European Journal of Obstetrics & Gynecology and Reproductive Biology 243 (2019) 168–172

Contents lists available at ScienceDirect

European Journal of Obstetrics & Gynecology and Reproductive Biology

journal homepage: www.elsevier.com/locate/ejogrb

Full length article

Google searches and medical publication trends since the 2014 US Food and Drug Administration position on power morcellation: Do these translate into patient awareness?

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ARTICLE INFO

Article history:
Received 4 June 2019
Received in revised form 26 September 2019
Accepted 13 October 2019

Keywords:
Power morcellation
Fibroids
Leiomyosarcoma
Health trends
Patient awareness

ABSTRACT

Objectives: Our primary objective was to assess patient awareness by observing Google Trends comparing search terms used in relation to morcellation rather than morcellation alone. Our secondary objective was to review trends and locations of publications on leiomyosarcoma and morcellation following the US Food and Drug Administration (FDA) position statement.

Study design: To assess Internet trends, we obtained the relative search volume (RSV) for each month from 1 January 2004 to 1 March 2019 from Google Trends using the terms 'fibroid', 'morcellation', and 'fibroid cancer'. RSV ranges from 0 to 100 with 100 being peak popularity for the term, and all other monthly search activity relative to the peak. To assess academic trends, we performed a systematic review of published literature discussing fibroid morcellation within the same time period. We used a two-way independent *t*-test to compare median RSV, and chi-squared test to compare academic output. $P < 0.05$ was considered statistically significant.

Results: Search volume for 'morcellation' peaked during the FDA statement (RSV 0.5 to 2.9, $t = 17.5$, $p < 0.05$) but was not sustained. There is an increase in 'fibroid' activity post-FDA statement (RSV 68.8 to 76.3, $t = 3.9$, $p < 0.05$). 'Fibroid cancer' remained static throughout ($t = 1.5$, $p = 0.1$ and $t=-0.5$, $p = 0.6$). Afro-Caribbean countries had the highest RSV for 'fibroid', whereas 'morcellation' RSV was highest in predominantly Western countries. There was a significant increase in the rate of papers published on the subject following the FDA statement (6.8 vs 55.6 papers per year, 95% CI -53.96 to -43.64, $p < 0.0001$). No academic papers on morcellation were published from countries with the highest RSV for 'fibroid'.

Conclusion: Our study suggests that interest in uterine fibroids has increased since the FDA statement, but the public are perhaps unaware or not concerned of the consequent potential risk of leiomyosarcoma following morcellation. Countries where fibroid interest is highest are not necessarily those that can offer power morcellation. Further studies are required to address how the Internet influences patient choice and informed consent, and how medical professionals can use it to further educate patients on the risks and benefits of laparoscopic myomectomy and power morcellation.

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Introduction

The advancement of minimal access surgery has allowed procedures of greater complexity to be performed. Compared to laparotomy, patients can benefit from the many well documented benefits of laparoscopic surgery including reduced blood loss, less analgesic requirements and earlier return to normal activities [1]. There are also significant benefits not only in term of surgical outcomes but also in a reduction in costs for healthcare providers [2]. With the increasing capabilities of laparoscopic surgery comes the increasing complexity of procedures and the frequent need to remove large solid tissue through small incisions. In gynaecology, the main requirements for this are during hysterectomies for large uteri [3] and fibroid removal at laparoscopic myomectomies [4].

The concept of power morcellation was first described in 1993 by Steiner et al and has played a pivotal role in complex laparoscopic surgery [5]. Electrical power morcellation then became increasingly popular until 2014 when the US Food and Drug Administration (FDA) published a ruling on the use of power morcellation effectively banning its use [6]. This ruling largely resulted as a consequence of an article in the Wall Street Journal based on the experience of an American anaesthetist who

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https://doi.org/10.1016/j.ejogrb.2019.10.010
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underwent morcellation and later died from dissemination of a previously undiagnosed leiomyosarcoma [7]. Since the FDA publication, the statistics, in particular the quoted incidence of leiomyosarcoma, used by the FDA have been challenged [8] and though power morcellation is still essentially "banned" in the USA, its use remains widespread in other countries. Most learned societies have encouraged patient choice and education to ensure patients are well informed and are made aware of the risks of the possibility of upstaging of an "occult" leiomyosarcoma [9–12].

In order for women to be informed and give informed consent, they need to be aware of the issues and within the appropriate context. With the advent of the Internet and the proliferation of health information available, more patients are turning to the Internet as their first source of health information [13]. Previous studies have concluded that an increased frequency of Google searches on the term morcellation alone indicates increased public awareness; however it is unclear whether those that searched were medical professionals or members of the public [14]. The aim of this study was to assess patient awareness by observing Google trends comparing search terms used in relation to morcellation rather than morcellation alone. The secondary objective was to review trends and locations of publications on leiomyosarcoma and morcellation following the FDA statement.

Method

Google trends

We chose layman terminology as search terms in order to accurately reflect layman interest (i.e. avoiding overly clinical terms such as leiomyosarcoma). These terms were identified using a triangulation approach whereby we confirmed these to be the most common words using the layman landscape of patient resources and patient forums (Appendix 1). As Google has an intrinsic location tracker, we used an Internet search engine to avoid filter bubbles.

Although morcellation was first described in 1998, Google only started capturing trends from the 1 st January 2004, hence its designation as our chosen start date. We chose a worldwide search to obtain a global perspective, which mirrored the academic output. We chose the "Health" query category because we wanted to assess interest in the context of health.

On the 1 st March 2019, we queried Google Trends and downloaded the data for the following search input: [fibroids] and [morcellation] and ["fibroid cancer"]. We performed a worldwide search from the 1 st January 2004 to the 1 st March 2019 using the "health" query category. We chose this strategy to interrogate Google Trends based on the work of Nuti et al [15], who recommended a checklist for documentation of Google Trends searches in order to maintain transparency and ensure results were replicable.

Data was normalised and scaled to create a monthly relative search volume (RSV) representing search interest relative to the highest point for the given query. RSV ranged from 0 to 100 with 100 being peak popularity for the term, and all other monthly search activity relative to the peak. We compared the RSV for three groups: pre- FDA statement, from FDA statement released on April 2014 to the following year, and from 1-year following the FDA statement thereafter. We used a two-way independent *t*-test to compare the median RSV where $p < 0.05$ was considered statistically significant.

Academic trends

We performed a comprehensive query into the published literature by systematically searching MEDLINE, Embase, the Cochrane Library, and ClinicalTrials.gov from the 1 st January 2004 to the 1 st March 2019 to identify papers discussing fibroid morcellation. A combination of Medical Subject Headings (MeSH) and text words were used to generate two subsets of citations, one including studies of fibroids ('leiomyoma', 'leiomyosarcoma', 'fibroids') and the other including studies of morcellation ('morcellation', 'morcellator'). These subsets were combined with 'and' to generate a subset of citations relevant to our research question. The complete search strategy is shown in Appendix 2. No language restrictions were placed in any of our searches. The reference list of articles was examined to identify the date of publication and country of publication. As there is often a lag in content between the public and the academic worlds with scientific work often being published later to an event due to the peer review process, we have simplified the categorisation of published work to pre- and post-FDA position statement on April 2014.

Published papers were calculated as proportion of total output by each country of origin. Chi-squared test was performed to compare output pre- and post-FDA statement. $P < 0.05$ was considered statistically significant.

As this study utilised data from the public domain and no patient information was utilised, ethical approval was not required. No funding was needed or acquired for the study. The systematic review of published papers was registered with PROSPERO (Registration number: CRD42019134206).

Results

Google trends

On Google Trends, there were 123 months identified pre-FDA announcement, 12 months following, and 48 months identified post-FDA announcement. The monthly RSV for 'morcellation' significantly increased from 0.5 to 2.9 ($t = 17.5$, $p < 0.05$) (Tables 1 and 2). This trend was not maintained as it returned to pre-announcement activity within one year (mean RSV 2.9 to 0.9, $t=-12.4$, $p < 0.05$). In contrast, there was a non-significant decrease in 'fibroid' activity (mean RSV 71.7 to 68.8, $t=-1.1$, $p = 0.26$), followed by a significant increase by 2015 (mean RSV 68.8 to 76.3, $t = 3.9$, $p < 0.05$). The monthly RSV for 'fibroid cancer' remained static throughout ($t = 1.5$, $p = 0.1$ and $t=-0.5$, $p = 0.6$). This is graphically represented in Fig. 1.

Academic trends

There were 348 papers published between January 2004 to March 2019. 68 of the 348 papers (19.5%) were published before the FDA report and 278 (79.9%) were published after. The rate of output increased significantly from 6.8 papers per year (95% CI: 5.28–8.62) to 55.6 papers per year (95% CI: 49.26–62.54)

Table 1
Descriptive statistics for the monthly relative search volume (RSV) of individual search terms.

	Mean ± SD		
	Fibroid	Morcellation	Fibroid cancer
Pre ($n = 123$)	71.7 ± 9.0	0.5 ± 0.3	0.4 ± 0.3
During ($n = 12$)	68.8 ± 4.7	2.9 ± 1.1	0.5 ± 0.0
Post ($n = 48$)	76.3 ± 6.2	0.9 ± 0.2	0.5 ± 0.1

Mean and standard deviation (SD) calculated by the months pre-FDA announcement, the immediate 12 months following, and the subsequent months post-FDA announcement. The monthly relative search volume (RSV) represents search interest relative to the highest point for the given query. RSV ranged from 0 to 100 with 100 being peak popularity for the term, and all other monthly search activity relative to the peak.

Table 2
Analysis of monthly RSV using independent *t*-test where p is significant.

	Fibroid		Morcellation		Fibroid cancer	
	t	*p*	*t*	*p*	*t*	*p*
Pre-FDA to During	−1.128	0.26	17.548	<0.00001	1.549	0.124
During to Post-FDA	+3.927	0.0002	−12.355	<0.00001	−0.497	0.621

The difference in monthly RSV is calculated using independent *t*-test. There is a significant increase, then decrease, in 'morcellation' around the time of the FDA announcement. This change is not seen for the search term 'fibroid cancer'.

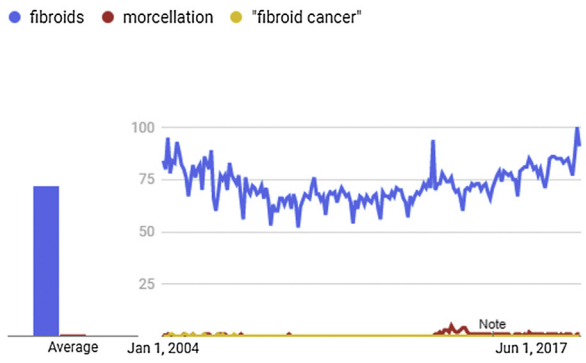

Fig. 1. Graphical representation of the search terms over time (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.).
Blue = 'fibroids', red = 'morcellation', yellow = 'fibroid cancer'. Data source: Google Trends.
The country with the largest search activity for 'fibroid' was Jamaica, followed by Botswana, Barbados, Zambia, and Trinidad & Tobago (Table 3, Fig. 2A). 'Morcellation' was a term most commonly searched for in the United States, followed by Canada, Australia, India and the United Kingdom (Fig. 2B). 'Fibroid cancer' was similarly most searched in the United States, but there appeared to be no other countries with demonstrable search interest (Fig. 2C).

(incidence rate difference -48.8, 95% CI: -53.96 to -43.64, $p < 0.0001$). The United States and England remain the countries with the highest output. Countries which had previously published on the topic prior to the report continued to do so at a similar rate, except for Switzerland who had a significant decrease ($x^2 = 5.3$, $p = 0.02$) in the amount of published output.

When compared to Google Trends, no papers were published from countries which had the highest RSV for 'fibroids'. The countries with the highest RSV for 'morcellation' were represented by their academic counterparts and appearing within the top ten for scientific publication (United States [153/278, 55%], UK [or England 47/278, 16.9%], India [6/278, 2.2%], and Australia [4/278, 1.4%]) (Table 4).

Discussion

Google trends

Our study demonstrates that although there is an increased frequency of Google searches on the subject of 'morcellation', this was not associated with an increased frequency of searches for 'fibroid cancer'. This suggests that the public are not aware of the consequent potential risk of disseminated disease due to fibroid morcellation. Similarly, there were more searches for 'fibroids' after the FDA announcement, but 'fibroid cancer' remained static to pre-FDA announcement levels of activity. This may represent an increased interest in power morcellation as a therapy for fibroid removal. Clinicians should be reassured that this shows an increased awareness of the technique rather than assuming that women are fearful of morcellation, a narrative frequently propagated by the media. Though the assumption of public awareness has been made for other medical conditions following FDA announcements [16], our study demonstrates a trend for increased Google searches but whether this translates into increased public awareness is unknown.

The activity of Google searches by country of origin reveals a potential trend for demand. 'Fibroids' is most commonly searched in Afro-Caribbean countries where uterine fibroids are more prevalent. In contrast, 'morcellation' is searched for in predominantly Western countries where the surgical technique exists, while 'fibroid cancer' as a search term is only apparent in the United States where the FDA announcement was made. This may indicate that women with fibroids are not aware of the option of power morcellation, let alone the risks associated with it. Our findings are in keeping with an anonymous survey by Mowers and colleagues [17] who investigated the knowledge and perception of patients on the issue of morcellation. Of the 500 women surveyed, only 8.3% of patients had heard of morcellation. Furthermore, our findings suggest that demand does not correlate with supply; countries in which fibroid interest is highest may not be able to offer morcellation as a treatment.

We were interested in other social media channels such as Twitter and Facebook, as they can often serve as a valuable source of information if the material originates from an expert in the field. But as both laymen and professionals use these forums, it is difficult to establish which sources are reliable. More recently, authenticity has become an important driver as the public are aware of the need for reliable information, and users are demonstrated to be authentic by the presence of a blue verified badge on social media platforms [18,19]. Previous research has demonstrated that this badge increases credibility to the public eye [20]. While certain industries such as journalism and business have made achieving verified status a priority [21], this has yet to be seen in health and thus, the public remain unsure of which sources are trustworthy.

Academic trends

Following the FDA announcement, there is a clear increase in scientific work pertaining to the use of morcellation for uterine fibroids. This may be attributable to laparoscopy becoming more commonplace and the demand for morcellation during laparoscopic myomectomy. Certain countries, such as the United States and England, remain at the forefront of the conversation, with

Table 3
Interest by country.

Number	Fibroids		Morcellation		"Fibroid cancer"	
1	Jamaica	100	United States	100	United States	100
2	Botswana	97	Canada	47		
3	Barbados	96	Australia	46		
4	Zambia	77	India	41		
5	Trinidad & Tobago	69	United Kingdom	25		

Interest was most popular during the specified time frame with values calculated on a scale from 0 to 100, where 100 is the location with the most popularity as a fraction of total searches in that location.

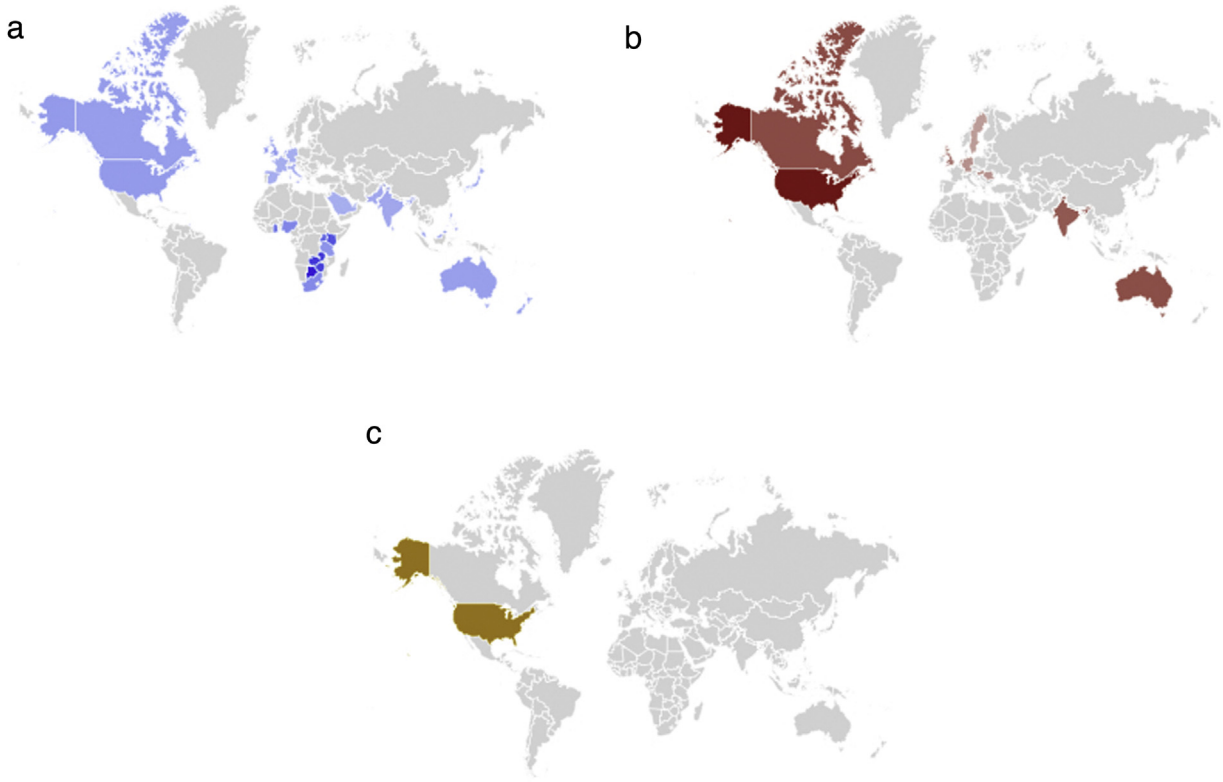

Fig. 2. Geographical interest (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.).
A = 'fibroids' in blue. B = 'morcellation' in red. C = 'fibroid cancer' in yellow. Data source: Google Trends.

Table 4
Academic output by country of pre- and post-FDA announcement.

Country	Pre FDA		Post FDA		Chi-squared	P-value
	Papers	Percentage	Papers	Percentage		
USA	37	54.4	153	55.0	0.008	0.92
England	12	17.6	47	16.9	0.019	0.89
Netherlands	2	2.9	14	5.9	0.975	0.32
Ireland	0	0	11	4.0	2.802	0.09
Germany	3	4.4	10	3.6	0.096	0.76
China	0	0	7	2.5	1.730	0.19
India	2	2.9	6	2.2	0.117	0.73
Italy	0	0	5	1.8	1.238	0.27
Australia	0	0	4	1.4	0.960	0.33
France	2	2.9	4	1.4	0.736	0.39
Turkey	0	0	4	1.4	0.960	0.33
Canada	0	0	2	0.7	0.477	0.49
Korea	0	0	2	0.7	0.477	0.49
Poland	0	0	2	0.7	0.477	0.49
Switzerland	3	4.4	2	0.7	5.301	0.02
Brazil	0	0	1	0.4	0.272	0.60
Bulgaria	0	0	1	0.4	0.272	0.60
Greece	0	0	1	0.4	0.272	0.60
Mexico	0	0	1	0.4	0.272	0.60
New Zealand	0	0	1	0.4	0.272	0.60
	68 in 10 years = 6.8 per year 95% CI: 5.28-8.62		278 in 5 years = 55.6 per year 95% CI: 49.26-62.54		Rate difference = -48.8 95% CI: -53.96 to -43.64, $p < 0.0001$	

similar publication rates both pre- and post-2014. The procedure also appears to have a global phenomenon, with greater academic output describing the technique around world, particularly in developed countries. However, there is a stark disparity between the country of origin for publication and countries where women are most commonly interrogating the Internet for a solution to their fibroids. This suggests that laparoscopic myomectomy is available for countries with more developed health systems which do not coincide with populations with the highest incidence of fibroids, and that more support should be provided to African and Caribbean countries to make this procedure more readily available.

Strengths and limitations

In order to identify the terms most commonly used by the public, we employed a triangulation approach commonly used in qualitative research to establish layman terminology to accurately reflect layman interest. To overcome the bias of Google's inherent search preferences and user preference algorithms, we used an alternative search engine which does not use filter bubbles. Despite this, there a number of intrinsic challenges that arise from using Google Trends in health research. Location is an important obstacle; Google is not available in certain countries and there are geotag functions that cannot be disabled. This may explain why China does not appear in Google Trends despite it being the sixth most prominent country to publish on fibroid morcellation. Another limitation was the use of English language to interrogate the search engine, which is the likely reason for why European countries such as Netherlands and Germany do not feature on the Google Trends for the term 'morcellation'. Overcoming these issues would require ubiquitous use of the search engine, the ability to translate the country of origin language to the user's preferred language, and the option to allow the user to disable discriminate functions.

Conclusion

Using Google Trends is a unique method of attempting to understand public perception on public health issues. Using the terms 'fibroid', 'morcellation', and 'fibroid cancer', it appeared there was an initial increase in the frequency of searches for 'morcellation; in the year following the FDA announcement but no associated increase in search volume for 'fibroid cancer'. Of note, the countries where fibroids are most frequently searched are not necessarily those that can offer power morcellators as a therapy. Further studies are required to address how the Internet influences patient choice and informed consent, and how medical professionals can use this data appropriately to further educate patients on the risks and benefits of laparoscopic myomectomy and power morcellation.

Declaration of Competing Interest

None.

Acknowledgements

We would like to acknowledge the work of health professionals and patient groups who provide information and support for women with fibroids.

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