REVIEW ARTICLE

The Most Impactful Articles on the Management and Outcomes of Acetabular Bone Loss: An Altmetric Analysis

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Abstract

Purpose: To identify the top articles pertaining to acetabular bone loss and understand the impact that social media platforms have on the dissemination of hip research.

Methods: In May 2023, the Altmetric database was searched using the PubMed MeSH terms "acetabular bone loss". Studies with the highest Altmetric Attention Scores (AAS) were reviewed to exclude topics irrelevant to the treatment or clinical outcomes of acetabular bone loss. Only the top articles that satisfied the inclusion criteria and had an AAS >1 were included in the final analysis. Bibliometric factors for each study were gathered to analyze article characteristics, following the methodology of previous studies.

Results: The query yielded 281 studies that had mentions. Following the application of our inclusion criteria, the top 45 articles were identified with a mean AAS of 13.56 ± 62.33 (range: 1–421) and a citation rate of 59.4 ±141 (range: 0–921). The included articles represented 17 journals, with 25 articles attributed to three journals: The Journal of Arthroplasty (JOA; 24.4%), Clinical Orthopedics & Related Research (CORR; 15.6%), and The Bone & Joint Journal (BJJ; 15.6%). More than half of all articles originated from North America (n = 24; 53.3%) followed by Europe (n = 15; 33.3%). A total of 40 of the 45 articles were Level 4 (n = 30; 66.7%) or 5 (n = 10; 22%) evidence. Twitter was the most utilized platform to share acetabular bone loss research (n = 33; 73.3%). There was a statistically significant increase in AAS for every incremental increase in journal impact factor (IF) (P = 0.030) and continent of origin in North America (p = 0.042), but no association between score and citation rate (p > 0.05).

Conclusion: Top articles on acetabular bone loss mostly comprise of studies with low levels of evidence performed in North America or Europe with a high citation rate. Twitter was the most utilized social media platform to share acetabular bone loss research. Higher journal IF and article origin in North America were associated with a higher AAS, but no correlation was found between AAS and citation rate.

Keywords: Acetabulum, Altmetric, Bone loss, Pelvic discontinuity, Social media

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Introduction

Acetabular bone loss is commonly recognized as a challenging reconstructive problem during revision total hip arthroplasty (THA), particularly when associated with a chronic pelvic discontinuity.[1] Following early descriptions of the classification and management of bone loss by Paprosky et al.[2] in 1994, a slow-growing body of literature has developed in efforts to understand the long-term outcomes of reconstructing these defects. The recognized impact of academics and their research on clinical practice has been historically rooted in metrics like the number of published articles, Hirsch index (h-index),article citation rate, and journal impact factor (IF).[3] These metrics aim to assess researchers' productivity, offering objective measures that can be used to determine not only research funding and academic positions but also the growth rate of a body of literature.[4,5] Specifically with a primary focus on citation rate, the scientific community fails to consider electronic dissemination and readership of articles. The utilization of open-access journals combined with an increase in reliance on social media platforms for health information sharing has led many individuals to bypass modern routes to accessing information, biasing traditional metrics.[6–8]

By capturing social media attention and non-traditional channels of research distribution garnered, the Altmetric Attention Score (AAS) was developed to quantify the comprehensive impact of an article.[9,10] The AAS was devised through a weighted algorithm of attention sources (for example, Twitter, Facebook, patent citations, news outlets, etc.) to provide a more comprehensive representation of research distribution and viewership. This score has been used to determine the most influential articles in total joint arthroplasty (TJA), total shoulder arthroplasty, and other heavily researched topics.[11–13] However, there are no prior studies evaluating the social media attention of articles pertaining to acetabular bone loss in the setting of revision THA or any niche orthopedic topic.

As a call to action to identify optimal channels for disseminating research on this complex clinical scenario, the goal of our study was

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to utilize the Altmetric database and identify the most impactful studies in social media regarding acetabular bone loss in the setting of revision THA. Our secondary purpose was to determine if any factors are associated with online popularity as measured by AAS.

Methods

Article Selection Criteria

The complete methodology for this article was adopted from the first author's previous work.[6] On May 22, 2023, articles regarding the management and outcomes of treatment for acetabular bone loss were identified in the Altmetric Explorer database (Digital Science, Holtzbrinck Publishing). The PubMed MeSH term "acetabular bone loss" was used as a query in the Altmetric Explorer. Articles were then ranked by descending AAS, followed by a review of titles and abstracts to exclude those unrelated or not directly focused on the topic, resulting in the selection of the top 40 articles. Including ties in scores, 45 articles focusing on acetabular bone loss with the highest AAS were chosen for evaluation. The AAS is a dynamic metric, updated in real-time, calculated by combining weighted social media activity scores with the total number of citations an article accumulates (**Table 1**). This score reflects online engagement across platforms such as Facebook, ResearchGate, and LinkedIn. Since mentions can continue to grow over time, there is no maximum limit to the AAS that an article can achieve. Articles that lack any online attention are assigned an AAS of zero. All Altmetric variables detailed in Table 1 were factored into the analysis.

Additional bibliometric characteristics of each study were gathered following methodologies established in prior research.[6,14,15] The collected article characteristics included the journal name, article title, publication date, highest academic degree of the first author, total number of authors, number of affiliated academic institutions, geographical region of publication origin, open-access availability, disclosure of conflicts of interest (presence or absence of self-reported conflicts), level of evidence (LOE), and the number of cited references. The continent of origin for each article was determined based on the institutional affiliation of the corresponding author. The LOE was assigned according to the criteria set by the Center for Evidence-based Medicine, where level I includes RCTs and systematic reviews/meta-analyses of Level-1 studies, Level 3 encompasses non-randomized cohort studies, Level IV consists of case series, and Level 5 includes editorials and expert opinions.[16]

Statistical Analysis

Statistical analysis was conducted using Stata version 16.1 (StataCorp, College Station, TX) in alignment with our prior works.[6] The Shapiro–Wilks test was applied to assess normality, which was not met for any of the variables analyzed. Bibliometric and Altmetric data were described using means and standard deviations for continuous variables, and frequencies with percentages for categorical variables. A multivariable linear regression analysis was utilized to examine the relationship between article characteristics and AAS, with statistical significance set at $p < 0.05$.

Results

A PubMed query of the Altmetric Database identified 1,268 studies published between 1990 and 2022. After the application of our inclusion criteria, we used AAS to rank and select the top 45 articles generating the highest online engagement that related to acetabular bone loss. About 221 articles were excluded from the query, most of which either were unrelated ($n = 203$) or focused on the classification of bone loss ($n = 18$). The median time since publication was 2 years (IQR: 0–8 years), with most articles being published after 2015 (60%). The mean and standard deviation for the AAS was 13.56 ± 62.33 [range, 1–421 (median: 3)]. The included articles were sourced from 17 journals, with 25 articles published in three journals and their open-access companions: The Journal of Arthroplasty (JOA; 24.4%), Clinical Orthopedics & Related Research (CORR; 15.6%), and The Bone & Joint Journal (BJJ; 15.6%). The mean IF for represented journals was 4.3 ± 1.6. The majority of studies were classified as Level 4 evidence (67%) or level V evidence (22%). The top article identified in this study, written by Vigdorchik et al.,[17] had an AAS that was significantly higher (AAS = 421) than all other included articles (AAS < 30). The most cited article included in this study was written by Paprosky et al.,[2] which garnered significantly more citations (citations = 921) than all other articles. An overview of all bibliometric and Altmetric characteristics included in the study is provided in Appendix 1 and Appendix 2, respectively.

Table 1: Altmetric attention score calculation

Social media outlet	*Weight*
News	7.0
Blog	5.0
Policy document	3.0
Patent	3.0
Wikipedia	3.0
Twitter	1.0
Peer review (Publons, PubPeer)	1.0
Google+**	1.0
F1000	1.0
Weibo*	1.0
Syllabi (Open syllabus)	1.0
LinkedIn	0.5
Reddit	0.25
Facebook	0.25
YouTube	0.25
Pinterest	0.25
Q&A (Stack overflow)	0.25
Mendeley readers	0 (tracked but not considered in calculation)

*not trackable since 2015, but historical data kept; **not trackable since 2019, but historical data kept. The total score is calculated as a function of the social media weights listed in the table.

Of the included articles, 53% originated from North America, 33% originated from Europe, and 34% were originated from outside the United States and Europe. One-fifth of the included articles came from the University of Toronto ($n = 5$) or the Mayo Clinic ($n = 4$). A significant number of the included articles were centered on treatment and outcomes using porous tantalum augments (25%) and those discussing the management of chronic pelvic discontinuity (18%).

A total of 218 Twitter mentions (mean ± standard deviation: 4.84 ± 10.1) were identified from the 45 included articles, representing the most utilized social media platform for sharing acetabular bone loss research. A multivariable linear regression was run on all collected bibliometric characteristics from the included studies to

Table 2: Multivariate linear regression model for key publication characteristics, citations, and the Altmetric attention score

Variable	*Regression coefficient*	*95% Confidence interval*	*p-value*
Reference: Subscription access			
Open-access	3.57	−48.87–56.01	0.891
Reference: No general COI			
COI	−38.39	−102.02–25.23	0.228
Reference: Non-MD/DO**			
MD or DO	−21.02	−98.84–56.79	0.592
Reference: Not from North America			
Continent of origin: North America	64.56	2.65–126.48	0.042*
Reference: Before 2016			
Year: After and including 2016	12.69	−35.16–60.55	0.593
Number of authors	−0.33	−11.66–11.00	0.954
Number of institutions	4.22	−11.66–20.11	0.592
Level of evidence	−3.23	−31.40–24.94	0.817
Journal impact factor	17.96	1.87–34.06	0.030*
Number of references	−0.05	−1.59–1.49	0.947
Number of citations	−0.03	−0.18–0.13	0.737

*Indicates statistical significance at $p < 0.05$ level; **Other author degrees include BS, MS, PhD, MD PhD, MD MBA, MD MS, MD MPH, and PT; COI, conflict of interest

assess the effect of each factor on the AAS (Table 2). The analysis revealed that IF (95% CI, 1.87–34.06; $p = 0.030$) and continent of origin (95% CI, 2.65-126.47; $p = 0.042$) were statistically significant predictors of AAS, with an additional mean increase in the AAS of 17.96 and 64.56 for every increase in IF by a factor of 1 or changing the continent of origin to North America, respectively. The regression analysis demonstrated that there was no significant association between citation rate and the AAS ($p > 0.05$).

Discussion

The top articles related to the management and outcomes of acetabular bone loss based on their online engagement, as indicated by AAS, were identified. The majority of these articles were Level 4 evidence studies performed in North America or Europe and published in one of three major journals. Increased IF and North American article origin were associated with higher AAS. The results of the current study indicate a promising opportunity to enhance the reach of acetabular bone loss research through the strategic use of social media. Additionally, this suggests that the synergistic effect of combining Altmetric with traditional bibliometric measures enables a more comprehensive assessment of research impact that extends beyond the scope of conventional bibliometric parameters.

The majority (56%) of acetabular bone loss papers identified here were published in three journals: The Journal of Arthroplasty (JOA), Clinical Orthopedics & Related Research (CORR), and The Bone & Joint Journal (BJJ). The present 5-year impact factors of these journals are 4.995, 4.837, and 5.385, respectively.[18–20] These represented the 7th, 38th, and 5th highest IFs of all 86 orthopedic journals, respectively. The promotional efforts of these reputable journals in disseminating their articles on social media may explain the heightened visibility of articles from these sources.[14] Additionally, journal self-promotion may play a role in the observed significant and positive relationship between AAS and IF, with an average AAS increase of 18 points for every unit rise in the journal's IF. There is no consensus in orthopedics on the association between IF and AAS, as some articles have reported no association while others have found a significant relationship; including the current investigation and those in the arthroplasty literature.[13–15,21,22] Nonetheless, the selection of impactful journals is critical for the dissemination of acetabular bone loss research as they may result in not only long-term increases in citation rates but also short-term visibility of research on social media.[4]

Of the acetabular bone loss papers, 53% were performed in North America and 33% were in Europe. This aligns with findings previously reported in other orthopedic studies investigating AAS as well as general trends in Altmetrics regarding adult reconstruction research, with Mirghaderi et al. found 58% of the top 50 most cited TJA studies came from the United States or Canada.[12,14,23,24] Given the amount of research produced and disseminated by these countries, Kunze et al. have previously shown that publications originating in North America are linked to higher AAS scores.[15] This is reflected in the results of our regression model, where we demonstrate a significant positive increase in AAS by 65 points for articles produced in North America, and highlight the social media prowess of the potential 450 million users reviewing a local author's promotion and dissemination of their work.[14,25,26]

When categorized by LOE, the vast majority of the included studies were Level 4 or 5 evidence (89%), while only 5 articles were Level 1 or Level 3 evidence. Acetabular bone loss in the context of revision THA continues to be one of the most challenging clinical scenarios for hip surgeons, with minimal research presented in the literature as compared with primary TJAs.[27,28] Studies have suggested a significant growth in the number of revision THA performed annually, citing 50,220 procedures in 2014 in the US alone, with an expected growth of 43–70% by 2030.[29] Previous Altmetric studies on heavily researched topics, such as those reviewing the top medial ulnar collateral ligament papers, top rotator cuff papers, and top primary TJA papers, saw a majority of studies at Level 3 evidence or higher.[14,23,30] Although social media metrics and AAS do not reflect article quality for low LOE studies, our research represents the first Altmetric analysis on a "niche" topic and brings attention to the need to produce and distribute stronger evidence on acetabular bone loss in the context of revision THA.[11,31]

We observed no association between citation rate and AAS. However, a positive correlation between AAS and citation counts has been documented in a variety of orthopedic topics and specialties, including TJA.[14,32,33] This may be the effect of the bias in the timeframe of articles included for the current study as it commonly takes 3–4 years for articles to fully penetrate the research community and to accrue citations and AAS for investigators to precisely analyze.[34] Among the top papers identified, only 16 were published within the aforementioned timeframe (2018–2022). For this reason, the lack of association between citation rate and AAS is in line with other "top Altmetric" studies. Parrish and coauthors report a very weak association between AAS and citation rate ($r = 0.1$) in the top spine articles while Civilette et al. did not find a correlation for the top anterior cruciate ligament articles.[22,24]

Furthermore, given the limited research on this topic, many foundational studies regarding acetabular bone loss were described before the age of social media. As an example, the classification and surgical management of acetabular bone loss written by Paprosky et al.[2] in 1994 is the most cited article on this topic, with 921 citations but only has 1 news mention for an AAS of 7. Particularly with the influence of Twitter on citations, as seen with ~ 75% of included articles in the current study, our inclusion of relatively older articles in our study may explain the lack of association we observed between AAS and citation count.[33,35]

Several important limitations related to this study and the use of AAS should be acknowledged. First, while our study included papers with unique identifiers spanning from 1990 to 2022, there is an inherent bias favoring increased online visibility and attention for more recent studies accessible via DOI searches. In particular, studies published after the insemination of Altmetrics in 2012 are more likely to have a higher AAS.[34] Second, due to the cross-sectional study design of this investigation, the scores and metrics captured to describe the relationship between citations and Altmetrics at a single point in time are not reproducible. Specifically, future research may yield a different selection of top articles depending on the particular date the search is conducted. In addition, the AAS is an unbiased reflection of article dissemination; there is no opportunity to garner the type of attention in the media delivered; this reduces the score's transparency for an individual article's true impact and quality. Lastly, the Altmetric Explorer does not capture confounding factors like self-promotion by journals and authors, as scores reflect dissemination at a snapshot in time. Therefore, it is possible that self-promotion is a primary contributor to article dissemination across social media platforms and may affect the true attention it receives in the orthopedic community.

Conclusion

Top articles on acetabular bone loss, as defined by high AAS, mostly represent studies with low levels of evidence performed in North America or Europe with a high citation rate. Twitter was the most utilized social media platform to share acetabular bone loss research. Higher journal IF and article origin in North America were associated with a higher AAS, but there was no association between AAS and citation rate. Future work is needed to understand how to optimize social media to disseminate research on more challenging, niche topics such as acetabular bone loss in the setting of revision THA.

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Appendix 1: Bibliometric characteristics of included articles

	Overall (N = 45)
Journal	
Clinical Orthopedics & Related Research	7 (15.6%)
Journal of Bone & Joint Surgery	4 (8.9%)
The Bone & Joint Journal	7 (15.6%)
The Journal of Arthroplasty	11 (24.4%)
Other	16 (35.5%)
Impact factor	
Mean (SD)	4.27 (1.55)
Median [Min, Max]	4.44 [0.612, 8.10]
Year of publication	
Before 2015	18 (40.0%)
After 2016 Inclusive	27 (60.0%)
Open access	
No	29 (64.4%)
Yes	16 (35.6%)
Number of author	
Mean (SD)	4.89 (1.99)
Median [Min, Max]	5.00 [2.00, 10.0]
Degree of first author	
MD/DO	41 (91.1%)
Other	4 (8.9%)
Number of institutions	
Mean (SD)	1.71 (1.41)
Median [Min, Max]	1.00 [1.00, 8.00]
Continent of origin	
North America	24 (53.3%)
Europe	15 (33.3%)
Asia	5 (11.1%)
Oceania	1 (2.2%)
Conflict of interest	
No	34 (75.6%)
Yes	11 (24.4%)
Level of evidence	
1	2 (4.4%)
2	0 (0.0%)
3	3 (6.7%)
4	30 (66.7%)
5	10 (22.2%)
Number of references	
Mean (SD)	31.1 (15.2)
Median [Min, Max]	29.0 [4.00, 81.0]
Number of Citations	
Mean (SD)	59.4 (141)
Median [Min, Max]	23.0 [0, 921]

Appendix 2: Altmetric characteristics of included articles

	Overall (N = 45)
AAS	
Mean (SD)	13.6 (62.3)
Median [Min, Max]	3.00 [1.00, 421]
Twitter mention	
No	12 (26.7%)
Yes	33 (73.3%)
Number of Twitter mentions	
Mean (SD)	4.84 (10.1)
Median [Min, Max]	2.00 [0, 53.0]
Facebook mention	
No	33 (73.3%)
Yes	12 (26.7%)
Number of Facebook mentions	
Mean (SD)	0.778 (3.00)
Median [Min, Max]	0 [0, 20.0]
Blog mentions	
No	45 (100%)
Yes	0 (0.0%)
Number of blog mentions	
Mean (SD)	0 (0)
Median [Min, Max]	0 [0, 0]
News mentions	
No	37 (82.2%)
Yes	8 (17.8%)
Number of news mentions	
Mean (SD)	1.42 (8.18)
Median [Min, Max]	0 [0, 55.0]
Video mentions	
No	44 (97.8%)
Yes	1 (2.2%)
Number of video mentions	
Mean (SD)	0.0222 (0.149)
Median [Min, Max]	0 [0, 1.00]
Mendeley readership	
No	2 (4.4%)
Yes	43 (95.6%)
Number of Mendeley readers	
Mean (SD)	44.4 (45.0)
Median [Min, Max]	36.0 [0, 290]
Policy mentions	
No	44 (97.8%)
Yes	1 (2.2%)
Number of policy mentions	
Mean (SD)	0.0222 (0.149)
Median [Min, Max]	0 [0, 1.00]
Patent mentions	
No	43 (95.6%)
Yes	2 (4.4%)
Number of patent mentions	
Mean (SD)	0.0444 (0.208)
Median [Min, Max]	0 [0, 1.00]
Google + Mentions	
No	42 (93.3%)
Yes	3 (6.7%)
Number of google+ mentions	
Mean (SD)	0.111 (0.438)
Median [Min, Max]	0 [0, 2.00]