



# Mining the Twittersphere: Insights about Public Interest in Facial Reanimation Surgery from a Decade of Twitter Data

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## Abstract

**Background** With 500 million tweets posted daily, Twitter can provide valuable insights about public discourse surrounding niche topics, such as facial paralysis surgery. This study aims to describe public interest on Twitter relating to facial paralysis and facial reanimation surgery over the last decade.

**Methods** Tweets containing the keywords “facial paralysis” and “Bell’s palsy” posted between January 1, 2009, and January 1, 2019, were collected using Twitter Scraper. Tweets were screened by keywords relating to facial paralysis, and usage of these terms trended over time. Logistic regression was used to identify correlations between the quantity of publications per year and these terms posted on Twitter.

**Results** 32,880 tweets were made during the study period, with no significant difference in the number of tweets per year. A very strong ( $r=0.8-1.0$ ) positive correlation was found between time and frequency of the term “plastic surgery” and “transfer” ( $p < 0.05$ ). A strong ( $r=0.60-0.79$ ) correlation was found between time and frequency for the following terms: “facial reanimation,” “gracilis,” “masseter,” “plastics,” “transplant” ( $p < 0.05$ ). A total of 619 studies with the keyword “facial reanimation” were published in PubMed within the study period. A very strong, positive correlation between publications per year and frequency was found for the terms “plastic surgery,” “function” and “esthetic,” and a strong, positive correlation was found for the “plastics,” “transplant,” “Botox,” “surgery,” “cosmetic,” “aesthetic” and “injection” ( $p < 0.05$ ).

**Conclusions** An increasing number of discussion about facial paralysis on Twitter correlates with increased publications and likely surgeon discourse on facial reanimation surgery, driving public interest.

## Keywords

- ▶ facial paralysis
- ▶ facial reanimation
- ▶ twitter
- ▶ social media
- ▶ web scraping
- ▶ data mining

## Introduction

Social media has become increasingly important in plastic surgery.<sup>1-3</sup> In the last decade, surgeons and patients have

started to use social media as a tool for marketing and engaging in dialogue about plastic surgery.<sup>4-7</sup> Prior research has investigated the top plastic surgery “influencers” on Twitter, the veracity of information about plastic surgery

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published on YouTube, and broad characterizations of the type of dialogue about plastic surgery occurring over Twitter.<sup>8-11</sup> While these studies represent early ventures into the area of social media data analyses, there is an untapped opportunity to leverage the massive amounts of data published on these platforms to gain insight into the public's understanding and interest in plastic surgery. To date, large-scale data mining from social media has not been attempted before to identify trends in public interest in various areas of plastic surgery.

One of the most relevant social media platforms in existence today is Twitter (Twitter, Inc.; San Francisco, CA), which receives over 500 million tweets daily on a global basis.<sup>10</sup> When compared with other available social media platforms, Twitter is ideal for the real-time analysis of public interest in a specific topic for several reasons. First, unlike other platforms, Twitter provides an advanced programming interface (API), which makes it possible to pull datasets representing Twitter activity easily and free of charge.<sup>12</sup> Second, because the majority of Twitter accounts are public, researchers are able to download tweets and data from the majority of users on the platform. Third, prior studies have shown that Twitter content relating to plastic surgery largely comprises tweets from patients, not surgeons or marketers, posting about their personal experience with or interest in plastic surgery procedures.<sup>10,11</sup> As a result, Twitter offers a direct window into the public dialogue occurring over social media. Nonetheless, to date, few studies in the plastic surgery literature have attempted to utilize Twitter data for the purpose of understanding public trends.

This study aims to use Twitter to investigate trends in public dialogue relating to specific niche plastic surgery topics and procedure, which were previously never performed. In this case, the topic of facial reanimation surgery was chosen, given that it is a small but growing area within plastic and reconstructive surgery, about which current public interest and awareness is unknown, not having previously been studied. Given the annual incidence of facial paralysis in the US, the authors hypothesized that enough individuals would be discussing their experience with facial paralysis to be captured well on Twitter, but missed by other social media platforms, which would result in an adequately powered analysis. The purpose of this article was therefore to investigate public interest in and awareness of facial reanimation surgery by analyzing trends in the past decade of Twitter data relating to facial paralysis and facial reanimation surgery.

## Methods

Twitter-scraper, a free and publicly accessible python-based program for aggregating Twitter data, was used to identify all included.<sup>13</sup> The program identified and returned all posted in the US between January 1, 2009, and January 1, 2019, which contained either of the key words "facial paralysis" or "Bell's palsy." The program returned the following data for each tweet: content, post

**Table 1** List of terms relating to reconstructive techniques for facial paralysis and facial reanimation surgery

Reconstructive	Technique	Microsurgery	Esthetic
Plastic surgery	Acupuncture	Transfer	Function
Gracilis	Surgical Treatment	Reconstruction	Facial Reanimation
Muscle transfer	Surgical	Study	Reanimate
Nerve transfer	Plastics	Paper	Transplant
Masseter	Cosmetic	Article	Moebius
Reanimation	Aesthetic	Sling	Weight
Botox	Reconstruction	Suspension	
Surgery	Injection	Neurotization	
Nerve surgery	Botulinum	Free muscle	

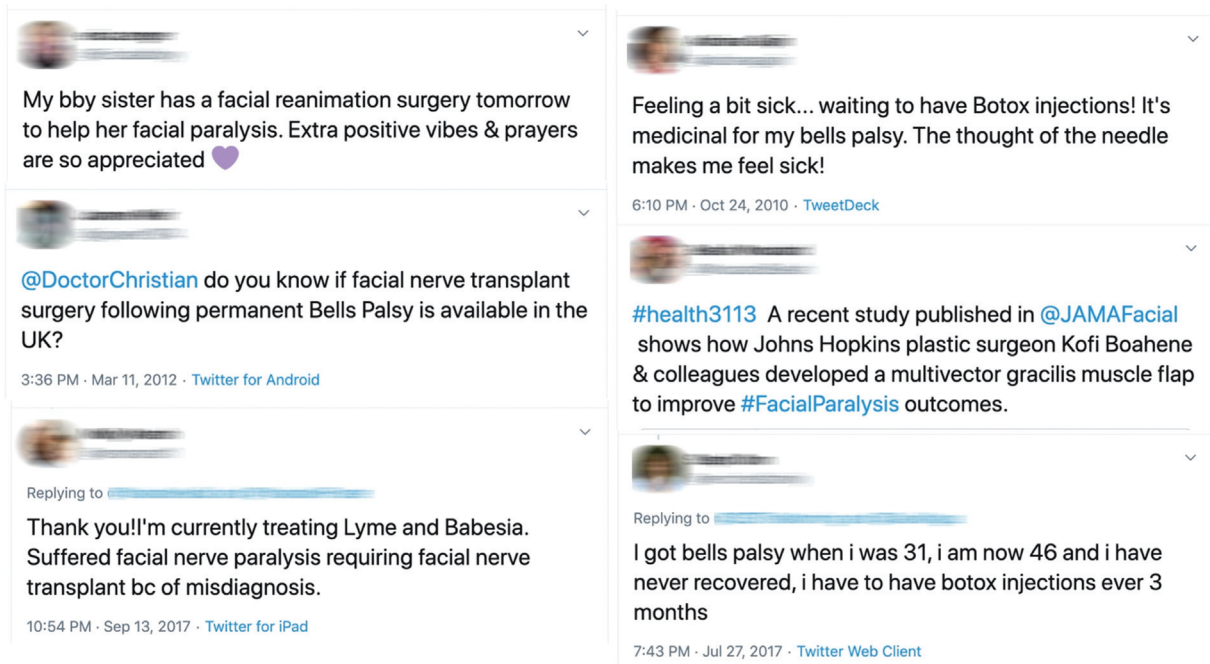
date, username, associated hashtags, number of retweets, and number of likes. Raw output data was imported into a CSV file using NumPy and subsequently organized in Microsoft Excel (Microsoft Inc., Redmond, Washington, USA).<sup>14</sup>

Prior to analysis, duplicate tweets were removed, and tweets were organized by date. A list of terms relating to facial reanimation surgery was generated from a literature search of recent review articles discussing facial reanimation surgery, which were posted on PubMed in the past 10 years. **Table 1** lists all terms that were included in this list. To determine whether the tweets were related to facial reanimation surgery or facial paralysis, the content for each tweet identified by the program was parsed using Microsoft Excel to identify whether it contained any of the identified key terms relating to facial reanimation surgery. Each time a reconstruction-related term appeared in a unique tweet, it was tabulated. After all tabulation was performed, the usage of reconstruction related terms were analyzed for trends in usage over time.

To determine the impact of research in facial reanimation surgery specifically on Twitter dialogue over the course of the study period, PubMed was indexed to identify the number of articles published within each year of the study period, which was associated with the keyword "facial reanimation." The number of published articles was then compared with the usage of reconstruction-related terms on Twitter in the same year. Multiple logistic regression was performed to determine the presence of trends in the frequency of term usage per year of the study period and to investigate the relationship between research activity in facial reanimation surgery and the usage of terms related to facial reanimation surgery each year. A very strong trend was defined as a correlation coefficient " $r$ " = 0.8 - 1.0. A strong trend defined as " $r$ " = 0.60 to 0.79 and a weak trend was defined as any " $r$ " value less than 0.60.

## Results

A total of 32,880 tweets that satisfied the Twitter-scraper criteria were posted to Twitter during the 10-year study



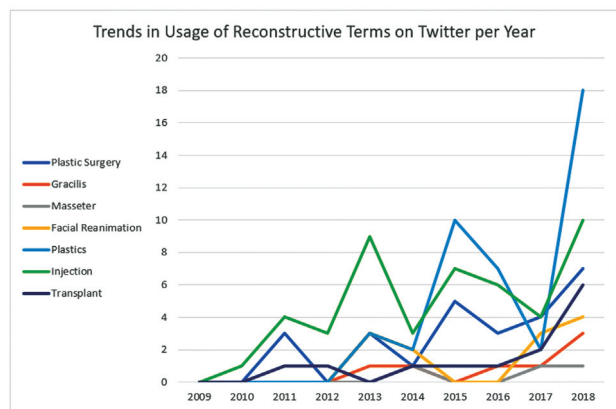
**Fig. 1** Sample of publicly available tweets that were aggregated in the study and which included the usage of reconstruction-related terms. Account information blurred for privacy.

period. Examples of publicly available tweets discussing facial reanimation surgeries are demonstrated in **►Fig. 1**. The mean number of tweets per year was 3,288, and there was no significant difference in the number of overall tweets posted per year of the study period ( $p = 0.47$ ). Analysis of the use of reconstruction-related terms in these tweets showed significant trend toward increasing usage throughout the course of the study period. A very strong ( $r = 0.8-1.0$ ) positive trend over time was found for the term “plastic surgery” ( $p < 0.05$ ). A strong ( $r = 0.60-0.79$ ) positive trend in frequency was found for the following terms: “facial reanimation,” “gracilis,” “masseter,” “plastics,” “transplant,” and “transfer” ( $p < 0.05$ ) (**►Table 2**). The remaining search terms demonstrated a weak or no correlation over time. **►Fig. 2** shows the correlation score of all significantly associated reconstruction-related terms that were analyzed for trends in usage over time.

A total of 619 articles associated with the keyword “facial reanimation surgery” were published during the study period from 2009 to 2019. The mean number of articles published per year was 61.9. There were no significant differences in the number of articles published per year ( $p = 0.58$ ). Regression analysis demonstrated a significant association between the number of studies published per year and the usage of reconstruction-related terms on Twitter in the same year. A very strong ( $r = 0.8-1.0$ ) positive correlation was found for the following terms: “plastic surgery,” “function,” and “esthetic” ( $p < 0.05$ ). A strong ( $r = 0.60-0.79$ ) correlation was found for the following terms: “plastics,” “transplant,” “Botox,” “surgery,” “cosmetic,” “aesthetic,” and “injection” ( $p < 0.05$ ) (**►Table 3**). The remaining search terms yielded a weak correlation/no correlation.

**Table 2** List of terms relating to reconstructive techniques that demonstrated statistically significant increase in usage on Twitter over a 10-year period

Term	r-value	p-value	Correlation strength
Plastic surgery	0.81	< 0.01	Very strong
Gracilis	0.75	< 0.01	Strong
Masseter	0.65	0.04	Strong
Facial reanimation	0.77	< 0.01	Strong
Plastics	0.75	< 0.01	Strong
Injection	0.84	< 0.01	Very strong
Transplant	0.72	0.02	Strong



**Fig. 2** Graph demonstrating the usage of reconstruction related terms over time on Twitter for terms that demonstrated a significant positive trend over the course of the study period.

**Table 3** List of terms that demonstrated statistically significant correlation between annual usage and number of studies published relating to facial reanimation surgery in the same year

Term	r-value	p-value
Esthetic	0.8318	< 0.01
Function	0.82669	< 0.01
Plastic surgery	0.80609	< 0.01
Aesthetic	0.78993	< 0.01
Botox	0.74481	0.01
Surgery	0.69937	0.02
Study	0.68655	0.03
Injection	0.682	0.03
Cosmetic	0.67815	0.03
Transplant	0.61823	0.05

## Discussion

Previously, researchers have used Google Trends, a free web-based tool for analyzing search queries over time, to investigate interest in plastic surgery procedures. For example, Tijerina and Whipple demonstrated a significant correlation between the annual number of Google search queries for various procedures and the annual surgical volumes for high-volume plastic surgery procedures from statistical reports of the American Society of Plastic Surgeons (ASPS) and American Society of Aesthetic Plastic Surgery (ASAPS).<sup>15–20</sup>

While demonstrating utility in investigating public interest in these broad areas of plastic surgery, Google Trends was not a well-suited tool to determine public interest in smaller, niche areas of plastic surgery such as facial reanimation. Rather than reporting the actual number of search queries per year for a given search term, Google Trends provides a score from 0 to 100, which represents the relative popularity of a given search term when compared with all other terms searched over a specific time range. The popularity of other commonly searched terms dwarfs smaller topics, even within the scope of plastic surgery, making it difficult or near impossible to identify trends among these less researched topics. Performing the current study with a Google Trends search rather than a Twitter posts, returned a value of zero for the search term “facial reanimation surgery” across all years of the study period, despite the absolute values for search queries likely being greater than 0. The same was true for Google Trend searches of the keywords that were used for Twitter queries in this study.

Twitter also provides access to a huge amount of raw data in the form of tweets that contain a certain keyword or hashtags, which can be downloaded along with associated data and analyzed independently, making it suitable for analysis of public opinion and interest in more niche topics. A recent study demonstrated that over 70% of tweets posted relating to plastic surgery are posted by the public, and not

by promotional, professional or plastic surgeon accounts, which underscores the validity of using Twitter discourse as a representation of general public interests.<sup>10</sup> Although limited analysis of Twitter has been performed to date, approximately 70 to 75% of tweets relating to plastic surgery are about cosmetic surgery.<sup>21</sup> Despite this, the authors did, in fact, find significant trends in tweets relating to facial reanimation surgery, a niche topic even within reconstructive plastic surgery. For most surgeons, Twitter analyses can be useful both for monitoring the emergence of new procedures and ideas in the consumer marketplace and for making informed marketing decisions, based on public trends. Given the ease of use of Twitter’s API, keywords relating to procedures can be monitored for trends in use overtime with little difficulty and generate meaningful insights in a cost-effective fashion. Furthermore, Twitter’s API parameters allow for geographic localization of results, which can be used to identify regional trends that might be more relevant to individual practitioners, based on the location of their practice.

Finally, the authors hypothesize that public excitement about new treatments for facial reanimation would be a driver of this topic of conversation on Twitter, as tweets initially made from professional accounts would be read by and discussed by the public. This theory is consistent with prior studies of Twitter which have demonstrated that approximately 20 to 40% of tweets relating to plastic surgery, which were made by professionals, were research or education oriented.<sup>10,11</sup> The present study did identify a significant association between the amount of research productivity per year and the annual amount of Twitter discourse relating to facial reanimation surgery. This could potentially represent that tweets by professionals (citing research to emphasize new techniques in facial reanimation surgery) might drive public excitement and therefore Twitter discourse on these topic.

There are several limitations to this study, including sampling bias and Twitter noise that are inherent to the study design. Recent data has demonstrated that while approximately 20% of Americans use Twitter, the platform is primarily used by younger demographics.<sup>22</sup> Although facial paralysis affects patients of all ages, it is likely that the conversation on Twitter captured in this study underestimates the general interests of the overall public or is skewed toward the opinions of younger patients. Another challenge inherent to Twitter analyses is the presence of Twitter noise, which is the phenomenon of tweets unrelated to the subject being included in the analysis, because they contain the specified keywords being investigated in the study. Finally, our study included the use of terms that would be more commonly used in academic research articles (i.e., masseter, gracilis) and those that would be more common among the public (i.e., transplant). Therefore, our results likely captured both professional and nonprofessional Twitter users, the majority of whom were likely nonprofessional. Parsing through these users to include only nonprofessional users posed a technical challenge to the study that could not be overcome.

## Conclusion

Twitter offers access to robust datasets, which are helpful to determine trends in the public interest in niche topics in surgery. In the last decade, there has been an increasing discussion about facial paralysis on Twitter, which correlated with increased publications on facial reanimation surgery, implying that research in this area may be a driver of public discourse. Additionally, given the number of users, active surgeon participation in Twitter can potentially help to raise the public's awareness of this important problem for patients.

### Author Contributions

H.R. designed the project, collected data, and drafted the manuscript.

J.R. designed the project, drafted the manuscript, edited the manuscript, and provided project oversight.

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### Conflicts of Interest

The authors have no conflicts of interest to report.

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