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ARTHROPLASTY

Golfing after Orthopaedic Surgery: A longitudinal follow-up (GOLF) study protocol

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Aims

The primary aim of this prospective, multicentre study is to describe the rates of returning to golf following hip, knee, ankle, and shoulder arthroplasty in an active golfing population. Secondary aims will include determining the timing of return to golf, changes in ability, handicap, and mobility, and assessing joint-specific and health-related outcomes following surgery.

Methods

This is a multicentre, prospective, longitudinal study between the Hospital for Special Surgery, (New York City, New York, USA) and Edinburgh Orthopaedics, Royal Infirmary of Edinburgh, (Edinburgh, UK). Both centres are high-volume arthroplasty centres, specializing in upper and lower limb arthroplasty. Patients undergoing hip, knee, ankle, or shoulder arthroplasty at either centre, and who report being golfers prior to arthroplasty, will be included. Patient-reported outcome measures will be obtained at six weeks, three months, six months, and 12 months. A two-year period of recruitment will be undertaken of arthroplasty patients at both sites.

Conclusion

The results of this prospective study will provide clinicians with accurate data to deliver to patients with regard to the likelihood of return to golf and timing of when they can expect to return to golf following their hip, knee, ankle, or shoulder arthroplasty, as well as their joint-specific functional outcomes. This will help patients to manage their postoperative expectations and plan their postoperative recovery pathway.

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Introduction

Golf is played by over 66 million people in 206 countries.[1] In 2019, UK golfers spent £5.1 billion on their sport, which reflects a 20% increase in consumer spending since 2014.[2] The sport helps golfers meet the World Health Organization (WHO) recommendations for physical activity,[3] and the health benefits of golf have been well presented in a scoping review by Murray et al,[4] with players describing improved physical and mental wellbeing.

Joint arthroplasty is one of the most common and cost-effective operative procedures worldwide and is an excellent intervention for patients suffering from end-stage arthritis.[5] Joint arthroplasty leads to reduced levels of pain and improved levels of function.[6,7] There are approximately 175,000 hip and knee arthroplasties performed in England, Wales, and Scotland each year,[8,9] while there are approximately 1.88 million hip and knee arthroplasties performed in the USA per annum.[10] Arthritis can have a significant impact on a patient's quality of life[11] and can prevent golfers from participating in their hobby (or livelihood). It is estimated that up to 20% of patients with joint arthroplasties are golfers.[12] Sorbie et al[13] studied the impact of golf course closure during the COVID-19 pandemic on wellbeing and life satisfaction. They reported that belonging,

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enjoyment, and wellbeing were significantly associated with outdoor course activity, and a sense of belonging and satisfaction increased following the reopening of golf courses.[13] It is likely that these findings are applicable to golfers who are unable to play secondary to their arthritis prior to arthroplasty.

A previous review analyzed the literature assessing return to golf after arthroplasty surgery;[14] however, to the authors' knowledge, there has been no prospective study describing the rate of return or predictive factors associated with returning to golf following arthroplasty. Swanson et al[15] suggested recommendations based on the literature regarding when patients can consider returning to play golf. However, this was based only on a consensus statement by orthopaedic surgeons regarding sporting activities following arthroplasty.[15] A retrospective study of returning to sport following unicompartmental knee arthroplasty (UKA) compared to total knee arthroplasty (TKA) showed a 100% return to golf in those undergoing UKA, compared to only 30% following TKA.[16] However, where this difference is observed prospectively is not clear, or whether other arthroplasty options such as resurfacing versus standard THA can influence return to golf. This protocol aims to outline the methodology that will be employed for a prospective study of golfers undergoing hip, knee, ankle, or shoulder arthroplasty. These were chosen as they are the most commonly performed arthroplasty procedures.[9]

Aims. The primary aim of this prospective, multicentre study is to describe the rates of returning to golf following hip, knee, ankle, and shoulder arthroplasty in an active golfing population. Secondary aims will include determining the timing of returning, changes in ability, handicap and mobility, and functional/health-related outcomes. In addition, outcome comparisons will be made between arthroplasty type.

Methods

Study setting and design. This is a multicentre, prospective, longitudinal study between the Hospital for Special Surgery, New York City and Edinburgh Orthopaedics, Royal Infirmary of Edinburgh. Both centres are tertiary referral centres, specializing in upper and lower limb arthroplasty.

Recruitment. Patients scheduled for hip, knee, ankle, and shoulder arthroplasty at each centre will be asked if they consider themselves a golfer. Potential patients will include those undergoing hip, knee, ankle, or shoulder arthroplasty at the two medical centres. Patients will be enrolled preoperatively and followed for one year postoperatively.

Eligibility criteria. Inclusion and exclusion criteria will be applied. Patients included in this study will not have any alterations to their treatment, nor will their treatment be affected if they are excluded or decline participation. Reasons for exclusion will be recorded.

Inclusion criteria are as follows: 1) age ≥ 18 years; 2) a self-reported golfer; 3) able to consent to treatment; and 4) assessed and listed for one of the following surgical procedures: total hip arthroplasty, hip resurfacing, revision hip arthroplasty, total knee arthroplasty, unicompartmental knee arthroplasty, revision knee arthroplasty, primary ankle arthroplasty, revision ankle arthroplasty, total shoulder arthroplasty, reverse shoulder arthroplasty, shoulder hemiarthroplasty, and revision shoulder arthroplasty. Exclusion criteria are as follows: 1) patients unable to comply with postoperative data gathering, including completing questionnaires; 2) patients declining operative management; 3) no desire to return to golf postoperatively; and 4) medical comorbidities that affect the patient's ability to play golf, that will ultimately not allow the patient to return to golf postoperatively.

Data collection and management. Patients undergoing arthroplasty will be identified from outpatient clinics and pre-assessment clinics. At the pre-assessment clinic, approximately two to four weeks prior to surgery, appropriate patients will be offered information regarding the study from the treating surgeon or research assistant. Patients will also be identified, enrolled, and consented electronically on the day of surgery if they are not identified at the pre-assessment. As the study is low-risk, additional patient interaction is minimal and does not impact their treatment. Consent will be performed by a member of the research team. In the UK, this will be a Good Medical Practice trained individual, and in the USA it will be a research assistant. On recruitment to the study, the patients' details (including name, age, and contact details) and hospital identification number will be logged into a secure database at the respective hospital site. Each database will be identical and allow for merging at the end of the study period, to allow for ease of data analysis.

Demographic and surgical data are routinely collected by both medical centres and accessible via electronic medical records (Table I). Golf-specific data collected in the 'Golfing after orthopaedic surgery: a longitudinal follow-up (GOLF) Questionnaire' (Supplementary Material) will be gathered via Research Electronic Data Capture (REDCap; Vanderbilt University, USA) at the Hospital for Special Surgery, and via the use of Formic forms (Formic, UK) at the Royal Infirmary of Edinburgh. Questionnaires will be collected electronically pre- and postoperatively.

The GOLF questionnaire. The questionnaire has been designed by multinational experts in orthopaedic surgery, sports medicine, physiatry, research, and public lay members who were active golfers and who had previously undergone arthroplasty. It is designed to be qualitative and applicable in the pre- and postoperative setting. The questionnaire can be seen in the Supplementary Material.

Table I. Demographic and surgical data for collection.

Demographic	Golf-specific
Age	Handicap
Sex	Current golf ability
Follow-up	Golf frequency
Handedness	Golf mobility
Side	Golf satisfaction
Type of joint arthroplasty	Time since last played
Method of joint arthroplasty	Number returning to golf
Approach	Time to return to golf
Revisions	Change in handicap
Awaiting other orthopaedic surgery	Severity symptoms during golf
Previous joint arthroplasty	Frequency of symptoms during golf
	Severity of symptoms after golf
	Frequency of symptoms after golf
	Golf-specific rehabilitation

Table II. Timepoints for data collection.

Data to be collected	Preoperative	6 wks	3 mths	6 mths	12 mths
Patient demographics	X				
GOLF Questionnaire	X	X	X	X	X
HOOS-JR/KOOS-JR/ASES/MOXFQ	X			X	X
GAAS Questionnaire				X	X

ASES, American Shoulder and Elbow Surgeons score; GAAS, Golf After Arthroplasty Surgery score; GOLF, Golfing after orthopaedic Surgery: a Longitudinal Follow-up study; HOOS-JR, Hip disability and Osteoarthritis Outcome Score - Joint Replacement; KOOS-JR, Knee injury and Osteoarthritis Outcome Score - Joint Replacement; MOXFQ, Manchester-Oxford Foot Questionnaire.

Data reporting. The response rate of golfers undergoing arthroplasty will be reported as a percentage of the total eligible cohort of golfers. The demographic details of those who declined follow-up or were lost to follow-up will be reported.

Primary outcome measures. The primary outcome will be to report the rates of return to golf following hip, knee, ankle, and shoulder arthroplasty. 'Returning to golf' will be defined as a golfer returning to their desired maximal level of involvement. Levels of involvement will include putting, chipping, iron shots, driver shots, and playing nine holes and 18 holes.

Secondary outcome measures. Secondary outcomes will include the timing of return, changes in the frequency of golfing, changes in mobility on the golf course, changes in handicap, joint pain during and after golf, and satisfaction with their involvement in golf. Other variables that will be reported include: if patients' golf is affected by any other joint problems, if patients have other existing joint arthroplasties or are awaiting consultation/surgery on other joints, and the type of golf course they play on. Patient-reported outcome measures will include the Golf After Arthroplasty Surgery score (GAAS) (Supplementary Material 2), Hip disability and Osteoarthritis Outcome Score – Joint Replacement (HOOS-JR),[2] Knee injury and Osteoarthritis Outcome Score – Joint Replacement (KOOS-JR),[17] American Shoulder and Elbow Surgeons score (ASES),[18] The Manchester-Oxford Foot Questionnaire (MOXFQ),[19] and PROMIS Global Health Survey.

GAAS score. The 20-item GAAS score was developed based on prior patient-reported outcome measures, literature research and expert opinion that identified items relevant to the average golfing population undergoing joint arthroplasty. All items were referring to the awareness of their joint during various golf-associated activities (Supplementary Material 2). Each question is scored on a Likert scale of never to mostly. The score is measured from 0 to 100, where 0 is complete joint awareness and 100 is no joint awareness.

HOOS-JR. The HOOS, JR was constructed from the longer, original version of the Hip disability and Osteoarthritis Outcome Score (HOOS). The HOOS, JR contains six items from the original HOOS survey. Items are scored from 0 to 4, none to extreme, respectively. HOOS, JR is calculated by summing the raw response (range 0 to 24) and then converting it to an interval score. The interval score ranges from 0 to 100, where 0 represents total hip disability and 100 represents perfect hip health.

KOOS-JR. The KOOS-JR was developed from the original version of the Knee injury and Osteoarthritis Outcome Score (KOOS). The KOOS, JR comprises seven items from the original KOOS survey. Items are coded from 0 to 4, none to extreme, respectively. KOOS, JR is scored by summing the raw response (range 0 to 28) and then converting it to an interval score. The interval score ranges from 0 to 100, where 0 represents total knee disability and 100 represents perfect knee health.

ASES. The ASES is a mixed outcome reporting measure for use in a variety of shoulder pathologies. The ASES score can be viewed as a 100-point scale that evaluates two dimensions of shoulder function: pain and performance in activities of daily living. Each of the two domains make up for 50 of the 100 points.

MOXFQ. The Manchester-Oxford Foot Questionnaire (MOXFQ) is a 16-item questionnaire scored on a five-point Likert scale (each item is scored from 0 to 4, with 4 signifying 'most severe'). There are three underlying domains: walking/standing problems (seven items), foot pain (five items), and social interactions (four items). Raw scores are converted to a scale from 0 to 100, where 100 represents the most severe. The three domain scales (walking/standing, pain, and social interaction) have been shown to have excellent psychometric properties in terms of reliability, validity, and responsiveness.

PROMIS Global-10. The PROMIS Global-10 is a publicly available global health assessment tool that

Table III. Strengths and weaknesses of the study.

Strengths	Limitations
First prospective study assessing return to golf following joint arthroplasty	Surgeons may influence patients' decision on when or if to return to golf
Multicentre study	Selection bias of patients willing to be recruited
Accurately defining 'return to golf'	Potential for loss to follow-up
Characterizing timing of returning to golf-specific activities (putting, chipping, etc.)	
First study to use a globally applied standardized handicap system	

allows measurements of symptoms, functioning, and healthcare-related quality of life for a variety of chronic diseases. It consists of ten items that assess general domains of health and functioning, including overall physical health, mental health, social health, pain, fatigue, and overall perceived quality of life.

Participant timeline. Patients will be assessed preoperatively and then again at six weeks, three months, six months, and 12 months postoperatively by completing the questionnaires. Follow-up will be done using email and/or phone consultation for non-responders. Data collection at each timepoint can be seen in Table II.

Strengths and limitations. The strengths and limitations of this prospective study can be viewed in Table III.

Sample size and statistics. There are no published data reporting the proportion of patients undergoing arthroplasty who are active golfers. However, one study suggested this might be as high as 20%.[12] The sample size calculation is based on the estimated numbers of patients who undergo hip, knee, ankle, or shoulder arthroplasty per year and meet the eligibility criteria. We estimate that 75, 20, 35, and 30 golfers will undergo hip, knee, shoulder, or ankle arthroplasty, respectively, per year at HSS. Edinburgh estimates that 45, 45, 10, and 10 golfers will undergo hip, knee, shoulder, or ankle arthroplasty per year, respectively. Across both sites, the yearly estimates are 120, 65, 45, and 40 golfers who undergo hip, knee, shoulder, and ankle arthroplasty, respectively. For procedure breakdowns, we estimate the following: 1) for hips, 65% will be primary total hip arthroplasties, 30% will be resurfacings, and 5% will be revisions; 2) for knees, 75% will be primary total knee arthroplasties, 15% will be unicompartmental knee arthroplasties, and 10% will be revisions; 3) for shoulders, 40% will be primary total shoulder arthroplasties, 50% will be reverse total shoulder arthroplasties, 7% will be revisions, and 3% will be resurfacings; and 4) for ankles, 80% will be primary total ankle arthroplasties, and 20% will be revisions.

We plan to collect data over a two-year period, which results in a total of 540 patients (240 hips, 130 knees, 90 shoulders, 80 ankles). From these, we expect 80% to agree to participate in the study, leading to final numbers of 192 hips, 104 knees, 72 shoulders, and 64 ankles (total = 432).

On completion of data collection, both datasets will be merged and analyzed by the Royal Infirmary of Edinburgh site. Data will be analyzed using SPSS Statistics v. 24.0 (IBM, USA), with continuous variables analyzed using range and standard measures of central tendency (mean and standard deviation (SD) or median and interquartile range (IQR) depending on the normality, which will be assessed using Shapiro-Wilk testing). Any comparison between study groups will use the chi-squared test (categorical variables) and paired *t*-test or non-parametric Mann-Whitney U test (continuous variables) as appropriate. Analysis of variance (ANOVA) testing will be used to compare the four main cohorts of arthroplasty. Statistical significance will be set at $p < 0.05$.

Data management. Data collected during the study will be handled and stored in line with the 1998 Data Protection Act, which states data should be de-identified as soon as it is practical to do so. Hard-copy data collection forms will be stored in locked filing cabinets at each respective site, and accessible only by research team members. Any hard-copy data and participant information will be converted to electronic spreadsheets stored securely on hospital servers only accessible by research team members on password-protected computers. Quality control procedures will be in the form of regular inspections of each master file at each site, and research will be in compliance with the protocol agreed by the ethics committee and Good Medical Practice. Access to the final dataset will be limited to the co-authors and research assistants involved in the study.

Protocol amendments. Any changes in research activity – except those necessary to remove an apparent, immediate hazard to the participant in the case of an urgent safety measure – must be reviewed and approved by the Principal Investigator at each Investigator Site. Amendments will be submitted to a sponsor representative for review and authorization, before being submitted in writing to the appropriate research ethics committee (REC) and local research and development (R&D) committees for approval prior to participants being enrolled into an amended protocol.

Data monitoring. The data steering and monitoring committee, which is composed of research personnel at both sites, will undertake regular checks to ensure data

collection and management is appropriate. In addition, they will ensure the feasibility of the study to continue. The Principal Investigator is responsible for the quality of the data recorded in the study database at each Investigator Site. Investigators and institutions involved in the study will permit trial-related monitoring and audits on behalf of the sponsor, REC review, and regulatory inspection(s). In the event of audit or monitoring, the Investigator agrees to allow the representatives of the sponsor direct access to all study records and source documentation. In the event of regulatory inspection, the Investigator agrees to allow inspectors direct access to all study records and source documentation.

Data protection. All Investigators and staff involved with this study will comply with the requirements of the appropriate data protection legislation (including the General Data Protection Regulation and Data Protection Act) with regard to the collection, storage, processing, and disclosure of personal information. Computers used to collate the data will have limited access measures via usernames and passwords. Published results will not contain any personal data or identifiable information, and will prevent re-identification from taking place.

Patient confidentiality. All records will be kept in a secure storage area with limited access. Clinical information will not be released without the written permission of the participant. The Investigator and study site staff involved with this study may not disclose (or use for any purpose other than performance of the study) any data, record, or other unpublished information which is confidential or identifiable, and has been disclosed to those individuals for the purpose of the study. Prior written agreement from the sponsor must be obtained for the disclosure of any said confidential information to other parties.

Ethics. The protocol was reviewed by the South East Scotland Research Ethics Service, and a letter of approval was provided on 10 November 2021 for the Royal Infirmary of Edinburgh site (21/SC/0380). The study also received ethical approval from the Hospital for Special Surgery (IRB 2021-0437). The study was registered with clinicaltrials.gov (NCT05675618 version 1.2). Access to the SPIRIT checklist for this study is available in Supplementary Material 3.

Dissemination. The results of this prospective study will be disseminated to the orthopaedic and sports medicine/physiatry communities via presentations at national and international meetings. A manuscript for a peer-reviewed journal will be prepared and submitted.

Discussion

This research aims to be the first prospective study to report the rates and timings of returning to golf following hip, knee, ankle, or shoulder arthroplasty. Currently, available evidence-based advice regarding returning to golf following joint arthroplasty is outdated.[20–22] A recent meta-analysis of all studies analyzing return to golf following hip, knee, or shoulder arthroplasty identified only retrospective studies. The authors reported pooled rates of returning to golf of 90%, 70%, and 80% for the hip, knee, and shoulder, respectively. Timings were reported to be 4.5 months for hip arthroplasty, 3.8 months for knee arthroplasty, and six months for shoulder arthroplasty.[23] The influence of joint prosthesis design on rates of returning to golf following knee arthroplasty has also recently been studied, but no difference was shown in posterior-stabilizing and cruciate-retaining implants.[24] Two retrospective studies analyzing the satisfaction levels of golfers when returning after hip or knee arthroplasty reported rates of 84% or 88%, respectively.[2,25]

This study aims to prospectively follow patients through their arthroplasty journey and accurately describe key milestones in their return to golf. In addition to standard outcome measures, this study will facilitate the validity of a newly designed outcome questionnaire. The GAAS questionnaire aims to highlight detailed experiences of golfers' perceptions of their joint arthroplasty during a variety of golf-specific activities. This outcome measure, and the overall study, will help to give accurate golf-specific expectations to patients awaiting surgery and during the consent process for surgery.

Take home message

- This study will provide accurate, key milestones in the return to golf journey of patients undergoing commonly performed arthroplasty surgery.
- Such data will guide clinicans in the counselling of future patient pre- and postoperatively.

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Supplementary material

Pre- and postoperative GOLF questionnaires, Golfing After Arthroplasty Surgery Score, and SPIRIT checklist

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Ethical review statement:
- The protocol was reviewed by the South East Scotland Research Ethics Service and a letter of approval was provided on 10 November 2021 for the Royal Infirmary of Edinburgh site (21/SC/0380). The study also received ethical approval from the Hospital for Special Surgery (IRB # 2021-0437).