Sağlık Akademisyenleri Dergisi
http://dergipark.gov.tr/sagakaderg

Sağ Aka Derg, 2025; 12(1): 127-142

Research Article / Araştırma

Studies on gunshot wound in the orthopedic science by science mapping method

Ateşli silah yaralanmalarının ortopedi biliminde bilim haritalama yöntemi ile incelenmesi

Mustafa Aydın

Gülhane Eğitim ve Araştırma Hastanesi, Ortopedi ve Travmatoloji Bölümü, Ankara, Türkiye, mustafaaydin5528@gmail.com, 0000-0002-9066-4606

Key Words:
Gunshot Wounds, Orthopedic Trauma, Science Mapping, Bibliometric Analysis, Firearm Injuries

Anahtar Kelimeler:
Ateşli Silah Yaralanmaları, Ortopedik Travma, Bilim Haritalama, Bibliyometrik Analiz, Silah Yaralanmaları

Corresponding Author/Sorumlu Yazar:
Gülhane Eğitim ve Araştırma Hastanesi, Ortopedi ve Travmatoloji Bölümü, Ankara, Türkiye, mustafaaydin5528@gmail.com, 0000-0002-9066-4606

DOI:
10.52880/sagakaderg.1639231

Received Date/Gönderme Tarihi:
13.02.2025

Accepted Date /Kabul Tarihi:
18.03.2025

Published Online/Yayımlanma Tarihi:
17.04.2025

ABSTRACT

Background and Aim: This study analyzes research trends on gunshot wounds in orthopedic science using the science mapping method. Gunshot wounds pose significant challenges in orthopedic trauma due to severe bone and soft tissue damage. This bibliometric analysis aims to examine the evolution, impact, and key themes in this field. **Material and Method:** A bibliometric, cross-sectional research design was employed using the Web of Science (WoS) database. A total of 658 articles published up to 2024 were included. Bibliometric techniques such as co-occurrence, co-citation, and collaboration network analyses were applied using Bibliometrix and VOSviewer to visualize research trends, key contributors, and thematic structures. **Results and Conclusion**: Research on gunshot wounds in orthopedics has grown steadily, with an annual increase of 9.02%. Frequent topics include firearm-related fractures, infection management, and surgical interventions. Citation analysis highlights key contributions in orthopedic trauma and battlefield medicine, with military medical centers leading research output. Collaboration analysis reveals limited international engagement. Thematic classification identified motor themes (e.g., "firearm injury," "amputation"), niche themes (e.g., "vascular injury"), and emerging topics (e.g., "arthroscopy"). Expanding interdisciplinary collaboration and further research on infection prevention, spinal cord injury rehabilitation, and surgical advancements are needed. This study provides a structured overview of research trends, offering insights for future orthopedic and trauma-related investigations.

ÖZ

Giriş ve Amaç: Bu çalışma, bilim haritalama yöntemi kullanılarak ortopedik bilimlerde ateşli silah yaralanmalarıyla ilgili araştırma eğilimlerini analiz etmeyi amaçlamaktadır. Ateşli silah yaralanmaları, kemik ve yumuşak dokuya verdiği ciddi hasarlar nedeniyle ortopedik travmada önemli zorluklar oluşturmaktadır. Bu bibliyometrik analiz, alanın evrimini, etkisini ve temel araştırma temalarını incelemeyi hedeflemektedir. **Gereç ve Yöntem**: Çalışmada bibliyometrik ve kesitsel bir araştırma tasarımı benimsenmiş olup, Web of Science (WoS) veritabanı kullanılmıştır. 2024 yılına kadar yayımlanmış toplam 658 makale analize dâhil edilmiştir. Bibliyometrik teknikler (eşzamanlı kullanım, eş-atıf ve iş birliği ağ analizleri) Bibliometrix ve VOSviewer yazılımları kullanılarak uygulanmış; araştırma eğilimleri, önde gelen yazarlar ve tematik yapılar görselleştirilmiştir. **Bulgular ve Sonuç**: Ortopedik bilimlerde ateşli silah yaralanmaları üzerine yapılan araştırmalar yıllık %9,02 oranında artış göstermektedir. Yaygın araştırma konuları arasında ateşli silah kaynaklı kırıklar, enfeksiyon yönetimi ve cerrahi müdahaleler bulunmaktadır. Atıf analizleri, ortopedik travma ve askeri tıp alanında önemli katkıları ortaya koymuştur. İş birliği analizleri, uluslararası araştırma katılımının sınırlı olduğunu göstermektedir. Tematik sınıflandırmalar, motor temalar (örn. "ateşli silah yaralanması", "ampütasyon"), niş temalar (örn. "vasküler yaralanma") ve yükselen konular (örn. "artroskopi") olarak belirlenmiştir. Enfeksiyon önleme, omurilik yaralanmalarının rehabilitasyonu ve cerrahi yenilikler konularında daha fazla araştırmaya ihtiyaç duyulmaktadır. Bu çalışma, araştırma eğilimlerine dair yapılandırılmış bir genel bakış sunarak gelecekteki ortopedik ve travma ile ilgili araştırmalara rehberlik edecek önemli içgörüler sağlamaktadır.

Reference | Atıf: Aydın, M. (2025).Ateşli silah yaralanmalarının ortopedi biliminde bilim haritalama yöntemi ile incelenmesi, *Sağlık Akademisyenleri Dergisi*, 12(1),127-142

INTRODUCTION

Gunshot wounds are considered one of the most complex types of trauma in orthopedic practice, often causing severe damage to bones, soft tissues, and neurovascular structures. The management of such injuries requires a comprehensive understanding of ballistics, wound ballistics, and the fundamental principles of fracture care (Fackler, 1996; Denton et al., 2006; Pinto et al., 2019; Dutton et al., 2025).

The severity of orthopedic injuries caused by gunshot wounds depends on factors such as energy transfer from the projectile, the extent of tissue destruction, and the risk of contamination (Lin et al., 2024; Baum et al., 2022; Orhan and Demirtaş, 2025). High-velocity bullets create a significant cavitation effect, leading to extensive soft tissue loss and comminuted fractures, whereas low-velocity gunshot injuries result in more limited tissue damage but pose a high risk of infection due to contamination (Luaubscher et al., 2021).

In the initial management of gunshot wounds, key priorities include hemorrhage control, neurovascular assessment, and infection prevention. To minimize the risk of infection and promote healing, the administration of antibiotics, tetanus prophylaxis, and timely surgical debridement are essential. The treatment of fractures varies depending on the complexity of the injury and the extent of soft tissue involvement, ranging from conservative approaches (immobilization) to surgical interventions, including internal or external fixation (Jabara et al., 2021; Tisnovsky et al., 2021; Nkosi and Sefeane, 2025).

Despite advancements in trauma surgery and orthopedic treatment, the management of gunshot wounds remains a topic of debate. Further research is needed to establish optimal strategies regarding surgical intervention indications, the choice between internal and external fixation techniques, and antibiotic administration protocols (Antoni & Maqungo, 2023; Nelson et al., 1987; Brown et al., 1997).

The orthopedic management of gunshot wounds necessitates a multidisciplinary approach that addresses the unique challenges associated with these injuries (Dougherty et al., 2009). A thorough understanding of ballistics, wound management, and fracture care principles is critical for optimizing patient outcomes and ensuring effective treatment.

Bibliometric analysis is an essential methodological tool for identifying emerging research trends, recognizing gaps in the literature, and mapping future directions based on objective and quantitative data (Balbay ve ark., 2024; Tengilimlioğlu ve ark., 2024). By analyzing the distribution of publications, citation networks, and interdisciplinary connections, researchers can gain a deeper understanding of the evolution of gunshot wound management within orthopedic science and its integration into clinical practice. This analytical approach not only provides a structured overview of current advancements in treatment strategies and surgical interventions but also highlights potential areas for future research, ultimately aiming to enhance patient outcomes and improve the efficacy of orthopedic trauma care.

To clarify the impact of research on gunshot wounds in orthopedic science, this study explores several key questions. First, can the academic performance of publications in this field be evaluated by analyzing metrics such as the annual number of publications, citation counts, and the most influential institutions, authors, journals, and studies? Second, can the conceptual framework of these publications be identified through co-occurrence analysis, revealing the primary themes and interconnections within the research? Third, can the intellectual foundation of the field be mapped using co-citation analysis to determine the most significant contributions and their scholarly influence? Lastly, can the critical years in which groundbreaking advancements in gunshot wound management within orthopedic science occurred be pinpointed, along with the seminal studies that have shaped its development? Addressing these questions will provide a comprehensive understanding of the evolution and trajectory of research in this specialized domain.

MATERIALS AND METHODS

Scientific mapping is a technique used to analyze the literature within a specific research domain, visualizing the structure, development processes, and research trends of a given field. This method employs bibliometric analyses and visual network maps to uncover relationships and interactions between scientific studies. In the medical field, scientific mapping techniques provide a comprehensive analysis of research conducted on specific diseases or treatment methods, helping to identify existing knowledge and research gaps. Such analyses enable researchers and clinicians to quickly identify key studies and trends in the literature, facilitating strategic planning for future research and clinical applications (Apostolova & Thompson, 2007; Zhao & Strotmann, 2015).

Scientific mapping is widely utilized to analyze and visualize the structure, evolution, and interactions of scientific knowledge. This method aims to create a comprehensive map of research fields by analyzing scientific publications, citation networks, keywords,

and other bibliometric data (Börner, Chen, et al., 2003; Tengilimoğlu, Orhan, et al., 2024).

Scientific mapping provides researchers with a deeper understanding of the flow of knowledge, research trends, and collaborations within a particular domain. Specifically, this method allows for the visualization of connections between different disciplines, uncovering new research opportunities (Van Eck & Waltman, 2010; Köse, Kurutkan, et al., 2020).

During the scientific mapping process, software tools such as Bibliometrix, VOSviewer, and CiteSpace are commonly used. These tools analyze large datasets, facilitating the visualization of scientific knowledge and assisting researchers in identifying trends, collaboration networks, and research gaps within the literature. Additionally, scientific mapping plays a critical role in the development of research policies and the identification of scientific priorities (Choudhri, Siddiqui, et al., 2015).

The search strategy and workflow designed for publications related to Gunshot Wound are presented in Figure 1. The study design and data collection process were conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, which are recommended for systematic reviews and meta-analyses (Page, McKenzie, et al., 2021).

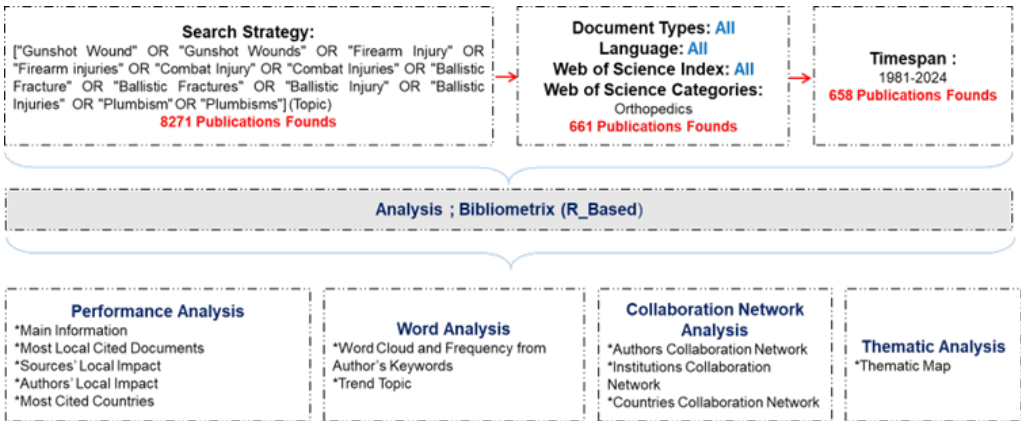
PRISMA aims to ensure transparency and reproducibility in the selection, evaluation, and reporting of studies. This method covers all steps in the systematic review process, from formulating the research question and conducting a literature search to selecting relevant studies and summarizing findings analytically.

In this study, the Web of Science (WoS) database was utilized for bibliometric analysis and literature reviews. WoS, provided by Clarivate Analytics, is a multidisciplinary citation index that includes high-impact scientific journals worldwide. This platform offers researchers comprehensive data across various disciplines, enabling scientific literature searches, citation analyses, and the evaluation of research performance (Li & Rollins, 2018).

The data retrieval process was conducted on February 1, 2025, using the Web of Science (WoS) database. In the subsequent phase, the retrieved data were filtered and refined to ensure relevance and accuracy. A comprehensive search was performed in the WoS database using the following keywords: ["Gunshot Wound" OR "Gunshot Wounds" OR "Firearm Injury" OR "Firearm Injuries" OR "Combat Injury" OR "Combat Injuries" OR "Ballistic Fracture" OR "Ballistic Fractures" OR "Ballistic Injury" OR "Ballistic Injuries" OR "Plumbism" OR "Plumbisms"], yielding a total of 8,271 publications.

To refine the dataset further, only publications categorized under the "Orthopedics" subject area were selected, reducing the number of records to 661. Since new publications continue to be indexed in the database, studies published in 2025 were excluded from the analysis to maintain consistency, resulting in a final dataset of 658 articles, which were subsequently analyzed.

The Bibliometrix software was employed to conduct a comprehensive analysis of the obtained dataset. Bibliometrix is an advanced open-source software



age, Matthew J, McKenzie, Joanne E, Bossuyt, Patrick M et al. (23 more authors) (2021) The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. Journal of Clinical Epidemiology. ISSN 0895-4356 https://doi.org/10.1016/j.jclinepi.2021.03.001

Figure 1. Search Strategy and Workflow Of Science Mapping

package developed in the R programming language specifically for bibliometric and scientometric analysis (Aria & Cuccurullo, 2017). This tool enables researchers to perform a wide range of functions, including data cleaning, network analysis, and visualization, facilitating the exploration of citation patterns, keyword co-occurrences, and collaboration networks. By leveraging Bibliometrix, this study ensures a systematic and structured examination of the dataset, allowing for the identification of key trends, influential publications, and emerging research themes within the studied field.

In this study, a total of 658 articles were analyzed in four sections. The first section focused on the performance analysis of publications related to Gunshot Wound research, the second section conducted a keyword analysis, the third section examined collaboration networks, and the fourth section performed a thematic analysis. To ensure consistency, similar keywords were merged under a unified category. Specifically, terms appearing after a comma were grouped under their preceding equivalent, including gunshot wound/gunshot wounds, gunshot wound/GSW, firearm/firearms, ballistic/ballistics, gunshot injury/gunshot injuries, and combat injury/combat injuries.

Performance Analysis

The statistical data on Gunshot Wound research is presented in Figure 2. Academic studies in this field have established a continuous research trajectory since 1981. A total of 658 academic documents have been published, demonstrating an average annual growth rate of 9.02%. These studies have been disseminated across 86 different academic sources, with contributions from 2,449 distinct authors. The majority of these publications have been collaborative efforts, with an average of 4.53 authors per article. However, the international collaboration rate remains relatively low at 8.055%, indicating limited global engagement in this research area.

The diversity of keywords used in scientific publications is notably broad, with 1,106 different keywords recorded. The total number of citations referenced within these academic studies has reached 11,527, highlighting the strong and well-established literature base in this field. The average age of publications is 14.8 years, suggesting that both historical and contemporary studies continue to have a significant impact on the field. Additionally, the average number of citations per article is 15.22, reflecting the substantial influence of research conducted on Gunshot Wounds within the scientific community. Overall, the increasing academic interest in this topic indicates that it is evolving as a multidisciplinary and collaborative research domain with growing contributions from various scientific perspectives.

Table 1 presents the most locally cited documents in the field of Gunshot Wound research, along with their respective metrics. Local citations (LC) indicate a document's impact within the specific research field, whereas global citations (GC) reflect its recognition and influence in the international academic community.

The oldest study in this dataset was published by Parisen JS in 1984, receiving 14 local citations (LC) and maintaining an LC/GC ratio of 70%, demonstrating its strong influence within the specialized domain. In contrast, the most recent study, published by Omid R in 2019, has accumulated 17 local citations (LC) with an LC/GC ratio of 54.84%, indicating its growing impact within the field.

The most locally cited study in the table is the article published by KNAPP TP in 1996, which has received 36 local citations (LC) and achieved an LC/GC ratio of 50%. Similarly, the study by Bartlett CS, published in 2003, stands out with 29 LC and an LC/GC ratio of 25.22%.

The highest LC/GC ratio (78.26%) belongs to the study by Zura RD, published in 2003. This high ratio indicates that while the study may not have been widely cited in the general literature, it holds significant influence within the specific domain of Gunshot Wound research. Likewise, the 2017 study by Nguyen MP has an LC/GC ratio of 68.97%, with 20 LC, positioning it as a highly influential work within the field in terms of local impact.

Research on Gunshot Wounds has been published in

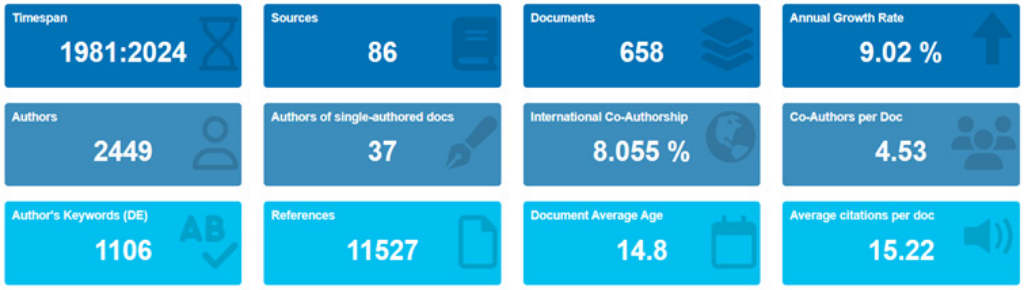


Figure 2. Main Information

Table 1. Most Local Cited Documents

Document	YP	LC	LC/YYP	GC	GC/YYP	LC/GC Ratio%
KNAPP TP, 1996, J BONE JOINT SURG AM	1996	36	1,241	72	2,48	50,00
WATERS RL, 1991, SPINE	1991	29	0,853	94	2,76	30,85
BARTLETT CS, 2003, CLIN ORTHOP RELAT R	2003	29	1,318	115	5,23	25,22
ROMANICK PC, 1985, J BONE JOINT SURG AM	1985	23	0,575	68	1,70	33,82
SATHIYAKUMAR V, 2015, CURR REV MUSCULOSKE	2015	22	2,200	43	4,30	51,16
SIMPSON BM, 2003, CLIN ORTHOP RELAT R	2003	21	0,955	48	2,18	43,75
NGUYEN MP, 2017, J ORTHOP TRAUMA-a	2017	20	2,500	29	3,63	68,97
TORNETTA P, 1997, J ORTHOP TRAUMA	1997	19	0,679	29	1,04	65,52
NGUYEN MP, 2017, J ORTHOP TRAUMA	2017	19	2,375	33	4,13	57,58
ROFFI RP, 1989, SPINE	1989	18	0,500	48	1,33	37,50
KUPCHA PC, 1990, SPINE	1990	18	0,514	59	1,69	30,51
WATERS RL, 2003, CLIN ORTHOP RELAT R	2003	18	0,818	60	2,73	30,00
ZURA RD, 2003, CLIN ORTHOP RELAT R	2003	18	0,818	23	1,05	78,26
LIN SS, 1995, J SPINAL DISORD	1995	17	0,567	38	1,27	44,74
OMID R, 2019, J AM ACAD ORTHOP SUR	2019	17	2,833	31	5,17	54,84
MARECEK GS, 2016, ARCH ORTHOP TRAUM SU	2016	15	1,667	21	2,33	71,43
PARISIEN JS, 1984, CLIN ORTHOP RELAT R	1984	14	0,341	20	0,49	70,00
HANSRAJ KK, 1995, ORTHOP CLIN N AM	1995	14	0,467	21	0,70	66,67
HANSRAJ KK, 1995, ORTHOP CLIN N AM-a	1995	14	0,467	0	0,00	∞
KUMAR A, 1998, J ORTHOP TRAUMA	1998	14	0,519	27	1,00	51,85

Year of Publication (YP), YYP= Year 2025-Year of Publication, Global Citations (GC), Local Citations (LC)

various journals, and their scientific impact is presented in Table 2, which is ranked based on the H-index. The journals are categorized according to H-Index, G-Index, total citation count (TC), number of publications (NP), citations per publication (TC/NP), and year of first publication (PY_start). These metrics are essential for understanding which journals have the highest concentration of literature related to Gunshot Wound research and assessing their overall academic influence.

Among these sources, Injury – International Journal of The Care of The Injured has made the most significant contribution, with 3,201 total citations and 208 publications (NP). It has an average citation per publication of 15.39 and has been active since 1981, with an H-index of 32. Similarly, Clinical Orthopaedics and Related Research demonstrates a high impact with 1,064 total citations and 44 articles, yielding a citation per publication rate of 24.18.

Table 2. Sources' Local Impact

Source	H-Index	G-Index	TC	NP	TC/NP	PY_start
INJURY-INTERNATIONAL JOURNAL OF THE CARE OF THE INJURED	32	42	3201	208	15,39	1981
CLINICAL ORTHOPAEDICS AND RELATED RESEARCH	19	31	1064	44	24,18	1982
JOURNAL OF ORTHOPAEDIC TRAUMA	19	28	905	50	18,1	1994
SPINE	13	21	517	21	24,62	1987
ORTHOPEDIC CLINICS OF NORTH AMERICA	12	19	365	20	18,25	1995
JOURNAL OF BONE AND JOINT SURGERY-AMERICAN VOLUME	11	15	688	15	45,87	1985
JOURNAL OF THE AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS	10	14	638	14	45,57	2005
ORTHOPEDICS	10	13	174	15	11,6	1985
JOURNAL OF HAND SURGERY-AMERICAN VOLUME	9	14	214	16	13,38	1982
INTERNATIONAL ORTHOPAEDICS	7	11	144	11	13,09	1996
SPINE JOURNAL	7	12	165	15	11	2008
ARTHROSCOPY-THE JOURNAL OF ARTHROSCOPIC AND RELATED SURGERY	6	7	106	7	15,14	2002
JOURNAL OF PEDIATRIC ORTHOPAEDICS	6	8	164	8	20,5	1991
ARCHIVES OF ORTHOPAEDIC AND TRAUMA SURGERY	5	9	101	9	11,22	1994
CHINESE JOURNAL OF TRAUMATOLOGY	5	6	50	13	3,846	2010
JOURNAL OF FOOT & ANKLE SURGERY	5	7	52	7	7,429	2012
PARAPLEGIA	5	6	138	6	23	1991
ASIAN SPINE JOURNAL	4	4	57	4	14,25	2013
FOOT & ANKLE INTERNATIONAL	4	4	26	4	6,5	2008
FOOT AND ANKLE CLINICS	4	4	58	4	14,5	2010

NP = Number of publications, TC = Total citations, TC/NP = Citations per paper, PY_start = Publication year starting

The Journal of Orthopaedic Trauma has also made a substantial contribution, with 905 total citations and 50 publications, maintaining an average citation rate of 18.1 per article. Meanwhile, Spine has received 517 total citations across 21 articles, resulting in an average citation rate of 24.62 per publication, positioning it among the highly influential sources in the field.

Despite having fewer publications (15 articles), the Journal of Bone and Joint Surgery – American Volume holds significant academic value, accumulating 688 total citations, with an impressive citation-per-publication rate of 45.87. Similarly, the Journal of the American Academy of Orthopaedic Surgeons has achieved 638 total citations across 14 articles, with an average citation-per-publication rate of 45.57, further highlighting its influence within the orthopedic trauma research domain.

Journals with lower publication and citation counts, such as Orthopedics (H-index: 10, TC: 174), Journal of Hand Surgery – American Volume (TC: 214, NP: 16), and International Orthopaedics (TC: 144, NP: 11), also exhibit notable local impact within the field. Meanwhile, relatively newer journals, such as the Chinese Journal of Traumatology, which was established in 2010, have received a total of 50 citations, with an average citation rate of 3.846 per article.

Among all journals, Injury – International Journal of the Care of the Injured holds the highest G-Index of 42, indicating the strong influence of its most highly cited publications. Other significant contributors, such as Clinical Orthopaedics and Related Research (G-Index: 31) and Journal of Orthopaedic Trauma (G-Index: 28), also demonstrate high G-Index values, reflecting their substantial impact on research related to Gunshot Wounds.

Journals with a high citation-per-publication ratio stand out as key contributors to scientific advancements in this research domain.

Table 3 evaluates the scientific impact of prominent researchers in Gunshot Wound research based on multiple bibliometric indicators. The H-Index is a widely used metric that measures a researcher's academic influence by considering both publication count and citation impact. A researcher's H-Index (h) means that at least "h" publications have received "h" citations each (Hirsch, 2005). This metric serves as a valuable tool in assessing both the quantitative and qualitative impact of scholars.

The G-Index, on the other hand, provides a more detailed examination of how citations are distributed across publications by assigning greater weight to highly cited works. The requirement that a set of "g" publications must have at least "g^2" cumulative citations ensures that high-impact research is prioritized in this evaluation (Egghe, 2006).

Additionally, the M-Index adjusts the H-Index by accounting for the researcher's career duration, offering a fairer comparison between early-career and senior scientists. This metric is calculated using the formula m = h/tm, where tm represents the number of years since the researcher's first publication. As a result, the M-Index is particularly useful for assessing the research productivity of early-stage scholars (Hirsch, 2005).

Table 3. Authors' Local Impact

Element	h_index	g_index	m_index	TC	NP	PY_start
VALLIER HA	8	13	0,8	175	16	2016
INABA K	7	9	0,368	190	9	2007
PENN-BARWELL JG	7	8	0,538	160	8	2013
VACCARO AR	7	8	0,226	303	8	1995
BASBOZKURT M	6	6	0,214	105	6	1998
DEMETRIADES D	6	6	0,353	143	6	2009
LINDSEY RW	6	6	0,207	118	6	1997
NGUYEN MP	6	8	0,667	123	8	2017
REICH MS	6	6	0,6	101	6	2016
WATERS RL	6	7	0,162	297	7	1989
ATESALP AS	5	5	0,179	92	5	1998
BENNETT PM	5	5	0,385	88	5	2013
HSU JR	5	5	0,313	143	5	2010
SARGEANT ID	5	6	0,385	101	6	2013
VAIDYA R	5	5	0,313	99	5	2010
ADKINS RH	4	4	0,108	180	4	1989
CLARKE DL	4	5	0,235	87	5	2009
CLASPER JC	4	4	0,125	49	4	1994
COMO JJ	4	4	0,444	87	4	2017
DEMIRALP B	4	4	0,174	48	4	2003

The researcher with the highest H-Index in the field of Gunshot Wound research is Vallier HA (h = 8), with 175 total citations (TC) and 16 publications (NP), establishing them as a leading scholar in this domain. Inaba K (h = 7, TC = 190, NP = 9), Penn-Barwell JG (h = 7, TC = 160, NP = 8), and Vaccaro AR (h = 7, TC = 303, NP = 8) follow closely, ranking among the most cited and influential contributors to this research area.

In terms of G-Index, Vallier HA again holds the highest value (G = 13), followed by Inaba K (G = 9). Since the G-Index reflects the impact of highly cited publications, these authors are recognized as key figures producing highly influential studies in Gunshot Wound research.

The M-Index, which adjusts the H-Index based on the duration of a researcher's academic career, provides further insight into research productivity over time. Vallier HA has one of the highest M-Index values (0.8), indicating rapid and impactful scholarly contributions. Similarly, Nguyen MP (M = 0.667), Reich MS (M = 0.6), and Penn-Barwell JG (M = 0.538) exhibit notably high M-Index values, suggesting their consistent and productive research output in the field.

Regarding total citation count (TC), Vaccaro AR leads with 303 total citations (NP = 8), followed by Waters RL (TC = 297, NP = 7) and Inaba K (TC = 190, NP = 9). These high citation counts indicate substantial contributions to the scientific literature, reinforcing their importance in Gunshot Wound research.

In conclusion, Vallier HA, Inaba K, and Vaccaro AR emerge as the most influential scholars in this domain. Researchers with high G-Index and M-Index values hold strong academic impact, positioning their work as foundational references for future studies in the field.

Figure 3 illustrates the countries with the highest citation counts in Gunshot Wound research. By comparing total citation counts and the average number of citations per publication, the academic influence of different countries can be assessed.

The United States ranks first, with a total of 6,610 citations and an average of 17.50 citations per article, significantly surpassing other countries. The United Kingdom (TC = 598), South Africa (TC = 387), and Turkey (TC = 348) follow, demonstrating notable contributions to the field.

The Netherlands stands out with the highest average citation per publication (35.00) in Gunshot Wound research. Similarly, Thailand (27.00), Ireland (26.00), and Lebanon (25.00) also exhibit high citation-per-publication rates, indicating that although these countries have produced a relatively low number of studies, their publications are highly impactful and frequently cited.

In contrast, countries such as France (5.50), China (7.10), Brazil (6.40), and Canada (7.60) demonstrate lower total citation counts as well as lower citation-per-publication averages, suggesting a comparatively weaker academic influence in this field.

Overall, the United States, the United Kingdom, South Africa, and Turkey emerge as the countries with the greatest total academic impact, while the Netherlands, Thailand, and Ireland distinguish themselves with high citation-per-publication rates. This indicates that while some countries contribute through a higher volume of publications, others produce fewer but more influential studies within Gunshot Wound research.

Figure 3. Most Cited Countries

Word Analysis

A word cloud is an analytical method used to visualize the most frequently occurring words in a text, helping to identify key themes within the content. In this technique, words are displayed in different sizes based on their frequency, with the most commonly used terms appearing larger and more prominent (Heimerl, Lohmann et al., 2014; Kurutkan & Orhan, 2018). Word clouds are widely employed in text mining, social media analysis, and academic literature reviews (Ghaheri, Ziyaee et al., 2015).

One of the main advantages of word clouds is their ability to summarize large text datasets quickly. However, it is important to note that this method does not fully capture contextual relationships between words and lacks the ability to analyze semantic connections. Therefore, it is recommended to supplement word cloud analysis with sentiment analysis, topic modeling, or network analysis for a more comprehensive understanding (Kucher, Paradis et al., 2018).

Figure 4 presents the 50 most frequently used keywords in Gunshot Wound research, displayed in a word cloud and frequency table format.

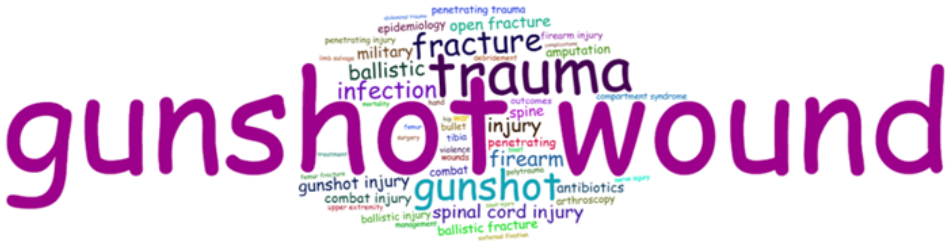
Among the most frequently occurring terms, Gunshot Wound (134 occurrences) and Trauma (60 occurrences) stand out, highlighting that traumatic injuries and firearm-related wounds are central topics in the literature. Additionally, words such as Gunshot (39), Fracture (31), and Infection (23) indicate that firearm injuries are frequently associated with fractures and infection risks.

Military and combat-related terms are also notable. For instance, Ballistic (20), Firearm (20), Military (15), and Combat Injury (13) suggest that such injuries are often linked to military operations and armed conflicts. Furthermore, terms such as Spinal Cord Injury (18) and Nerve Injury (6) emphasize the significance of neurological damage as a major area of research in Gunshot Wound studies.

Among the keywords related to treatment and management, terms such as Antibiotics (13), Amputation (12), Debridement (7), and External Fixation (6) indicate that infection control, limb loss, and surgical interventions are critical aspects of Gunshot Wound management. Additionally, general medical intervention terms like Surgery (6) and Treatment (6) are also frequently cited, highlighting their relevance in this research area.

Overall, the data suggest that studies on firearm injuries primarily focus on trauma, fractures, infections, nerve damage, and surgical interventions. Notably, research in military settings appears to be a major area of investigation, with various treatment strategies being explored to address these injuries.

Figure 5 illustrates how specific keywords have gained popularity over different years based on their frequency in research publications. The visualization includes two keywords per year that appeared at least five times, with the X-axis representing the years and the Y-axis displaying the most frequently used keywords. The size of each bubble corresponds to the frequency of the term's occurrence in that particular year.



Terms	Frequency	Terms	Frequency	Terms	Frequency	Terms	Frequency
gunshot wound	134	antibiotics	13	tibia	9	femur	6
trauma	60	combat injury	13	war	9	femur fracture	6
gunshot	39	amputation	12	compartment syndrome	8	hip	6
fracture	31	ballistic fracture	12	penetrating injury	8	limb salvage	6
infection	23	penetrating	12	violence	8	mortality	6
ballistic	20	combat	11	wounds	8	nerve injury	6
firearm	20	epidemiology	11	debridement	7	surgery	6
injury	19	arthroscopy	10	hand	7	treatment	6
spinal cord injury	18	ballistic injury	10	management	7	abdominal trauma	5
gunshot injury	16	penetrating trauma	10	polytrauma	7	blast injury	5
military	15	bullet	9	upper extremity	7	complications	5
open fracture	15	firearm injury	9	blast	6		
spine	14	outcomes	9	external fixation	6		

Figure 4. Word Cloud and Frequency from Author's Keywords

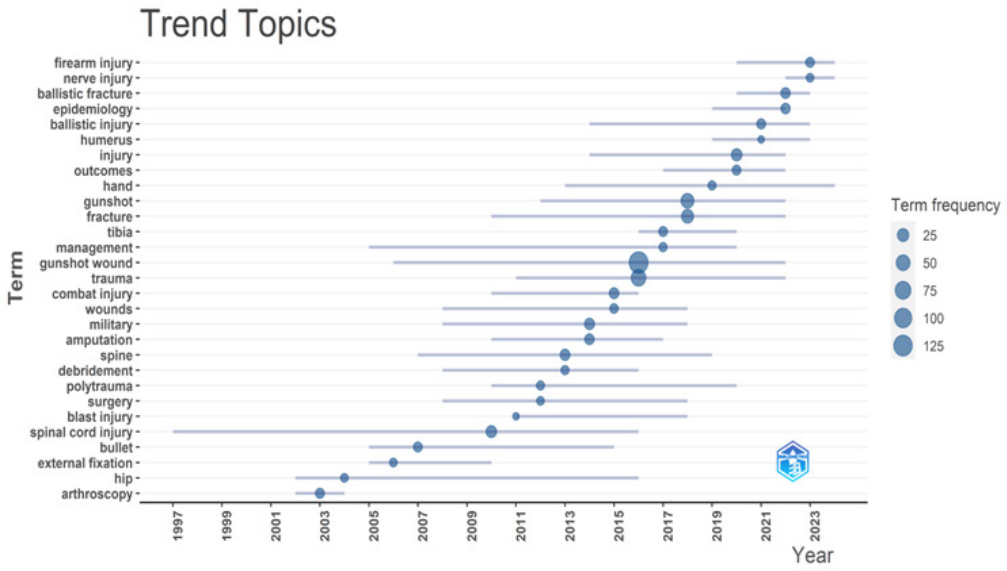


Figure 5. Trend Topics

In the early 2000s, terms such as Arthroscopy, Hip, and External Fixation appeared with low frequency. However, after 2010, keywords like Gunshot Wound, Trauma, Combat Injury, and Military became more dominant, indicating a notable increase in research on firearm-related injuries over the past 10–15 years.

In the 2020s, terms such as Firearm Injury, Nerve Injury, Ballistic Fracture, and Epidemiology have gained prominence, suggesting an increasing focus on the clinical and epidemiological aspects of firearm-related trauma. Furthermore, the rising frequency of keywords like Management, Outcomes, and Surgery in recent years indicates that research on treatment approaches and patient outcomes has expanded significantly.

Overall, the trend analysis illustrates how scientific interest in gunshot wound research has evolved over time, highlighting periods of increased focus on specific topics. In particular, recent years have seen a surge in studies examining nerve damage, fractures, and management strategies, suggesting that these areas are becoming increasingly important focal points in firearm injury research.

Collaboration Network Analysis

Collaboration Network Analysis is a critical method used to examine collaborative relationships among researchers, institutions, and countries in academic research. This analysis helps identify key connections within a specific research domain, providing insights into scientific productivity, impact levels, and collaborative structures (Newman, 2004). In the case of Gunshot Wound research, collaboration network analysis can reveal leading researchers and institutions, the strength of international connections, and how scientific partnerships are structured within this specialized field.

This analysis is assessed based on fundamental network measures, including nodes (representing authors, institutions, or countries), edges (indicating collaboration relationships), density (frequency of collaborations within the network), and centrality (identifying the most influential researchers or institutions) (Freeman, 1979). By examining these metrics, it becomes possible to understand how scientific research is organized and determine which areas require further collaboration. Typically, this analysis is conducted using specialized software such as Bibliometrix, VOSviewer, Gephi, and CiteSpace, which enable the visualization of scientific networks and the discovery of new research collaboration opportunities (Van Eck & Waltman, 2010). For bibliometric mapping in Gunshot Wound research, Collaboration Network Analysis is instrumental in identifying leading countries and institutions while also pinpointing researchers in central positions, thereby facilitating more effective academic collaborations.

The results of the author collaboration network analysis (Authors Collaboration Network) are presented in Figure 6. In this analysis, 20 nodes were selected, and the Walktrap algorithm was applied.

The Authors Collaboration Network in Figure 6 illustrates collaborative relationships among researchers in the field of Gunshot Wound research. The size of the nodes represents the academic contribution of authors, reflecting the number of publications and their impact,

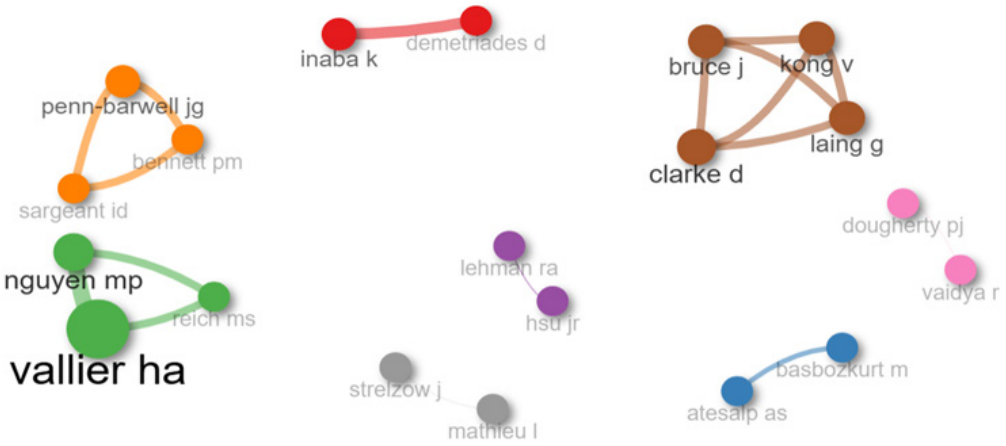


Figure 6. Authors Collaboration Network

while the thickness of the connecting edges indicates the strength of collaboration between two authors.

The largest node in the collaboration network belongs to Vallier HA, indicating that this researcher holds the most significant impact in the field of Gunshot Wound research. Given the strong connections with other researchers, Vallier HA is among the most productive and collaborative figures in this domain. This author has particularly strong partnerships with Nguyen MP and Reich MS, forming a well-defined cluster of highly collaborative researchers.

Additionally, the collaboration between Bruce J, Kong V, Laing G, and Clarke D is remarkably strong, as indicated by the thick connecting edges, reflecting high levels of co-authorship. This group functions as a closely-knit research team, conducting frequent joint studies. Similarly, Penn-Barwell JG, Bennett PM, and Sargeant ID form another highly interactive research cluster, depicted in orange, which demonstrates a tight-knit scientific collaboration.

On the other hand, smaller and less-connected research groups appear to be more scattered, indicating that some collaboration networks are fragmented. The links between Inaba K and Demetriades D, Basbozkurt M and Atesalp AS, as well as Lehman RA and Hsu JR, are relatively weak, suggesting more limited co-authorship efforts. Additionally, gray and pink-colored clusters represent more isolated researchers who have fewer collaborative ties, illustrating that some partnerships remain within smaller, less integrated networks.

Overall, the Gunshot Wound research community appears to be structured into specific research clusters, with some researchers engaging in intense collaboration, while others remain more isolated. Collaboration network analyses such as this one are valuable for identifying potential research partners and enhancing scientific interaction within the field.

The results of the Institutional Collaboration Analysis (Institutions Collaboration Network) are presented in Figure 7. The analysis was conducted using 19 nodes, with the Louvain Algorithm applied. Each node represents an institution, and the size of each node reflects the academic contribution and impact of the institution in Gunshot Wound research. The thickness of the connecting edges indicates the strength of collaborative efforts between institutions.

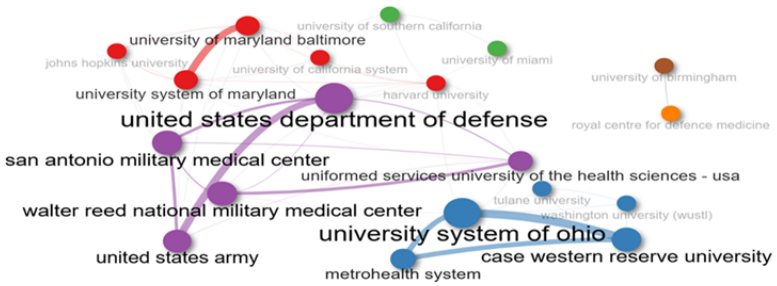


Figure 7. Institutions Collaboration Network

In the Institutional Collaboration Network, the largest node belongs to the United States Department of Defense, indicating that it is the most influential and highly collaborative institution in Gunshot Wound research. This institution maintains strong connections with San Antonio Military Medical Center, Walter Reed National Military Medical Center, and the United States Army, highlighting the military and defense-oriented nature of Gunshot Wound studies. The thick purple edges connecting these institutions indicate intensive collaboration, further supporting the dominance of military medical research in this field.

In addition to military institutions, the University System of Ohio also plays a significant role in Gunshot Wound research, establishing strong partnerships with Case Western Reserve University and MetroHealth System. This demonstrates that civilian academic institutions are also actively involved in advancing research in this area.

On the other hand, institutions such as the University of Maryland Baltimore, the University System of Maryland, and Johns Hopkins University have smaller nodes, suggesting that while they contribute to Gunshot Wound research, their collaborations are more limited. Similarly, prestigious academic institutions such as Harvard University and the University of California System are present in the network, but their collaborative links appear weaker compared to the dominant institutions in the field.

Institutions such as the University of Birmingham and the Royal Centre for Defence Medicine appear more isolated in the network, with fewer global collaborations and positioning toward the periphery of the network.

Overall, these findings suggest that Gunshot Wound research is primarily driven by military medical centers and defense-related institutions, although certain civilian academic and healthcare systems also play a role in advancing this field. Collaboration network analyses such as this are essential for identifying new research partnerships and ensuring that studies are conducted within a broader institutional framework.

The results of the Countries Collaboration Network Analysis are presented in Figure 8. This analysis was conducted using 22 nodes, with the Walktrap Algorithm applied. Each circle represents a country, where the size of the node indicates the academic contribution and impact of that country in Gunshot Wound research. The thickness of the connecting edges reflects the intensity of collaboration between countries in this domain.

In the Countries Collaboration Network, the largest node belongs to the United States, highlighting its position as the most influential and highly collaborative country in Gunshot Wound research. The USA has developed strong research partnerships with Canada, the United Kingdom, Japan, and Spain, demonstrating its role as a global hub for firearm injury research. This indicates that academic studies on gunshot wounds are largely centralized in the United States, with extensive international collaborations.

Examining Europe-centered collaborations, countries such as Germany, Greece, Austria, Ireland, Estonia, and South Africa form a smaller yet interconnected group. While these European and African nations have strong internal collaborations, they appear to have fewer direct links with major research centers like the USA.

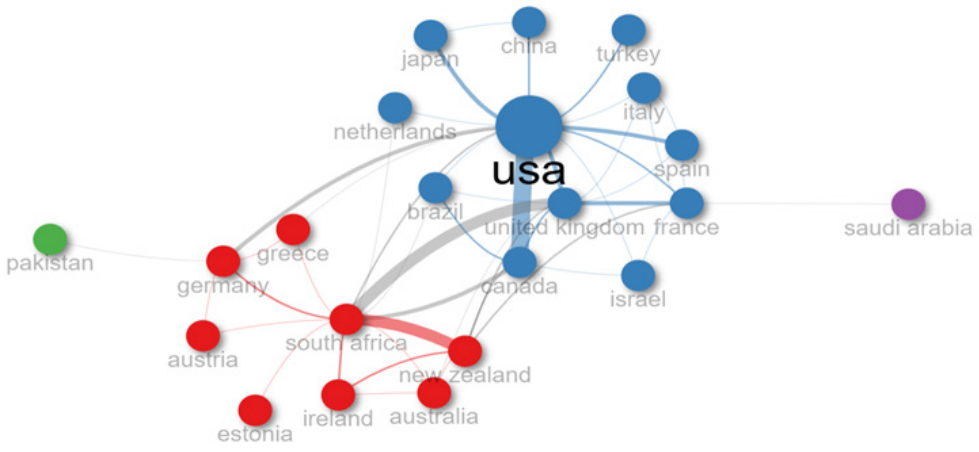


Figure 8. Countries Collaboration Network

In the Southern Hemisphere, a notable collaboration exists between Australia, New Zealand, and South Africa. The thick edges between these countries suggest that regional research partnerships in firearm injury studies are well-established. Brazil is also integrated into this network but has relatively weaker connections, indicating a more limited role in the global research landscape.

Meanwhile, Pakistan and Saudi Arabia are positioned toward the outer edges of the network, indicating that these countries have a more limited contribution to Gunshot Wound research.

Overall, this analysis demonstrates that Gunshot Wound research is predominantly led by the United States, while European and Oceania-based countries tend to develop more regional collaborations. Scientific network analyses like this one are crucial for enhancing international research partnerships and fostering a more globally integrated approach to Gunshot Wound studies.

Thematic Analysis

Figure 9 presents a thematic map of Gunshot Wound research, created using Bibliometrix. This map encompasses each sub-period of research and was generated using the top 300 author keywords that appeared at least eight times. The most frequently used keywords were grouped into thematic clusters, with each cluster represented by the two most recurring keywords. The clustering process was conducted using the Louvain clustering algorithm. The size of the circles was determined based on the frequency of the associated keywords.

Thematic analysis is a method used in qualitative research to extract meaningful themes from data sets through the stages of data coding, theme identification, and interpretation (Clarke & Braun, 2017). This approach is particularly valuable in the social sciences and health sciences, helping researchers uncover both explicit and implicit meanings (Vaismoradi, Jones et al., 2016).

Thematic mapping, on the other hand, is a bibliometric technique used to analyze trends in scientific fields and the evolution of research topics (Donthu, Kumar et al., 2021). This analysis is based on two primary metrics: centrality, which indicates the contextual relevance of a theme within the research field, and density, which reflects the maturity and development level of a theme. Motor themes (high centrality and high density) represent well-developed and core topics in the field. Niche themes (low centrality and high density) are highly specialized but have weaker connections with the broader field. Basic themes (high centrality and low density) serve as the fundamental building blocks of the research domain but require further investigation. Emerging or declining themes (low centrality and low density) represent topics that are either gaining or losing significance over time (Zupic & Čater, 2015).

Among the motor themes, Firearm Injury, Hand, Upper Extremity; Military, Combat Injury, and Amputation emerge as the most prominent. These topics focus on the surgical and rehabilitative aspects of gunshot wounds, representing the most developed and central research areas in the field. Particularly within military medicine and combat trauma, these themes are crucial for treating extremity injuries and post-amputation rehabilitation. In the future, advancements in biotechnology and prosthetics are expected to drive further research in this area. Regenerative medicine, bionic limbs, and rehabilitation techniques for war-related injuries may shape the future research directions of these themes.

Niche themes include topics that are concentrated in specific areas but have limited impact on the broader research domain, such as Compartment Syndrome, Complications, Vascular Injury; Polytrauma, External Fixation, and Blast Injury. These topics primarily focus on surgical interventions, the management of severe trauma, and vascular injuries. Although Compartment Syndrome is a critical complication in trauma surgery, it appears less frequently in broader firearm injury research. External Fixation and Polytrauma are among the most significant topics in trauma surgery, particularly concerning the surgical management of severe injuries. Future advancements in vascular surgery are expected to make Vascular Injury a more central theme, while biomaterial-supported fixation techniques may further improve surgical interventions.

Emerging or declining themes include topics that are either gaining relevance or becoming less significant over time. In this quadrant, Arthroscopy, Bullet, Hip, and Ballistic Fracture are the main topics identified. Arthroscopy, primarily associated with sports injuries, appears to have limited relevance in the field of gunshot wounds. Bullet and Ballistic Fracture are related to studies examining the effects of ballistic trauma on bones, which may gain renewed importance with advancements in forensic medicine and ballistic science. The Hip theme, associated with pelvic fractures and femur injuries, holds a relatively smaller place within the broader field of trauma research. In the future, developments in forensic medicine and ballistic science may lead to increased interest in Bullet and Ballistic Fracture studies. Additionally, with the expansion of minimally invasive surgical techniques, new research may explore the potential role of arthroscopy in trauma surgery.

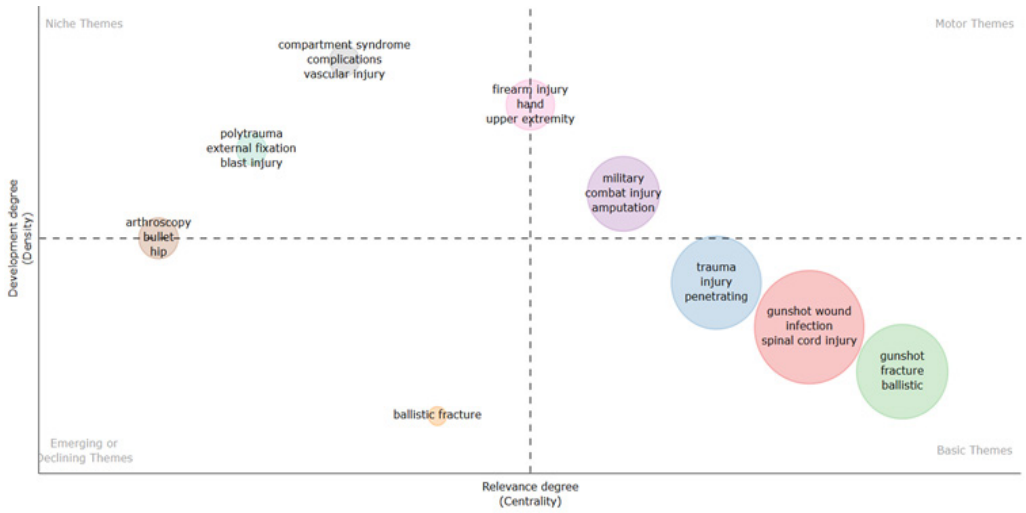


Figure 9. Thematic Map

Core themes are central to the research field but require more in-depth studies. Topics such as Gunshot Wound, Infection, Spinal Cord Injury; Trauma, Injury, Penetrating; Gunshot, Fracture, and Ballistic constitute the most critical aspects of firearm-related injuries. Gunshot Wound and Infection address the risk of infections associated with firearm injuries and the complications arising from such trauma. Spinal Cord Injury is a crucial research area due to the long-term rehabilitation it necessitates, as these injuries often result in permanent disabilities. In the future, advancements in biotechnology and tissue engineering are expected to lead to the development of stem cell therapies, artificial nerve repair techniques, and regenerative medicine for spinal cord injuries. Additionally, as antibiotic resistance continues to rise, new therapeutic approaches for managing infections resulting from firearm injuries will be necessary. Ballistic medicine may evolve as an interdisciplinary research area, particularly to enhance the understanding of the effects of bullet wounds on human tissue.

In conclusion, future research is expected to focus primarily on Spinal Cord Injury, Gunshot Wound Rehabilitation, Infection and Antimicrobial Resistance, Ballistic Trauma and Forensic Science, Combat Injury and Military Medicine, Polytrauma, and Vascular Injury. Regenerative medicine and biomaterials could revolutionize the treatment approaches for spinal cord injuries, while the development of new antibiotics will become increasingly critical in infection management for firearm injuries. The integration of ballistic medicine with forensic sciences may enable artificial intelligence-supported analyses and digital simulations to enhance the understanding of injury mechanisms. Advancements in war surgery and military medicine could lead to improved rapid-response techniques and limb preservation strategies, particularly in conflict zones. Furthermore, next-generation surgical techniques, bioengineered tissue solutions, and advanced hemorrhage control methods are expected to play a significant role in future trauma management.

DISCUSSION

The bibliometric analysis of gunshot wound research in orthopedic science provides valuable insights into the development, trends, and impact of academic studies in this field. By mapping the evolution of publications, collaboration networks, and thematic structures, this study highlights key advancements, emerging research gaps, and potential directions for future investigations.

The findings indicate that research on gunshot wounds in orthopedics has steadily increased over the past decades, with an average annual growth rate of 9.02%. The total number of published studies (658) and their consistent citation rates reflect the academic and clinical significance of this field. The widespread authorship and the predominance of collaborative research (average of 4.53 authors per publication) suggest that multidisciplinary contributions play a crucial role in advancing this domain. However, the relatively low international collaboration rate (8.05%) indicates that global engagement in gunshot wound research remains limited, potentially due to regional differences in the prevalence of firearm-related injuries and funding allocations.

The keyword analysis further underscores the central themes in this research area, with terms such as

"Gunshot Wound," "Trauma," "Fracture," and "Infection" frequently appearing in publications. The presence of military-related terms like "Ballistic," "Firearm," "Combat Injury," and "Military" suggests that a substantial portion of this research is driven by military and defense medicine, where firearm injuries are a critical concern. Additionally, the prominence of terms such as "Spinal Cord Injury," "Nerve Injury," "Amputation," and "External Fixation" highlights the importance of orthopedic interventions in mitigating long-term disability and complications associated with gunshot wounds.

The citation analysis revealed that the most locally cited documents within this domain primarily focus on orthopedic trauma management, infection control, and surgical interventions. The high local citation/global citation (LC/GC) ratio of studies such as those by Zura et al. (2003) (78.26%) and Nguyen et al. (2017) (68.97%) indicates that certain studies have a profound impact within this specialized field, even if their global recognition remains moderate. This suggests that while the findings are highly relevant for orthopedic surgeons and trauma specialists, broader interdisciplinary dissemination may be limited.

Journals with the highest impact in this field, such as Injury – International Journal of the Care of the Injured, Clinical Orthopaedics and Related Research, and the Journal of Orthopaedic Trauma, serve as key platforms for disseminating research on gunshot wound management. The high H-index and citation-per-publication ratio of these sources reflect their role in shaping clinical and surgical approaches to treating firearm injuries.

The authorship impact analysis highlights several key contributors in the field. Researchers such as Vallier HA (h-index = 8, TC = 175) and Vaccaro AR (h-index = 7, TC = 303) have made significant contributions to the understanding of gunshot wound management in orthopedics. The high m-index values of early-career researchers, such as Nguyen MP (m-index = 0.667) and Reich MS (m-index = 0.6), suggest that emerging scholars are actively contributing to advancing knowledge in this area.

The collaboration network analysis indicates that research is primarily concentrated within specific groups of authors, with strong ties between Vallier HA, Nguyen MP, and Reich MS. However, a significant portion of researchers remains isolated or engaged in minimal collaborative work. Expanding collaborative efforts and fostering interdisciplinary partnerships could enhance knowledge-sharing and accelerate scientific progress in this field.

Institutional collaboration analysis reveals that military medical centers, particularly the United States Department of Defense, Walter Reed National Military Medical Center, and San Antonio Military Medical Center, are among the most influential research hubs. Their dominant role aligns with the significant focus on battlefield trauma and military medicine. While several civilian institutions, such as Case Western Reserve University and the University of Maryland, are also active in this domain, their influence appears relatively lower compared to military-affiliated research centers.

At the global level, the United States leads the field in both publication output and scientific collaboration, maintaining strong research ties with Canada, the United Kingdom, and Japan. European countries such as Germany, Austria, and Ireland form a smaller but interconnected research cluster, while Australia and South Africa show regional collaboration patterns. The limited participation of countries from Latin America, Asia, and Africa suggests the need for increased global engagement and funding to address firearm-related trauma beyond military contexts.

The thematic analysis classifies research topics into four major categories:

Motor Themes (high relevance and development): These include "Firearm Injury," "Military," "Combat Injury," and "Amputation." Research in these areas is well-established, indicating a mature and actively expanding field. Future studies in prosthetic advancements, nerve regeneration, and battlefield trauma management could further refine treatment approaches.

Niche Themes (specialized topics with lower centrality): Topics such as "Compartment Syndrome," "Blast Injury," and "Vascular Injury" represent subdomains that, while crucial, require greater integration with broader orthopedic trauma research. Advancements in vascular repair techniques and minimally invasive surgery could enhance treatment outcomes in these areas.

Emerging or Declining Themes: The presence of "Arthroscopy," "Hip," and "Ballistic Fracture" in this category suggests either an increasing focus on specific fracture patterns or a declining interest in certain subtopics. Future studies should assess whether arthroscopic techniques can be effectively applied in the management of ballistic trauma.

Basic Themes (foundational but underdeveloped areas): Topics such as "Gunshot Wound," "Infection," "Spinal Cord Injury," and "Fracture" remain at the core of research but require further investigation. Given the rising challenge of antibiotic resistance, studies on infection prevention and antimicrobial treatments

should be prioritized. Similarly, stem cell therapies and tissue engineering could transform spinal cord injury rehabilitation.

CONCLUSION

This study highlights the increasingly interdisciplinary nature of gunshot wound research in orthopedics. While the field has experienced steady growth in publication output, research collaborations remain geographically and institutionally concentrated. This underscores the need to expand international partnerships and encourage civilian-military research collaborations to enhance knowledge dissemination and clinical application.

From a thematic perspective, infection management, spinal cord injury rehabilitation, and ballistic trauma biomechanics emerge as key areas for future research. Additionally, the integration of biotechnology, artificial intelligence-based diagnostics, and personalized medicine approaches holds the potential to drive significant advancements in this field. Given the continued global rise in firearm-related injuries, future studies should also address the socioeconomic and policy dimensions of gunshot wound management.

In terms of scientific contribution, the science mapping approach employed in this study provides a comprehensive overview of the evolution, impact, and trajectory of research in this specialized area. By identifying critical gaps in the existing body of knowledge, this analysis contributes to the strategic planning of future research efforts in orthopedics and trauma surgery.

REFERENCES

Antoni, A., & Maqungo, S. (2023). Current Concepts Review: Management of civilian transpelvic gunshot fractures. Injury, 111086.

Apostolova, L. G., Thompson, P. M. (2007). Brain Mapping as a Tool to Study Neurodegeneration. Neurotherapeutics, 4(3), 387–400. doi:10.1016/j.nurt.2007.05.009

Aria, M., Cuccurullo, C., (2017). Bibliometrix: An R-Tool For Comprehensive Science Mapping Analysis. Journal of Informetrics, v.11, n.4, pp. 959-975. https://doi.org/10.1016/j.joi.2017.08.007

Balbay, E. G., Kurutkan, M. N., Yıldız, P., & Balbay, Ö. (2024). Earthquake-Related Lung Diseases; A Bibliometric Analysis of Publications. Sağlık Bilimlerinde Değer, 14(1), 8-17.

Baum, G. R., Baum, J. T., Hayward, D., & MacKay, B. J. (2022). Gunshot wounds: ballistics, pathology, and treatment recommendations, with a focus on retained bullets. Orthopedic research and reviews, 14, 293.

Börner, K., Chen, C., Boyack, KW., (2003). Visualizing Knowledge Domains. Annual Review of Information Science and Technology, 37(1), 179–255. https://doi.org/10.1002/aris.1440370106

Brown, T. D., Michas, P., Williams, R. E., Dawson, G., Whitecloud, T. S., & Barrack, R. L. (1997). The impact of gunshot wounds on an orthopaedic surgical service in an urban trauma center. Journal of orthopaedic trauma, 11(3), 149-153.

Choudhri, A. F., Siddiqui, A., Khan, N. R., Cohen, H. L. (2015). Understanding Bibliometric Parameters and Analysis. Radiographics, 35(3), 736-746. doi:10.3171/2015.1.JNS142170

Clarke, V., Braun, V. (2017). Thematic Analysis. The Journal of Positive Psychology, 12(3), 297-298.

Denton, J. S., Segovia, A., & Filkins, J. A. (2006). Practical pathology of gunshot wounds. Archives of pathology & laboratory medicine, 130(9), 1283-1289.

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., Lim, W. M. (2021). How to Conduct a Bibliometric Analysis: An Overview and Guidelines. Journal of Business Research, 133, 285-296.

Dougherty, P. J., Najibi, S., Silverton, C., & Vaidya, R. (2009). Gunshot wounds: epidemiology, wound ballistics, and soft-tissue treatment. Instr Course Lect, 58(131), e139.

Dutton, R. P., Pivalizza, E., & Herbstreit, F. (2025). Firearm Injuries: An American Disease. Anesthesia & Analgesia, 140(3), 550-553.

Egghe, L. (2006). Theory And Practise Of The G-Index. Scientometrics, 69(1), 131-152.

Fackler, M. L. (1996). Gunshot wound review. Annals of emergency medicine, 28(2), 194-203.

Freeman, L. C. (1979). Centrality in Social Networks: Conceptual Clarification. Social Networks, 1(3), 215-239. doi:10.1016/0378-8733(78)90021-7

Ghaheri, A., Ziyaee, A., Yaghoobi, M., Golmohammadi, H. (2015). Discovering Trends in Scientific Literature Using Topic Modeling and Word Cloud Techniques. International Journal of Information Science and Management, 13(2), 25-40.

Heimerl, F., Lohmann, S., Lange, S., Ertl, T. (2014). Word Cloud Explorer: Text Analytics Based on Word Clouds. Proceedings of the 47th Hawaii International Conference on System Sciences (HICSS), 1833-1842. https://doi.org/10.1109/HICSS.2014.231

Hirsch, J. E. (2005). An Index to Quantify an Individual's Scientific Reserach Output. Proceedings of the National Academy of Sciences United States of America, 102, 16569–16572.

Jabara, J. T., Gannon, N. P., Vallier, H. A., & Nguyen, M. P. (2021). Management of civilian low-velocity gunshot injuries to an extremity. JBJS, 103(11), 1026-1037.

Köse, G., Kurutkan, M.K., Orhan, F.,(2020). Kalp Yetmezliği Konusunda En Çok Atıf Alan ilk 100 Makalenin Bibliyometrik Analizi. Bibliometric Analysis of the Top 100 Most Cited Articles on Heart Failure. Sağlık Akademisyenleri Dergisi. Cilt:7, Sayı:2

Kucher, K., Paradis, C., Kerren, A., El-Assady, M. (2018). Visual Analytics for Text Similarity Detection in Large Document Collections. Journal of Visualization, 21(1), 33-52. https://doi.org/10.1007/s12650-017-0463-4

Kurutkan, MN., Orhan, F., (2018). Sağlık Politikası Konusunun Bilim Haritalama Teknikleri İle Analizi, Iksad Publishing House, ISBN: 978-605-7510-99-0,0, Ankara

Laubscher, M., Ferreira, N., Birkholtz, F. F., Graham, S. M., Maqungo, S., & Held, M. (2021). Civilian gunshot injuries in orthopaedics: a narrative review of ballistics, current concepts, and the South African experience. European Journal of Orthopaedic Surgery & Traumatology, 31(5), 923-930.

Li, Z., Rollins, J., Yan, E. (2018). Web of Science use in Published Research and Review Papers 1997–2017: a Selective, Dynamic, Cross-Domain, Content-Based Analysis. Scientometrics, 115(1), 1-20. doi:10.1007/s11192-018-2773-0

Lin, C. C., Shankar, D. S., Anil, U., & Carter, C. W. (2024). Demographic and Geographic Trends in Gunshot Wound-Associated Orthopedic Injuries among Children, Adolescents, and Young Adults in New York State from 2016–2020. Trauma Care, 4(2), 189-197.

Nelson, C. L., Puskarich, C. L., & Marks, A. (1987). Gunshot wounds: Incidence, cost, and concepts of prevention. Clinical Orthopaedics and Related Research®, 222, 114-122.

Newman, M. E. J. (2004). Coauthorship Networks and Patterns of Scientific Collaboration. Proceedings of the National Academy of Sciences, 101(Suppl 1), 5200-5205. doi:10.1073/pnas.0307545100

Nkosi, C. S., & Sefeane, T. I. (2025). Lead arthropathy from a wrist gunshot wound: A rare case report. Journal of Orthopaedic Reports, 4(2), 100452.

Orhan, A., & Demirtaş, M. T. (2025). Advancing Surgical Outcomes in Extremity Vascular Trauma: Insights from Clinical Experience. Genel Tıp Dergisi, 35(1), 174-180.

Page, M.J., McKenzie, J.E., Bossuyt, P.M., et al. (23 more authors) (2021) The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews. Journal of Clinical Epidemiology. ISSN 0895-4356 https://doi.org/10.1016/j.jclinepi.2021.03.001

Pinto, A., Russo, A., Reginelli, A., Iacobellis, F., Di Serafino, M., Giovine, S., & Romano, L. (2019). Gunshot wounds: ballistics and imaging findings. In Seminars in Ultrasound, CT and MRI (Vol. 40, No. 1, pp. 25-35). WB Saunders.

Tengilimoğlu, D., Orhan, F., Tekin, P.Ş., Younis, M., (2024). Analysis of Publications on Health Information Management Using the Science Mapping Method: A Holistic Perspective, Healthcare, 12, 287. https://doi.org/10.3390/healthcare12030287

Tisnovsky, I., Katz, S. D., Pincay, J. I., Reinoso, L. G., Redfern, J. A., Pascal, S. C., ... & Suneja, N. (2021). Management of gunshot wound-related hip injuries: A systematic review of the current literature. Journal of orthopaedics, 23, 100-106.

Vaismoradi, M., Jones, J., Turunen, H. (2016). Theme Development in Qualitative Content Analysis and Thematic Analysis. Journal of Nursing Education and Practice, 6(5), 100-110.

Van Eck, N. J., Waltman, L. (2010). Software Survey: VOSviewer, a Computer Program for Bibliometric Mapping. Scientometrics, 84(2), 523-538. https://doi.org/10.1007/s11192-009-0146-3

Zhao, D., Strotmann, A. (2015). Analysis and Visualization of Citation Networks. Synthesis Lectures on Information Concepts, Retrieval, and Services, 7(1), 1–207. doi:10.2200/S00624ED1V01Y201501ICR038

Zupic, I., Čater, T. (2015). Bibliometric Methods in Management and Organization. Organizational Research Methods, 18(3), 429-472.