

Public Interest in Shoulder Platelet-Rich Plasma Injections Is Increasing: A 10-Year Google Trends Analysis



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Purpose: To quantify and analyze public interest trends in platelet-rich plasma (PRP) therapy for shoulder pathology between 2011 and 2020 using Google Trends data. **Methods:** Google Trends data were queried for online search data ranging from January 2011 to December 2020. Various combinations of terms related to PRP and shoulder pathology were queried. Terms related to corticosteroid therapy in association with shoulder pathology were also generated for comparative analysis. Analyses were performed regarding trends in online search volumes. **Results:** Linear models were generated to evaluate trends in the volume of online searches for PRP and corticosteroid therapy for shoulder pathology. For both the PRP and steroid groups, linear models showed a statistically significant increase in search volume for the period studied ($P < .001$). The PRP group showed a significantly greater growth rate than the steroid group ($P < .001$). There were no statistically significant differences in online search volume when compared between different geographic and socioeconomic locations. **Conclusions:** This study indicates consistently increasing public interest in PRP injections in the shoulder. The rate of online search volume growth of PRP is significantly greater than that of corticosteroid injections for the period studied. **Clinical Relevance:** Awareness of patient perceptions has value in informing shared decision making, aligning patient expectations, and guiding areas of future research. Each of these has an impact on patient care. Being aware of patient interest and expectations is particularly important in areas with controversial or emerging research.

Shoulder pain has been shown to decrease quality of life and is a prominent cause of musculoskeletal disability in the United States.^{1,2} Estimates of the point prevalence of shoulder pain range between 4% and 26%, and it carries a lifetime incidence as high as 67%.^{3,4} Pain can originate from various locations including the glenohumeral joint, acromioclavicular joint, rotator cuff, or soft tissues surrounding the joint. Among the most common specific causes of shoulder

pain are rotator cuff pathology, glenohumeral arthritis, and adhesive capsulitis.⁵ Treatment varies depending on the specific condition, but in most cases, shoulder pain can be managed conservatively without surgery.⁶

Over the past decade, the role of platelet-rich plasma (PRP) in the nonoperative management of shoulder pain has increased considerably.⁷ As a centrifuged derivative of whole blood, PRP is a simple means of acquiring autologous growth factors that are theorized to modulate the inflammatory cascade to promote healing of tendon, ligament, muscle, and bone.⁸⁻¹¹ Studies evaluating PRP's efficacy in the shoulder are relatively few and usually inconclusive.¹² Additionally, there is considerable heterogeneity within these data given the differences in PRP preparation, component concentration, and administration.¹³ Despite mixed conclusions regarding its efficacy, PRP continues to be increasingly used in the management of shoulder pain.¹⁴

Several factors likely explain the increasing use of PRP despite a lack of consistently proven benefits. Financially, providers are incentivized to include it in their treatment regimens given its high cost. Cost estimates for a single shot of PRP reach as high as \$2,500,

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and it has been reported to be twice as expensive as a conventional steroid injection.^{15,16} Moreover, PRP injections are not typically covered by insurance, further contributing to the high cost of PRP.¹⁶ Patient requests may also in part explain the increased use of PRP. It is well recognized that an increasing number of patients are using the Internet to access health-related information, and in some instances, it is the preferred means of obtaining information.¹⁷⁻¹⁹ Particularly regarding new or emerging technology, this online research can contribute to “science hype,” an exaggerated understanding of the benefits compared with the risks that results from media coverage.²⁰ PRP may be particularly susceptible to this bias given that it regularly garners popular media attention for its use in elite athletes and celebrities.^{20,21} Despite increasing use overall and frequent media coverage, actual public or patient interest in PRP injections for shoulder pathology remains unquantified.

Internet search volume data offer a large-scale way to assess public interest. Google Trends (Mountain View, CA) is an open-access resource that tracks historical and current online search volumes. It has previously been used to assess public interest and health care utilization in several areas.^{22,23} Specifically in the field of orthopaedics, Google Trends has been used to track public interest in stem cell injections, as well as PRP injections, for hip and knee osteoarthritis.^{24,25} Patient interest in PRP for shoulder pathology remains unreported.

The purpose of this study was to quantify and analyze public interest trends in PRP therapy for shoulder pathology between 2011 and 2020 using Google Trends data. We hypothesized that patient interest in PRP for shoulder pathology would substantially increase throughout this period, surpassing interest related to corticosteroid injections.

Methods

Google Trends

Data for this study were obtained through Google Trends (<https://trends.google.com>). Google Trends is a free and open-source tool that tracks historical and current online Google search volumes. Once a keyword or key phrase is entered, a chart is generated that displays the relative volume of that search over a defined period. Data are presented as relative search volume (RSV) values as compared with peak popularity of a certain term during a defined time frame, which is assigned a value of 100. The data are computed relative to this peak popularity, with RSV values between 0 and 100 reflecting percentages of a search term's volume within a defined geographic location and period.

Search Queries

Search terms were modeled on previous Google Trends analyses in hip and knee arthritis.^{24,25} To detect differences based on the cause of shoulder pain, we included terms related to arthritis and rotator cuff pathology. Additionally, we input search terms related to corticosteroid injections to establish a comparative group for trend analysis over time. In total, the following keywords were included for analysis: shoulder, shoulder arthritis, shoulder osteoarthritis, rotator cuff, rotator cuff tear, PRP, platelet-rich plasma, corticosteroid, and steroid. For the PRP group specifically, only the following keywords were searched, alone or in combination: shoulder, shoulder arthritis, shoulder osteoarthritis, rotator cuff, rotator cuff tear, PRP, and platelet-rich plasma. For the steroid group, only the following keywords were used: shoulder, shoulder arthritis, shoulder osteoarthritis, rotator cuff, rotator cuff tear, corticosteroid, and steroid. For example, in the PRP group, combined search terms such as “rotator cuff PRP” were used and the resulting search volume data were extracted. Occasionally, a combination of search terms did not result in a sufficient volume of data available for analysis. For each group, corticosteroid and PRP, the aforementioned relevant keywords were input into Google Trends and the raw RSV data were extracted. These data were then compiled into 2 separate databases, 1 for corticosteroid-related search volumes and 1 for PRP-related search volumes. As many search queries as possible were performed for each group so that a broad, representative database of search volumes could be compiled.

Temporal Trends

To detect temporal trends in public interest in PRP treatment versus corticosteroid treatment of shoulder pathology, various combinations and permutations of the previously mentioned keywords relevant to the 2 groups were entered into the Google Trends tool. The resulting data for each term's interest volume were compiled into a database. Data were collected between January 1, 2011, and December 31, 2020, representing a 10-year interval. Additionally, only data from the United States were used. Microsoft Excel (Redmond, WA) was used to generate linear, quadratic, and exponential growth models portraying the shifting public interest over the 10-year interval of study for the search terms related to the PRP and steroid groups. The strength of the generated models was determined using standard measures of accuracy, including mean absolute percentage error, mean absolute deviation, and mean squared deviation. Additionally, regression analysis was performed to assess whether the public interest in PRP or steroid treatment of shoulder

Linear Trend Model for PRP and Shoulder Pathology

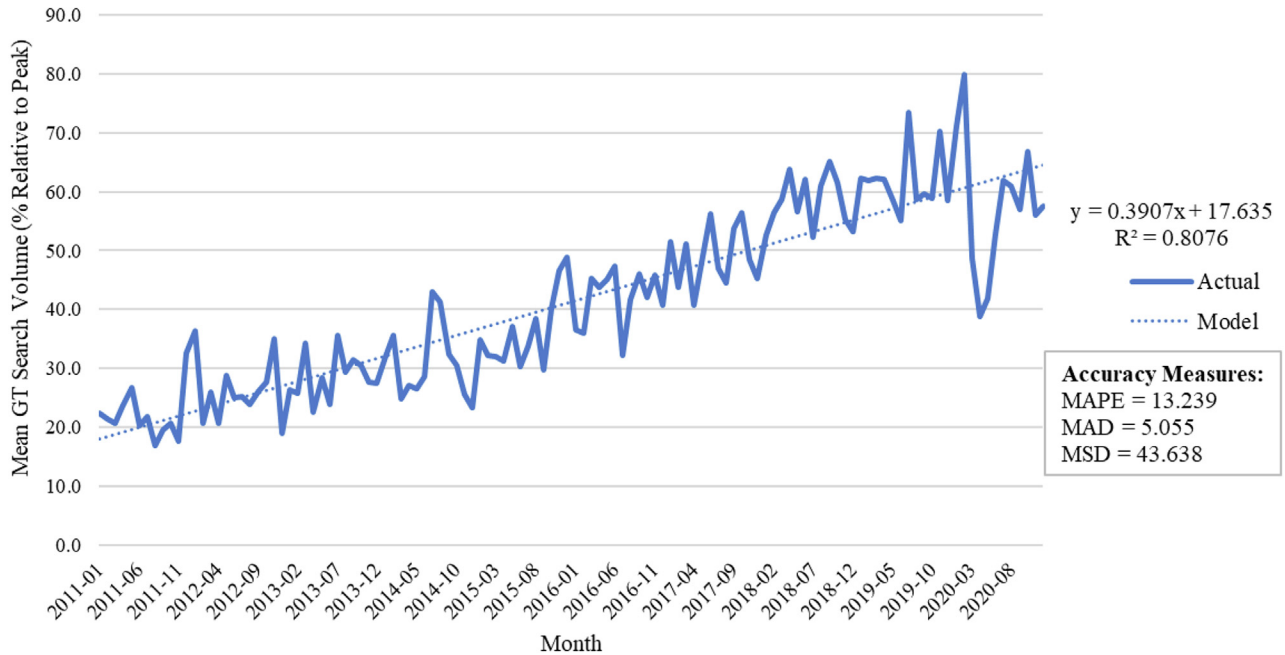


Fig 1. Linear trend model for platelet-rich plasma (PRP) and shoulder pathology from 2011 to 2020. (GT, Google Trends; MAD, mean absolute deviation; MAPE, mean absolute percentage error; MSD, mean squared deviation.)

pathology increased significantly over the 10-year interval. The slopes of the 2 regression models were also compared to determine whether a statistically significant difference existed between the growth rates in public interest in the PRP and steroid groups over time.

Public Health Trends

The World Health Organization declared the novel coronavirus (COVID-19 [coronavirus disease 2019]) outbreak a global pandemic on March 11, 2020.²⁶ Previous investigations have noted a decrease in public interest in elective orthopaedic procedures concordant with the COVID-19 pandemic.²⁷ Data from our temporal trend analysis were examined between the months of February and March 2020 to explore the change in public interest in shoulder PRP and steroid injections before versus after the announcement of the global pandemic.

Absolute Search Volume Trends

To provide additional context, a separate online tool, Google Keywords, was used to collect data for absolute Google search volumes. Google Keywords is an online tool that collects and reports the estimated absolute search volume for a particular term or keyword over the past 4 years. The term "PRP shoulder" was searched in the Google Keywords tool, and the search volumes for the 4-year period from 2017 to 2021 were totaled. To gauge income-related differences in public interest

in PRP treatment of the shoulder, search volumes for the 5 states with the highest median income (Maryland, New Jersey, Hawaii, Massachusetts, and Connecticut) and the 5 states with the lowest median income (Mississippi, West Virginia, Arkansas, New Mexico, and Louisiana) were calculated. A 2-tailed *t* test was also performed to determine whether the difference in search volume between high-income and low-income states was statistically significant. Additionally, the search volumes for the 5 US states and 5 US cities with the highest public interest in PRP treatment of the shoulder were recorded.

Results

Temporal Trends

Between January 1, 2011, and December 31, 2020, both the PRP and steroid linear models showed a consistent increase in search volume and public interest. For both the PRP and steroid models, the linear model was shown to have the most robust measures of accuracy. The mean absolute percentage error was 13.2% for the PRP group and 10.4% for the steroid group. The mean absolute deviation was 5.0 for the PRP group and 4.6 for the steroid group. The mean squared deviation was 43.6 for the PRP group and 32.2 for the steroid group.

On comparison of the 2 models, the search volume related to PRP treatment of shoulder pathology showed

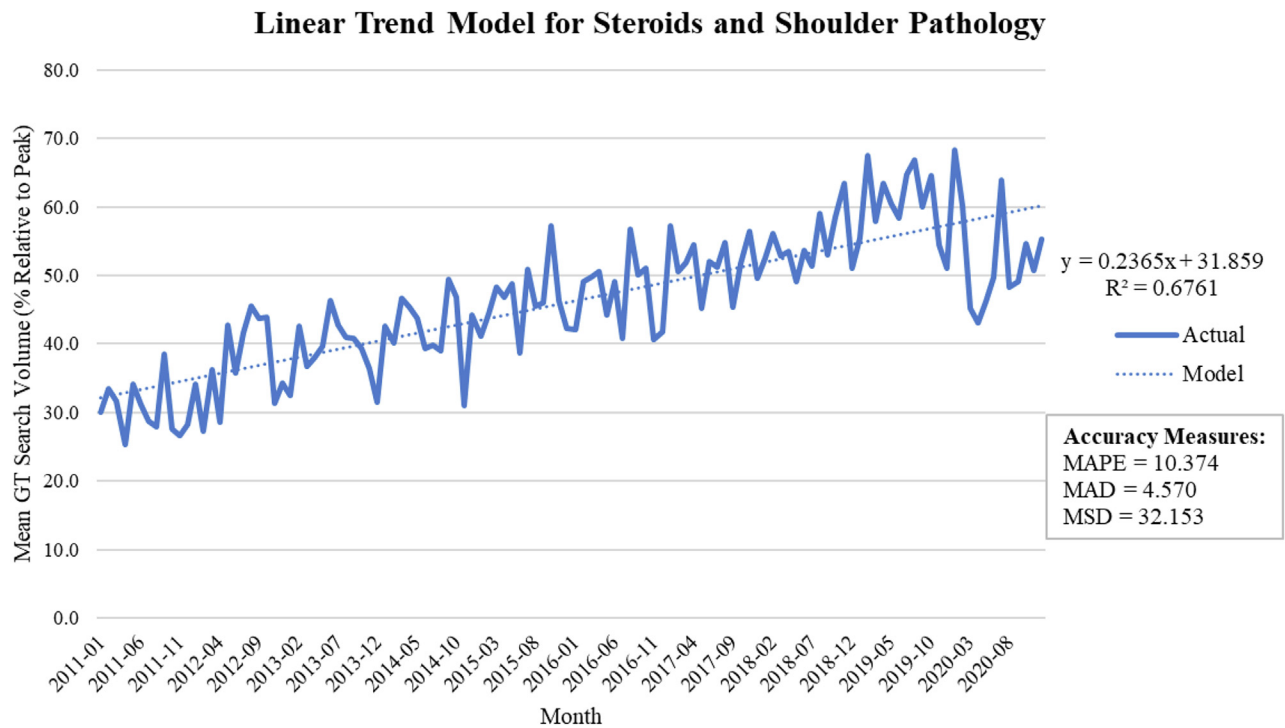


Fig 2. Linear trend model for steroids and shoulder pathology from 2011 to 2020. (GT, Google Trends; MAD, mean absolute deviation; MAPE, mean absolute percentage error; MSD, mean squared deviation.)

a more rapid increase when compared with steroid treatment of shoulder pathology (Figs 1 and 2). Furthermore, the increase in public interest over time in both the PRP and steroid groups was shown to be statistically significant ($P < .001$ for both; $R^2 = 0.808$ for PRP group and $R^2 = 0.676$ for steroid group). Additionally, when we compared the growth rates in Google Trends public interest in PRP treatment versus steroid treatment of shoulder pathology, there was a statistically significantly greater growth rate in the PRP group ($P < .001$).

Absolute Search Volume Trends

The 5 high-income states had an average absolute search volume for “PRP shoulder” of 714.7, with a range of 673 (Connecticut) to 878 (New Jersey) (Table 1). Hawaii had the most searches per million residents (389.9), whereas Massachusetts had the fewest searches per million residents (95.6). The 5 low-income states had an average absolute search volume for “PRP shoulder” of 325.6, with a range of 200 (West Virginia) to 576 (Louisiana). Arkansas had the most searches per million residents (130.9), whereas Mississippi had the fewest searches per million residents (70.6). There was no statistically significant difference in the absolute search volume per million residents when comparing the high-income and low-income states ($P = .236$).

When considering the 5 states with the highest absolute search volume for “PRP shoulder,” California came in first with 2,917 searches, followed by Florida, New York, Texas, and New Jersey (Table 2). New Jersey had the most searches per million residents (98.8), whereas California had the highest percentage share of the total search volume (16.6%). Moreover, the 5 cities with the highest absolute search volume were Los Angeles, New York, Phoenix, Houston, and Chicago. Phoenix had the most searches per million residents (411.7), whereas Los Angeles had the highest percentage share of the total search volume (8.0%) (Table 2).

Discussion

Our results showed a consistent and statistically significant increase in online searches related to PRP for the shoulder between 2011 and 2020, with an increased growth rate between the years 2017 and 2021. Furthermore, when compared with searches regarding corticosteroid injections, online searches related to PRP showed a statistically significantly increased rate of growth. These results suggest that public interest in shoulder PRP injections could continue to grow at an increasing rate and could eventually surpass that in corticosteroid shoulder injections.

The increasing public interest in both PRP and corticosteroid injections shown in this study coincides with

Table 1. Total Absolute Search Volume for “PRP Shoulder” for 5 States With Highest Median Income and 5 States With Lowest Median Income Between 2017 and 2021

	Search Volume*	2019 Population	Searches per Million Residents
High-income states			
New Jersey	878	8,882,190	98.8
Maryland	812	6,045,680	134.3
Connecticut	673	3,565,287	188.8
Massachusetts	659	6,892,503	95.6
Hawaii	552	1,415,872	389.9
Average	714.7	5,501,157	129.9
Low-income states			
Mississippi	210	2,976,149	70.6
West Virginia	200	1,792,147	111.6
Arkansas	395	3,017,804	130.9
New Mexico	247	2,096,829	117.8
Louisiana	576	4,648,794	123.9
Average	325.6	2,906,345	112.0

PRP, platelet-rich plasma.

* $P = .236$ for difference in absolute search volume per million residents between high-income and low-income states.

previous work that noted increasing information-seeking behavior by patients in the digital age.²⁸ Trends reported in this study appear to similarly reflect those previously reported for PRP and stem cell injections in the hip or knee, given that all showed consistently increasing volumes. Our results show that the increasing rate of change in PRP interest in the shoulder is 0.3907, which is greater than similar trends reported for the hip (0.2296) and similar to data reported for the knee (0.4027).²⁵ This observation is supported by previous reports showing that when compared with other joints, the shoulder is most commonly treated with PRP.¹⁴

Exploring the data by location allows for insight into geographic and income-based differences. The states and cities with the highest search volumes were seemingly well distributed geographically across the United States, rather than concentrated in 1 area of the United States. This finding could indicate widespread public interest in PRP therapy for shoulder pathology. Additionally, although it has been previously shown that biologics are more available in high-income regions, our study found no significant difference in normalized search volumes in PRP interest when compared between low- and high-income states.²⁹ Taken together, these results show that interest in PRP is nationwide and is not significantly isolated to regions with high socioeconomic status or areas with increased access to biological therapy or increased advertising.

Substantial decreases in public interest were noted during the COVID-19 pandemic for PRP therapy as well as steroid therapy. Between the months of February and March 2020, the PRP and steroid groups showed decreases of 39.1% and 24.9%, respectively (Figs 1

Table 2. Total Absolute Search Volume for “PRP Shoulder” for 5 States and Cities With Highest Total Search Volume Between 2017 and 2021

	Search Volume	2019 Population	Searches per Million Residents	% Share of Total Search Volume
States				
California	2,917	39,512,223	73.8	16.6
Florida	1,661	21,477,737	77.3	9.4
New York	1,518	19,453,561	78.0	8.6
Texas	1,121	28,995,881	38.7	6.4
New Jersey	878	8,882,190	98.8	5.0
Average	1,619.0	23,664,318	73.3	9.2
Cities				
Los Angeles, CA	1,408	3,979,576	353.8	8.0
New York, NY	852	8,336,817	102.2	4.8
Phoenix, AZ	692	1,680,992	411.7	3.9
Houston, TX	657	2,320,268	283.2	3.7
Chicago, IL	590	2,693,976	219.0	3.4
Average	697.8	3,758,013	185.7	4.0

PRP, platelet-rich plasma.

and 2). For each model, this decrease was the largest month-to-month variation throughout the 10 years analyzed. Similar findings in public interest in elective total joint arthroplasty as a result of the pandemic were reported.³⁰ These results likely reflect decreased public interest in attending health clinics or interacting with the public or a perceived inability to access this care during the pandemic. Of note, the decreased interest in PRP was greater in severity than that in steroid therapy.

There have been significant research efforts into understanding and evaluating PRP. Laboratory studies involving animal models have shown PRP's efficacy in generating increased cell proliferation, growth factors, and angiogenesis.^{31,32} In rat models, PRP has been shown to regenerate Achilles tendons to a greater degree when compared with controls and thereby has been theorized to accelerate the initial inflammatory and healing phase of tendon repair.³³ However, clinical studies have reported mixed results. Lui et al.¹² recently performed a systematic review analyzing PRP for nonoperative management of rotator cuff pathology. They reported a significant pain benefit of PRP on within-group analysis but noted a lack of adequate controls in the included studies. Their overall results showed no significant benefit of PRP over physical therapy in terms of pain or range of motion. However, a separate systematic review by Hamid and Sazlina³⁴ noted that PRP injection was safe and effective for long-term pain control and range of motion in patients with rotator cuff disorders. Studies evaluating the use of PRP in other joints such as the hip or knee have shown similarly inconsistent findings.³⁵⁻³⁹ The increased public interest in PRP does not reflect the increased efficacy shown in these reports. There is a need for high-quality reports dedicated to PRP in the shoulder considering the

current literature, in addition to significantly rising public interest in this therapy.

As described earlier, further clinical trials are needed to confirm the clinical benefit of PRP. Additionally, as of the time of this report, the US Food and Drug Administration has not yet approved PRP, although it can be legally offered to patients as an off-label treatment. Despite the lack of US Food and Drug Administration approval and consistent clinical results, our study notes a significant upward trend in public interest in PRP injections in the shoulder. With the continuation of this trend, public requests for shoulder PRP injections may outnumber cases in which it is appropriately indicated, threatening discordance between physicians and patients on the topic. A consensus among governing bodies and providers regarding the current data, indications, and expected benefit of PRP may be of value for providers going forward. Recommendations published by governing bodies such as the American Academy of Orthopaedic Surgeons have previously shown utility in impacting patient behavior, and such recommendations regarding PRP may offer patients an objective and realistic understanding of this therapy.²⁷

Limitations

This study is not without limitations. Google Trends data do not include demographic information in the output, making it difficult to analyze the specific groups represented in this study or to understand whether the searches analyzed represent the US population as a whole. Additionally, data are not provided regarding searches performed outside of Google's search engine.

Conclusions

This study indicates consistently increasing public interest in PRP injections in the shoulder. The rate of online search volume growth of PRP is significantly greater than that of corticosteroid injections for the period studied.

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