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Patient Perception of Robotic Total Knee Arthroplasty: A Qualitative Study

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ABSTRACT

Introduction: Total knee arthroplasty (TKA) is one of the most commonly performed orthopedic surgeries. The goal of robotic-assisted technology is to optimize outcomes through preoperative planning, ensuring accuracy in component sizes and precision in bone cuts. There is a paucity of literature that addresses patient perceptions of this new technology.

Therefore, the purpose of this study was to assess why patients choose to undergo robotic-assisted TKA.

Methods: All patients who underwent robotic-assisted TKA between July 1, 2017, and December 31, 2018, were given a 12-question survey to complete. The final cohort consisted of 76 patients composed of 51 women and 25 men with a mean age of 71 years (range, 51–88 years). All de-identified data was evaluated and tabulated for assessment.

Results: Eighty-three percent stated they would recommend undergoing robotic-assisted TKA as opposed to conventional TKA with 72% stating the main influencer in their decision was physician input. Fifty-seven percent stated they thought their components would be placed in a more optimal position using robotics. Sixty-two percent believed they would achieve better outcomes with robotic TKA as opposed to their conventional counterparts. Among outcome questions, 55% believed they would have less pain with robotic-assisted TKA. However, the majority of the cohort stated they would have no difference in length-of-stay or infection risk compared to manual TKA. Exactly 50% of patients stated there would be similar operating room time between robotic and manual TKA.

Discussion: The vast majority of our cohort believed there were benefits in opting for robotic-assisted TKA. Future studies should evaluate how attitudes and beliefs may influence patient-reported satisfaction and outcomes in the long term.

Keywords: Patient perceptions, Robotic-assisted TKA

Introduction

Worldwide, total knee arthroplasty (TKA) remains one of the most commonly performed major orthopedic procedures with high patient satisfaction rates and excellent functional outcomes.^{1,2} However, there continue to be efforts to optimize the precision of component placement and patient-reported outcomes through the use of new and innovative technologies.^{3,4} As such, many institutions have implemented the use of robotic-assisted TKA.^{5,6} Using preoperative X-ray or computed tomography (CT), robotic technology recreates the anatomy of the patient in a three-dimensional computer model and is able to direct the precision of cuts as

well as assist in soft-tissue balancing, which in theory should optimize outcomes.^{7,8}

Several studies have shown excellent postoperative outcomes and patient satisfaction in the short-term following robotic-assisted TKA.^{3,7–10} Furthermore, there are studies that show robotic technology may optimize component positioning and sizing in comparison to their manual counterparts.^{4,11–13} As this new technology becomes more common, it is imperative that the attitudes and beliefs of patients regarding robotic arthroplasty are explored. Therefore, the purpose of this study was to assess the attitudes, beliefs, and conceptions of patients prior to undergoing robotic-assisted TKA.

Methods

Appropriate institutional review board approval was obtained prior to the initiation of this study. All patients who underwent robotic-assisted TKA at one single high-volume inner-city institution were considered for inclusion in this study. These patients were randomly selected if they underwent their robotic-assisted TKA from January 1, 2019, to December 31, 2019. Our final cohort consisted of 76 patients composed of 51 women and 25 men with a mean age of 71 years (range, 51–88 years). A 12-question survey was administered to each patient anonymously and randomly to ensure appropriate sampling. These questions evaluated the attitudes, beliefs, and conceptions of patients regarding the use of robotic technology in their surgery. This study was reported in line with the Standards for Reporting Qualitative Research guidelines¹⁴ (see the supplementary material).

All questionnaires were administered prior to patients undergoing their arthroplasty. All patients underwent robotic-assisted TKA using the Triathlon implant system (Stryker Orthopaedics, Mahwah, New Jersey). The MAKO robotic arm-assisted system (Stryker Orthopaedics, Mahwah, New Jersey) was used in all operations. All patients underwent preoperative CT of the operative lower extremity, which was then loaded into the computer system to create an operative template for the surgeon.

All surgeries were performed by a board-certified orthopedic surgeon who had undergone certification for the use of robotic technology. All patients received 24 hours of perioperative antibiotics and at least 30 days of venous thromboembolic prophylaxis. All patients began physical therapy within 24 hours of their arthroplasty. All de-identified data was inputted into an Excel spreadsheet (Microsoft Corporation, Redmond, Washington) for tabulation and calculation.

Results

Among the cohort, 83% ($n = 63$) stated they would recommend undergoing robotic-assisted TKA as opposed to conventional TKA. Although many patients do recommend this surgery, most of the cohort stated they would not be willing to pay more for the robotic technology ($n = 41$ of 76; 54%). Additionally, 88% of patients ($n = 67$) were concerned about the robot malfunctioning during surgery. Furthermore, 72% ($n = 55$) of patients stated the main influencer in their decision to undergo robotic arthroplasty was physician input (Figure 1).

When evaluating the attitudes of patients toward the procedure itself, 57% of patients ($n = 43$) stated they thought their components would be placed in a more optimal position using robotics. Furthermore, 62% ($n = 47$) believed they would achieve better outcomes with robotic TKA as opposed to their conventional counterparts. However, only 18% ($n = 14$) believed that the surgeon required robotic technology to achieve an optimal result.

When assessing the beliefs of patients regarding postoperative outcomes, the majority of patients believed they would have less pain with robotic-assisted TKA ($n = 42$ of 76 patients; 55%). Thirty patients (39%) stated they would have pain similar to those who underwent conventional arthroplasty while four (5%) thought they would have more pain comparatively. However, 39 patients (51%) thought there would be no difference in length of stay when comparing robotic-assisted and conventional TKA. Only 7 patients (9%) thought there would be a longer length of stay, while the remaining 28 patients believed it would be shorter. Additionally, 46 patients (61%) among the cohort believed the infection risk between robotic and conventional arthroplasties would be similar. Three patients (4%) thought their infection risk was higher with robotic TKA, while the remaining 27 believed their risk was lower.

Regarding operating room time, 50% ($n = 38$) of all patients thought there would be no difference between robotic arthroplasty and their conventional

counterparts. Only 8% ($n = 6$) thought robotic TKA would take longer, while the remaining 42% ($n = 32$) thought their robotic operation would take less time. Among those who thought there would be a difference in operating room time, 68% ($n = 26$ out of 38) thought there would be a difference of no greater than 30 min. Furthermore, 26% ($n = 10$) thought there would be a 31 to 60 minutes difference in surgical time, while the remaining two patients thought there would be a difference greater than 60 min.

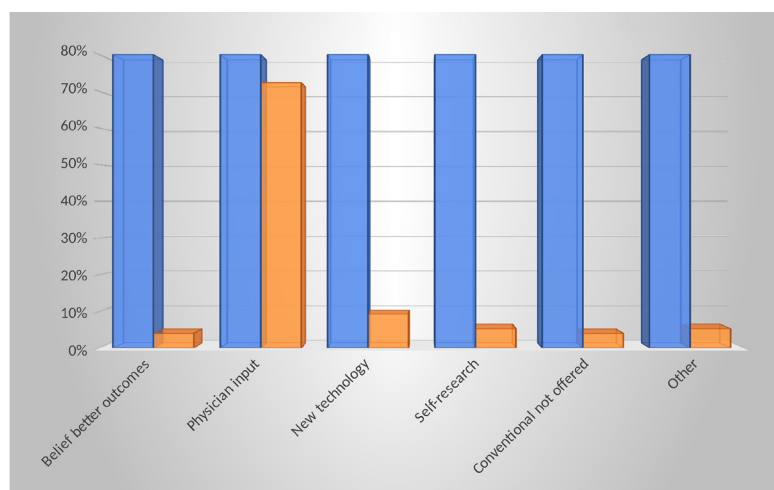
Discussion

Robotic-assisted TKA is a new technology introduced to optimize patient outcomes through the precision of bone cuts and ideal component placement. Our study aimed to determine the preconceived conceptions, attitudes, and beliefs of patients regarding the use of this innovative arthroplasty technology. We found that the majority of the cohort recommended undergoing robotic-assisted TKA. Furthermore, the majority expected less pain and more optimal component placement. However, many of these patients expected no difference in length of stay, operating room time, or risk of infection. To the best of our knowledge, this is one of the first studies to evaluate the conceptions, attitudes, and beliefs of patients who undergo robotic-assisted TKA.

This study has several limitations. This is a small study done at one single institution, which may lead to questions regarding extrapolation to different institutions. Additionally, our questionnaire did not assess if someone had a manual TKA on their contralateral side, which could be a source of bias as well. Furthermore, our study did not evaluate patient-specific factors, such as socioeconomic or comorbidities, that may have influenced answers to these questions. Despite these limitations, this study allows surgeons to better understand the motivations and attitudes that patients have regarding a new innovative arthroplasty technology.

One of the findings of this study was that practitioners were the most influential in patients deciding to undergo robotic TKA. Barlow et al. evaluated the decision-making of patients regarding TKA using a systematic review of seven qualitative studies ($n = 234$ patients).¹⁵ Four of the studies assessed found that the relationship of the patient with the clinician was an important factor in the decision regarding undergoing TKA. Although these results were formulated through qualitative research, the importance of a good rapport and effective communication should be emphasized. This may be particularly important regarding new and innovative technologies such as robotic arthroplasty.

Patients from this study indicated that they believed that their components would be placed in a more optimal position when compared to manual TKA. Recently, Marchand et al. assessed the postoperative flexion and extension gaps of a cohort of patients who underwent robotic-assisted TKA ($n = 335$ patients).⁴ Postoperatively, they



found that all arthroplasties had extension gaps of -2 to 2 mm with a flexion gap being -2 to 2 mm in 99% (n = 332 of 335) of the cohort. Additionally, Sires et al. evaluated the accuracy and precision of bone cuts for robotic-assisted TKA in a series of 45 patients. When comparing actual bone cuts to the preoperative template, the mean difference in distal and anterior femur bone cuts was 0.38 and 0.44 mm, respectively. Tibia cuts showed a mean difference of 0.37 mm. Furthermore, 94% of the cuts were within 1 mm of the preoperative plan (n = 99 out of 105 cuts). Thus, robotic arthroplasty may allow for more precise and accurate component placement.

There was an overall belief within our cohort of achieving better outcomes with robotic TKA when compared to their manual counterparts. Recently, Marchand et al. evaluated the 1-year outcomes of those undergoing robotic TKA compared to manual arthroplasty in a 1:1 manner using the Western Ontario and McMaster Universities Osteoarthritis (WOMAC) score (n = 106 arthroplasties). They found those in the robotic cohort had better mean WOMAC scores at the final follow-up (6 versus 9 points; p = 0.03). Conversely, Liow et al. evaluated the 2-year outcomes of those who underwent robotic TKA (n = 31) versus conventional arthroplasty (n = 29).¹⁶ They found no difference in the final postoperative knee society scores (81 versus 79 points; p > 0.05). However, this study used a different robotic system, which may play a role in outcome differences. Therefore, it is plausible to achieve better outcomes with robotic arthroplasty when compared to their manual counterparts.

In conclusion, the majority of patients recommended robotic TKA. This may likely be influenced by their belief that they would achieve better component placement, less postoperative pain, and better outcomes when compared to their conventional arthroplasty counterparts. Furthermore, this study shows that patients are most influenced by their practitioners in the decision to undergo robotic TKA as opposed to manual TKA. As such, it is imperative that surgeons understand the perspective of patients, so they may be appropriately educated. Given the growing popularity of robotics and its potential cost and benefits, future studies should evaluate how attitudes and beliefs may

influence patient-reported satisfaction and outcomes in the long term.

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