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TRANSFORAMINAL EPIDURAL INJECTIONS: A BIBLIOMETRIC ANALYSIS OF THE 50 MOST CITED ARTICLES

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ABSTRACT

Objective: Evaluating the articles with the highest citations provides the authors with more detailed information about transforaminal injection, and we think that it will contribute to the production of high-quality articles in their future studies.

Materials and Methods: In between February-March 2022, Web of Science (WOS) was used as the data search source. Journals from 1900 to 2022 were searched in the database. The following keywords were used in related "Topic" searches: Nerve root injection, root injection, transforaminal injection, transforaminal epidural injection, selective nerve root block, root block. WOS citations, year of publication, country of origin and content of article were evaluated.

Results: The total number of citations of the Top 50 articles was 5817 and the average number of citations was 118.7. Of the Top 50 articles, 24 refer to lumbar transforaminal injection, 22 to cervical transforaminal injection, and 4 to cervical and lumbar transforaminal injection. It was seen that the articles that received the Top 50 citations were most frequently produced by the anesthesia department, and the second most frequently produced by the orthopedics and neuroscience department. Fourthy percent (n=20) of the articles were about complications such as intraarticular injection, spinal cord infarction, paralysis, paraplegia, and death that developed after transforaminal injection.

Conclusion: In our study, the first 50 most cited articles about transforaminal injections were evaluated and a resource was tried to be created by including detailed information. Our work will help readers benefit from the most influential and important articles out of hundreds of articles.

Keywords: Transforaminal, citation, root injection, epidural injection

INTRODUCTION

Radicular nerve root pain is a condition that can adversely affect a person's quality of life[1]. Sciatica often occurs due to lumbar disc herniation and lumbar stenosis. These problems can cause pain along with nerve root inflammation[2]. For this reason, corticosteroid injections can be used in the treatment of pain by reducing inflammation[3,4].

Epidural injections have been practiced since the 1900s[5,6]. Epidural injections can be administered in 3 ways: Transforaminal, caudal and interlaminar. These 3 methods were found to be effective in the treatment of pain, but the amount of corticosteroid required for transforaminal injection was less[7]. Transforaminal injection is the process of injecting a long-acting steroid together with a local anesthetic into the neural foramen where the nerve root comes out. It can relieve pain by reducing inflammatory reactions around the nerve root and joint.

Bibliometrics such as impact factor and citation number are frequently used to evaluate the importance, value and scientific level of the article. Although the traditional method used to measure the quality of an article is the impact factor, the number of citations is also frequently used[7,8].

We evaluated the citation power of articles on transforaminal epidural steroid injection with the Web of Science (WOS) program. Evaluation of the most cited articles will also assist the authors in obtaining detailed information about transforaminal injections.

To the best of our knowledge, there is no bibliometric study of transforaminal injections so far. We performed citation analysis with the WOS program to identify high-value articles. Evaluating the articles with the highest citations provides the authors with more detailed information about transforaminal injection, and we think that it will contribute to the production of high-quality articles in their future studies.

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MATERIALS AND METHODS

WOS was used as the data search source in February 2022. Journals from 1900 to 2022 were searched in the database. More than 10000 journals were reviewed for the highest citation rating to perform bibliometric analysis of transforaminal injection. The following keywords were used in related "Topic" searches: Nerve root injection, root injection, transforaminal injection, transforaminal epidural injection, selective nerve root block, root block. All of the journals were in the SCI-Expanded category. The 50 publications with the highest citation are listed. Ethics committee approval was not required. Studies related to laboratory research or basic science were excluded. As a result of the searches, a database was created and the evaluation of the articles was carried out by two independent observers (author 1 and 2). In case of disagreement, a common solution was obtained through discussion among the authors. WOS citations, year of publication, country of origin and content of article were evaluated. If more than one country contributed to the article, the country of the first author was taken into consideration.

RESULTS

The total number of citations of the Top 50 articles was 5,817 and the average number of citations was 118.7. Table 1 shows the Top 10 articles with the highest citation. All articles in the Top 50 were published between 2000 and 2014. The list of journals with more than one article in the top 50 on transforaminal injection is shown in Table 2. Of the Top 50 articles, 24 refer to lumbar transforaminal injection, 22 to cervical transforaminal injection, and 4 to cervical and lumbar transforaminal injection. It was observed that four countries contributed to the production of more than one publication. At the same time, it was seen that the articles were mostly produced in the USA (Table 3). It was seen that the articles that received the Top 50 citations were most frequently produced by the anesthesia department, and the second most frequently produced by the orthopedics and neuroscience department (Table 4). Fourthy percent (n=20) of the articles were about complications such as intraarticular injection, spinal cord infarction, paralysis, paraplegia, and death that developed after transforaminal injection.

DISCUSSION

Many methods are used to determine the importance of the article in bibliometric studies. Determining the number of citations is one of the methods used. Although the power of an article is not always determined by the number of citations, it is widely used to determine the impact power of the researcher and the journal. To our knowledge, there is no bibliometric study on transforaminal injection so far.

The article with the highest citation (n=338) was Riew et al.'s[9] article named "The effect of nerve-root injections on the need for operative treatment of lumbar radicular pain - A prospective, randomized, controlled, double-blind study" published in the journal of "Journal of Bone and Joint Surgery-American Volume". They showed that the results of the patients who received steroid root injection were significantly

Table 1. Top 10 articles with the highest citation

Rank	First author	Article title	WOS citations	Journal	Year
1	Riew	The effect of nerve-root injections on the need for operative treatment of lumbar radicular pain -A prospective, randomized, controlled, double-blind study	338	Journal of Bone and Joint Surgery-American Volume	2000
2	Vad	Transforaminal epidural steroid injections in lumbosacral radiculopathy - A prospective randomized study	336	Spine	2002
3	Buenaventura	Systematic Review of Therapeutic Lumbar Transforaminal Epidural Steroid Injections	221	Pain Physician	2009
4	Ghahreman	The Efficacy of Transforaminal Injection of Steroids for the Treatment of Lumbar Radicular Pain	204	Pain Medicine	2010
5	Scanlon	Cervical transforaminal epidural steroid injections - More dangerous than we think?	203	Spine	2007
6	Baker	Cervical transforaminal injection of corticosteroids into a radicular artery: a possible mechanism for spinal cord injury	176	Pain	2003
7	Riew	Nerve root blocks in the treatment of lumbar radicular pain - A minimum five-year follow-up	169	Journal of Bone and Joint Surgery-American Volume	2006
8	Kennedy	Paraplegia Following Image-Guided Transforaminal Lumbar Spine Epidural Steroid Injection: Two Case Reports	162	Pain Medicine	2009
9	Rozin	Death during transforaminal epidural steroid nerve root block (C7) due to perforation of the left vertebral artery	160	American Journal of Forensic Medicine and Pathology	2003
10	Rathmell	Cervical transforaminal injection of steroids	155	Anesthesiology	2004

better than the patients who received local anesthetic. The article with the highest annual citation average (n=16.8) was Vad et al.'s[10] article named "Transforaminal epidural steroid injections in lumbosacral radiculopathy - A prospective randomized study" published in the journal of "Spine". They compared the transforaminal steroid injection and saline-containing trigger point injection. They found that steroid injection was statistically significantly effective in reducing pain. The oldest article in the Top 50 (n=24) is the article by Slipman et al.[11], published in the "Archives of Physical Medicine and Rehabilitation" in 2000, about selective root injections for cervical spondylotic radicular pain. They stated that fluoroscopically guided therapeutic selective nerve root block is a clinically effective intervention in the treatment of atraumatic cervical spondylotic radicular pain. The most recent article (2014) in the Top 50 (n=48) was Manchikanti et al.'s[12] article named "Transforaminal Epidural Injections in Chronic Lumbar Disc Herniation: A Randomized, Double-Blind, Active-Control Trial" published in the journal of "Pain Physician". They reported the lack of superiority of steroids compared with local anesthetic at 2-year follow-up.

Table 2. The list of journals with more than one article in the Top 50

Pain Medicine	11
Spine	7
Archives of Physical Medicine and Rehabilitation	4
Pain Physician	4
Journal of Bone and Joint Surgery-American Volume	2
Pain	2
Anesthesiology	2
Regional Anesthesia and Pain Medicine	2
PM&R	2

Table 3. The nations of origin of the Top 50 articles about transforaminal injection

USA	35
South Korea	4
England	3
Australia	3
New Zeland	1
France	1
Switzerland	1
Sweden	1
Norway	1

Table 4. Departments of the articles that produced the Top 50 article

Anesthesia	24
Orthopedics and Neurosurgery	13
Physical Therapy and Rehabilitation	8
Radiology	3
Rheumatology	2

It was mostly seen that the production of articles was the USA origin (70%). In previous bibliometric studies, it was seen that there were most frequently USA original studies[13-15]. Less often it has been seen that in our study articles producted in South Korea (8%).

It has been determined that the complications that occur in the transforaminal injection procedure have a high citation capacity. The study with the highest citation (n=203) about complications was published by Scanlon et al.[16] "Cervical transforaminal epidural steroid injections - More dangerous than we think?" was published in the journal of "Spine" in 2007. They reported that accidental intra-articular administration of particulate steroids affects the embolism cascade. They also recommended the use of non-particulate steroids such as dexamethasone, the use of blunt needles, the use of short-acting local anesthetics such as lidocaine, and the administration of a test dose of local anesthetic before steroid administration. The second most frequently cited study on complications is the "Paraplegia Following Image-Guided Transforaminal Lumbar Spine Epidural Steroid Injection: Two Case Reports" by Kennedy et al.[17] published in the journal of "Pain Medicine".

Paraplegia developed in both cases and they thought that particulate steroid caused the development of paraplegia. They also recommended testing with Digital Subtraction Angiography for intra-arterial injection and local anesthetic prior to cortisol injection. Rozin et al.'s[18] study "Death during transforaminal epidural steroid nerve root block (C7) due to perforation of the left vertebral artery" was published in the "American Journal of Forensic Medicine and Pathology" and received 160 citations in total. They reported the death of a 44-year-old female patient after massive cerebral edema due to left vertebral artery dissection while performing C7 nerve root block with a 25-gauge spinal needle, as a very catastrophic complication.

Study Limitations

There are several limitations of our study. First of all, it can be expected that the number of citations of older articles is higher than that of new articles. In addition, the articles published after our article search process may have changed the citation order, but this change is not expected to happen quickly. As another limitation, self-citation or not citing another competitor is another factor that can affect the results. There are also strengths of our study. First of all, this study is the first citation study about selective transforaminal root injection. It also provides physicians with access to high-quality articles on this specific topic.

CONCLUSION

In our study, the first 50 most cited articles about transforaminal epidural injections were evaluated and a resource was tried to

be created by including detailed information. Our work will help readers benefit from the most influential and important articles out of hundreds of articles.

Ethics

Ethics Committee Approval: Ethics committee approval was not required.
Informed Consent: Not applicable.
Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: E.B., Y.K., Design: E.B., Y.K, Data Collection or Processing: E.B., Y.K, Analysis or Interpretation: E.B., Y.K., Literature Search: E.B., Y.K, Writing: E.B., Y.K.
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