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Original research

Global scientific production of robotic surgery in medicine: A 20-year survey of research activities

Guoxin Fan [1], Zhi Zhou [1], Hailong Zhang, Xin Gu, Guangfei Gu, Xiaofei Guan, Yunshan Fan, Shisheng He*

Orthopedic Department, Shanghai Tenth People's Hostipal, Tongji University School of Medicine, China

HIGHLIGHTS

- This was the first bibliometric analysis to demonstrate the macroscopic view of robotic surgery.
- There is a skyrocket trend of robotic surgery over the last two decades.
- Countries with high GDP tend to make more contributions.

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ABSTRACT

Introduction: Robot-assisted surgery operations are being performed more frequently in the world these years. In order to have a macroscopic view of publication activities about robotic surgery, the first bibliometric analysis was conducted to investigate the publication distributions of robotic surgery.

Methods: The original articles about robotic surgery were extracted from the Science Citation Index Expanded (SCI-E) on Web of Science and analyzed concerning their distributions. We also explored the potential correlations between publications of different countries and their Gross Domestic Product (GDP).

Results: The total number of original articles retrieved from SCI-E was 3362 from 1994 to 2015. The number of original articles published in the last decade has a burgeoning increase of 572.87% compared with that published in the former decade. The leading country was USA who have published 1402 pieces of articles (41.701%), followed by Germany with 342 (10.173%). The journal published the highest number of original articles was Journal of Endourology with 237 (7.049%), followed by Surgical Endoscopy and Other Interventional Techniques (188, 5.592%). There was strong correlations between publication numbers and GDP of different countries ($r^2 = 0.889$, $p < 0.001$). In the different medical fields, urology has the highest number of articles (n = 878, 26.007%).

Discussions: The macroscopic view of research activities has the potential to guide future trend in the field of robotic surgery.

Conclusions: There is a skyrocket trend of robotic surgery in medical research over the last two decades, and countries with high GDP tend to make more contributions to the medical field of robotic surgery.

1. Introduction

For decades, surgical robots have gained more and more attentions all over the world, and it began playing an important role in current clinical practice [1,2]. Surgical robots provide surgeons with advanced hand and create a new surgical fields which are less-invasive with virtual reality, micro observation, and remote operation [3]. It has been validated that the application of robotic technology for surgery was technically feasible and safe with the help of improved dexterity, better visualization, and high level of precision [4]. To provide a macroscopic view about the distributions of robotic surgery and evaluate the value of the articles about robot surgery might be an interesting topic to witness its development. However, to the best of our knowledge, there was no available literature of bibliometric analysis focusing on robotic surgery.

* Corresponding author. 301 Yanchang Road, Shanghai, 200072, China.
E-mail address: tjhss7418@foxmail.com (S. He).
[1] These two authors equally contribute to the study.

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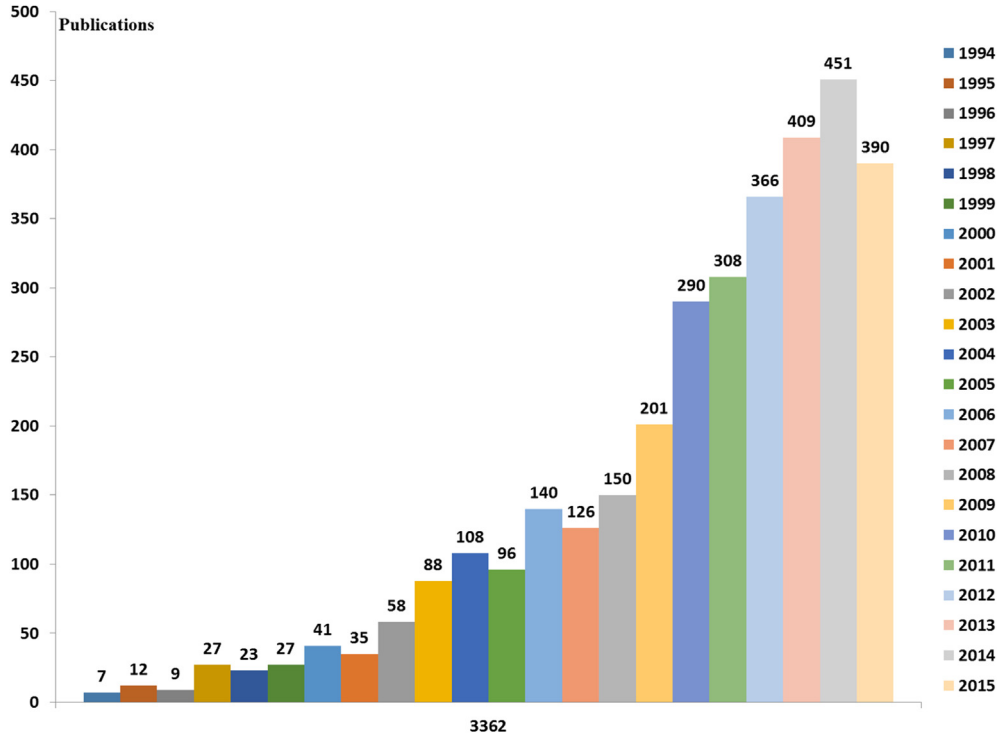

Fig. 1. Publications about robot surgery from SCI-E distributing in each year (by Nov. 2015).

Nowadays, the quantity and quality of scientific literature are well-validated measurements of scientific achievement. The contents and quantity of scientific literature can be used to analyze the history and current status of science and technology and to forecast trends [5]. Bibliometric technique is a useful tool for appraising research output quality [6], which is becoming a parameter for academic achievement to prioritize resources and funds support in academic institutions and funding sectors [7]. Bibliometric analysis has been performed in many medical fields such as head and surgery [8,9], dentistry [10,11], general surgery [12], cardiac surgery [13], neurosurgery [14], plastic and reconstructive surgery [15], arthroscopy [16], orthopedic surgery [17–19] and its subspecialty such as spine surgery [20]. Therefore, we conducted a bibliometric analysis to investigate the distributions and demonstrate the application of robotic surgery in different medical fields.

Table 1
Top 10 most-cited articles about robotic surgery.

Title	First author	Journals (IF[a] 2014)	Publication year	Country	Research field	Total citation
A prospective comparison of radical retropubic and robot-assisted prostatectomy: experience in one institution	Tewari, A	BJU Int (3.533)	2003	USA	Urology	277
Robotics in general surgery – Personal experience in a large community hospital	Giulianotti, PC	Arch Surg (4.926)	2003	Italy	General surgery	274
Force modeling for needle insertion into soft tissue	Okamura, AM	IEEE Trans Biomed Eng (2.347)	2004	USA	Engineering	266
Constitutive modeling of brain tissue: Experiment and theory	Miller, K	J Biomech (2.751)	1997	Australia	Engineering	258
Nerve-sparing robot-assisted radical cystoprostatectomy and urinary diversion	Menon, M	BJU Int (3.533)	2003	USA	Urology	233
Robot assisted partial nephrectomy versus laparoscopic partial nephrectomy for renal tumors: A multi-institutional analysis of perioperative outcomes	Benway, Brian M.	J Urol (4.471)	2009	USA	Urology	212
Feasibility of robotic laparoscopic surgery: 146 cases	Cadiere, GB	World J Surg (2.642)	2001	Belgium	General surgery	200
Transoral robotic surgery (TORS) for base of tongue neoplasms	O'Malley, Bert W.	Laryngoscope (2.144)	2006	USA	Otorhinolaryngology-head and neck surgery	197
Image-guided hypo-fractionated stereotactic radiosurgery to spinal lesions	Ryu, SI	Neurosurgery (3.620)	2001	USA	Neurosurgery	192
Satisfaction and regret after open retropubic or robot-assisted laparoscopic radical prostatectomy	Schroeck, Florian R.	Eur Urol (13.983)	2008	USA	Urology	181

[a] IF: impact factor.