Original Research

Robotic Total Knee Arthroplasty Surgeon Marketing: Do Claims Align With the Literature?

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ARTICLE INFO

ABSTRACT

Background: Robotic total knee arthroplasty (R-TKA) utilization and marketing continue to rise. We examined the marketing on surgeon websites regarding R-TKA benefits and sought to determine if the claims were supported by existing literature.
Methods: A Google search identified 10 physician websites from each of the 5 largest U.S. markets by population with the term "robotic total knee arthroplasty city, state." Claims on websites about R-TKA were categorized. Literature from 2012-2022 was reviewed for data "for" or "against" each claim. Level of evidence for each publication was collected.
Results: Fifty websites were captured that included 59 surgeons. A specific R-TKA platform was mentioned on 68% of websites. Website claims about robotics were placed into 8 major categories. Literature review supported the claims of more precise/accurate, reduced injury to tissue, and less pain with more literature "for" than "against" the claims.
Conclusions: Claims made on physician websites regarding the benefits of R-TKA are variable and not definitively supported by existing literature. Most available data can be categorized into levels of evidence III, IV, and V. There is a paucity of level I evidence to support the various marketing statements. Physicians should be cognizant of both the claims made on their websites and the literature that could be used to support or refute those specific claims.

Introduction

Utilization of robotic total knee arthroplasty (R-TKA) continues to increase, with a rise from 0.1% in 2009 to 0.7% in 2014 [1]. Marketing for R-TKA further drives interest in the technology from both a physician and consumer standpoint. As digital direct-to-consumer marketing evolves, consumers have exponentially increased their use of online medical searches and physician websites to gather information [2]. Surgeons in competitive markets may be inclined to adopt R-TKA in their practice for a variety of reasons including industry advertising money, the appearance of surgeon expertise and authority, and a competitive edge over other

surgeons not using R-TKA [3]. These market forces may drive arthroplasty surgeons to advertise the availability of R-TKA in their practice through websites linked to either a physician group or their individual name.

The American Academy of Orthopaedic Surgeons (AAOS) established in the Standards of Professionalism that advertising of services along with competition between and among orthopaedic surgeons is ethical and acceptable [4]. The Standards of Professionalism advises that physicians follow the U.S. Federal Trade Commission rules governing physician advertising but does not bar physicians from advertising specific services or making statements of benefit. Thus, physician websites may make claims about superior outcomes related to R-TKA. In contrast, the Australian Orthopaedic Association specifically recommends against advertising superior clinical results when using a robot [5]. To our knowledge, no studies have assessed the content of publicly made claims on physician websites related to R-TKA and evaluated the available

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Table 1
Categories of claims with individual listed claims from websites.

More precise/accurate	Minimally invasive	Rapid recovery	Reduced injury to tissue
Precise placement of implant	Smaller incisions	Shorter hospital stay	Less chance inadvertent injury
Improved sizing	Reduced scarring	Fewer physical therapy sessions	Better access to knee joint
Improved alignment	Minimally invasive	Quicker return to activities	Less bone loss
Less chance ligament balancing error	Less invasive	Shorter surgery	Reduced injury to adjacent tissue
Less chance cutting error		Rapid recovery	Less tissue damage
Improved surgical accuracy		Quicker recovery	Protects soft tissues and ligaments
More consistency			Preserve healthy tissue
Most advanced option			
Greater accuracy			
More accurate cuts			

Increased implant longevity	Less pain	Improved outcomes/function	Less blood loss
Increased implant longevity	Less pain	Reduced risk of infection	Minimal blood loss
Knee joint last longer	Less pain medication	Improved overall surgical outcome	Less blood loss
	Lower pain scores	More comfortable knee	
	Better pain control	Stronger joint	
		Increased range of motion	
		Better joint stability	
		Lower incidence of complications	
		More effective	
		Safer	
		Better health outcomes	
		More natural feeling	
		Higher overall satisfaction	
		Best outcomes	
		Improved joint function	
		More natural joint motion	
		Enhance natural knee function	
		Better patient satisfaction scores	

support for or against those assertions. The purpose of our study is to catalog physician websites for claims made regarding R-TKA, categorize these claims, and assess their merit based on the existing literature.

Material and methods

The top 5 largest U.S. markets by population were identified based on United States census data from 2021 and used as a surrogate for competitive orthopaedic markets [6]. These included New York City, Los Angeles, Chicago, Houston, and Phoenix. Using Google search engine, an internet search was performed using the term "robotic total knee arthroplasty city, state." All paid and company advertisements were excluded. We then identified the 10 website listings based on order of appearance on the search results page that mentioned R-TKA and identified an orthopaedic surgeon by name who performed R-TKA in either the Google details or the website accessed through the search link. Some webpages listed multiple surgeons associated with R-TKA. All surgeons who advertised that they utilized R-TKA on a given website were included for further analysis. Websites from a group of orthopedic surgeons without a clear indication of who utilized R-TKA and who did not were excluded from our analysis. Websites that advertised R-TKA but did not list a surgeon by name, such as hospital websites, were excluded. The search to identify websites was done on October 30, 2022. Prior to the search, all cookies, cache, and history were deleted on the computer so as not to influence website order. All websites were cataloged in a single day on the same computer. No Institutional Review board approval was required, given the nature of the publicly available data.

Each of the 50 websites was reviewed for claims made about the benefits of R-TKA, and each of these claims was recorded. The claims were then assimilated into categories based upon the content of the claim (Table 1). The major categories of robotic TKA

claims included the following: more precise/accurate, minimally invasive, rapid recovery, reduced injury to tissue, increased implant longevity, less pain, improved outcomes/function, and less blood loss. Websites were further gauged for the visibility of a specific R-TKA company or platform, whether there was literature linked to support the R-TKA claims, and academic vs private practice. We then performed a Pubmed search by author to determine if the surgeon advertising R-TKA had published literature on robotic TKA.

Next, a literature review utilizing PubMed, Medline, and Google Scholar was conducted to evaluate publications on R-TKA from 2010-2022. Studies that evaluated the merits of R-TKA, or lack thereof, were assimilated with focus on study topics that aligned with claims made on surgeon websites. The level of evidence for each publication was collected. The existing systematic review by Agarwal et al. (2020) was used as a base for the literature review [7]. The results, discussion, and conclusions sections in the body of each manuscript were reviewed. The literature was classified as either "for" or "against" a given claim based on the results presented in the manuscript data (Table 2). Some literature was both "for" and "against" different categories of claims in the same study depending upon the reported results. We did not critically evaluate each manuscript for study quality but instead collected their reported results to determine if they could be used on a website in support of a given claim.

Results

Fifty websites were captured, which included a total of 59 surgeons. Specific company (or companies) R-TKA platforms were mentioned on 34 of 50 (68%) websites. Reported benefits of TKA were reported on 32 of 50 (64%), while 8 of 50 (16%) websites provided links or references to published literature referencing the claim. Literature search demonstrated that 20 of the 59 (34%) identified surgeons had published on R-TKA. The practice type was

Table 2
Published literature "for" and "against" each claim category.

Claim	Literature for	Literature against
More precise/accurate	18 [8−25]	5 [26−30]
Minimally invasive	0	1 [27]
Rapid recovery	10 [16,28,31−38]	18 [11−13,16,27−30,34,36−44]
Reduced injury to tissue	4 [14,45−47]	1 [39]
Increase implant longevity	0	3 [9,26,27]
Less pain	8 [16,22,31,34,36,48−50]	5 [9,19,38,44,51]
Improved outcomes/function	9 [28,32,48−50,52−55]	26 [9,11−13,15,18,26−28,30,31,33,35−39,43,50,54,56−58]
Less blood loss	1 [13]	5 [27,29,30,34,39]

evaluated via public search with 12 academic practices and 38 private practices encompassing the 59 surgeons.

The major claim categories, along with the number of articles "for" and "against" each category are listed in Table 2. The category of "more precise/accurate" had the most literature in support of the claim, followed by "rapid recovery," "improved outcomes/function," "less pain," "reduced injury to tissue," and "less blood loss" in descending order. The claims of "minimally invasive" and "increased implant longevity" demonstrated no support in the literature. The claims of "more precise/accurate," "reduced injury to tissue," and "less pain" all had more literature in support of the claim than against. The categories of "minimally invasive," "rapid recovery," "increased implant longevity," "improved outcomes/ function," and "less blood loss" all had more literature against the claim.

Of the available literature, 3 publications were level I evidence, 13 were level II evidence, 25 were level III evidence, 7 were level IV evidence, and 5 were level V evidence. The literature in support of the claim "more precise/accurate" demonstrated a single manuscript with level I evidence, 7 with level II, 5 with level III, 3 with level IV, and 2 with level V. "Rapid recovery" had 2 manuscripts with level II evidence and 8 with level III. "Reduced injury to tissue" had 1 manuscript with level II and 3 with level V. "Less pain" had 2 publications with level II and 6 with level III. "Improved outcomes/ function" had 3 publications with level II, 5 with level II, and 1 with level IV. "Less blood loss" had a single manuscript in support with level II evidence (Table 3). The remaining 2 level I evidence publications were against the claims of "minimally invasive" and "rapid recovery."

A specific R-TKA platform was mentioned or had an image of the robotic platform on 68% of the websites. Of those who listed a company platform, 50% advertised Mako (Stryker, Mahwah, NJ), 8% Navio (Smith and Nephew, Pittsburgh, PA), 8% ROSA (Zimmer Biomet, Warsaw, IN), 2% Velys (Depuy Synthes, Raynham, MA), and 2% OMNIBotics (Corin, Tampa, FL). A single website listed both Mako and ROSA. There are no websites listed for Microport (Irvine, CA).

There were 10 websites that made a series of 5 identical claims using the same phrasing. These claims were: "smaller incision," "rapid recovery," "precise placement of implant," "reduced injury to adjacent tissues," and "increased longevity of the implant." Of these websites with identical appearing claims, 3 advertised Mako, 1 ROSA, 1 Navio, and 5 did not advertise a specific R-TKA platform.

Discussion

Robotic-assisted total knee arthroplasty utilization continues to rise, and marketing from both industry and physicians directly to patients is commonplace [2,3]. Orthopedic surgeons continue to promote themselves and their skills, particularly in competitive geographic markets. A precise determination of the benefits of new technology is difficult. In the recent past, metal-on-metal articulations were extensively advertised as a better option for wear and range of motion and were subsequently found to have catastrophic problems [60]. More recently, the direct anterior approach to hip arthroplasty has been the subject of extensive promotion on the internet [61]. Our study shows that direct advertising is now common on the internet for robotic-assisted arthroplasty.

We discovered overarching themes regarding claims made about R-TKA through a search of orthopedic surgeon websites and categorized similar claims into 8 categories. We did not critically appraise the literature for study quality but instead evaluated the results of each study to determine if there were findings that could be cited in support of a website claim or if the results ran against a purported benefit. Differentiating literature support regarding claimed benefits of R-TKA is challenging due to the conflicting nature of the publications "for" or "against" a given claim [7,26]. While we attempted to parse the results of each study to determine if a claim was supported, prior literature has demonstrated that most studies comparing robotic to conventional techniques involve financially conflicted authors, which could potentially influence the "for" claims [62].

Only the categories of "more precise/accurate," "reduced injury to tissue," and "less pain" were found to have more citations in support of the claim than against. In all other categories, the quantity of available literature against the claim outnumbered those in support. Frequently, a given citation could be used "for" one claim and "against" another claim. As an example of conflicting evidence as it pertained to the category of "rapid recovery," Samuel et al. (2021) demonstrated in propensity-matched cohorts of manual total knee arthroplasty (M-TKA) and R-TKA that patient reported outcomes were similar between cohorts while M-TKA had significantly shorter operative time and fewer physical therapy visits. However, R-TKA had a longer operative time with shorter hospital length of stay [37]. The shorter hospital stay is "for" the rapid recovery category, while the fewer physical therapy visits with M-TKA are "against" the same category (Table 1). Only 3 of the identified publications were level 1 evidence (Fig. 1). This further brings to light the paucity of high-quality literature surrounding R-TKA and does call into question the ability to support a website marketing claim with the existing literature.

We identified 10 websites that were portrayed as being personalized websites for a single surgeon, yet all made identical claims that were presented in the same phrasing format. This suggests that the content was provided by a third-party operator, and direct surgeon involvement in content creation remains unclear. While this strategy allows surgeons with a busy clinical practice to delegate digital marketing to companies with the expertise, it would mean the surgeon is allowing his or her name to be placed on publicly available online content that is being provided by a third-party entity. There is no variation in the claims as listed on these websites, which also suggests that the surgeons may not have had the opportunity to vet, edit, or individualize the

Table 3
Level of evidence of published literature "for" claims [59].

Claim	Level of evidence of "for" claims				
	I	II	III	IV	IV
More precise/accurate	1	7	5	3	2
Rapid recovery	0	2	8	0	0
Reduced injury to tissue	0	1	0	0	3
Less pain	0	2	6	0	0
Improved outcomes/function	0	3	5	1	0
Less blood loss	0	1	0	0	0

claims in support of R-TKA. Further, no literature on the website is referenced to support said claims. Surgeons should assess marketing opportunities to ensure alignment with the values of AAOS, physician personal values, and verify that claims made are supported by the existing literature.

We recognize that our study has several weaknesses. The 8 major categories of claims were created through grouping of similar claims. This was a subjective process wherein these claims could be alternatively classified into different groups, which would impact the literature scoring for support of claims. However, we believe similar claims were successfully assimilated. We only evaluated literature from 2012-2022, as this period aligns with the recent rise in R-TKA publications [3]. Newer literature will continue to evaluate the benefits of R-TKA moving forward, which will impact support for claims, which means our results are temporarily limited. The order of websites that appear within a Google search may change depending on the search algorithm and the search terms used. A different search term may have resulted in different physician websites appearing or may have impacted the order in which the websites appeared. We also submit that we do not have a defined method for how a potential patient may search for a physician; thus, we attempted to construct a search phrase with simple wording that an educated healthcare consumer might utilize. We may have obtained significantly different results by using a different search methodology. We did not seek to include all surgeons that advertise online. As such, we targeted the 5 most populated cities in the United States as a surrogate for the most competitive markets for arthroplasty surgeons. We do not claim these cities to have the highest arthroplasty volume or the highest utilization of R-TKA; instead, we chose these cities because they may have competitive environments for orthopedic surgeons and thus may drive the surgeon to seek a competitive advantage by offering a specific technology that others do not. We recognize that these particular cities are not generalizable to other parts of the country or the international setting. We recognize the data presented here is limited to the United States and is likely neither relevant nor can it be extrapolated to an international audience given the particular healthcare environment in the United States.

Conclusions

Claims made on physician websites regarding the benefits of R-TKA are highly variable and not well supported by the existing literature. For claims that have more literature in support, much of the available evidence is level III, IV, or V. Level I support for claims made in advertising robotic-assisted total knee arthroplasty is largely lacking. Surgeons should be cognizant of the claims made on websites bearing their names along with the advertisement of a particular R-TKA platform, given the lack of high-quality evidence. Further studies are needed to determine the validity of the purported R-TKA benefits.
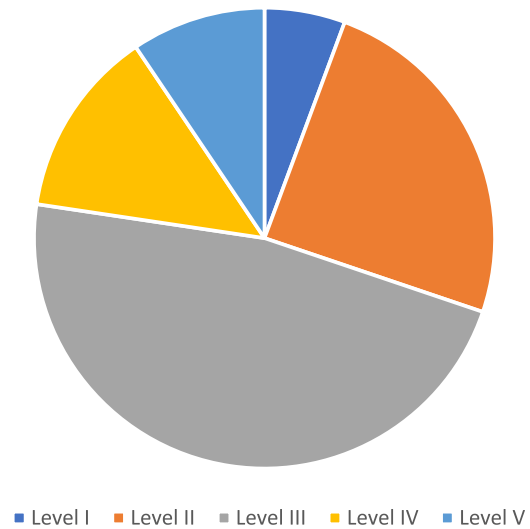

Figure 1. Publication levels of evidence.

CRediT authorship contribution statement

Dustin B. Rinehart: Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Data curation. **Jeffrey B. Stambough:** Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Simon C. Mears:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Investigation, Formal analysis, Data curation, Conceptualization. **C. Lowry Barnes:** Writing – review & editing, Writing – original draft, Project administration, Investigation, Formal analysis, Conceptualization. **Benjamin Stronach:** Writing – review & editing, Writing – original draft, Project administration, Investigation, Formal analysis, Data curation, Conceptualization.

Acknowledgments

Conflicts of interest

C. Lowry Barnes receives royalties from DJO and Zimmer; is a paid consultant of MicroPort Orthopaedics; has stock options in Avant-garde Health, BEKHealth, Clozex Medical, Excelerate Health Ventures, Green OR, Hayle Surgical, In2Bones SAS, MiCare Path, Plakous, Ride Health, ROM3 Rehab, LLC, Sleep Partners, LLC, and Sniffle; is an editorial/governing board member of Journal of Knee Surgery and Journal of Surgical Orthopaedic Advances; and is a board/committee member of American Association of Hip and Knee Surgeons, HipKnee Arkansas Foundation, and Southern Orthopaedic Association. B. M. Stronach receives royalties from MiCare Path, Sawbones/Pacific Research Laboratories, and Tightline Development LLC; is a speaker bureau of DJ Orthopaedics; is a paid

consultant of DJ Orthopaedics and Johnson & Johnson; has stock options in Joint Development LLC; is an editorial board member of JBJS-Br; and is a board/committee member of AAOS and the American Association of Hip and Knee Surgeons. S. C. Mears has stock options in Delta Ortho LLC; is an editorial board member of Journal of the American Geriatrics Society and SAGE; and is a board/committee member of Fragility Fracture Network. J. B. Stambough receives royalties from Signature Orthopaedics; is a paid consultant and receives financial support from Smith & Nephew; is an editorial board member of the Journal of Arthroplasty; and is a board/committee member of the American Association of Hip & Knee Surgeons (AAHKS), Education Committee (AJRR), and Steering Committee. The other author declares no potential conflicts of interest.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2024.101357.

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