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Citation versus disruption in the military: Analysis of the top disruptive military trauma research publications

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BACKGROUND: Bibliometric analysis of surgical research has become increasingly prevalent. Citation count (CC) is a commonly used marker of research quality, but may overlook impactful military research. The disruption score (DS) evaluates manuscripts on a spectrum from most innovative with more positive scores (disruptive [DR]) to most entrenched with more negative scores (developmental; DV). We sought to analyze the most DR and DV versus most cited research in military trauma.

METHODS: Top trauma articles by DS and by CC were identified via professional literature search. All publications in military journals were included. Military trauma-related keywords were used to query additional top surgical journals for military-focused publications. Publications were linked to the iCite NIH tool for CC and related metrics. The top 100 DR and DV publications by DS were analyzed and compared with the top 100 articles by CC.

RESULTS: Overall, 32,040 articles published between 1954 and 2014 were identified. The average DS and CC were 0.01 and 22, respectively. Most articles were published in *Mil Med (*68%). The top 100 DR articles were frequently published in *Mil Med* (51%) with a mean DS of 0.148. Of these, the most cited article was only the 40th most disruptive. The top 100 CC articles averaged a DS of 0.009 and were commonly found in *J Trauma* (53%). Only five publications were on both the top 100 DR and top 100 CC lists; 19 were on both the top DV and CC lists. Citation count was not correlated with DR ($r = -0.134$; $p = 0.07$) and only weakly correlated with DV ($r = 0.215$; $p = 0.003$).

CONCLUSION: DS identifies publications that changed military paradigms and future research directions previously overlooked by citation count alone. The DR and DV articles are distinct with little overlap between highly cited military articles. Multiple bibliometric measures should be employed to avoid overlooking impactful military trauma research. (*J Trauma Acute Care Surg.* 2023;95: S157–S169.

LEVEL OF EVIDENCE: Diagnostic Test or Criteria; Level IV.

KEY WORDS: Disruption score; developmental score; citation count; military trauma publications.

The output of academic surgical research is continually increasing and has significantly expanded over the past few years in an exponential fashion.[1,2] This increased amount of research and academic publications has made it difficult to maintain currency and to evaluate the most impactful and relevant projects. Bibliometric analysis has gained popularity in the evaluation of both researchers and the work performed in the surgical community. Surgeon academic productivity and potential faculty appointments have also been impacted by this, as bibliometrics are often an important factor considered during hiring or promoting academic surgeons.[1,3] Common bibliometrics include citation count and the H-index and primarily derive their scale from a simple count of total citations of a published article, both of which are not without limitations.[1,4] Citation counts do not factor the relevance or scientific impact of the citation or reason for increased citations while the H-index has similar limitations and is also biased against older publications.[5,6] Additionally, citation counts are confounded by authors citing their own work. Not all citations are equal, and the count simplifies the true impact of the referenced work.[1] These measures were also not designed to capture scientific work that is truly "disruptive," or leads to major impact and change in a given area of study that displaces much of the previously published research in that field.

The lack of a single metric to properly identify impactful scientific work led to the development of a new metric called the disruption score.[7,8] The disruption score, a ratio between −1 and 1, measures the degree to which a published work introduces a new idea compared with previous literature. Negative scores reflect developmental work and identify publications that continue to expand upon known ideas and further that current paradigm of scientific thought. Positive scores reflect disruptive work and reflect literature that changes the known paradigm of cited related work, thus guiding the scientific thought in a new direction.

Disruption score analysis can identify important scientific work that may be missed by other bibliometric techniques. This

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technique has been used to identify important works in multiple surgical subspecialties that had previously been overlooked.[2,9–16] Disruptive work in the surgical field is rare. Previous analysis has found that only 25% of the PubMed library have positive disruptive scores, and only 10% have scores >0.10.[11] However, this analysis has not specifically been applied to the trauma surgery publications. Because current trauma management has been so heavily impacted by military experiences and research, we sought to apply disruption score bibliometric analysis to military published works. To identify the most disruptive military trauma publications as well as previously overlooked works, the goal of this study was to identify the top 100 disruptive and developmental military trauma publications by disruption score and compare them to the top 100 publications using the standard citation count metric. We hypothesize that bibliometric analysis of military trauma publications using disruption score will identify distinct academic work compared with publications identified by citation counts alone.

METHODS

A PubMed search was performed in August of 2022 in order to extract the PubMed identifiers (PMID) of all articles published in core military journals from 1954 to 2014. To capture relevant work published in non-military specific journals, key military and trauma search terms were used to identify published work from top surgical academic journals (Supplemental Table 1, http://links.lww.com/TA/D30). The PMID's were merged with a validated dataset that contains the disruption scores on articles from 1954 to 2014[7] (Supplemental Data Hyperlink, http://links.lww.com/TA/D31).

The disruption score listed was determined for each article by the calculation: "$X = (A-B)/(A + B + C)$, where X = disruption score for article X, A = # of future articles that cite article X without article X's references being cited simultaneously, B = # of future article that cite article X and at least one of article X's references, and C = # of future article that cite one of the references of article X, but not article X itself."[11] Sullivan et al.[11] describe the impact of this calculation as follows: "As an example, an article was cited 100 times. Of those 100 citations, 90 did not include any of the index article's references (A), and 10 articles included both the index article and the article's references (B). An additional 20 articles cited any one of the index article's citations, but not the index article itself (C). This would result in a score of 0.667 = (90–10)/(90 + 10 + 20).[11] Scores with positive ratios are considered disruptive, with results closer to 1 being the most disruptive. Scores with negative ratios are viewed to be developmental, with scores the furthest from 0 to be the most developmental.

The top 100 disruptive (DR) and top 100 developmental (DV) articles were identified by disruption score. The top 100 most cited (CC) articles were identified using the National Institute of Health iCite tool.[17] For the top 100 DR articles, analysis was performed to identify journal location and research design. Citation counts of the top 100 DR and top 100 DV articles were compared with the top 100 CC articles using the Mann-Whitney U test. Correlation coefficients between disruption scores and citation counts were estimated. All variables were analyzed IBM SPSS Statistics 28 software (IBM Corporation, Armonk, NY).

RESULTS

Professional literary search of the PubMed universe identified 15,537 articles published between 1954 and 2014. Of all identified articles, 73.8% (n = 11,473) were published in *Military Medicine*; *Lancet* was the second most common journal with 5.7% (n = 880). The average disruptive score across all articles was 0.01 with a median of 0 [IQR, –0.004 to 0.005]. Supplemental Figure 1, http://links.lww.com/TA/D32, shows the percent of DR and DS articles from the 10 most commonly identified journals. Regarding citation counts, the average citations were 22 with a median of 4 [IQR, 1–13].

Tables 1 and 2 report the top 100 DR and top 100 DV articles, respectively. The top DR articles have disruption scores ranging from 0.039 to 0.844 and citation counts ranging from 0 to 662. The majority of the DR articles were published in *Military Medicine* (51%) with the next most common journal being the *Journal of Trauma* (18%). The types of articles were most commonly retrospective reviews (38%) or editorials/commentaries (37%) and commonly focused on injury management or wartime experience (Figs. 1 and 2). Of these, the most disruptive article was "A profile of combat injury" published in a 2003 issue of the *Journal of Trauma*. This article, also the second most cited of the top DR articles, was a retrospective review of combat injuries and death across multiple military campaigns. The most cited of the top disruptive articles was "Combat wounds in Operation Iraqi Freedom and Operation Enduring Freedom" published in a 2008 issue of *Journal of Trauma*. Similar to the most disruptive article, this was a review of combat injuries and wounds from two specific recent military campaigns. However, this was only the 40th most disruptive, with a score of 0.130.

The publication distribution of the top developmental articles was similar, with 45% being published in *Military Medicine* and 28% published in *Journal of Trauma.* As with the top DR articles, the top DV articles were most commonly retrospective reviews (34%). The most developmental article was "Arterial repair during the Korean war" published in *Annals of Surgery* in 1954. This retrospective review of arterial repair and reconstruction helped lay the groundwork for later military vascular trauma research. However, the article was only the 29th most cited of the top DV articles. The most cited of the top DV articles was "The ratio of blood products transfused affects mortality in patients receiving massive transfusions at a combat support hospital" published in *Journal of Trauma*. Despite the high citation count (1006), this article was only the 34th most developmental.

The most cited article identified was "Mild traumatic brain injury in US soldiers returning from Iraq," a survey study published in a 2008 edition of *New England Journal of Medicine*. This article identified a potential link between combat traumatic brain injury and post-deployment post-traumatic stress disorder. With a negative disruption score, this article was considered developmental. Upon review, 77% of the top CC articles had negative disruption scores and were thus classified as developmental. The top CC articles are most commonly published in trauma-specific journals, with 59% coming from *Journal of Trauma* and *Journal of Trauma and Acute Care Surgery.*

Only five of the top DR articles were also found among the top 100 CC articles. Identifying articles by disruption yielded a distinct sample compared to the top CC articles, as

TABLE 1. The Top 100 Most Disruptive Articles in Military Trauma

Rank	Title	Authors	Journal	Citations	Year	DS
1	A profile of combat injury	Champion HR, Bellamy RF, Roberts CP, Leppaniemi A.	J Trauma	386	2003	0.844
2	Lessons learned: Operation Anaconda	Midla GS.	Mil Med	9	2004	0.625
3	Clinical observations on the use of dextran and modified fluid gelatin in combat casualties	Artz CP, Howard JM, Fraley JP.	Surgery	2	1955	0.469
4	External fixation in war trauma management of the extremities–experience from the war in Croatia	Dubravko H, Zarko R, Tomislav T, Dragutin K, Vjenceslav N.	J Trauma	11	1994	0.455
5	Blast injury of the ear: treatment and evaluation	Ziv M, Philipsohn NC, Leventon G, Man A.	Mil Med	0	1973	0.404
6	Trauma training and the military	Barker P.	Injury	5	2003	0.400
7	Bladder entrapment after external fixation of traumatic pubic diastasis: importance of follow-up computed tomography in establishing prompt diagnosis	Geracci JJ, Morey AF.	Mil Med	11	2000	0.364
8	George Crile, Harvey Cushing, and the Ambulance Americaine: military medical preparedness in World War I	Rutkow EI, Rutkow IM.	Arch Surg	9	2004	0.333
9	Triage: the past revisited	Swan KG, Swan KG Jr.	Mil Med	0	1996	0.333
10	The military surgeon and the war on terrorism: a Zollinger legacy	Pratt JW, Rush RM Jr.	Am J Surg	16	2003	0.300
11	Bacterial flora of one hundred and twelve combat wounds	Kovaric JJ, Matsumoto T, Dobek AS, Hamit HF.	Mil Med	9	1968	0.288
12	Croatia and Bosnia: the imprints of war–I. Consequences	Horton R.	Lancet	31	1999	0.265
13	Analysis of dental casualties in prolonged field training exercises	Payne TF, Posey WR.	Mil Med	13	1981	0.259
14	Postdeployment domestic violence by US Army soldiers	Newby JH, Ursano RJ, McCarroll JE, Liu X, Fullerton CS, Norwood AE.	Mil Med	19	2005	0.257
15	Military surgeons and surgery, old and new: an instructive chapter in management of contaminated wounds	Wangensteen OH, Wangensteen SD.	Surgery	2	1967	0.228
16	Blood type discrepancies on military identification cards and tags: a readiness concern in the US Army	Rentas FJ, Clark PA.	Mil Med	15	1999	0.222
17	Some clinical factors involved in the healing of war wounds	Seidenstein M, Newman A, Tanski EV.	Arch Surg	1	1968	0.219
18	Combat casualties in Afghanistan cared for by a single Forward Surgical Team during the initial phases of Operation Enduring Freedom	Peoples GE, Gerlinger T, Craig R, Burlingame B.	Mil Med	74	2005	0.216
19	Bacterial quantification of open wounds	Robson MC, Heggers JP.	Mil Med	27	1969	0.216
20	Death of a soldier: accident or neglect?	Brahams D.	Lancet	6	1988	0.214
21	To heal and to serve: military medical education throughout the centuries	Scultetus AH, Villavicencio JL, Koustova E, Rich NM.	J Am Coll Surg	2	2006	0.200
22	Heat illness in the Navy	Brahams D.	Lancet	1	1990	0.200
23	Deployment and the probability of spousal aggression by US Army soldiers	McCarroll JE, Ursano RJ, Liu X, Thayer LE, Newby JH, Norwood AE, Fullerton CS.	Mil Med	7	2000	0.200
24	Another British soldier dies from heat illness	Brahams D.	Lancet	2	1989	0.182
25	Tourniquets for hemorrhage control on the battlefield: a 4-year accumulated experience	Lakstein D, Blumenfeld A, Sokolov T, Lin G, Bssorai R, Lynn M, et al.	J Trauma	157	2003	0.175
26	Spectrum of care provided at an echelon II Medical Unit during Operation Iraqi Freedom	Murray CK, Reynolds JC, Schroeder JM, Harrison MB, Evans OM, Hospenthal DR.	Mil Med	63	2005	0.173
27	Strategic disaster preparedness and response: implications for military medicine under joint command	Burkle FM Jr, Frost DS, Greco SB, Petersen HV, Lillibridge SR.	Mil Med	1	1996	0.172
28	Distribution and care of shipboard blast injuries (USS Cole DDG-67)	Davis TP, Alexander BA, Lambert EW, Simpson RB, Unger DV, Lee J, et al.	J Trauma	19	2003	0.169

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TABLE 1. *(Continued)*

Rank	Title	Authors	Journal	Citations	Year	DS
29	Prevalence of tension pneumothorax in fatally wounded combat casualties	McPherson JJ, Feigin DS, Bellamy RF.	J Trauma	60	2006	0.169
30	The prevalence of lip injury during US Army cold-weather exercises	Lewis DM, Shulman JD, Carpenter WM.	Mil Med	2	1985	0.167
31	Cost analysis of military eye injuries in fiscal years 1988–1998	Buckingham RS, Whitwell KJ, Lee RB.	Mil Med	7	2005	0.167
32	A literature review of dental casualty rates	Mahoney GD, Coombs M.	Mil Med	25	2000	0.160
33	Interhospital patient transport by rotary wing aircraft in a combat environment: risks, adverse events, and process improvement	Lehmann R, Oh J, Killius S, Cornell M, Furay E, Martin M.	J Trauma	15	2009	0.152
34	Comparative mortality among US military personnel in the Persian Gulf region and worldwide during Operations Desert Shield and Desert Storm	Writer JV, DeFraites RF, Brundage JF.	JAMA	66	1996	0.151
35	History, the torch that illuminates: lessons from military medicine	DeBakey ME.	Mil Med	1	1996	0.147
36	Fatal motorcycle accidents of military personnel: a study of 223 cases	Smith BH, Dehner LP.	Mil Med	0	1969	0.146
37	Epidemiology of combat casualties in Thailand	Johnson DE, Panijayanond P, Lumjiak S, Crum JW, Boonkrapu P.	J Trauma	9	1981	0.143
38	A humanitarian mission in southern Iraq: utilization of the 7th Field Hospital of the Army of the Czech Republic–a report on its medical activities and working conditions	Chmátal P, Bohoněk M, Dobiásová M, Hasek R, Cernohous M.	Mil Med	4	2005	0.143
39	Estimating selected disease and nonbattle injury Echelon I and Echelon II outpatient visits of United States soldiers and Marines in an operational setting from corresponding Echelon III (hospitalizations) admissions in the same theater of operation	Kilian DB, Lee AP, Lynch L, Gunzenhauser J.	Mil Med	12	2003	0.133
40	Combat wounds in operation Iraqi Freedom and operation Enduring Freedom	Owens BD, Kragh JF Jr, Wenke JC, Macaitis J, Wade CE, Holcomb JB.	J Trauma	662	2008	0.130
41	An investigation of cold injured soldiers in Alaska	Miller D, Bjornson DR.	Mil Med	3	1962	0.128
42	Splenectomy and subsequent mortality in veterans of the 1939–45 war	Robinette CD, Fraumeni JF Jr.	Lancet	105	1977	0.127
43	More on medical planning for war	Goodman S.	N Engl J Med	2	1982	0.125
44	Medical problems of detainees after the conclusion of major ground combat during Operation Iraqi Freedom	Murray CK, Roop SA, Hospenthal DR.	Mil Med	5	2005	0.125
45	Management of small fragment wounds: experience from the Afghan border	Bowyer GW.	J Trauma	41	1996	0.116
46	Practical advance in obtaining an emergency airway via cricothyroidotomy	Huber WG, Dahman MH, Thomas D, Lipschutz JH.	Mil Med	5	2007	0.115
47	Utilization of pulsed sonic beams (echoencephalogram) for detection of fragments of bone indriven into the brain	Jackson FE, Hussey M, Relyea D.	Mil Med	0	1965	0.115
48	Prevention of heat casualties in Marine Corps recruits. Period of 1955–60, with comparative incidence rates and climatic heat stresses in other training categories	Minard D.	Mil Med	13	1961	0.115
49	A US Army Forward Surgical Team's experience in Operation Iraqi Freedom	Patel TH, Wenner KA, Price SA, Weber MA, Leveridge A, McAtee SJ.	J Trauma	120	2004	0.107
50	Value of the multiservice casualty processing unit in Operation Desert Storm: teamwork and flexibility	Crawford PE, Armstrong JF, Kerstein MD, Oxler S, Draude TV.	Mil Med	0	1997	0.106
51	Abdominal wounds in Korea; a report of ninety-two cases	Aalpoel JA.	Ann Surg	1	1954	0.105
52	Combat wounds of the extraperitoneal rectum	Armstrong RG, Schmitt HJ Jr, Patterson LT.	Surgery	7	1973	0.102
53	Management of war wounds in the Continental United States	Metz CW Jr, Barclay WA.	Arch Surg	0	1968	0.100

54	External fixator frames as interim damage control for limb injuries: experience in the 2010 Haiti earthquake	Lebel E, Blumberg N, Gill A, Merin O, Gelfond R, Bar-On E.	J Trauma	19	2011	0.100
55	Fluid replacement recommendations for training in hot weather	Montain SJ, Latzka WA, Sawka MN.	Mil Med	64	1999	0.097
56	The combat soldier	Artiss KL.	Mil Med	1	2010	0.097
57	Vascular trauma secondary to diagnostic and therapeutic procedures: 1974 through 1982. A comparative review	Youkey JR, Clagett GP, Rich NM, Jaffin JH, Cohen AJ, Brigham RB, et al.	Am J Surg	46	1983	0.097
58	Causes of death in United States Military personnel hospitalized in Vietnam	Arnold K, Cutting RT.	Mil Med	5	1978	0.097
59	A review of 168 maxillo-facial fractures treated at Naval Hospital, Long Beach	Mainous EG, Crowell NT, Smith GL.	Mil Med	0	1974	0.095
60	Afghan war wounded: experience with 200 cases	Rautio J, Paavolainen P.	J Trauma	62	1988	0.090
61	Tourniquet use on the battlefield	Mabry RL.	Mil Med	41	2006	0.087
62	Protecting military convoys in Iraq: an examination of battle injuries sustained by a mechanized battalion during Operation Iraqi Freedom II	Gondusky JS, Reiter MP.	Mil Med	157	2005	0.085
63	Mass casualty in an isolated environment: medical response to a submarine collision	Jankosky CJ.	Mil Med	4	2008	0.083
64	Surgical research in the communication zone. II. Enzyme fluctuations in wounded combat soldiers during the convalescent period	Matsumoto T, Wyte SR, Moseley RV, Nemhauser GM, Henry JN, Aaby G.	Arch Surg	0	1969	0.078
65	External fixator for war purposes: the CMC fixator	Korzinek K, Delimar D, Tripković B.	Mil Med	8	1999	0.078
66	UK statistical indifference to its military casualties in Iraq	Bird SM.	Lancet	8	2006	0.078
67	Navy and Marine Corps active duty mortality patterns for 1995 to 1999	Almond MD, Carlton J, Bohnker BK.	Mil Med	8	2003	0.075
68	Rehabilitation of the upper extremity traumatic amputee	Munroe B, Nasca RJ.	Mil Med	1	1975	0.074
69	Treatment of wounded in the combat zone	Jevtić M, Petrović M, Ignjatović D, Ilijevski N, Misović S, Kronja G, et al.	J Trauma	19	1996	0.074
70	The adoption of laparotomy for the treatment of penetrating abdominal wounds in war	Bamberger PK.	Mil Med	8	1996	0.071
71	War injuries of the chest	Suleman ND, Rasoul HA.	Injury	14	1985	0.071
72	Medical planning for disaster in Israel. Evaluation of the military surgical experience in the October 1973 War, and implications for the organization of the civilian disaster services	Naggan L.	Injury	34	1976	0.068
73	A delayed complication after injury in World War II	Surov A, Taege C, Behrmann C.	N Engl J Med	5	2006	0.068
74	Operation Iraqi Freedom: surgical experience of the 212th Mobile Army Surgical Hospital	Cho JM, Jatoi I, Alarcon AS, Morton TM, King BT, Hermann JM.	Mil Med	31	2005	0.067
75	Warm water immersion foot: still a threat to the soldier	Humphrey W, Ellyson R.	Mil Med	5	1997	0.067
76	Hyperbaric oxygen therapy for gas gangrene in war wounds	Johnson JT, Gillespie TE, Cole JR, Markowitz HA.	Am J Surg	1	1969	0.063
77	Hemostasis with cyanoacrylate: a new method	Heisterkamp CA 3rd, Matsumoto T, Hardaway RM 3rd.	Mil Med	1	1969	0.063
78	Civil war head injury and twentieth-century treatment	Gruen MB, Ko K, Nosko MG.	J Trauma	2	1999	0.063
79	Military blood banking: criteria for storage, refrigeration, transport, and other aspects required in whole blood and blood component logistics	Camp FR Jr, McPeak DW, Allen TE Jr.	Mil Med	2	1976	0.063
80	US Army surgical experiences during the NATO peacekeeping mission in Bosnia-Herzegovina, 1995 to 1999: lessons learned	Grosso SM.	Mil Med	5	2001	0.063

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TABLE 1. *(Continued)*

Rank	Title	Authors	Journal	Citations	Year	DS
81	Executive summary: Guidelines for the prevention of infections associated with combat-related injuries: 2011 update: endorsed by the Infectious Diseases Society of America and the Surgical Infection Society	Hospenthal DR, Murray CK, Andersen RC, Bell RB, Calhoun JH, Cancio LC, Cho JM, Chung KK, Clasper JC, Colyer MH, Infectious Diseases Society of America; Surgical Infection Society.	J Trauma	13	2011	0.060
82	Death and injury from landmines and unexploded ordnance in Afghanistan	Bilukha OO, Brennan M, Woodruff BA.	JAMA	41	2003	0.059
83	Splenic rupture as an incidental complication of decompression sickness, report of a case	Sonnenburg RE.	Mil Med	0	1967	0.059
84	Protection of medical personnel in armed conflicts-case study: Afghanistan	Goniewicz M, Goniewicz K.	Eur J Trauma Emerg Surg	4	2013	0.059
85	Mass casualty triage knowledge of military medical personnel	Janousek JT, Jackson DE, De Lorenzo RA, Coppola M.	Mil Med	16	1999	0.057
86	Combat casualty care: the Alpha Surgical Company experience during Operation Iraqi Freedom	Marshall TJ Jr.	Mil Med	28	2005	0.053
87	Battlefield casualties treated at Camp Rhino, Afghanistan: lessons learned	Bilski TR, Baker BC, Grove JR, Hinks RP, Harrison MJ, Sabra JP, et al.	J Trauma	83	2003	0.049
88	War surgery in a forward surgical hospital in Vietnam: a continuing report	Byerly WG, Pendse PD.	Mil Med	2	1971	0.048
89	Modern war surgery: operations in an evacuation hospital during the October 1973 Arab-Israeli war	Pfeffermann R, Rozin RR, Durst AL, Marin G.	J Trauma	0	1976	0.048
90	Injury and illness casualty distributions among US Army and Marine Corps personnel during Operation Iraqi Freedom	Zouris JM, Wade AL, Magno CP.	Mil Med	30	2008	0.047
91	Trivial head trauma and its consequences in a perspective of regional health care	Plaut MR, Gifford RR.	Mil Med	1	1976	0.047
92	High-velocity bullet causing indirect trauma to the brain and symptomatic epilepsy	Treib J, Haass A, Grauer MT.	Mil Med	0	1996	0.047
93	Tympanic-membrane perforation as a marker of concussive brain injury in Iraq	Xydakis MS, Bebarta VS, Harrison CD, Conner JC, Grant GA, Robbins AS.	N Engl J Med	57	2007	0.046
94	Frontoethmoidal fractures as a result of war injuries	Ivanović A, Jović N, Vukelić-Marković S.	J Trauma	3	1996	0.045
95	Combat arterial trauma. Analysis of 106 limb-threatening injuries	Gorman JF.	Arch Surg	1	1969	0.044
96	Surgical treatment results of Iranian abdominal trauma casualties in the Iran and Iraq war	Payravi H, Mortaz SS, Fazel I.	Mil Med	5	2001	0.042
97	Death of a soldier	Porter AM.	Lancet	1	1988	0.042
98	Epidemiologic analysis of warfare. A historical review	Garfield RM, Neugut AI.	JAMA	70	1991	0.041
99	Studies of adrenal function in combat and wounded soldiers; a study in the Korean theater	Howard JM, Olney JM, Frawley JP, Peterson RE, Smith LH, Davis JH, et al.	Ann Surg	5	1955	0.039
100	Logistics of parenteral fluids in battlefield resuscitation	Pearce FJ, Lyons WS.	Mil Med	14	1999	0.039

TABLE 2. The Top 100 Most Developmental Articles in Military Trauma

Rank	Title	Authors	Journal	Citations	Year	DS
1	Arterial repair during the Korean war	Hughes CW.	Ann Surg	51	1958	−0.174
2	Motorcycle/motor scooter hazards in a military population	Reid RL, Ward CL.	Mil Med	0	1968	−0.167
3	Silicone for immersion foot prophylaxis: where and how much to use	Douglas JS Jr, Eby CS.	Mil Med	0	1972	−0.161
4	The management of chronic subdural hematoma using a compact hand twist drill	Burton C.	Mil Med	5	1968	−0.146
5	Evaluation of neurologic function in Gulf War veterans. A blinded case-control study	Haley RW, Hom J, Roland PS, Bryan WW, Van Ness PC, Bonte FJ, et al.	JAMA	165	1997	−0.133
6	Clinical evaluation of pushover mechanical ventilation with the Ohmeda Universal Portable Anesthesia Complete vaporizer	Hawkins JK, Ciresi SA, Phillips WJ.	Mil Med	2	1998	−0.125
7	Blast injuries: bus versus open-air bombings–a comparative study of injuries in survivors of open-air versus confined-space explosions	Leibovici D, Gofrit ON, Stein M, Shapira SC, Noga Y, Heruti RJ, et al.,	J Trauma	205	1996	−0.124
8	Parachuting injuries: a medical analysis of an airborne operation	Kragh JF Jr, Taylor DC.	Mil Med	0	1996	−0.113
9	Different soils in simulated combat wound. I. Vietnam	Matsumoto T, Hardaway RM 3rd, Dobek AS, Noyes HE.	Mil Med	2	1967	−0.111
10	Terminal velocity impacts into snow	Snyder RG.	Mil Med	0	1966	−0.111
11	Rupture of the brachial artery in closed elbow dislocation: case report	Peabody CN.	Mil Med	1	1978	−0.108
12	Bullet velocity as applied to military rifle wounding capacity	DeMuth WE Jr.	J Trauma	10	1969	−0.105
13	Injuries of the penile and bulbous urethra	Herwig KR, Blumberg N, Hubbard H.	Mil Med	0	1970	−0.098
14	Performance of the universal portable anesthesia complete vaporizer with mechanical ventilation in both drawover and pushover configurations	Hawkins JK, Ciresi SA, Phillips WJ.	Mil Med	6	1998	−0.095
15	Violence-related mortality in Iraq from 2002 to 2006	Alkhuzai AH, Ahmad IJ, Hweel MJ, Ismail TW, Hasan HH, Younis AR, Shawani O, Al-Jaf VM, Al-Alak MM, Rasheed LH, Iraq Family Health Survey Study Group	N Engl J Med	69	2008	−0.095
16	Parachuting injuries: a retrospective study of 43,542 military jumps	Bar-Dayan Y, Bar-Dayan Y, Shemer J.	Mil Med	21	1998	−0.089
17	Screen filtration pressure in combat casualties	McNamara JJ, Molot MD, Stremple JF.	Ann Surg	21	1970	−0.088
18	Foot drop due to cranial gunshot wound	Atac K, Ulas UH, Erdogant E, Gokcil Z.	Mil Med	9	2004	−0.083
19	Parachuting injuries among Army Rangers: a prospective survey of an elite airborne battalion	Kragh JF Jr, Jones BH, Amaroso PJ, Heekin RD.	Mil Med	4	1996	−0.083
20	Long range transport of war-related burn casualties	Renz EM, Cancio LC, Barillo DJ, White CE, Albrecht MC, Thompson CK, et al.	J Trauma	44	2008	−0.080
21	Chest wall thickness in military personnel: implications for needle thoracentesis in tension pneumothorax	Harcke HT, Pearse LA, Levy AD, Getz JM, Robinson SR.	Mil Med	5	2007	−0.080
22	The postwar hospitalization experience of US veterans of the Persian Gulf War	Gray GC, Coate BD, Anderson CM, Kang HK, Berg SW, Wignall FS, et al.	N Engl J Med	137	1996	−0.077
23	Duodenal obstruction by the superior mesenteric artery in bedridden combat casualties	Wayne E, Miller RE, Eiseman B.	Ann Surg	7	1971	−0.077
24	THE PREVENTION OF ACCIDENTS IN THE ARMED SERVICES	McFarland RA, Moore RC.	Mil Med	1	1963	−0.077
25	Cervical spine protection in a combat zone	Mahoney PF, Steinbruner D, Mazur R, Dodson C, Mehta SG.	Injury	6	2007	−0.074
26	Combat fatigue versus pseudo-combat fatigue in Vietnam	Strange RE.	Mil Med	0	1968	−0.071
27	Eye injuries during training exercises with paint balls	Zwaan J, Bybee L, Casey P.	Mil Med	2	1996	−0.065

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TABLE 2. *(Continued)*

Rank	Title	Authors	Journal	Citations	Year	DS
28	How satisfied are soldiers with their ballistic helmets? A comparison of soldiers' opinions about the advanced combat hel met and the personal armor system for ground troops helmet	Ivins BJ, Schwab KA, Crowley JS, McEntire BJ, Trumble CC, Brown FH Jr, et al.	Mil Med	3	2007	−0.063
29	Can external signs of trauma guide management?: Lessons learned from suicide bombing attacks in Israel	Almogy G, Luria T, Richter E, Pizov R, Bdolah-Abram T, Mintz Y, et al.	Arch Surg	56	2005	−0.062
30	The weapons that kill civilians–deaths of children and noncombatants in Iraq, 2003–2008	Hicks MH, Dardagan H, Guerrero Serdán G, Bagnall PM, Sloboda JA, et al.	N Engl J Med	23	2009	−0.060
31	Survival with emergency tourniquet use to stop bleeding in major limb trauma	Kragh JF Jr, Walters TJ, Baer DG, Fox CJ, Wade CE, Salinas J, et al.	Ann Surg	323	2009	−0.057
32	Delayed hemothorax after blunt trauma without rib fractures	Bundy DW, Tilton DM.	Mil Med	5	2003	−0.057
33	War-stress-induced medical emergencies in south Croatia	Rumboldt Z, Giunio L, Miric D, Polic S, Bozic I, Tonkic A.	Lancet	17	1993	−0.055
34	Mortality among UK Gulf War veterans	Macfarlane GJ, Thomas E, Cherry N.	Lancet	60	2000	−0.054
35	The retention of bone fragments in brain wounds	Meirowsky AM.	Mil Med	2	1968	−0.053
36	DIRECT BODY-BODY HUMAN CADAVER BLOOD TRANSFUSION	Kevorkian J, Nicol N, Rea E.	Mil Med	0	1964	−0.053
37	The ratio of blood products transfused affects mortality in patients receiving massive transfusions at a combat support hospital	Borgman MA, Spinella PC, Perkins JG, Grathwohl KW, Repine T, Beekley AC, et al.	J Trauma	1006	2007	−0.052
38	The military anti-shock trouser in civilian pre-hospital emergency care	Kaplan BC, Civetta JM, Nagel EL, Nussenfeld SR, Hirschman JC.	J Trauma	10	1973	−0.051
39	Medical support to a nonprofessional brigade during the Croatian Operation Storm	Janković S, Sapunar D, Jurisić Z, Majić V.	Mil Med	2	1997	−0.049
40	Increased mortality associated with the early coagulopathy of trauma in combat casualties	Niles SE, McLaughlin DF, Perkins JG, Wade CE, Li Y, Spinella PC, Holcomb JB.	J Trauma	249	2008	−0.046
41	Respiratory insufficiency in combat casualties. II. Pulmonary edema following head injury	Simmons RL, Martin AM Jr, Heisterkamp CA 3rd, Ducker TB.	Ann Surg	17	1969	−0.046
42	The health status of Gulf War veterans: lessons learned from the Department of Veterans Affairs Health Registry	Murphy FM, Kang H, Dalager NA, Lee KY, Allen RE, Mather SH, et al.	Mil Med	75	1999	−0.046
43	How does casualty load affect trauma care in urban bombing incidents? A quantitative analysis	Hirshberg A, Scott BG, Granchi T, Wall MJ Jr, Mattox KL, Stein M.	J Trauma	69	2005	−0.045
44	Battlefield urologic injuries: the Gulf War experience	Thompson IM, Flaherty SF, Morey AF.	J Am Coll Surg	15	1998	−0.044
45	Hemostatic efficacy of two advanced dressings in an aortic hemorrhage model in Swine	Kheirabadi BS, Acheson EM, Deguzman R, Sondeen JL, Ryan KL, Delgado A, et al.	J Trauma	89	2005	−0.043
46	Afghan war wounded: application of the Red Cross wound classification	Bowyer GW.	J Trauma	19	1995	−0.042
47	The ratio of fibrinogen to red cells transfused affects survival in casualties receiving massive transfusions at an army combat sup port hospital	Stinger HK, Spinella PC, Perkins JG, Grathwohl KW, Salinas J, Martini WZ, et al.	J Trauma	284	2008	−0.041
48	The ratio of fibrinogen to red cells transfused affects survival in casualties receiving massive transfusions at an army combat support hospital	Stinger HK, Spinella PC, Perkins JG, Grathwohl KW, Salinas J, Martini WZ, et al.	J Trauma	284	2008	−0.041
49	The use of deployable military hospitals after hurricanes: lessons from the Hurricane Marilyn response	Weddle M, Prado-Monje H.	Mil Med	2	2000	−0.041
50	Functional outcomes of unilateral lower limb amputee soldiers in two districts of Sri Lanka	Gunawardena NS, Seneviratne Rde A, Athauda T.	Mil Med	22	2006	−0.040

51	Wandering intravascular missiles: report of five cases from the Lebanon war	Abdo F, Massad M, Slim M, Fahl M, Saba M, Najjar F, et al.	Surgery	32	1988	−0.039
52	Improved survival of burned patients with inhalation injury	Rue LW 3rd, Cioffi WG, Mason AD, McManus WF, Pruitt BA Jr.	Arch Surg	96	1993	−0.039
53	Association of bacterial colonization at the time of presentation to a combat support hospital in a combat zone with subsequent 30-day colonization or infection	Kaspar RL, Griffith ME, Mann PB, Lehman DJ, Conger NG, Hospenthal DR, et al.	Mil Med	23	2009	−0.038
54	Care of war veterans with mild traumatic brain injury–flawed perspectives	Hoge CW, Goldberg HM, Castro CA.	N Engl J Med	184	2009	−0.038
55	Perforation of the terminal ileum induced by blast injury: delayed diagnosis or delayed perforation?	Paran H, Neufeld D, Shwartz I, Kidron D, Susmallian S, Mayo A, et al.	J Trauma	44	1996	−0.037
56	Croatian experience in the treatment of 629 urogenital war injuries	Vucković I, Tucak A, Gotovac J, Karlović B, Matos I, Grdovíc K, et al.	J Trauma	17	1995	−0.037
57	Tympanic membrane perforation after combat blast exposure in Iraq: a poor biomarker of primary blast injury	Harrison CD, Bebarta VS, Grant GA.	J Trauma	28	2009	−0.036
58	Tracheo-esophageal fistula due to blast injury	Volk H, Storey CF, Marrangoin AG.	Ann Surg	2	1955	−0.036
59	Comparison of hemorrhage control agents applied to lethal extremity arterial hemorrhages in swine	Acheson EM, Kheirabadi BS, Deguzman R, Dick EJ Jr, Holcomb JB.	J Trauma	103	2005	−0.036
60	Injury severity and causes of death from Operation Iraqi Freedom and Operation Enduring Freedom: 2003–2004 versus 2006	Kelly JF, Ritenour AE, McLaughlin DF, Bagg KA, Apodaca AN, Mallak CT, et al.	J Trauma	409	2008	−0.035
61	Safety evaluation of new hemostatic agents, smectite granules, and kaolin-coated gauze in a vascular injury wound model in swine	Kheirabadi BS, Mace JE, Terrazas IB, Fedyk CG, Estep JS, Dubick MA, et al.	J Trauma	109	2010	−0.035
62	Cerebral tissue emboli in the lungs: a finding in severe head trauma	Nishiyama RH.	Mil Med	0	1966	−0.034
63	QuikClot use in trauma for hemorrhage control: case series of 103 documented uses	Rhee P, Brown C, Martin M, Salim A, Plurad D, Green D, et al.	J Trauma	137	2008	−0.034
64	Early predictors of massive transfusion in combat casualties	Schreiber MA, Perkins J, Kiraly L, Underwood S, Wade C, Holcomb JB.	J Am Coll Surg	172	2007	−0.034
65	Response to infection control challenges in the deployed setting: Operations Iraqi and Enduring Freedom	Hospenthal DR, Crouch HK, English JF, Leach F, Pool J, Conger NG, et al.	J Trauma	21	2010	−0.034
66	Temporal changes in combat casualties from Afghanistan by nationality: 2006–2010	Schoenfeld AJ, Nelson JH, Burks R, Belmont PJ Jr.	Mil Med	18	2013	−0.033
67	Trans-jugular extraction of bullet embolus to the heart	O'Neill PJ, Feldman DR, Vujic I, Byrne TK.	Mil Med	16	1996	−0.032
68	Humanitarian care by a forward surgical team in aAghanistan	Woll M, Brisson P.	Mil Med	3	2013	−0.032
69	Osteomyelitis in military personnel wounded in Iraq and Afghanistan	Yun HC, Branstetter JG, Murray CK.	J Trauma	111	2008	−0.032
70	Military free fall training injuries	Glorioso JE Jr, Batts KB, Ward WS.	Mil Med	6	1999	−0.031
71	Prehospital tourniquet use in Operation Iraqi Freedom: effect on hemorrhage control and outcomes	Beekley AC, Sebesta JA, Blackbourne LH, Herbert GS, Kauvar DS, Baer DG, Walters TJ, Mullenix PS, Holcomb JB; 31st Combat Support Hospital Research Group.	J Trauma	228	2008	−0.030
72	Death on the battlefield (2001–2011): implications for the future of combat casualty care	Eastridge BJ, Mabry RL, Seguin P, Cantrell J, Tops T, Uribe P, et al.	J Trauma Acute Care Surg	963	2012	−0.030
73	Penetrating wounds of the neck. A military and civilian experience	Fitchett VH, Pomerantz M, Butsch DW, Simon R, Eiseman B.	Arch Surg	3	1969	−0.029
74	The military emergency tourniquet program's lessons learned with devices and designs	Kragh JF Jr, O'Neill ML, Walters TJ, Dubick MA, Baer DG, Wade CE, et al.	Mil Med	0	2011	−0.029
75	War injuries of the ureter	Tucak A, Petek Z, Kuvezdic H.	Mil Med	0	1997	−0.029
76	Supporting the Global War on Terror: a tale of two campaigns featuring the 250th Forward Surgical Team (Airborne)	Rush RM Jr, Stockmaster NR, Stinger HK, Arrington ED, Devine JG, Atteberry L, et al.	Am J Surg	51	2005	−0.028

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TABLE 2. *(Continued)*

Rank	Title	Authors	Journal	Citations	Year	DS
77	Postmortem cesarean section following maternal blast injury: case report	Awwad JT, Azar GB, Aouad AT, Raad J, Karam KS.	J Trauma	8	1994	−0.028
78	The US military wartime pediatric trauma mission: how surgeons and pediatricians are adapting the system to address the need	Fuenfer MM, Spinella PC, Naclerio AL, Creamer KM.	Mil Med	18	2009	−0.028
79	Severe lung contusion and death after high-velocity behind-armor blunt trauma: relation to protection level	Gryth D, Rocksén D, Persson JK, Arborelius UP, Drobin D, Bursell J, et al.	Mil Med	19	2007	−0.027
80	In-theater management of vascular injury: 2 years of the Balad Vascular Registry	Clouse WD, Rasmussen TE, Peck MA, Eliason JL, Cox MW, Bowser AN, et al.	J Am Coll Surg	108	2007	−0.027
81	Therapeutic urogenital modalities during the last three years of the Iran and Iraq War (1985–1987)	Heidarpour A, Dabbagh A, Khatami MS, Rohollahi G.	Mil Med	8	1999	−0.027
82	Rectal wounds incurred in Vietnam	Miller RE, Sullivan FJ.	Mil Med	1	1976	−0.027
83	Orofacial injuries and mouth guard use in elite commando fighters	Zadik Y, Levin L.	Mil Med	11	2008	−0.026
84	Effect of vancomycin, streptomycin and tetracycline pulsating jet lavage on contaminated wounds	Cutright DE, Bhaskar SN, Gross A, Perez B, Beasley JD 3rd, Mulcahey DM.	Mil Med	0	1971	−0.026
85	Clinical and radiological management of wartime eye and orbit injuries	Janković S, Zuljan I, Sapunar D, Buća A, Plestina-Borjan I.	Mil Med	12	1998	−0.025
86	Long-term follow-up of unilateral transfemoral amputees from the Vietnam war	Dougherty PJ.	J Trauma	56	2003	−0.025
87	Complications associated with prolonged tourniquet application on the battlefield	Dayan L, Zinmann C, Stahl S, Norman D.	Mil Med	40	2008	−0.025
88	Implementation and execution of military forward resuscitation programs	Pasquier P, Dubost C, Nau A, Mérat S, Martinaud C.	Shock	1	2014	−0.025
89	Suicide bombers form a new injury profile	Aharonson-Daniel L, Klein Y, Peleg K; ITG.	Ann Surg	44	2006	−0.025
90	Simple derivation of the initial fluid rate for the resuscitation of severely burned adult combat casualties: in silico validation of the rule of 10	Chung KK, Salinas J, Renz EM, Alvarado RA, King BT, Barillo DJ, et al.	J Trauma	34	2010	−0.025
91	Incidence and severity of combat hand burns after All Army Activity message	Hedman TL, Renz EM, Richard RL, Quick CD, Dewey WS, Barillo DJ, et al.	J Trauma	14	2008	−0.024
92	Mortality in Iraq	von Schreeb J, Rosling H, Garfield R.	Lancet	6	2007	−0.024
93	Investigation of materials and methods for air delivery of whole blood and blood products	Shields CE, McPeak DW, Rothwell JC, Seeger GH, Camp FR Jr.	Mil Med	0	1968	−0.023
94	Comparative study of cyanoacrylate and cross-linked gelatin compound in hemostasis of anticoagulated wound	Matsumoto T, Pani KC, Heisterkamp CA 3rd, Hamit HF.	Mil Med	0	1969	−0.022
95	Resuscitation of severely burned military casualties: fluid begets more fluid	Chung KK, Wolf SE, Cancio LC, Alvarado R, Jones JA, McCorcle J, et al.	J Trauma	63	2009	−0.022
96	Tactical surgical intervention with temporary shunting of peripheral vascular trauma sustained during Operation Iraqi Freedom: one unit's experience	Chambers LW, Green DJ, Sample K, Gillingham BL, Rhee P, Brown C, et al.	J Trauma	58	2006	−0.020
97	Incidence and epidemiology of combat injuries sustained during "the surge" portion of operation Iraqi Freedom by a US Army brigade combat team	Belmont PJ Jr, Goodman GP, Zacchilli M, Posner M, Evans C, Owens BD.	J Trauma	116	2010	−0.020
98	Sanctions against Iraq	Ronsmans C, Campbell O.	Lancet	1	1996	−0.020
99	Occlusion of the axillary artery complicating shoulder dislocation: case report	Lescher TJ, Andersen OS.	Mil Med	0	1979	−0.020
100	Hindfoot injuries due to landmine blast accidents	Khan MT, Husain FN, Ahmed A.	Injury	13	2002	−0.020

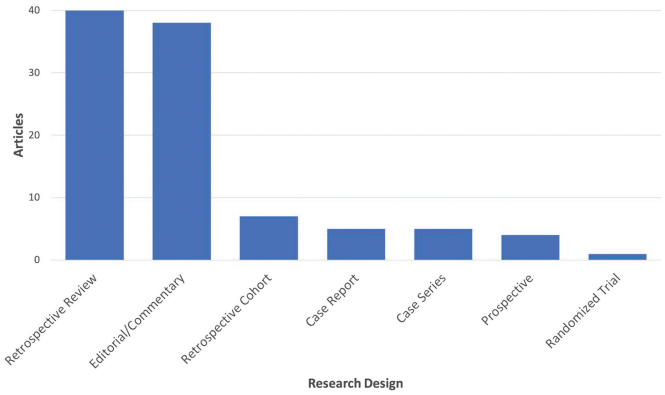

Figure 1. Distribution of research design of the top 100 disruptive military trauma surgery articles.

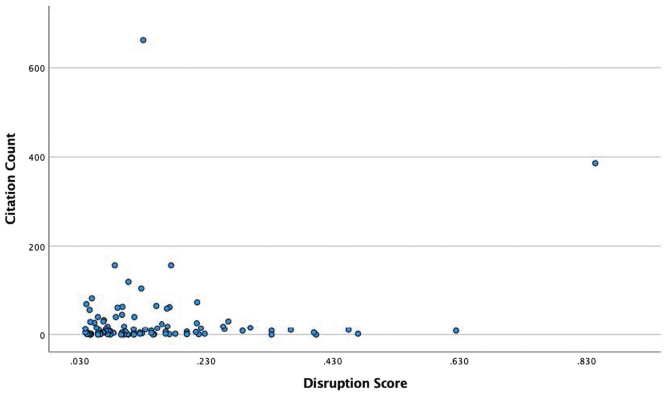

Figure 3. Scatterplot of citation count by disruption scores of the top 100 most disruptive military trauma articles.

evidenced by a significant lack of correlation between disruption metrics and citation counts ($r = -.134$; $p = 0.07$) (Fig. 3). Nineteen articles were found on both the top DS and top CC lists. However, developmental scores (negative disruption scores) were only weakly correlated with citation count ($r = 0.215$; $p = 0.003$) (Fig. 4).

DISCUSSION

This is the first use of a novel bibliometric analysis, the disruption score, to be applied to the military trauma literature. We identified the most 100 disruptive military trauma articles and compared them to the highest cited articles of the same research field. We also identified the most developmental articles in military trauma surgery. These were also compared with the most cited military trauma publications. The comparison showed that disruptive articles and highly cited articles are distinct entities with no strong correlation identified. Similarly, developmental and highly cited military trauma literature are not synonymous, as an article's developmental score was only weakly correlated with citation count.

Bibliometric analysis has been developed to help identify and evaluate relevant academic literature.[7,8] The ability to quantify academic literature has previously been fragmented, with some measures focusing on the author while other focus on the article. H-index and m-score measure the productivity of an individual researcher or academic institution.[3,18,19] The "relative citation ratio" (RCR), is an enhanced citation-based score that attempts to compare the importance of a publication against is field of academia.[20] While the RCR seems to overcome some potential analytic biases, it is not designed to explain how an article has influenced its field of associated literature. However, these scores can have significant professional impact and have been used as a surrogate for academic prowess.[1,3,18] Using the disruption score can identify a different segment of academic literature that has been previously missed by conventional measures. in addition, the disruption can help qualify how work has influenced science by measuring its impact on disrupting previous dogma or solidifying developing thought. This article does not argue for one bibliometric analysis over another; rather, it merely identifies important military trauma literature previously overlooked by other measures of relevance.

This bibliometric technique has been previously applied to several other surgical subspecialties with interesting results. Sullivan and colleagues[11] identified the most disruptive articles from the pediatric surgical literature. The authors found multiple articles describing early clinical outcomes and important surgical innovations that were not among their highest cited companions.[11] Among these were articles by leaders in the historic and current field of pediatric surgery.[11] Becerra et al.[2] applied a

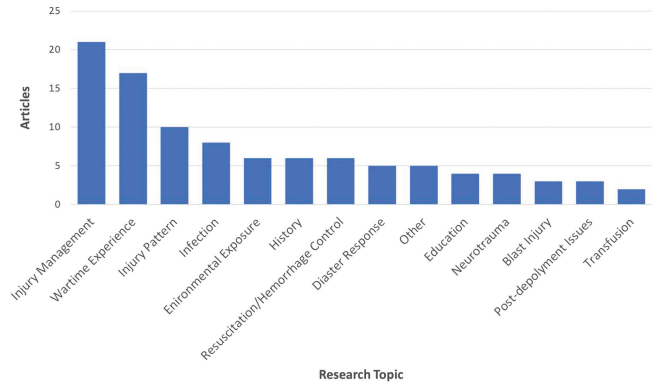

Figure 2. Distribution of clinical focus of the top 100 disruptive military trauma surgery articles.

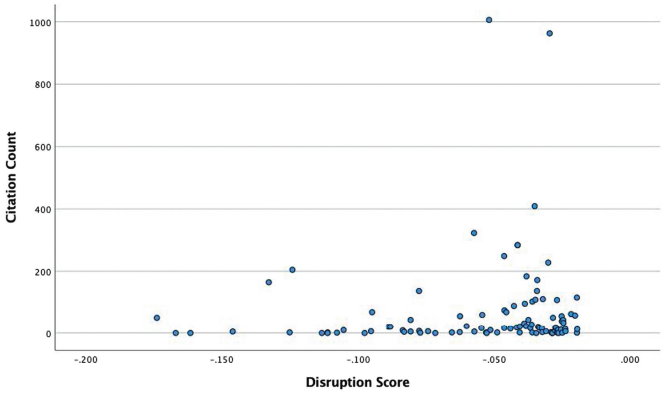

Figure 4. Scatterplot of citation count by disruption scores of the top 100 most developmental military trauma articles.

similar technique in the evaluation of colorectal surgery. In addition to analyzing disruptive articles, they also identified the top developmental contributions to the colorectal field.[2] As with the pediatric literature, the colorectal disruptive and developmental scores did not correlate highly with citation count.[2,11]

Important perspective on the trajectory of military trauma academia is gained by the evaluation of the top disruptive and developmental articles. The disruptive articles, those that are often cited separately from their own referenced work, can identify periods of paradigm shift and practice changes. The most disruptive article, "A profile of combat injury" describes factors associated with and related to battlefield injuries across multiple US military expeditions. In addition, the article identified key differences between battlefield and civilian injury patterns, with recommendations for improvement. The timing of this article likely impacts the disruption score: the article was submitted a mere 14 months after US soldiers were deployed to Afghanistan following the 9/11 terrorist attacks. The injury patterns and barriers to management identified by the article likely helped guide future decisions and research strategies throughout the more recent military campaigns. In addition, the second most disruptive article, "Lessons learned: Operation Anaconda," focused on medical and logistical issues of the first major campaign into Afghanistan following the previously mentioned terrorist attacks. While this article is not highly cited, the combination of the top two disruptive articles sheds insight into the changing military trauma paradigm associated with the global war on terror. These important scientific articles that disrupted previously existing literature on these topics may be overlooked when using standard metrics such as the citation count or any of its derivative metrics that are primarily based on volume of citations.

Developmental military trauma surgery articles appear to affirm ideas, surgical techniques, and practices. For example, the most developmental, "Arterial repair during the Korean war," described the combined experiences and outcomes of arterial injuries needing repair. Not long before its publication, ligation of vascular injuries was standard. World War II saw amputation rates approaching 36% after arterial repair was performed.[21] However, the developmental article found only a 13% amputation rate following vascular repair during the Korean War. While this article did not change the paradigm, it served to further the notion that reconstruction and repair of combat arterial injuries is feasible.

There are limitations of this study that warrant mention. The database of disruption scores is limited to years 1954 to 2014. There are likely many disruptive articles on either side of the included years that have been missed in this analysis. Although it would be interesting to identify those missing articles, these capture dates have been used to evaluate other surgical subspecialties and we feel that 60 years encompasses a significant amount of military campaign literature worth analyzing. We also noted that a large number of disruptive articles were not considered highly scientific research. Becerra and colleagues[2] also found this in their analysis of the colorectal literature. The authors argued that while more rigorously designed research endeavors may gain more citation traction, they often build upon literature that is difficult to supplant. Editorials, commentaries, and case reports may represent newer ideas supplanting previously cited literature. While this may be a limitation of using the disruption score as a sole method of identifying sentinel literature, we believe that it still yields identification of important thoughts that would otherwise be overlooked. The disruption score itself is not without significant limitations. Although it has been validated to identify impactful achievements,[7] its mathematical application to surgical literature has the potential to identify disruptive articles without clinical impact. Articles with extremely low references may lead to misleadingly high disruption scores, especially if the article is not highly cited by others. Other advanced impact scoring systems, like RCR, may be better suited in that scenario. However, the addition of this score to other bibliometrics adds valuable insight into the clinical impact of an academic work. It should also be noted that bibliometric analytics are not adequately tailored to influence current military training protocols. The relevance of the disruption score is not realized immediately, as citations accumulate over time.

Solely using conventional bibliometric analysis of military trauma literature misses important historical and educational literature. Using the disruption score, we were able to identify unique literature that either enhanced or changed the medical thought at the time. This analysis, providing a unique historical assessment, enables previously overlooked military trauma literature to be properly recognized and appreciated. Moving forward, the disruption score should be included in the bibliometric armamentarium of how military trauma research is evaluated.

AUTHORSHIP

J.D. contributed in literature search, study design, data collection, data analysis, data interpretation, writing, and critical revision. S.G. participated in the study design, data collection, data interpretation, writing, and critical revision. R.B. participated in the study design, data interpretation, writing, and critical revision. E.W. participated in the study design, data interpretation, writing, and critical revision. A.G. participated in the contributed in study design, writing, and critical revision. K.M. participated in the contributed in study design, writing, and critical revision. M.S. participated in the contributed in study design, writing, and critical revision. K.I. participated in the contributed in study design, writing, and critical revision. M.M. participated in the contributed in literature search, study design, data collection, data analysis, data interpretation, writing, and critical revision.

DISCLOSURE

The authors declare no funding or conflicts of interest.
The views presented here are the authors and do not necessarily reflect those of the United States government, the Department of Defense, or the United States Army.

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