

ORIGINAL ARTICLE

Research Trends and Top Cited Articles on the Frozen Elephant Trunk Procedure: A Bibliometric Analysis

Donmuş Fil Hortumu Prosedürü Hakkında Araştırma Eğilimleri ve En Çok Alıntı Yapılan Makaleler: Bibliometrik Analiz

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ABSTRACT

Background: Bibliometric studies can direct academics. There have been many speciality and speciality where bibliometric analyses have been published, but our literature search yielded no bibliometric analysis of the frozen elephant trunk (FET) procedure. The primary objective of this study was to identify the most frequently referenced papers on FET procedure research and investigate the research trends.

Methods: A dataset of all scientific journals published in the English language was created using the Web of Science (WoS) database. This search was then cross-referenced with a comparable search phrase query of the Scopus Library database in order to locate any publications that might have been overlooked during the first search. Citation counts were used to rank the articles. Also knowledge maps were created using VOSviewer software, and articles and reviews pertaining to the FET procedure in CVDs were taken from the WoS Core Collection.

Results: A total of 484 documents on Scopus and 494 documents on WoS pertaining to the FET procedure were included in this study. The leading countries that published most of the research were Germany, Japan, and Italy in both databases. The largest subset of the FET procedure articles has been published since 2012. The most cited authors were Karck, Shrestha, and Uchida. The mean Hirsch index of the articles was 40 and 10.47 per article.

Conclusion: This study offers information on the traits and standards of the FET procedure literature that has received the most citations, as well as a ranking of the most important sources for this procedure. This study provides as a guide to what constitutes a citeable FET procedure publication by offering the most important references and mostly published journals.

Keywords: Aort; bibliometrics; cardiac surgery; frozen elephant trunk procedure; Scopus; Web of Science.

ÖZ

Amaç: Bibliyometrik çalışmalar akademisyenleri yönlendirebilir. Bibliyometrik analizlerin yayınlandığı birçok uzmanlık ve alt uzmanlık vardır, ancak literatürü araştırdığımızda donmuş fil hortumu (FET) prosedürünün bibliyometrik analizinin olmadığını gördük. Bu çalışmanın birincil amacı, FET prosedür araştırması hakkında en sık başvurulan makaleleri belirlemek ve araştırma eğilimlerini araştırmaktır.

Yöntem: Web of Science (WoS) veri tabanı kullanılarak İngilizce dilinde yayınlanan tüm bilimsel dergilerden bir veri seti oluşturulmuştur. Bu arama daha sonra ilk arama sırasında gözden kaçmış olabilecek yayınları bulmak için Scopus Kütüphanesi veritabanının karşılaştırılabilir bir arama ifadesi sorgusu ile çapraz referanslandı. Makaleleri sıralamak için atıf sayıları kullanılmıştır. Ayrıca VOSviewer yazılımı kullanılarak bilgi haritaları oluşturulmuş ve CVD'lerdeki FET prosedürü ile ilgili makaleler ve incelemeler WoS Core Collection'dan alınmıştır.

Bulgular: Bu çalışmaya FET prosedürü ile ilgili Scopus veri tabanından 484 ve WoS veri tabanından 494 belge dâhil edildi. Her iki veri tabanında da araştırmaların çoğunu yayınlayan önde gelen ülkelerin Almanya, Japonya ve İtalya olduğu görüldü. FET prosedürü makalelerinin en büyük alt kümesinin 2012'den beri yayınlandığı gözlemlendi. En çok alıntı yapılan yazarlar Karck, Shrestha ve Uchida idi. Makalelerin ortalama Hirsch indeksi makale başına 40 ve 10.47 idi.

Sonuç: Bu çalışma, en çok atıf alan FET prosedürü literatürünün özellikleri ve standartları ile bu prosedür için en önemli kaynakların bir sıralaması hakkında bilgi sunmaktadır. Bu çalışma, en önemli referansları sunarak ve çoğunlukla dergileri yayınlayarak, atıf yapılabilir bir FET prosedürü yayını neyin oluşturduğuna dair bir kılavuz niteliğindedir.

Anahtar Kelimeler: Aort, bibliyometri, kalp ameliyatı, donmuş fil hortumu prosedürü, scopus, Web of Science

Introduction

The aorta is the main blood artery in the body, and disorders of this major artery can be hard to treat (1,2). Multiple surgical procedures are typically required to treat aortic disorders depending on the pathology's etiology, its severity, and probable long-term complications (2).

The treatment of individuals with these complex disorders has recently improved thanks to innovative technology like the frozen elephant trunk (FET) technique (1). By making surgical procedures less complicated and invasive, recent developments in

endovascular therapy for thoracic aortic disease have expanded the range of surgical indications (3). The FET technique is a new approach in aortic surgery for difficult thoracic aortic aneurysms and dissections that has improved aortic arch repair to allow for simultaneous treatment of the descending thoracic aorta and a more extended arch. The FET technique is a hybrid device that combines a coated metal stent with medical textiles (a tube inserted into the blood vessel to keep it open). The FET procedure approach allows for single-stage repair of coupled aortic arch and descending aortic aneurysms by employing a hybrid prosthesis with

a stented and a nonstented end (1,4). In order to facilitate both distal lumen thrombosis and easier distal aortic anastomosis following total arch replacement, the FET technique has become popular (2). Multiple-stage aortic replacement is greatly facilitated and risk is reduced by the FET technique (5).

A surgical treatment plan for severe thoracic aortic disease was first proposed by Hans Borst et al. (6) in the year 1983. They called it the "two-stage elephant trunk principle." (6). Based on an elephant trunk extension of the arch graft inserted into the descending aorta during the first stage operation, which is done through a median sternotomy, this method replaces the entire arch with a prosthetic. The elephant trunk-shaped graft segment, however, is floating freely in the descending aortic lumen, which prevents thrombus from forming between the graft and the aneurysmal vessel wall. This procedure inherently necessitates a second stage operation, carried out via a left thoracotomy (2).

In 2003, Karck et al. (7) reported patients to whom they first applied the FET technique. The FET procedure is indicated for proximal and descending thoracic aortic aneurysms, residual dissection after proximal aortic repair, chronic type B aortic dissection, and acute type I aortic dissection. Given a simultaneous distal arch or proximal descending aortic tear, the FET procedure is extremely beneficial for this population cohort even though its utility in acute type I aortic dissection is still debatable (8). The FET treatment has been developed over the past few years, and in many facilities it is now the initial choice for individuals with persistent aortic dissection undergoing arch repair (9).

The most significant articles in their field have been determined through citation rank analysis in many medical and surgical disciplines, including cardiac surgery (10-13). The most important publications in the newly-emerging field of the FET technique have not yet been determined through research. The goal of this bibliometric analysis was to identify the research topics which has greatest impact on the FET procedure.

Methods

In September 2022 we used two databases to determine the FET procedure literature. Scopus Library database (www.scopus.com) and the Thompson Reuters Web of Science (WoS) databases were searched in September 2022 for all citations pertaining to the FET procedure. The search strategy was "TS = (frozen elephant trunk procedure or frozen elephant trunk technique*)".

In order to make sure that no article was missed, we also conducted searches in other journals using a variety of keywords. We did not restrict our search based on study type, non-human research subjects, or the availability of abstracts. Also there was no time limit imposed. Only articles from the fields of cardiology and cardiac surgery with a primary focus on FET procedure were chosen in order to maintain a pertinent and narrowly focused list of the FET procedure articles.

The only articles that were included were those from journals that covered subjects other than medicine. Both the print and electronic International Standard Serial Numbers were used to conduct a search across all journals. The 10 most cited articles were further examined by topic, author, journal, year of publication and citation numbers.

Articles written in languages other than English and those with primary subject of study something other than the FET procedure were excluded.

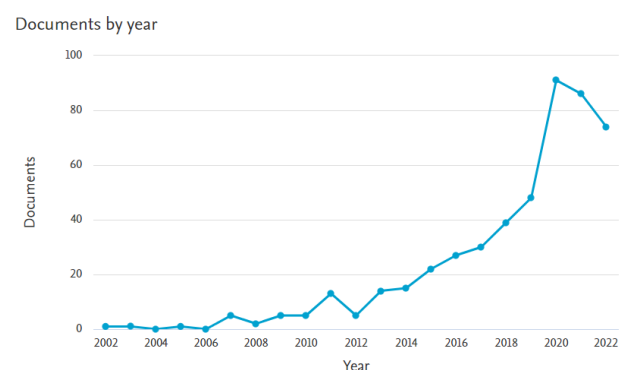
The citation rates of articles with numbers of citations were ranked.

In addition, knowledge maps were created using VOSviewer software, and articles and reviews related to the FET procedure in CVDs were taken from the WoS Core Collection. The Microsoft Office Excel 2019 (Los Angeles, CA, USA) and the free web application Dimension AI was used for the co-authorship analysis and citation analysis (<https://www.dimensions.ai/>) was used to visualize and analyze the dataset.

Results

We reached 484 documents on Scopus and 494 documents on WoS database. The number of the FET procedure articles have increased yearly since 2012 (Graphic 1 and Graphic 2). These publications came from 39 countries, led by Germany (Graphic 3 and Graphic 4). Journal of Thoracic and Cardiovascular Surgery was the top-cited journal (Graphic 5 and Graphic 6). The number of citations was 5173 and 10.47 average per item and 258.65 average per year, according to WoS database.

Table 1 and Table 2 summarized the 10 most cited papers on the FET procedure Scopus versus WoS databases. The most cited article by Karck et al. was published in the Journal of Thoracic and Cardiovascular Surgery in 2003 and cited 227 times in Scopus and 207 times in WoS.



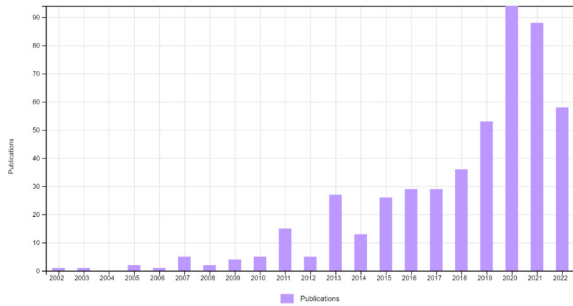
Graphic 1. Articles by years according to Scopus

Table 1. The top cited 10 articles on the FET procedure according to Scopus database

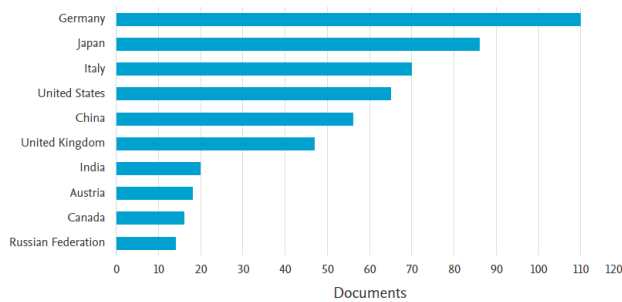
Ranking	Document title,	First Author, (Reference number)	Year	Source	Cited by
1	The frozen elephant trunk technique: A new treatment for thoracic aortic aneurysms	Karck, M (7)	2003	Journal of Thoracic and Cardiovascular Surgery	227
2	Current status and recommendations for use of the frozen elephant trunk technique: A position paper by the Vascular Domain of EACTS	Shrestha, M (14)	2015	European Journal of Cardio-thoracic Surgery	195
3	Operative Strategy for Acute Type A Aortic Dissection: Ascending Aortic or Hemiarch Versus Total Arch Replacement With Frozen Elephant Trunk	Uchida, N(15)	2009	Annals of Thoracic Surgery	126
4	Total aortic arch replacement with a novel 4-branched frozen elephant trunk prosthesis: Single-center results of the first 100 patients	Shrestha, M (16)	2016	Journal of Thoracic and Cardiovascular Surgery	103
5	Impact of clinical factors and surgical techniques on early outcome of patients treated with frozen elephant trunk technique by using EVITA open stent-graft: Results of a multicentre study	Leontyev, S (17)	2016	European Journal of Cardio-thoracic Surgery	101
6	The frozen elephant trunk for the treatment of chronic dissection of the thoracic aorta: A multicenter experience	Pacini, D (18)	2011	Annals of Thoracic Surgery	98
7	The Frozen Elephant Trunk Technique for Treatment of Thoracic Aortic Aneurysms	Baraki, H(4)	2007	Annals of Thoracic Surgery	87
8	Simplified frozen elephant trunk repair for acute DeBakey type i dissection	Roselli, E.E(19)	2013	Journal of Thoracic and Cardiovascular Surgery	85
9	Aortic remodelling in aortic dissection after frozen elephant trunk	Dohle, D.-S(20)	2016	European Journal of Cardio-thoracic Surgery	83
10	Evolution of Simplified Frozen Elephant Trunk Repair for Acute DeBakey Type I Dissection: Midterm Outcomes	Roselli, E.E(21)	2018	Annals of Thoracic Surgery	82

Table 2. The top cited 10 articles on the FET procedure according to Wos database

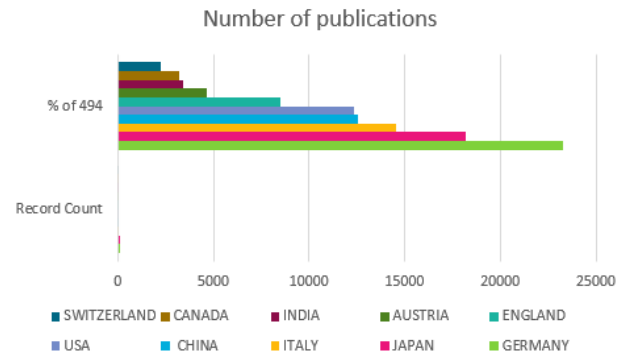
Ranking	Document title	First Author, (Reference number)	Year	Source	Cited by
1	The frozen elephant trunk technique: A new treatment for thoracic aortic aneurysms	Karck, M(7)	2003	Journal of Thoracic and Cardiovascular Surgery	207
2	Current status and recommendations for use of the frozen elephant trunk technique: A position paper by the Vascular Domain of EACTS	Shrestha, M (14)	2015	European Journal of Cardio-thoracic Surgery	183
3	Operative Strategy for Acute Type A Aortic Dissection: Ascending Aortic or Hemiarch Versus Total Arch Replacement With Frozen Elephant Trunk	Uchida, N(15)	2009	Annals of Thoracic Surgery	123
4	A systematic review and meta-analysis on the safety and efficacy of the frozen elephant trunk technique in aortic arch surgery	Tian, DH (22)	2013	Annals of Cardiothoracic Surgery	115
5	Systematic review protocol: the frozen elephant trunk approach in aortic arch surgery	Tian, DH (23)		Annals of Cardiothoracic Surgery	115
6	Total aortic arch replacement with a novel 4-branched frozen elephant trunk prosthesis: Single-center results of the first 100 patients	Shrestha, M(16)	2016	Journal of Thoracic and Cardiovascular Surgery	95
7	The frozen elephant trunk for the treatment of chronic dissection of the thoracic aorta: A multicenter experience	Pacini, D (18)	2011	Annals of Thoracic Surgery	98
8	Impact of clinical factors and surgical techniques on early outcome of patients treated with frozen elephant trunk technique by using EVITA open stent-graft: Results of a multicentre study	Leontyev, S (17)	2016	European Journal of Cardio-thoracic Surgery	95
9	Aortic remodelling in aortic dissection after frozen elephant trunk	Dohle, D.S(20)	2016	European Journal of Cardio-thoracic Surgery	82
10	Simplified frozen elephant trunk repair for acute DeBakey type i dissection	Roselli, E.E(19)	2013	Journal of Thoracic and Cardiovascular Surgery	80



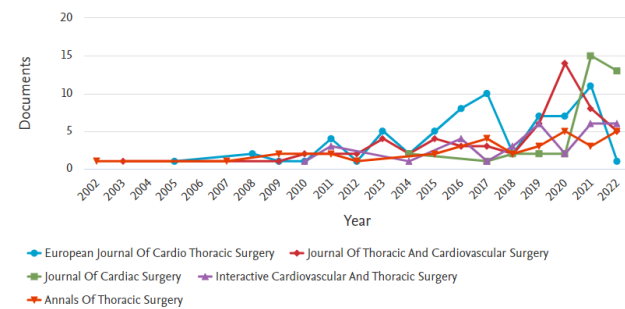
Graphic 2. Articles by years according to WoS



Graphic 3. Articles by countries according to Scopus

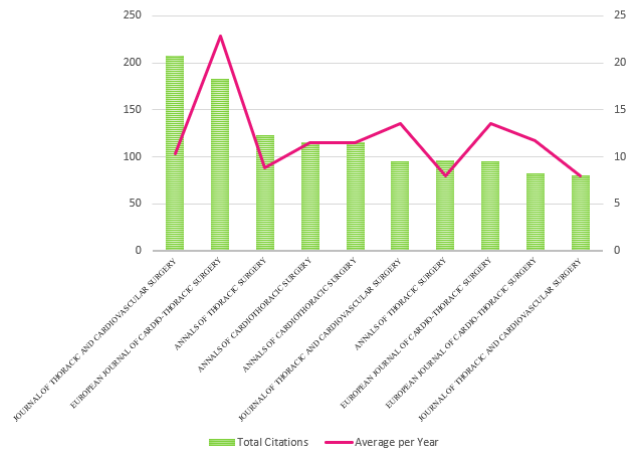


Graphic 4. Articles by countries according to WoS



Graphic 5. Publishing journals and citations by years according to Scopus

MOSTLY PUBLISHING JOURNALS AND CITATIONS



Graphic 6. Publishing journals and citations by years according to WoS

Karck et al. (7) published the article that the most cited article in both databases (Scopus and WoS) (Table 1, Table 2). Journal of Thoracic and Cardiovascular Surgery published this most cited article.

Mapping with Vosviewer

Co-authorship and citing analysis among the top published 100 authors are given in Figure 1 and Figure 2. The size of a cluster in this visualization corresponds to how many publications are included in the cluster. More publications are included in larger clusters. The approximate distance between two clusters reveals how closely related they are in terms of citations. In terms of citations, clusters that are close to one another tend to be strongly related, whereas clusters that are farther apart tend to be less strongly related. Curved lines connecting the clusters show how closely related they are, with the width of a line indicating how many citations there are between two clusters. There is no special significance to the horizontal and vertical axes.

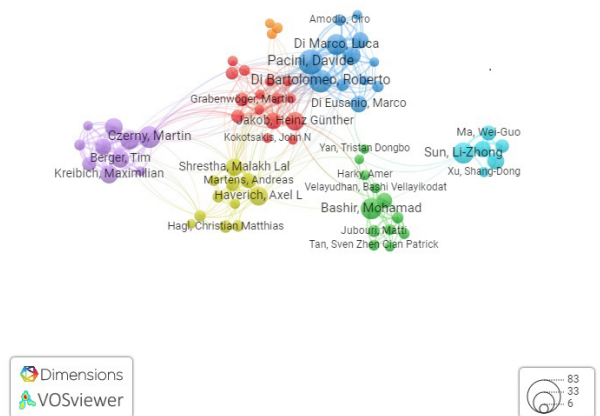


Figure 1. Co-authorship analysis among the top published 100 authors

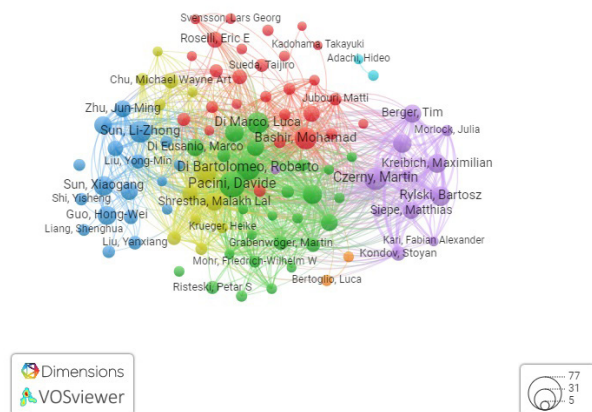


Figure 2. Citation analysis among the top published 100 authors

Discussion

According to the European Society of Cardiology (ESC) Cardiovascular Surgery Working Group, ESC Aortic, and Peripheral Vascular Diseases Working Group, ESC's European Society for Percutaneous Cardiovascular Interventions (EAPCI) and the European Union's recent expert consensus document Cardio-Thoracic Surgery (EACTS), the FET procedure provides an excellent platform for downstream endovascular or open repair (24). In the light of the great interest in FET procedure, it is expected that the publications on FET procedure will increase. However, although the number of publications is in an increasing trend in our study, it has not reached the desired level yet. Worldwide publications are not available. Unlike many bibliometric analysis results, the most publications were not from the USA (25,26), they were from European countries, especially Germany.

Citation analyses can be useful in identifying significant problems and discoveries in the field of medicine, even though the value of citation rates has been contested(27). Citation analyses do provide an intriguing summary of the most important achievements within a topic and in this example show the manner in which cardiac surgery has advanced over the past few decades, despite certain limitations (10). This bibliometric analysis's objective was to highlight the study areas that have had the biggest effects on enhancing management and comprehension of the FET procedure.

In 2003, Karck et al. (7) reported the patients who first applied the FET technique. In our study, this article was the most cited article in both databases (Scopus and WoS). The most cited articles were similar in both databases. However, 2 meta-analysis studies published in the WoS database were also among the most cited publications. Both of these meta-analysis studies were written by Tian et al.(22,23). Articles published in the Journal of Thoracic and Cardiovascular Surgery

received 415 total citations, and articles published in the Annals of Thoracic Surgery journal received 393 total citations. The Journals of Thoracic and Cardiovascular Surgery and Annals of Thoracic Surgery are indexed both Scopus and WoS (SCI) databases originating from the USA. Citations of articles published in recent years are usually not very high due to their short duration. According to the results of the study, the 10 most cited articles had two main themes: surgical treatment methodology and outcomes of patients.

Since 2012, there has been a noticeable rising trend in the total number of publications. The number of publications in 2020 and 2021 was the highest during the preceding 20 years, despite the fact that the annual total was somewhat lower in 2021 than the previous year. These findings show that the FET procedure in cardiac surgery has been the subject of substantial recent research and has attracted ongoing interest. Although the number of articles published by many academic institutions from other countries is less than those in Germany, there have been publications on this subject from many countries (Japan, India, European and Russia).

Limitations and advantages

We acknowledge that our results were arbitrary as a result of the questions we chose to look into, the inclusion/exclusion criteria, and the database constraints. First of all, studies of this kind typically ignore seminal works from the last ten years and favor more recent publications. On the other hand, in this study, roughly 50% of the articles that received the most citations were written within the last ten years. Second, this methodology may have flaws due to the database used and the exclusion of textbooks. Because of prejudice and inadequate recognition in the field, articles published in other languages than English may have received unfairly high citation counts. It is important to take note of the inherent issues with citation analyses, such as the bias associated with relying solely on the total number of citations an article receives. Self-citation was considered in our study, though it was minimal. Despite these drawbacks, our analysis sheds some light on the most popular and cited articles in the FET procedure research.

Conclusion

This analysis provides information on the number of citations of the most popular cardiovascular surgery journals published, which may be used to determine the standard of the works, breakthroughs, and trends guiding academics in the FET technique.

Ethical consideration: Our study did not require approval from an institutional review board because it was a retrospective analysis of data that was already available to the public.

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