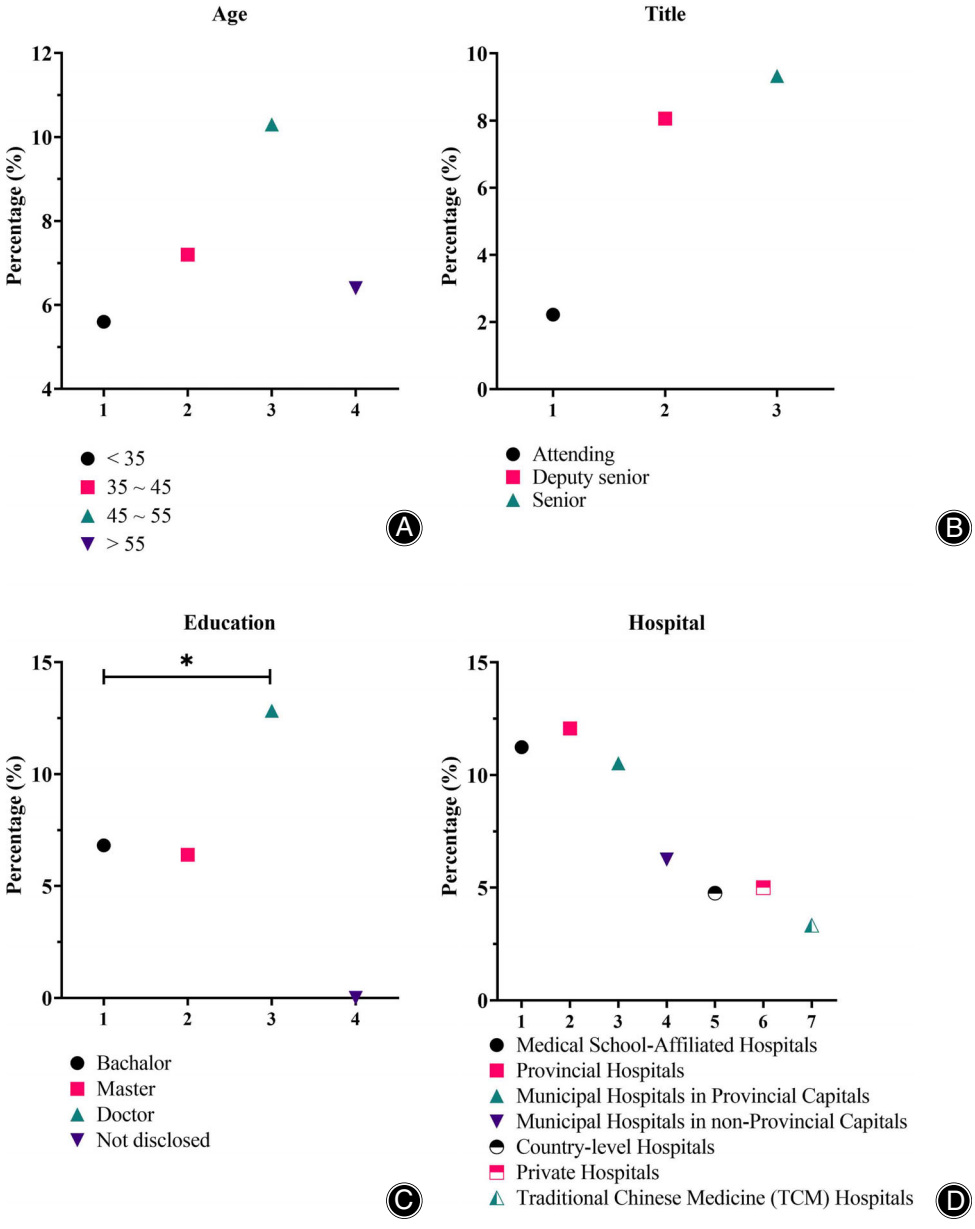

Fig. 4 (A) The percentage of direct anterior approach in different age groups; (B) the percentage of direct anterior approach in different professional title groups; (C) the percentage of direct anterior approach in different education level groups; and (D) the percentage of direct anterior approach in different hospital groups. The differences were considered significant at * $P < 0.05$, ** $P < 0.01$ and ***$P < 0.005$

modular junction.[18] Additionally, clinical data also reveal that ceramic on ceramic bearings offer greater survivorship (97%) after a 20-year follow-up, with a lower revision rate than metal on metal bearings for any reason.[16,19] The most common complication in ceramic on ceramic THA is noise while it is not associated with pain or functional outcomes,[20] which is relatively acceptable in the present medical status in China. Similar to the American joint surgeons,[21] Chinese surgeons prefer uncemented fixation, for multiple reasons. For example, uncemented fixation decreases the duration of surgery which increases the turnover of patients on the operating table, and is more convenient due to the longer life of implants, which accords with the longer life expectancy of patients. But regarding the surgical approaches, Chinese joint surgeons have a particular preference for PLA although DAA has developed rapidly over the recent years. Despite commercial promotion, the initial advantage of DAA, such as faster recovery and enhanced joint stability[22] is preferred by Chinese surgeons. Compared to the application of robots or navigation systems, the choice of surgical approach depended on the personal choice instead of the collective decision of a hospital, which objectively created convenience for its promotion. In addition, the preference of DAA in surgeons with doctorates could lead to a trend and give the impetus to its spread. Based on the above reasons, we estimate that the popularization of the DAA will continue over the forthcoming years, promoted for both the commercial reasons and its initial advantages.

TABLE 4 Surgical techniques

Questions	Variable, n (%)	N
Q1. What is your most commonly used approach in primary total hip arthroplasty?		
Posterolateral approach	526 (75.36)	698
Posterior approach	24 (3.44)	
Lateral approach	65 (9.31)	
Super-PATH approach	10 (1.43)	
Posterior mini-incision approach	13 (1.86)	
Direct anterior approach	58 (8.31)	
Orthopdische Chirurgie München approach	2 (0.29)	
Q2. How do you deal with the capsule and external rotator muscle when using a posterolateral approach?		
Reconstruct capsule and external rotator muscles in every case	372 (53.30)	698
Reconstruct capsule only in every case	28 (4.01)	
Reconstruct external rotator muscles only in every case	156 (22.35)	
Do NOT reconstruct capsule or external rotator muscles in any case	22 (3.15)	
Reconstruct capsule and external rotator muscles depending on the case	120 (17.19)	
Q3. How do you usually reconstruct external rotator muscles?		
Sew the external rotators to the greater trochanter with non-absorbable suture	164 (25.31)	648
Sew the external rotators to holes drilled in the greater trochanter with non-absorbable suture	225 (34.72)	
Did not disclose.	259 (39.97)	
Q4. What proportion of primary total hip arthroplasties is a direct anterior approach?		
<10%	550 (78.80)	698
10%–20%;	76 (10.89)	
20%–40%	25 (3.58)	
40%–80%	19 (2.72)	
≥80%	28 (4.01)	
Q5. What approach do you most commonly use in revision total hip arthroplasty?		
Posterolateral approach	274 (85.09)	322
Posterior approach	4 (1.24)	
Lateral approach;	41 (12.73)	
Super-PATH approach	0 (0.00)	
Posterior mini-incision approach	1 (0.31)	
Direct anterior approach	2 (0.62)	
Q6. What is your preference for prostheses selection in elderly patients without strength in their gluteus medius?		
Large diameter femoral head prostheses	244 (34.96)	698
Constrained acetabular liners	70 (10.03)	
Dual-mobility cups	152 (21.78)	
Hemiarthroplasty	232 (33.24)	
Q7. What proportion of your total hip arthroplasties uses adductor release?		
<5%	572 (81.95)	698
5%–10%	94 (13.47)	
10%–20%;	20 (2.87)	
20%–30%	6 (0.86)	
≥30%	6 (0.86)	
Q8. What is your frequency of usage of pulse irrigation systems in total hip arthroplasty?		
Always	164 (23.50)	698
Often	144 (20.63)	
Sometimes	268 (38.40)	
Never	122 (17.48)	
Q9. What is your preference for tranexamic acid usage in total hip arthroplasty?		
Venously	164 (23.50)	698
Venously and topically	373 (53.44)	
Venously and orally	88 (12.61)	
Venously, topically and orally	73 (10.46)	

Application of the Intelligent Facility in Total Hip Arthroplasty

Orthopedic robots and navigation systems have become increasingly popular in China due to their benefits, such as more precise positioning.[23] In the United States, the proportion of surgeons who used robots was 6.2% in 2008, increasing to 17.1% by 2015.[24] Currently, surgeons who use robots or navigation systems in THA surgery accounted for approximate only 8.31% of the respondents in China. Robot or navigation-assisted arthroplasty is just developing in China, which is along the right lines but gaps still exist. Many reasons have contributed to this phenomenon. First, the early generation of orthopedic robots were all derived from the developed countries.[25] This suggests that these countries are more likely to be able to take advantage of such tools earlier. Second, the economies and insurance schemes are

TABLE 5 Prosthesis selection

Questions	Variable, n (%)	N
Q1. In what proportion of arthroplasties do you use domestic prostheses?		
<10%	212 (30.37)	698
10%–20%	92 (13.18)	
20%–40%	116 (16.62)	
40%–80%	108 (15.47)	
≥80%	170 (24.36)	
Q2. What is your preference for friction interface?		
Metal on UHMWPE	129 (18.48)	698
Ceramics on UHMWPE	306 (43.84)	
Ceramicized metal on UHMWPE	24 (3.44)	
Ceramics on ceramics	238 (34.10)	
Others	1 (0.14)	
Q3. What is your preference for processing technique of acetabular prosthesis?		
Simple hydroxyapatite coating	64 (9.17)	698
Sandblasting	108 (15.47)	
Sandblasting and hydroxyapatite coating	156 (22.35)	
Porous metal coating	198 (28.37)	
Porous metal and hydroxyapatite coating	172 (24.64)	
Q4. What is your preference for prosthesis fixation?		
Cemented acetabular cup-Cemented femoral stem	12 (1.72)	698
Cemented acetabular cup-Uncemented femoral stem	8 (1.15)	
Uncemented acetabular cup-Cemented femoral stem	20 (2.87)	
Uncemented acetabular cup-Uncemented femoral stem	658 (94.27)	
Q5. What proportion of cemented acetabular cups do you use in total hip arthroplasty?		
<10%	650 (93.12)	698
10%–20%	33 (4.73)	
20%–40%	11 (1.58)	
40%–80%	3 (0.43)	
≥80%	1 (0.14)	
Q6. What proportion of cemented femoral stems do you use in total hip arthroplasty?		
<10%	588 (84.24)	698
10%–20%	69 (9.89)	
20%–40%	27 (3.87)	
40%–80%	13 (1.86)	
≥80%	1 (0.14)	
Q7. What is your preference for cement?		
High viscosity	282 (40.40)	698
Middle viscosity	300 (42.98)	
Low viscosity	116 (16.62)	
Q8. What is your preference for antibiotics in cement fixation?		
Antibiotic-free cement	180 (25.79)	698
Antibiotic-free cement with supplementary antibiotics	82 (11.75)	
Antibiotic-containing cement	350 (50.14)	
Antibiotic-containing cement with supplementary antibiotics	86 (12.32)	

powerful enough in these countries to cover the expenses of orthopedic robots. In addition, the conservative nature of the Chinese people may contribute to this phenomenon to some extent. In the present study, we found that surgeons older than 55 appear to have a preference for robots and navigation systems. A total of 20% of all respondents over 55 years of age use robots or navigation systems in performing an arthroplasty. The use of robots and navigation systems seems also to relate to educational levels, professional titles and hospital types. Robots or navigation systems are of more significance to inexperienced young surgeons. However, the application rate of robots or navigation is significantly higher in surgeons with higher educational levels or professional titles at present. That is because some robots or navigation systems are undergoing clinical trials guided by experienced experts at the current stage in China. We estimate that with the development of both international and Chinese brand robots or navigation systems, Chinese young joint surgeons would have more access to robots or navigation systems and get more benefits in the future.

Shortcomings of the Lack of the Nationwide Databases

Although Chinese joint surgeons have made rapid progress in arthroplasty over recent years, much remains to be done to make additional progress. A nationwide joint registry system has not been established, for many reasons, making it difficult to access to huge amounts of exact data on both patients and joint surgeons. As a result, systematic clinical data is not available that could assist in the evaluation of the development of arthroplasty and guide joint surgeons in treating patients most appropriately. The lack of a joint registry system may also inhibit the development of products suitable for the Chinese market by enterprises. In addition, the absence of a nationwide

joint registry system increases the difficulty of exploring the real demands in a bottom-up manner. Especially, it is hard to hear the voice of basic-level hospital surgeons, who need continuing education more urgently.

Limitations

There are some limitations to this study. First, there are no systems that would allow contact with every Chinese Orthopedic Association member. We published the questionnaire on a third-party website and invited members to complete it at meetings. However, COVID-19 increased the difficulty to have more joint surgeons participate in the offline conference and some potential respondents will have been missed. Additionally, this would be a cause of bias. Second, the questionnaire aimed at ascertaining the current occupational perspective of total joint surgeons. Their responses reflect general attitudes toward total joint arthroplasty qualitatively. A complete joint registry system in China is required so that the current exact statistics in THA can be determined quantitatively.

In summary, the present survey provides a general view of the occupational situation for Chinese total joint surgeons, currently. The results revealed that Chinese total joint surgeons tend to choose the traditional surgical approach for THA. Modern techniques, such as robot/navigation-assisted arthroplasty are becoming increasingly popular in China. For controversial issues, the mainstream views of Chinese total joint surgeons are consistent with those in other medical systems. However, they have their preferences, such as the choice of bearing surface. In terms of continuing education, the association should launch more academic conferences and training courses to increase the diversity of surgical techniques.

Conclusion

This study has investigated the current occupational perspective of total hip joint surgeons in China. The posterolateral approach is the most commonly used technique in China, while the direct anterior approach is increasing rapidly. The application of intelligent orthopedic equipment including robots and navigation is just in the initial stage but has a broad development prospect. More training programs are going to establish to increase the diversity of surgical techniques. It is urgent to develop a nationwide joint registry system to obtain abundant but detailed statistics about both the surgeons and the patients.

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Authors' Contributions

Dr. Ning Kong and Dr. Run Tian collected the data and performed data filtration and analysis. Prof. Pei Yang and Prof. Kunzheng Wang helped to design the questionnaire. Prof. Li Cao and Prof. Yonggang Zhou helped refine the questionnaire. The manuscript was drafted by Dr. Ning Kong and revised by Prof. Yonggang Zhou and Prof. Pei Yang. This work was guided by Prof. Kunzheng Wang and Prof. Pei Yang.

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