Journal of Robotic Surgery (2020) 14:155–165
https://doi.org/10.1007/s11701-019-00956-9

ORIGINAL ARTICLE

# The 100 most influential manuscripts in robotic surgery: a bibliometric analysis

**Tara M. Connelly[1] · Zoya Malik[1] · Rishabh Sehgal[1] · Gerrard Byrnes[1] · J. Calvin Coffey[1,2] · Colin Peirce[1,2]**

Received: 10 March 2019 / Accepted: 28 March 2019 / Published online: 4 April 2019



## Abstract

Since the first robotic assisted surgery in 1985, the number of procedures performed annually has steadily increased. Bibliometric analysis highlights the key studies that have influenced current practice in a field of interest. We use bibliometric analysis to evaluate the 100 most cited manuscripts on robotic surgery and discuss their content and influence on the evolution of the platform. The terms 'robotic surgery,' 'robot assisted surgery' and 'robot-assisted surgery' were used to search Thomson Reuters Web of Science database for full length, English language manuscripts. The top 100 cited manuscripts were analyzed by manuscript type, surgical specialty, first and last author, institution, year and journal of publication. 14,980 manuscripts were returned. Within the top 100 cited manuscripts, the majority featured urological surgery ($n=28$), followed by combined results from multiple surgical subspecialties ($n=15$) and colorectal surgery ($n=13$). The majority of manuscripts featured case series/reports ($n=42$), followed by comparative studies ($n=24$). The most cited paper authored by Nelson et al. (432 citations) reviewed technological advances in the field. The year and country with the greatest number of publications were 2009 ($n=15$) and the USA ($n=68$). The Johns Hopkins University published the most top 100 manuscripts ($n=18$). The 100 most cited manuscripts reflect the progression of robotic surgery from a basic instrument-holding platform to today's articulated instruments with 3D technology. From feasibility studies to multicenter trials, this analysis demonstrates how robotic assisted surgery has gained acceptance in urological, colorectal, general, cardiothoracic, orthopedic, maxillofacial and neuro surgery.


**Keywords** Robotic surgery · Robot-assisted surgery · Bibliometric analysis

## Introduction

To date, over 2 million robot-assisted surgeries have been performed in the United States [1]. The first was performed in 1985. The Programmable Universal Machine for Assembly (PUMA) was used to obtain neurosurgical biopsies and for resection [2]. This was followed by the first minimally invasive surgery, a laparoscopic cholecystectomy, in 1987 [3]. The robotic and laparoscopic fields were subsequently combined with the development of the voice command AESOP robotic system in 1994. This system was primarily used for holding an endoscope to eliminate tremor and unnecessary movements [2]. This was followed by the ZEUS system which was comprised of 3 arms and a control console. The earliest version of the most commonly used platform today, the daVinci system was first utitlised in the hospital setting in 1999. This platform provides a 3-dimensional view and articulated instruments. Its first published use in humans was for a gastric fundoplication [4].

Currently, proponents of robotic-assisted surgery highlight the precision and cosmesis afforded by its use. Opponents note increased cost and prolonged operative times when compared to open and laparoscopic approaches. Although, it is most commonly utilised for urological, colorectal and gynecological surgery, it is gaining acceptance in several other fields including neurosurgery and orthopedic, cardiothoracic and maxillofacial surgery. As a result, several studies, reviews and case series have been published in this relatively novel field. We aimed to determine the most influential of these works using bibliometric analysis.

✉ Tara M. Connelly
tarconnelly@rcsi.ie

1 Department of Colorectal Surgery, University Hospital Limerick, Dooradoyle, Limerick, Ireland

2 Graduate Entry Medical School, University of Limerick, Limerick, Ireland

Bibliometric analysis records and analyses the citation history of individual manuscripts on a topic of interest. The number of citations of a particular manuscript in subsequent publications reflects its contribution to the field of interest and is often considered a proxy for how influential a work is. Thus, a large number of citations suggest a direct influence on the understanding and development of the field of interest. Bibliometric citation analysis has been used to analyse the most influential scientific papers in plastic, orthopedic and general surgery [5–7]. Such analysis has had not yet been performed for robotic surgery.

## Methods

The terms 'robotic surgery,' 'robot assisted surgery' and 'robot-assisted surgery' were used to search Thomson Reuters Web of Science database. Available from: http://thomsonreuters.com/thomson-reuters-web-of-science/). The search was performed on Sept 1st 2018 and limited to full length, English language manuscripts. No limitations on publication date were applied. The returned dataset was sorted by number of citations. The 100 most cited manuscripts were identified and further evaluated. Number of citations, title, first and senior author, publishing institution of first author, year of publication and the country of origin of each manuscript were recorded and analyzed. This method was developed by Paladugu [7] and replicated by Kelly, Joyce and Kavanagh [8–10]. The 2017 and 5 year impact factors of each journal publishing the manuscripts were determined using InCites Journal Citation reports (Clarivate Analytics, 2018) and recorded.

## Results

The Web of Science search returned 14,980 full-length English language papers. The number of citations derived from each of the top 100 cited works ranges from 492 (Nelson's 'Microbots for Minimally Invasive Surgery') to 122 (Kreindler's 'Computer-Assisted And Robot-Assisted Resection of Thalamic Astrocytomas in Children') [11, 12]. Published in 1991, Kreindler's manuscript was also the oldest manuscript featured on the list. The most recent manuscript was published in 2015. This manuscript by Wakabayashi et al. reported a consensus statement on liver resection from the Second International Consensus Conference Held in Morioka, Japan [13]. The year which yielded the highest number of influential papers was 2009 ($n=15$, 2608 citations) followed by 2007 ($n=9$, 1855 citations, Fig. 1). The top 10 manuscripts are provided in Table 1. The complete list of 100 manuscripts is provided in Table 2. The majority ($n=4$) of the top 10 featured urology, followed by maxillofacial surgery ($n=2$), collaborations between multiple surgical subspecialities ($n=2$), general surgery ($n=1$) and medical engineering ($n=1$).

The top 100 manuscripts were published in 38 journals (Table 3). European Urology published the most papers in

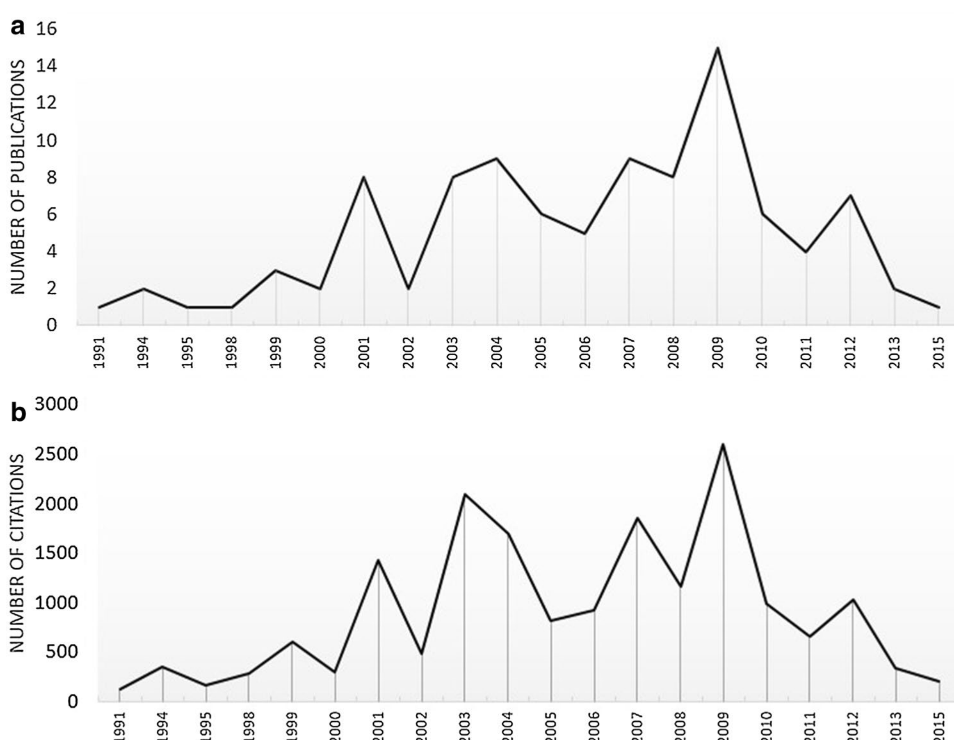


**Fig. 1** **a** Number of top 100 publications per year. **b** Number of top 100 citations per year

**Table 1** Top 10 cited manuscripts

| | Times cited | First author | Last author | Title | Year | Field | Country |
|---|---|---|---|---|---|---|---|
| 1 | 494 | Nelson, BJ | Abbott, JJ | Microrobots for minimally invasive medicine | 2010 | Other | Switzerland |
| 2 | 432 | Taylor, RH | Stoianovici, D | Medical robotics in computer-integrated surgery | 2003 | Other | USA |
| 3 | 417 | Giulianotti, PC | Caravaglios, G | Robotics in general surgery—personal experience in a large community hospital | 2003 | General surgery | Italy |
| 4 | 390 | Lanfranco, AR | Meyers, WC | Robotic surgery—a current perspective | 2004 | Multiple fields | USA |
| 5 | 340 | Tewari, A | Menon, M | A prospective comparison of radical retropubic and robot-assisted prostatectomy: experience in one institution | 2003 | Urology | USA |
| 6 | 328 | Menon, M | Peabody, JO | Vattikuti Institute prostatectomy: Contemporary technique and analysis of results | 2007 | Urology | USA |
| 7 | 306 | O'Malley, BW | Hockstein, NG | Transoral robotic surgery (TORS) for base of tongue neoplasms | 2006 | Oral/Max Facs | USA |
| 8 | 304 | Benway, BM | Stifelman, MD | Robot assisted partial nephrectomy versus laparoscopic partial nephrectomy for renal tumors: a multi-institutional analysis of perioperative outcomes | 2009 | Urology | USA |
| 9 | 301 | | Ballantyne, GH | Robotic surgery, telerobotic surgery, telepresence, and telementoring—review of early clinical results | 2002 | Multiple fields | USA |
| 10 | 298 | Menon, M | Ghoneim, MA | Nerve-sparing robot-assisted radical cystoprostatectomy and urinary diversion | 2003 | Urology | USA |

the top 100 and also generated the largest number of citations with 15 papers and a total of 2595 citations. The United States of America is the country with the greatest number of publications in the top 100 ($n=68$) followed by Korea and Italy ($n=4$ each, Fig. 2). The Johns Hopkins University was the institution that had the greatest number of manuscripts with eight papers generating 1605 citations combined (Table 4). The University of Pennsylvania, Vattikuti Urology Institute, Henry Ford Health System, Yonsei University College of Medicine and Cleveland Clinic followed with five top 100 publications each.

Seven authors had three or more first and or senior authorship in the top 100 list (Table 5). M. Menon, the Rajendra and Padma Vattikuti Chair in Oncology at the Vattikuti Urology Institute, Henry Ford Health System in Michigan, USA, had the most authorships with 3 first and 3 senior authorships. He has made several advances in the field of robotic prostatectomy including developing the Vattikuti Institute Prostatectomy.

The majority of top 100 manuscripts featured urological surgery ($n=28$), followed by collaborations between multiple specialities ($n=15$), colorectal surgery ($n=13$), other fields ($n=11$), maxillofacial surgery ($n=8$), hepatobiliary surgery ($n=7$), cardiothoracic surgery and gynecology ($n=5$ each), upper gastrointestinal surgery, thyroid/endocrine surgery, orthopedics ($n=2$ each) and general surgery and ortolaryngology ($n=1$ each) (Fig. 3).

The majority of studies were case series/reports ($n=42$), followed by comparative studies ($n=24$). Two animal studies were included (An Image-Directed Robotic System for Precise Orthopedic-Surgery and Robotic laparoscopic surgery: A comparison of the daVinci and Zeus Systems) [14, 15]. Two consensus statements were also included (Best Practices in Robot-assisted Radical Prostatectomy: Recommendations of the Pasadena Consensus Panel and Recommendations for Laparoscopic Liver Resection: A Report from the Second International Consensus Conference held in Morioka) [13, 16]. Two systematic reviews/meta-analyses were included (Robotic Versus Laparoscopic Partial Nephrectomy: A Systematic Review and Meta-Analysis and Positive Surgical Margin and Perioperative Complication Rates of Primary Surgical Treatments for Prostate Cancer: A Systematic Review and Meta-Analysis Comparing Retropubic, Laparoscopic, and Robotic Prostatectomy) [17, 18]. Three subspecialities contributed four multicentre trials to the top 100 (2 colorectal, 1 cardiothoracic and 1 maxillofacial surgery). The titles of the trials were: Robotic mitral valve surgery: A United States multicenter trial; Multicentric Study on Robotic Tumor-Specific Mesorectal Excision for the Treatment of Rectal Cancer; An international, multicentre, prospective, randomised, controlled, unblinded, parallel-group trial of robotic-assisted versus standard laparoscopic surgery for the curative treatment of rectal cancer and Transoral robotic surgery: A multicenter study to assess feasibility, safety, and surgical margins (Fig. 4) [19–22].

**Table 2** The top 100 manuscripts in robotic surgery

| Rank | Citations | First author | Rank | Citations | First author |
|---|---|---|---|---|---|
| 1 | 432 | Taylor, RH [11] | 51 | 155 | Peirs, J [71] |
| 2 | 417 | Giulianotti, PC [27] | 52 | 154 | Sung, GT [15] |
| 3 | 390 | Lanfranco, AR [3] | 53 | 150 | Seamon, LG [72] |
| 4 | 340 | Tewari, A [28] | 54 | 150 | Tholey, G [73] |
| 5 | 328 | Menon, M [29] | 55 | 149 | Geller, EJ [74] |
| 6 | 306 | O'Malley, BW [30] | 56 | 148 | Horgan, S [75] |
| 7 | 304 | Benway, BM [31] | 57 | 148 | Bodner, J [76] |
| 8 | 301 | Ballantyne, GH [4][a] | 58 | 146 | Gehrig, PA [77] |
| 9 | 298 | Menon, M [32] | 59 | 146 | Baik, SH [78] |
| 10 | 284 | Weinstein, GS [33] | 60 | 145 | Wang, AJ [79] |
| 11 | 278 | DiGioia, AM [34] | 61 | 144 | Weinstein, GS [22] |
| 12 | 270 | Badani, KK [35] | 62 | 144 | Hassfeld, S [80] |
| 13 | 259 | Ficarra, V [36] | 63 | 143 | Rogers, CG [81] |
| 14 | 253 | Cadiere, GB [37] | 64 | 142 | Genden, EM [82] |
| 15 | 244 | Nix, J [38] | 65 | 141 | Zorn, KC [83] |
| 16 | 237 | Loulmet, D [39] | 66 | 141 | Rassweiler, J [84] |
| 17 | 231 | Gettman, MT [40] | 67 | 140 | Hanly, EJ [85] |
| 18 | 228 | Tewari, A [18] | 68 | 140 | Taylor, RH [14] |
| 19 | 226 | Taylor, R [41] | 69 | 140 | Davies[a] [86] |
| 20 | 219 | Baik, SH [42] | 70 | 139 | Mottrie, A [87] |
| 21 | 215 | Mohr, FW [43] | 71 | 137 | Yu, HY [88] |
| 22 | 214 | Wright, JD [44] | 72 | 137 | Menon, M [89] |
| 23 | 213 | Kang, SW [45] | 73 | 137 | Kitagawa, M [90] |
| 24 | 205 | Sackier, JM [46] | 74 | 137 | Howe, RD [91] |
| 25 | 203 | Mack, MJ[a] [47] | 75 | 136 | Nifong, LW [19] |
| 26 | 201 | Wakabayashi, G [13] | 76 | 135 | Simaan, N [92] |
| 27 | 199 | D'Annibale, A [48] | 77 | 135 | Lenihan, JP [24] |
| 28 | 198 | Magrina, JF [49] | 78 | 135 | Ballantyne, GH [93] |
| 29 | 197 | Nguyen, PL [50] | 79 | 135 | van der Meijden, OAJ [94] |
| 30 | 193 | Weinstein, GS [51] | 80 | 134 | Weinstein, GS [95] |
| 31 | 189 | Abbou, CC [52] | 81 | 134 | Hellan, M [96] |
| 32 | 183 | Lee, RS [53] | 82 | 133 | Aboumarzouk, OM [17] |
| 33 | 182 | Weber, PA [54] | 83 | 133 | Kim, JY [97] |
| 34 | 179 | Giulianotti, PC [55] | 84 | 132 | Atug, F [98] |
| 35 | 179 | Benway, BM [56] | 85 | 132 | Camarillo, DB [99] |
| 36 | 176 | Okamura[a] [57] | 86 | 132 | Shoham, M [100] |
| 37 | 174 | Delaney, CP [58] | 87 | 131 | Bokhari, MB [25] |
| 38 | 173 | Paraiso, MFR [59] | 88 | 131 | Pigazzi, A [20] |
| 39 | 173 | Kang, SW [60] | 89 | 130 | Corcione, F [101] |
| 40 | 167 | Kaouk, JH [61] | 90 | 129 | Scales, CD [102] |
| 41 | 165 | Okamura[a] [62] | 91 | 129 | Collinson, FJ [21] |
| 42 | 165 | Talamini, MA [63] | 92 | 129 | Spinoglio, G [103] |
| 43 | 164 | Pigazzi, A [64] | 93 | 127 | Moorthy, K [104] |
| 44 | 164 | Kavoussi, LR [23] | 94 | 127 | Pasticier, G [105] |
| 45 | 163 | Moore, EJ [65] | 95 | 124 | Nelson, B [106] |
| 46 | 160 | Falk, V [66] | 96 | 124 | Montorsi, F [16] |
| 47 | 159 | Krambeck, AE [67] | 97 | 123 | Daouadi, M [107] |
| 48 | 159 | Song, J [68] | 98 | 122 | Aron, M [108] |
| 49 | 157 | Maeso, S [69] | 99 | 122 | Kaul, S [109] |
| 50 | 155 | Gill, IS [70] | 100 | 122 | Drake, JM [12] |

[a]Denotes solitary author

**Table 3** Journals Publishing the Top 100 manuscripts

| | Number of top 100 manuscripts | Number of citations from publications | 2017 IF |
|---|---|---|---|
| European Urology | 15 | 2595 | 17.59 |
| Surgical Endoscopy and Other Interventional Techniques | 10 | 1651 | 3.12 |
| Journal of Urology | 8 | 1367 | 5.38 |
| Annals of Surgery | 6 | 1180 | 9.20 |
| BJU International | 5 | 1086 | 4.69 |
| Annals of Surgical Oncology | 4 | 617 | 3.86 |
| Diseases of The Colon & Rectum | 4 | 684 | 3.62 |
| International Journal of Robotics Research | 4 | 634 | 4.05 |
| Journal of Thoracic And Cardiovascular Surgery | 4 | 725 | 4.88 |
| Urology | 3 | 530 | 2.30 |
| Gynecologic Oncology | 3 | 494 | 4.54 |
| IEEE Transactions on Robotics and Automation | 3 | 704 | 2.13[a] |
| Laryngoscope | 3 | 613 | 2.44 |
| American Journal of Surgery | 2 | 272 | 2.14 |
| Annual Review of Biomedical Engineering | 1 | 117 | 8.79 |
| Archives of Otolaryngology-Head & Neck Surgery | 2 | 418 | 2.33[a] |
| European Journal of Cardio-Thoracic Surgery | 2 | 308 | 3.50 |
| JAMA-Journal of The American Medical Association | 2 | 417 | 47.66 |
| Obstetrics and Gynecology | 2 | 322 | 4.98 |
| Surgical Endoscopy-Ultrasound and Interventional Techniques | 1 | 205 | 2.37[b] |
| World Journal of Surgery | 1 | 253 | 2.77 |
| Annals of Otology Rhinology and Laryngology | 1 | 193 | 1.51 |
| Archives of Surgery | 1 | 417 | 4.92[a] |
| Cancer | 1 | 270 | 6.54 |
| Clinical Orthopaedics and Related Research | 1 | 278 | 4.09 |
| Current Opinion in Urology | 1 | 165 | 1.81 |
| Head and Neck-Journal For The Sciences and Specialties of The Head and Neck | 1 | 142 | 2.47 |
| Industrial Robot-An International Journal | 1 | 176 | 1.27 |
| Journal of Clinical Oncology | 1 | 197 | 26.03 |
| Journal of Laparoendoscopic and Advanced Surgical Techniques | 1 | 148 | 1.26 |
| Journal of Minimally Invasive Gynecology | 1 | 135 | 3.06 |
| Proceedings of The Institution of Mechanical Engineers Part H-Journal Of Engineering In Medicine | 1 | 140 | 1.12 |
| Sensors and Actuators A-Physical | 1 | 155 | 2.31 |
| Surgery | 1 | 213 | 3.57 |
| Surgical Clinics of North America | 1 | 135 | 1.95 |

[a]2014 Impact factor

[b]2001 Impact factor

## Discussion

The evolution of the robotic platform is illustrated by this bibliometric analysis. Early reports, including the first paper in the Top 100, feature the first platform, the PUMA. In 1994, Taylor describes the early systems used in orthopedics and details the second generation platform which was in clinical trial at that time [14]. In 1995 Kavoussi report on the improved camera control using the robotic platform in a small case series of 11 patients undergoing laparoscopic pelvic surgery [23]. These early feasibility studies are followed by studies in orthopedic, cardiothoracic, colorectal and gynecological surgery from 1991 to 2001. Between 2000 and 2004, the majority of studies were case series and reviews. The number of case studies peaked at 23 between 2005 and 2009 and a surge in studies comparing robot assisted surgery to laparoscopic surgery was seen. In the later years, the majority of multicentre

**Fig. 2** Countries of origin of the most cited manuscripts in robotic surgery

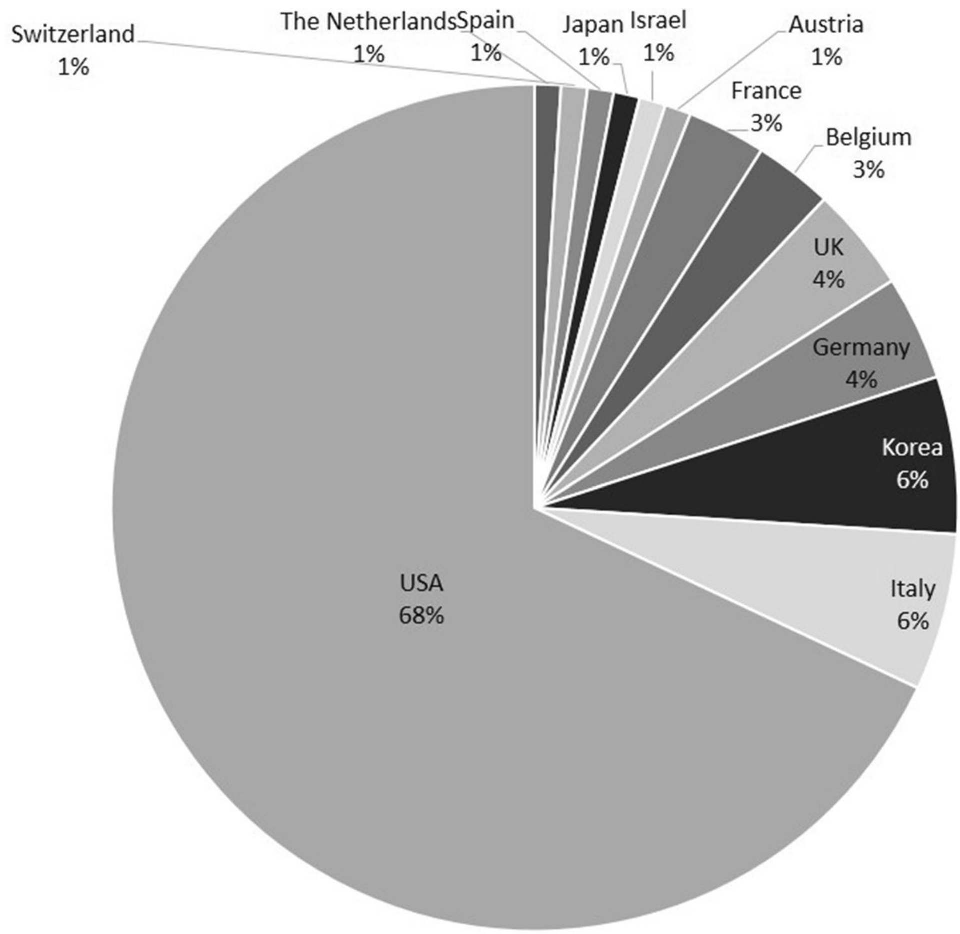


**Table 4** Top Publishing Institutions

| Institution | Number of manuscripts in top 100 | Number of citations |
|---|---|---|
| The Johns Hopkins University | 8 | 1605 |
| University of Pennsylvania | 5 | 1061 |
| Vattikuti Urology Institute, Henry Ford Health System | 5 | 1358 |
| Yonsei University College of Medicine | 5 | 897 |
| Cleveland Clinic | 5 | 790 |
| Mayo Clinic | 4 | 751 |
| Washington University School of Medicine | 3 | 628 |
| City of Hope National Medical Center | 3 | 429 |
| Hackensack University Medical Center | 3 | 618 |
| University of North Carolina at Chapel Hill | 3 | 539 |
| Drexel University | 2 | 540 |

trials published their results. The first systematic reviews/meta-analyses were also published. It is interesting that a large number of review papers were published in the earlier time period when limited evidence was available. This reflects the interest in the platform at the time. Evidence based reviews followed several years later, between 2010 and 2015.

After safety was established, the focus of the literature shifted to improvements in outcomes. Multiple manuscripts on the effect of a learning curve were published as it was noted that, with time, oncological outcomes improved and operating time decreased. Atug et al. described the learning curved and improved oncologic margins in prostatectomy over a 2-year time period [18]. Similarly, Leninhan

**Table 5** Authors with the most significant contributions to the top 100 manuscripts in robotic surgery

| | First author manuscripts | Senior author manuscripts |
|---|---|---|
| Menon, M | 3 | 3 |
| Weinstein, GS | 4 | – |
| Taylor, R | 3 | – |
| Pigazzi, A | 2 | 1 |
| Ballantyne, GH | 1 | 2 |
| Gill, IS | 1 | 2 |
| Kaouk, JH | 1 | 2 |

and Bokhari describe improved operating times and hospital lengths of stay in gynecological and colorectal surgery, respectively [24, 25]. Bokhari writes of their cohort that 'the learning phase was achieved after 15 to 25 cases [25].'

Although several subspecialities contribute to the Top 100, urological surgery is the main contributor. Both of the systematic reviews and consensus statements were from Urology groups. Additionally, the journal publishing the highest number of publications was a urological journal. This is due to the early adoption of robotics for prostatectomy and expansion of the platform to include nephrectomy and other urological procedures. This is followed by colorectal surgery. In both specialties, the robot assisted approach is particularly beneficial while operating deep in the pelvis, i.e. for a prostatectomy or total mesorectal excision for rectal carcinoma.

A large number of collaborations with single institutions present their data together in the Top 100. Several studies including all robotic assisted procedures performed to a specific date in a single institution (i.e. combined urological, colorectal and gynaecological results) are found. Although providing early data primarily on safety, it is often difficult to determine individual specialty results within these papers.

## Limitations

Several types of bias may have potentially affected our results. These biases are inherent to all bibliometric analyses and are well documented. Institutional, language, self-citation and powerful person bias and deliberate citation omission may result in disproportionate or inappropriate citations [26]. Often in bibliometric analyses, the majority of manuscripts are found in the earlier time periods of the study inclusion dates. A longer duration since publication often leads to the accumulation of a higher number of citations in older manuscripts. However, this is not found in our analysis. The majority of publications were between 2005 and 2009. This is likely due to the large number of case series published during this time.

Several multicentre collaborations are currently underway. Reports from these trials will in future alter the top 100 manuscripts as they will likely be cited heavily. Another limitation is the inclusion of only the senior and first authors and the institutions of the first author for analysis. In fact, several authors in the Top 100 may have contributed toward

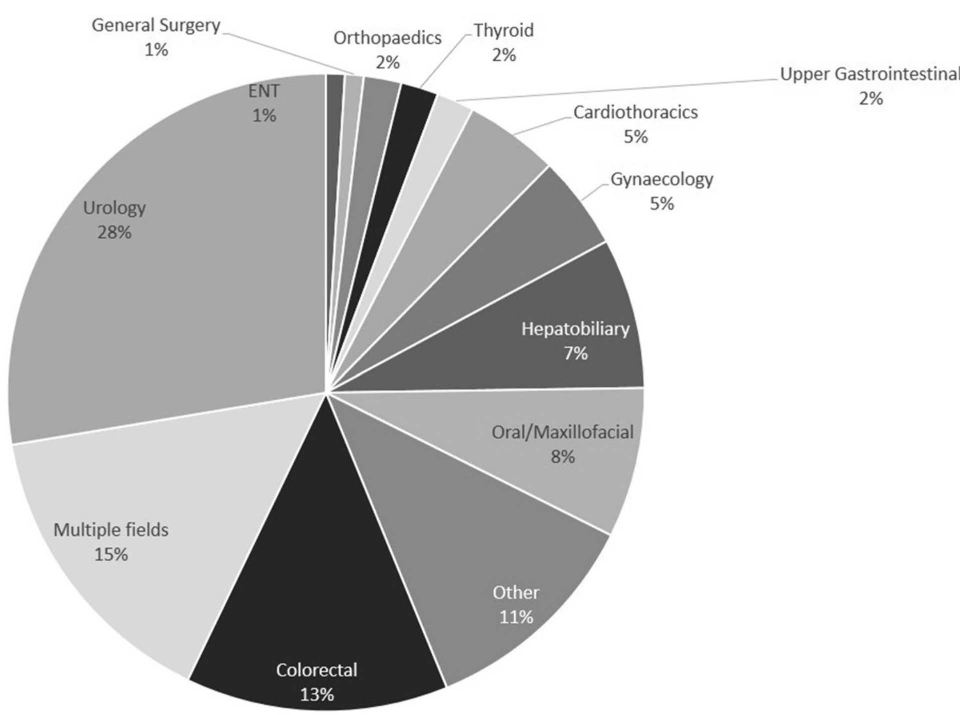


**Fig. 3** Top 100 by medical specialty

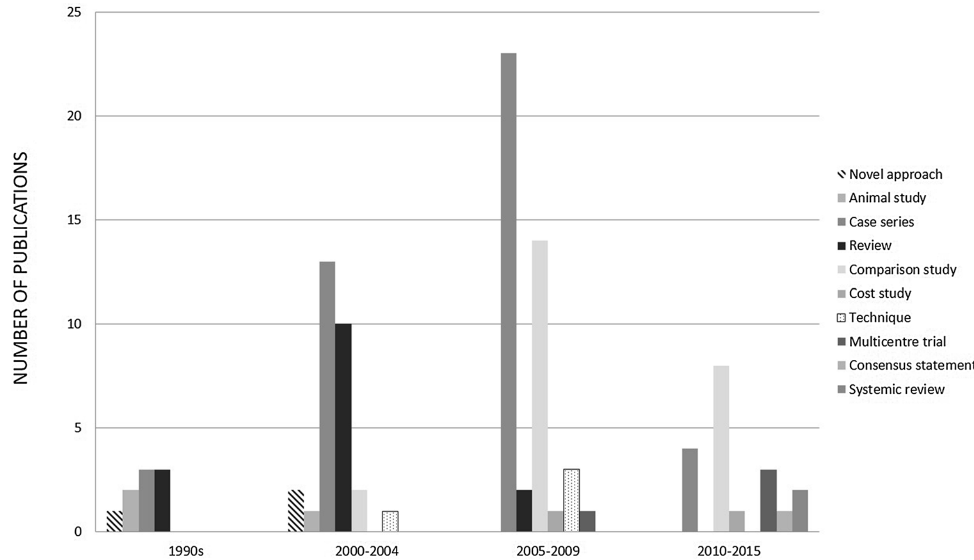


**Fig. 4** Manuscript types featured in the top 100 manuscripts

multiple manuscripts. However, including first and senior authors only reflects the authors traditionally with the most significant contribution to the manuscript.

In this work, we acknowledge the early observations and research from which the current platform has developed and will continue to develop. The ongoing advancements in robotic-assisted surgery means that the list of 100 most cited papers will change with these advancements. Thus, regular 5–10 yearly reviews of the most cited papers to keep up with advancements are warranted.

## Conclusion

The 100 most cited manuscripts highlighted describe the progression of the robotic surgical platform from a basic platform used to steadily hold instruments to the 3D platform with articulated instruments used today. These manuscripts highlight the evolution from early feasibility studies to effectiveness studies and finally multicentre trials and meta-analyses. These studies demonstrate how robotic assisted surgery has gained acceptance in the fields of urological, colorectal, general, cardiothoracic, orthopedic, maxillofacial and neurosurgery. These works were cited over 120 times each reflecting their impact on the field as it is today.

**Funding** No funding was used for this study.

### Compliance with ethical standards

**Conflict of interest** Drs. Tara M. Connelly, Zoya Malik, Rishabh Seghal, Gerrard Byrnes, J Calvin Coffey and Colin Peirce declare that he/she has no conflict of interest.

**Ethical approval** This article does not contain any studies with human participants performed by any of the authors. This article does not contain any studies with animals performed by any of the authors. This article does not contain any studies with human participants or animals performed by any of the authors.

## References


1. Alemzadeh H, Raman J, Leveson N, Kalbarczyk Z, Iyer RK (2016) Adverse events in robotic surgery: a retrospective study of 14 years of FDA data. PLoS One 11:e0151470
2. Pugin F, Bucher P, Morel P (2011) History of robotic surgery: from AESOP(R) and ZEUS(R) to da Vinci(R). J Visc Surg 148:e3–e8
3. Lanfranco AR, Castellanos AE, Desai JP, Meyers WC (2004) Robotic surgery: a current perspective. Ann Surg 239:14–21
4. Ballantyne GH (2002) Robotic surgery, telerobotic surgery, telepresence, and telementoring—review of early clinical results. Surg Endosc Other Interv Tech 16:1389–1402
5. Loonen MP, Hage JJ, Kon M (2008) Plastic surgery classics: characteristics of 50 top-cited articles in four plastic surgery journals since 1946. Plast Reconstr Surg 121:320e–327e
6. Dubin D, Hafner AW, Arndt KA (1993) Citation classics in clinical dermatologic journals. Citation analysis, biomedical journals, and landmark articles, 1945–1990. Arch Dermatol 129:1121–1129
7. Paladugu R, Schein M, Gardezi S, Wise L (2002) One hundred citation classics in general surgical journals. World J Surg 26:1099–1105
8. Kelly JC, Glynn RW, O'Briain DE, Felle P, McCabe JP (2010) The 100 classic papers of orthopaedic surgery: a bibliometric analysis. J Bone Joint Surg Br 92:1338–1343
9. Joyce CW, Kelly JC, Sugrue C (2014) A bibliometric analysis of the 100 most influential papers in burns. Burns 40:30–37
10. Kavanagh RG, Kelly JC, Kelly PM, Moore DP (2013) The 100 classic papers of pediatric orthopaedic surgery: a bibliometric analysis. J Bone Joint Surg 95:e134 **(American volume)**
11. Taylor RH, Stoianovici D (2003) Medical robotics in computer-integrated surgery. IEEE Trans Robot Autom 19:765–781

12. Drake JM, Joy M, Goldenberg A, Kreindler D (1991) Computer- and robot-assisted resection of thalamic astrocytomas in children. Neurosurgery 29:27–33
13. Wakabayashi G, Cherqui D, Geller DA et al (2015) Recommendations for laparoscopic liver resection: a report from the second international consensus conference held in Morioka. Ann Surg 261:619–629
14. Taylor RH, Paul HA, Hanson W et al (1994) An image-directed robotic system for precise orthopaedic surgery. IEEE Trans Robot Autom 10:261–275
15. Sung GT, Gill IS (2001) Robotic laparoscopic surgery: a comparison of the DA Vinci and Zeus systems. Urology 58:893–898
16. Montorsi F, Wilson TG, Rosen RC et al (2012) Best practices in robot-assisted radical prostatectomy: recommendations of the Pasadena Consensus Panel. Eur Urol 62:368–381
17. Aboumarzouk OM, Stein RJ, Eyraud R et al (2012) Robotic versus laparoscopic partial nephrectomy: a systematic review and meta-analysis. Eur Urol 62:1023–1033
18. Tewari A, Sooriakumaran P, Bloch DA (2012) Positive surgical margin and perioperative complication rates of primary surgical treatments for prostate cancer: a systematic review and meta-analysis comparing retropubic, laparoscopic, and robotic prostatectomy. Eur Urol 62:1–15
19. Nifong LW, Chitwood WR, Pappas PS et al (2005) Robotic mitral valve surgery: a United States multicenter trial. J Thorac Cardiovasc Surg 129:1395–1404
20. Pigazzi A, Luca F, Patriti A et al (2010) Multicentric study on robotic tumor-specific mesorectal excision for the treatment of rectal cancer. Ann Surg Oncol 17:1614–1620
21. Collinson FJ, Jayne DG, Pigazzi A et al (2012) An international, multicentre, prospective, randomised, controlled, unblinded, parallel-group trial of robotic-assisted versus standard laparoscopic surgery for the curative treatment of rectal cancer. Int J Colorectal Dis 27:233–241
22. Weinstein GS, O'Malley BW Jr, Magnuson JS et al (2012) Transoral robotic surgery: a multicenter study to assess feasibility, safety, and surgical margins. Laryngoscope 122:1701–1707
23. Kavoussi LR, Moore RG, Adams JB et al (1995) Comparison of robotic versus human laparoscopic camera control. J Urol 154:2134–2136
24. Lenihan J, Kovanda C, Seshadri-Kreaden U (2008) What is the learning curve for robotic assisted gynecologic surgery? J Minim Invasive Gynecol 15:589–594
25. Bokhari MB, Patel CB, Ramos-Valadez DI et al (2011) Learning curve for roboticassisted laparoscopic colorectal surgery. Surg Endosc 25:855–860
26. Seglen PO (1997) Citations and journal impact factors: questionable indicators of research quality. Allergy 52:1050–1056
27. Giulianotti PC, Coratti A, Angelini M et al (2003) Robotics in general surgery: personal experience in a large community hospital. Arch Surg 138:777–784
28. Tewari A, Srivasatava A, Menon M et al (2003) A prospective comparison of radical retropubic and robot-assisted prostatectomy: experience in one institution. BJU Int 92:205–210
29. Menon M, Shrivastava A, Sarle R et al (2003) Vattikuti Institute Prostatectomy: a single-team experience of 100 cases. J Endourol 17:785–790
30. O'Malley BW, Weinstein GS, Snyder W et al (2006) Transoral robotic surgery (TORS) for base of tongue neoplasms. Laryngoscope 116:1465–1472
31. Benway BM, Bhayani SB, Rogers CG et al (2009) Robot assisted partial nephrectomy versus laparoscopic partial nephrectomy for renal tumors: a multi-institutional analysis of perioperative outcomes. J Urol 182:866–872
32. Menon M, Hemal AK, Tewari A et al (2003) Nerve-sparing robot-assisted radical cystoprostatectomy and urinary diversion. BJU Int 92:232–236
33. Weinstein GS, O'Malley BW, Snyder W et al (2007) Transoral robotic surgery: radical tonsillectomy. Arch Otolaryngol Head Neck Surg 133:1220–1226
34. DiGioia AM, Jaramaz B, Colgan BD (1998) Computer assisted orthopaedic surgery—image guided and robotic assistive technologies. Clin Orthop Relat Res 354:8–16
35. Badani KK, Kaul S, Menon M (2007) Evolution of robotic radical prostatectomy: assessment after 2766 procedures. Cancer 110:1951–1958
36. Ficarra V, Cavalleri S, Novara G et al (2007) Evidence from robot-assisted laparoscopic radical prostatectomy: a systematic review. Eur Urol 51:45–55
37. Cadière GB, Himpens J, Germay O et al (2001) Feasibility of robotic laparoscopic surgery: 146 cases. World J Surg 25:1467–1477
38. Nix J, Smith A, Kurpad R et al (2010) Prospective randomized controlled trial of robotic versus open radical cystectomy for bladder cancer: perioperative and pathologic results. Eur Urol 57:196–201
39. Loulmet D, Carpentier A, d'Attellis N et al (1999) Endoscopic coronary artery bypass grafting with the aid of robotic assisted instruments. J Thorac Cardiovasc Surg 118:4–10
40. Gettman MT, Blute ML, Chow GK et al (2004) Robotic-assisted laparoscopic partial nephrectomy: technique and initial clinical experience with DaVinci robotic system. Urology 64:914–918
41. Taylor R, Jensen P, Whitcomb L et al (1999) A steady-hand robotic system for microsurgical augmentation. Int J Robot Res 18:1201–1210
42. Baik SH, Kwon HY, Kim JS et al (2009) Robotic versus laparoscopic low anterior resection of rectal cancer: short-term outcome of a prospective comparative study. Ann Surg Oncol 16:1480–1487
43. Mohr FW, Falk V, Diegeler A et al (2001) Computer-enhanced 'robotic' cardiac cardiac surgery: experience in 148 patients. J Thorac Cardiovasc Surg 121:842–853
44. Wright JD, Ananth CV, Lewin SN et al (2013) Robotically assisted vs laparoscopic hysterectomy among women with benign gynecologicdisease. JAMA 309:689–698
45. Kang SW, Lee SC, Lee SH et al (2009) Robotic thyroid surgery using a gasless, transaxillary approach and the da Vinci S system: the operative outcomes of 338 consecutive patients. Surgery 146:1048–1055
46. Sackier JM and WangY (1994) Robotically assisted laparoscopic surgery. From concept to development. Surg Endosc. 1994 Jan;8(1):63-6
47. Mack MJ (2001) Minimally invasive and robotic surgery. JAMA 285:568–572
48. D'Annibale A, Morpurgo E, Fiscon V et al (2004) Robotic and laparoscopic surgery for treatment of colorectal diseases. Dis Colon Rectum 47:2162–2168
49. Magrina JF, Kho RM, Weaver AL et al (2008) Robotic radical hysteretomy: comparison with laparoscopy and laparotomy. Gynecol Oncol 109:86–91
50. Nguyen PL, Gu X, Lipsitz SR et al (2011) Cost implications of the rapid adoption of newer technologies for treating prostate cancer. J Clin Oncol 29:1517–1524
51. Weinstein GS, O'Malley BW Jr, Snyder W et al (2007) Transoral robotic surgery: supraglottic partial laryngectomy. Ann Otol Rhinol Laryngol 116:19–23
52. Abbou CC, Hoznek A, Salomon L et al (2001) Laparoscopic radical prostatectomy prostatectomy with a remote controlled robot. J Urol 165:1964–1966

53. Lee RS, Retik AB, Borer JG et al (2006) Pediatric robot assisted laparoscopic dismembered pyeloplasty: comparison with a cohort of open surgery. J Urol 175:683–687
54. Weber PA, Merola S, Wasielewski A et al (2002) Telerobotic-assisted laparoscopic right and sigmoid colectomies for benign disease. Dis Colon Rectum 45:1689–1694
55. Giulianotti PC, Sbrana F, Bianco FM et al (2010) Robot-assisted laparoscopic pancreatic surgery: single-surgeon experience. Surg Endosc 24:1646–1657
56. Benway BM, Wang AJ, Cabello JM et al (2009) Robotic partial nephrectomy with sliding-clip renorrhaphy: technique and outcomes. Eur Urol 55:592–599
57. Okamura AM (2004) Methods for haptic feedback in teleoperated robot-assisted surgery. Ind Robot 31:499–508
58. Delaney CP, Lynch AC, Senagore AJ et al (2003) Comparison of robotically performed and traditional laparoscopic colorectal surgery. Dis Colon Rectum 46:1633–1639
59. Paraiso MF, Jelovsek JE, Frick A et al (2011) Laparoscopic compared with robotic sacrocolpopexy for vaginal prolapse: a randomized controlled trial. Obstet Gynecol 118:1005–1013
60. Kang SW, Jeong JJ, Yun JS et al (2009) Robot-assisted endoscopic surgery for thyroid cancer: experience with the first 100 patients. Surg Endosc 2:2399–2406
61. Kaouk JH, Goel RK, Haber GP et al (2009) Robotic single-port transumbilical surgery in humans: initial report. BJU Int 103:366–369
62. Okamura AM (2009) Haptic feedback in robot-assisted minimally invasive surgery. Curr Opin Urol 19:102–107
63. Talamini MA, Chapman S, Horgan S et al (2003) A prospective analysis of 211 robotic-assisted surgical procedures. Surg Endosc 17:1521–1524
64. Pigazzi A, Ellenhorn JD, Ballantyne GH et al (2006) Robotic-assisted laparoscopic low anterior resection with total mesorectal excision for rectal cancer. Surg Endosc 20:1521–1525
65. Moore EJ, Olsen KD, Kasperbauer JL (2009) Transoral robotic surgery for oropharyngeal squamous cell carcinoma: a prospective study of feasiblity and functional outcomes. Laryngoscope 119:2156–2164
66. Falk V, Diegeler A, Walther T et al (2000) Total endoscopic computer enhanced coronary artery bypass grafting. Eur J Cardiothorac Surg 17:38–45
67. Krambeck AE, DiMarco DS, Rangel LJ et al (2009) Radical prostectomy for prostatic adenocarcinoma: a matched comparison of open retropubicand robotassisted techniques. BJU Int 103:448–453
68. Song J, Oh SJ, Kang WH et al (2009) Robot- assisted gastrectomy with lymph node dissection for gastric cancer: lessons learned from an intial 100 consecutive procedures. Ann Surg 249:927–932
69. Maeso S, Reza M, Mayol JA et al (2010) Efficacy of the Da Vinci surgical system in abdominal surgery compared with that of laparoscopy: a systematic review and meta-analysis. Ann Surg 252:254–262
70. Gill IS, Eisenberg MS, Aron M et al (2011) "Zero ischemia" partial nephrectomy: novel laparoscopic and robotic technique. Eur Urol 59:128–134
71. Peirs J, Clijnen J, Reynaerts D et al (2004) A micro optical force sensor for force feedback during minimally invasive robotic surgery. Sens Actuators A 115:447–455
72. Seamon LG, Cohn DE, Henretta MS et al (2009) Miniamally invasive comprehensive surgical staging for endometrial cancer: robotics or laparoscopy? Gynecol Oncol 113:36–41
73. Tholey G, Desai JP, Castellanos AE (2005) Force feedback plays a significant role in minimally invasive surgery: results and analysis. Ann Surg 241:102–109
74. Geller EJ, Siddiqui NY, Wu JM et al (2008) Short-term outcomes of robotic sacrocolpopexy compared with abdominal sacrocolpopexy. Obstet Gynecol 112:1201–1206
75. Horgan S, Vanuno D (2001) Robots in laparoscopic surgery. J Laparoendosc Adv Surg Tech A. 11:415–419
76. Bodner J, Wykypiel H, Wetscher G et al (2004) First experiences with the da Vinci operating robot in thoracic surgery. Eur J Cardiothorac Surg 25:844–851
77. Gehrig PA, Cantrell LA, Shafer A et al (2008) What is the optimal minimally invasive surgical procedure for endometrial cancer staging in the obese and morbidly obsese woman? Gynecol Oncol 111:41–45
78. Baik SH, Ko YT, Kang CM et al (2008) Robotic tumor-specific mesorectal excision of rectal cancer: short-term outcome of a pilotrandomized trial. Surg Endosc 22:1601–1608
79. Wang AJ, Bhayani SB (2009) Robotic partial nephretomy versus laparoscopic partial nephrectomy for renal cell carcinoma: single-surgeon analysis of > 100 consecutive procedures. Urology 73:306–310
80. Hassfeld S, Mühling J (2001) Computer assisted oral and maxillofacial surgery-a review and assessment of technology. Int J Oral Maxillofac Surg 30(1):2–13
81. Rogers CG, Singh A, Blatt AM et al (2008) Robotic partial nephrectomy for complex renal tumors: surgical technique. Eur Urol 53:514–521
82. Genden EM, Desai S, Sung CK (2009) Transoral robotic surgery for the management of head and neck cancer: a preliminaryexperience. Head Neck 31:283–289
83. Zorn KC, Gofrit ON, Orvieto MA et al (2007) Robotic-assisted laparoscopic prostatectomy: functional and pathologic outcomes with interfascial nerve preservation. Eur Urol 51:755–762
84. Rassweiler J, Hruza M, Teber D et al (2006) Laparoscopic and robotic assisted radical prostatectomy –critical analysis of the results. Eur Urol 49:612–624
85. Hanly EJ, Talamini MA (2004) Robotic abdominal surgery. Am J Surg 188:19S26S
86. Davies B (2000) A review of robotics in surgery. Proc Inst Mech Eng H 214:129–140
87. Mottrie A, De Naeyer G, Schatteman P et al (2010) Impact of the learning curve on perioperative outcomes in patients who underwent roboticpartial nephrectomy for parenchymal renal tumours. Eur Urol 58:127–132
88. Yu HY, Hevelone ND, Lipsitz SR et al (2012) Use, costs and comparative effectiveness of robotic assisted, laparoscopic and open urological surgery. J Urol 187:1392–1398
89. Menon M, Kaul S, Bhandari A et al (2005) Potency following robotic radical prostatectomy: a questionnaire based analysis of outcomes after conventional nerve sparing and prostatic fascia sparing techniques. J Urol 174:2291–2296
90. Kitagawa M, Dokko D, Okamura AM et al (2005) Effect of sensory substitution on suture-manipulation forces for robotic surgical systems. J Thorac Cardiovasc Surg 129:151–158
91. Howe RD, Matsuoka Y (1999) Robotics for surgery. Annu Rev Biomed Eng 1:211–240
92. Simaan N, Xu K, Kapoor A et al (2009) Design and integration of a telerobotic telerobotic system for minimally invasive surgery of the throat. Int J Rob Res 1:1134–1153
93. Ballantyne GH, Moll F (2003) The da Vinci telerobotic surgical system: the virtual operative field and telepresence surgery. Surg Clin North Am 83:1293–1304
94. van der Meijden OA, Schijven MP (2009) The value of haptic feedback in conventional and robot-assisted minimal invasive surgery and virtual reality training: a current review. Surg Endosc 23:1180–1190

95. Weinstein GS, O'Malley BW Jr, Cohen MA et al (2010) Transoral robotic surgery for advanced oropharyngeal carcinoma. Arch Otolaryngol Head Neck Surg 136:1079–1085
96. Hellan M, Anderson C, Ellenhorn JD et al (2007) Short-term outcomes after roboticassisted total mesorectal excision for rectal cancer. Ann Surg Oncol 14:3168–3173
97. Kim JY, Kim NK, Lee KY et al (2012) A comparative study of voiding and sexual function after total mesorectal excision with autonomic nerve preservation for rectal cancer: laparoscopic versus robotic surgery. Ann Surg Oncol 19:2485–2493
98. Atug F, Castle EP, Srivastav SK et al (2006) Positive surgical margins in roboticassisted radical prostatectomy: impact of learning curve on oncologic outcomes. Eur Urol 49:866–871
99. Camarillo DB, Krummel TM, Salisbury JK Jr (2004) Robotic technology in surgery: past, present, and future. Am J Surg 188:2S–15S
100. Shoham M, Burman M, Zehavi E et al (2003) Bone-mounted miniature robot for surgical procedures: concept and clinical applications. IEEE Trans Robot Autom 19:893–901
101. Corcione F, Esposito C, Cuccurullo D et al (2005) Advantages and limits of robotassisted laparoscopic surgery: preliminary experience. Surg Endosc 19:117–119
102. Scales CD Jr, Jones PJ, Eisenstein EL et al (2005) Local cost structures and the economics of robot assisted radical prostatectomy. J Urol 174(6):2323–2329
103. Spinoglio G, Summa M, Priora F et al (2008) Robotic colorectal surgery: first 50 cases experience. Dis Colon Rectum 51:1627–32104
104. Moorthy K, Munz Y, Dosis A et al (2004) Dexterity enhancement with robotic surgery. Surg Endosc 18:790–795
105. Pasticier G, Rietbergen JB, Guillonneau B et al (2001) Robotically assisted laparoscopic radical prostatectomy: feasibility study in men. Eur Urol 40:70–74
106. Nelson B, Kaufman M, Broughton G et al (2007) Comparison of length of hospital stay between radical retropubic prostatectomy and robotic assisted laparoscopic prostatectomy. J Urol 177:929–931
107. Daouadi M, Zureikat AH, Zenati MS et al (2013) Robot-assisted minimally invasive distal pancreatectomy is superior to the laparoscopic technique. Ann Surg 257:128–132
108. Aron M, Koenig P, Kaouk JH et al (2008) Robotic and laparoscopic partial nephrectomy: a matched-pair comparison from a high-volume centre. BJU Int 102:86–92
109. Kaul S, Laungani R, Sarle R et al (2007) da Vinci-assisted robotic partial nephrectomy: technique and results at a mean of 15 months of follow-up. Eur Urol 51:186–191