Mapping of Intragastric Balloon Use: a Guide to the Activity of Institutions Through Bibliometry

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Abstract

Background Bibliometric analysis is an effective method for measuring scientific contributions in a variety of fields. It enables the numerical analysis of publications in a specific field and period of time, as well as the relationships between these publications. The present bibliometric analysis of publications relating to obesity treatment by means of intragastric balloons aimed to identify the bariatric centers using intragastric balloons, through the publications relating to their productivity; and furthermore, to reveal collaborations, types of balloons used, number of patients involved, and authors’ productivity and favored journals.

Method The PubMed and Scopus databases were used to retrieve only original articles presenting the results in body weight reduction.

Results Bibliographic research identified 164 publications for the period 2000–2021. Italy was ranked first with 37 publications; USA participated as collaborator with 9 different countries; the fluid-filled Orbera balloon is featured in 126 publications; the journal Obesity Surgery hosted 86 publications; Brazil reported the greatest number of patients with 5874 cases; Lorenzo M and Genco A, co-authors from Italy, authored 14 and 12 publications, respectively, and the most cited article was that of Genco et al. [2007] with 441 citations.

Conclusions Bibliometric analysis gave us the opportunity to identify the centers through their scientific publications and to classify them in relation to their productivity in articles, in collaborations, in number of cases reported, and in the number of citations gained.

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Key Points: • The idea of using an intragastric balloon as a space-occupying device has proved itself, filling the void between pharmacotheapy and bariatric surgery.
• This is the first bibliometric study which attempts to analyze the authors’ scientific productivity and to identify the centers systematically dealing with intragastric balloons placement.
• The last two decades have seen a 5-fold increase in both the number of publications and the number of cases included in each study, and half of the pioneering research has come from European countries and started with the Orbera.
• Obesity Surgery, which published 86 articles, accounted for 52.44% of the total number of papers analyzed.

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Graphical abstract

METHODS
Bibliometric Analysis

| Articles [n] | 164 |
|-------------|-----|
| Years of publications | 2000-2021 |
| Authors [n] | 1240 |
| Authors per publication [mean] | 7.56 |
| Journals [n] | 48 |
| Citations [n] | 7943 |
| Average citation per article | 48.43 |
| Countries of origin [n] | 33 |
| Countries in collaboration only [n] | 7 |

RESULTS
TOP 5-PUBLICATIONS

Keywords
Intragastic balloons · Bibliometry · Obesity · Orbera

Introduction

In the last two decades, there has been an impressive increase in the number of studies dealing with non-invasive, endoscopic treatments for obesity. Among them, intragastric balloons — based on the philosophy of restrictive surgical procedures — have gained an augmented popularity, emerging as the most effective treatment of this kind and filling the gap between numerous conventional measures, such as diet and lifestyle modification, and bariatric surgeries. Since the procedure has proved to be of minimal operational risk, intragastric balloons are ideal in cases of obese individuals refusing or not eligible for bariatric surgery, of high risk for complications from surgery, or just as a bridge to bariatric surgery. They are also ideal for anyone simply needing to achieve limited weight reduction, either prior to surgery of whatever kind and for whatever reason or merely for aesthetic purposes [1–3].

The advantageous results of the method, its simplicity, and the relatively low cost of the device are clearly reflected not only in its growing worldwide popularity, but mainly in the expansion of technological research towards improvement of the “classic” fluid-filled balloon, which, for more than a decade, has been the absolute status [4] and has the most historical data supporting its use.

However, as treatment of choice, intragastric balloons are not without problems: various studies indicate that they have limited sustainable effectiveness for the vast majority attempting such therapy, resulting, after months, in a return to the previous/initial weight. Endoscopic assistance for insertion and retrieval, which can cause some discomfort, is also a necessity; and there are reports of minor complications, such as accommodative symptoms, in the early days following implantation; and later on, more serious, or even life-threatening visceral complications, attributable to either the patient, the doctor, or the device itself. Some bariatric centers therefore avoid performing such procedures, or do not consider them as treatment of first choice; thus, there is no publication of their data series [5].

Bibliometric analysis is an effective method for measuring scientific contributions in a variety of fields since it enables numerical analysis of publications in a specific field and period of time, as well as the relationships between these publications [6, 7]. Intragastric balloon placement as a minimally invasive procedure for weight loss has never before been evaluated regarding which authors, bariatric centers, countries, or journals are most
involved and, even more, which authors/centers present the highest productivity.

Thus, the aim of the present bibliometric analysis of publications relating to this specific procedure is to provide valuable insight into the current trends, worldwide, on intragastric balloon treatment. The main objective was to identify the countries/centers which — through multi-disciplinary teams — are seriously active in intragastric balloon placement as evidenced through their published experience. The secondary objectives were to classify the productivity of these bariatric centers, to identify the main contributors and their cooperation networks, and, finally, to evaluate the impact of these publications through the number of citations the authors received.

Materials and Method

Search Strategies

The literature search was performed between February 11 and 13, 2022, the required data being retrieved from PubMed and Scopus databases utilizing the terms “obesity” AND “intragastric balloon” NOT “review” and NOT “meta-analysis.” Data was extracted and assessed by two review authors [VS and SG], who independently screened initially the titles and abstracts of the retrieved references; in the case of discrepancy, the issue was resolved by a third reviewer [KK]. For further processing, the articles were downloaded to a comma-separated values format, and imported into Microsoft Excel 2019.

The predefined inclusion/exclusion criteria for accepting a study were as follows: original-only articles with the primary purpose of assessing the efficacy [positive or negative] of intragastric balloons to achieve body weight reduction; articles dealing with other parameters, but strictly in relation to weight loss results, were also accepted. Systematic reviews and meta-analyses, case reports, complications, animal studies, or articles referring to other pathologies studied in relation to individuals with an implanted intragastric balloon were excluded. Regarding language, all studies written in English or other western European language were included; four [one each] in Chinese, Hungarian, Russian, and Ukrainian were excluded simply because our team could not understand the language. The search strategy was limited to the period 2000–2021. The year 2000 signaled the adoption in Tarpon Springs, Florida [8], became widely commercially available, up to the end of December 2021. The number of publications per year [Fig. 2] exhibits a statistically significant increase over time [p = 0.003].

Results

Our search strategy revealed a total of 331 records. After exclusion of those considered not meeting the predefined criteria, 164 publications remained. The search outcome is shown in the flowchart [Fig. 1], while some general information concerning the basic characteristics of the study can be found in Table 1. The search covered a 21-year period from 2000, when the first fluid-filled balloon, fulfilling the criteria adopted in Tarpon Springs, Florida [8], became widely commercially available, up to the end of December 2021. The number of publications per year [Fig. 2] exhibits a statistically significant increase over time [p = 0.003].

Active Countries

Thirty-three countries were found to have at least one publication each, while 7 more [Canada, India, Qatar, UAE, Dubai, Slovakia, and Sweden] are referred to as collaborating with only 5 out of the 33 countries, respectively; the 5 countries being Italy, Brazil, Czech Republic, the Netherlands, and Kuwait.

Eleven out of the 33 countries were found to have collaboration with other countries, from the group of 33, sharing a total of 15 publications. Interestingly, the USA was the only country to participate as collaborator in 9 different studies [Fig. 3]. The number of studies per country, without their collaborators, is presented in Fig. 4.

Country Productivity

The country with the highest productivity was Italy, with a total of 37 publications [22.56%], either alone [n = 33] or in collaboration [n = 4] with other countries. USA and Brazil followed, with 17 [10.36%] and 14 [8.53%] studies,
respectively; two studies from each country being done in collaboration with others. Of the top five countries, the other two were Greece and Spain, with 11 [6.70%] publications each, one study from each country being done in collaboration with USA. These top 5 countries cover more than half the number of publications included in this analysis, that is 90 [54.88%] out of 164 studies [Fig. 5]; the next 5 countries were Turkey with 8, France with 7, Poland and Netherlands with 6, and the Czech Republic with 5.

Country and City Collaboration Networks

After exclusion of the 15 [multiple-countries] studies mentioned above, the remaining 149 publications can be divided into single-center studies [n = 112], and multiple-center studies [n = 37]. Analyses of the data show Italy as accounting for the most: from the 33 exclusively national studies, 26 come from a single center [from Rome — 8 studies; and Milan and Naples 4] and the remaining 7 come from 2 to 7 Italian centers. Rome being the main center in 5 of them. From the 15 USA [national] studies, 10 were the result of cooperation between 3 to 13 centers in different states, and the remaining 5 from a single center. Nine Brazilian studies are from a single center — from Rio de Janeiro 7, Sao Paulo 2, and Pernambuco 1; 3 more studies are multi-city, Rio de Janeiro being included in 3, Sao Paulo in 2, and Pernambuco in 1. All the 10 Greek studies are single-center, originating from 3 University Hospitals [7 studies from Thessaloniki; 2 from Heraklion; 1 from Patras]. Finally, all the 10 national Spanish studies are from a single center — 5 from Madrid, and one each from Barcelona, Seville Valencia, Murcia, and Vigo.

Number of Patients Involved in the Studies

After the total 164 publications were divided according to country of origin, the number of balloon-treated patients in each study was ascertained. One study per country, that with the maximum number of patients — independently of both balloon type and whether collaboration was involved — was ranked in descending order [Table 2, Fig. 6]. Brazil, Italy, Egypt, USA, and the Netherlands are the top 5, with the most publications (5874, 2515, 1600, 1343, and 672 cases, respectively); all 5 publications were the result of either national collaboration, or with the USA [Egypt and Netherlands]. The following 5 publications came from Greece, Germany, Japan, Puerto Rico, and Jordan (668, 634, 399, 239, and 229 cases, respectively); the Jordanian study was...
in collaboration with USA, the Japanese was multi-center, and the others were national studies.

**Balloon Types**

The balloons referred to in the 164 publications were as follows: the majority, 126 papers, refer to the fluid-filled balloon; 116 to the original Orbera [one recent paper to the Orbera365]; and 10 to others of similar technology [Silimed, Medsil, Lexball, and Medicone, depending of the country of origin]; 12 publications refer to the swallowable fluid-filled balloon [Elipse]; 6 to the air-filled Heliosphere [2 in comparison to Orbera]; 4 to the swallowable gas-filled [Obalon, Ullorex]; 6 to the fluid-filled double balloon [ReShape Duo]; 6 to the adjustable Spatz [the 1 in comparison to Orbera]; 3 to the air/fluid-filled End-Ball; and 1 to an unnamed biodegradable balloon [Table 3].

The number of publications relating to the fluid-filled Orbera per year \( p = 0.003 \), as well as that of the other entire balloon types, exhibited a statistically significant increase over time \( p = 0.006 \). [Fig. 7].

**Active Countries for Each Balloon Type**

The 126 papers dealing with the Orbera and similar balloons originate from 30 countries; Italy again accounting for the majority of published articles [29 articles, 23.01%], followed by Brazil [12; 9.52%] and Greece [10, 7.93%]. Then — to conclude the top 5 countries and 53.96% of the 126 publications — Spain and Turkey follow, with 9 [7.14%] and 8 publications [6.34%], respectively [Fig. 8]. The only 3 countries which have no publications referring to fluid-filled balloons are Korea [using the gas/fluid-filled End-Ball], Norway, and Kuwait [the swallowable, fluid-filled Elipse] [Table 4].
Patient Numbers in Relation to Each Balloon Type

Since the Orbera was the balloon used in the majority of studies (126 of 164 [76.83%]), it is unsurprising that it is also the balloon used for the majority of individuals in these studies [Fig. 6].

The Elipse balloon [12 articles] was used primarily in Italy — in collaboration with Spain, France, Kuwait, UAE, and Qatar (1770 cases); the very few other papers describe 34 [Czech Rep in collaboration with 3 other countries] or fewer cases.

The swallowable gas-filled balloon, commercially available as Obalon and Ullorex, featured in 4 publications, with 1343 cases being American, as were also the studies with the ReShape Duo [326 cases] and the Spatz [288 cases]. The maximum number of cases reported with Heliosphere was 72 from Italy, while, finally, Israel reported 141 and 52 cases with the air/gas-filled End-Ball and a biodegradable balloon, respectively [Table 2].

Journals of Publication

The 164 articles were published in 48 journals, only seven relating exclusively to obesity. Obesity Surgery, with 86 articles, accounts for 52.44% of the total number of papers analyzed; the remaining 78 [47.56%] publications distributed between another 47 journals [Fig. 9].
Although 1240 authors were identified, a single article is attributed to 712 authors [57.42%], two articles to 121 [9.76%]; and 3, 4, and 5 articles to 26 [2.1%], 20 [1.61%], and 10 [0.8%] each. The group of authors from Italy was again at the top: Lorenzo M authored 14 and Genco A, 12 publications; followed by Mathus-Vliegen E from the Netherlands with 9 articles, Cipriano M and Maselli R from Italy with 8 articles each, Basso N from Italy, Kotzampassi K and Papakostas P from Greece with 7 articles each, and Abu Dayyeh BK, from the Mayo Clinic, Rochester, MN, USA, with 6 publications [Fig. 10].
Numbers of Citations Received and Most Cited Authors

164 articles were cited a total of 7943 times [average citation per article, \( n = 48.43 \)], the most cited being “BioEnterics Intragastric Balloon: The Italian Experience with 2,515 Patients,” published by Genco A, et al. in Obesity Surgery, 2005 [3]. This received a total of 441 citations [PubMed search on Feb 20, 2022].

The ten most-cited articles are tabulated in Table 5 [3, 9–17]. Nine out of the 10 articles refer to the Orbera balloon and one to the ReShape Duo. Six out of ten were published in Obesity Surgery. The 9 most-cited articles dealing with the Orbera balloon were published between 2001 and 2006, and only one in 2012. According to country of origin of the first author, there were 3 studies from Italy [1st, 5th, and 10th position]; 2 from USA [2nd and 6th], and one each from Netherlands [3rd], Brazil [4th], France [7th], Belgium [8th], and Greece [9th].

The 126 articles referring to fluid-filled balloons resulted in 6379 citations [average citation per article, \( n = 50.62 \)], meaning that 76.83% of total publications had 80.53% of the total number of citations, with no significant
difference in the distribution of citations in relation to balloon type.

However, the 86 articles published in Obesity Surgery [IF = 4.129], and accounting for 52.44% of the total number of papers, were the most cited, with a total of 5090 citations [average citation per article, \( n = 59.18 \)], i.e., 52.44% of publications had 64.08% of citations.

Finally, the authors ranked according to the total number of citations received from the articles under assessment are presented in Table 6. This list comprises 12 authors, since the 5th and 9th positions are shared by two co-authors [Roman S/Mion F and Kotzampassi K/Papakostas P].

**Table 4** Balloon types used by each active country

| Countries         | Orbera | Elipse | Obalon | Heliosphere | ReShape Duo | Spatz | End-Ball | Biodegradable |
|-------------------|--------|--------|--------|-------------|-------------|-------|----------|---------------|
| Brazil            | ●      |        | ●      | ●           | ●           |       |          |               |
| Italy             | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Egypt             | ●      | ●      | ●      | ●           | ●           |       |          |               |
| USA               | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Netherlands       | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Greece            | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Germany           | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Japan             | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Puerto Rico       | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Jordan            | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Lebanon           | ●      | ●      | ●      | ●           | ●           |       |          |               |
| S. Arabia         | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Croatia           | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Mexico            | ●      | ●      | ●      | ●           | ●           |       |          |               |
| UK                | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Turkey            | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Hong Kong         | ●      | ●      | ●      | ●           | ●           |       |          |               |
| France            | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Belgium           | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Spain             | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Australia         | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Poland            | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Portugal          | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Iran              | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Romania           | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Venezuela         | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Singapore         | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Taiwan            | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Israel            | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Czech Republic    | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Kuwait            | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Norway            | ●      | ●      | ●      | ●           | ●           |       |          |               |
| Korea             | ●      | ●      | ●      | ●           | ●           |       |          |               |

**Fig. 9** Journals with at least 3 publications
Discussion

Bibliometric analysis is an effective measure of numerical analysis of the scientific contribution in a specific field and period of time, as well as of the relationships between these publications [18], i.e., to ascertain which authors, scientific centers, countries, and journals have the greatest influence in the advances in the given field of science, and especially in medicine [19].

Intragastric balloons as an alternative option for obesity treatment were first introduced in the late 1980s as an instant restrictive procedure, reducing the active gastric space to accommodate food and thus increasing satiety [16, 20]. Today, almost 30 years later, the idea of using a balloon as a space-occupying device in the stomach has proved itself, filling the void between pharmacotherapy and bariatric surgery. It is a less expensive, minimally invasive, and easy-to-perform nonsurgical procedure, the advantage of which is its full reversibility and low rate of reported complications, ensuring a significant weight loss in selected obese patients [16]. Thousands of devices are now placed globally each year and the literature contains numerous studies of methodology, results, and the applicability of the various balloon types [2, 4, 21, 22].

To our knowledge, this is almost the first bibliometric study — if we exclude a previous study from our group published only in the proceedings of a non-medical congress [22] — which not only presents the dynamics of article production in this field but also attempts to analyze the authors’ scientific productivity and to identify the academic institutes as well as NHS centers systematically dealing with intragastric balloons placement. The last two decades have seen a fivefold increase in both the number of publications and the number of cases included in each study; of course, this may be associated with the population density of most countries involved, i.e., Brazil with 5874 cases, Italy with 2515, and Egypt with 1600, but there is also undoubtedly a progressive general drive worldwide towards less invasive, but reliable procedures [23].

In the bibliographic analysis of country of origin, the numerical superiority of Italy is obvious, more than double in relation to Brazil and USA. These findings are easily explained by the fact that intragastric balloons were not FDA approved until 2015, and therefore banned from the largest market in the world: the USA. This is also noticeable in the analysis of balloon type: a progressive polarization towards two balloon types — the old-time classic fluid-filled balloon [Orbera or similar] applied in hundreds of thousands of cases and the newer, swallowable fluid and/or gas-filled ones, with one or two bubbles, making their first exploratory steps. This difference in numbers may be explained by the great popularity of the Orbera in Europe, due to its safety and effectiveness after a more than a decade as the sole balloon. One way or another, the numbers of publications resulting from use of the Orbera show a considerable and consistent increase over the years.

The Orbera-related publications exponentially increase over our period of study, recording the balloon’s effectiveness, its long-lasting positive effects on weight loss, and the reduction in comorbidities. Later publications relating to new balloon types attempt to present them as comparable to the Orbera, in particular, promoting their easier handling for placement and removal.

Apart from the statistical figures, our study provides a new insight into which countries have played a key role in understanding the advantages and promoting the use of intragastric balloons for obesity management. Moreover, the detailed analysis of related publications covering two decades could help to identify changes occurring in scientific trends over this period [24]. It has thus become clear that many centers with long-term experience with the Orbera balloon consider it trustworthy and reliable, and are disinclined to change just for the sake of a study [4]. On the other hand, new physicians in this era, or new markets, as big as the USA or as small as the Czech Republic, are trying the more modern balloons.

As regards cooperation between countries, analyzed in terms of the affiliations of all authors, 11 out of the 33 countries — sharing a total of 15 publications — have conducted at least one such collaborating project. It is of interest that the USA has a central position in terms of co-authorship, having collaboration with 9 different countries, although it is not the dominant country in terms of the number of overall
publications. (This may relate to the restrictions on use of intragastric balloons before 2015.) Italy, the country with the majority of publications (37), had only 4 performed in collaboration with other countries — probably due to the extensive intra-country network, leading to 7 national collaborating studies.

However, this cooperation was clearly not in the field of ideas exchange for scientific research, but rather merely collaboration among centers or even countries in order to increase the number of cases presented and achieve valuable statistical documentation. While the largest intra-country network collaboration, 8 centers/cities, is the Italian — they present their early experience with the Orbera balloon in 2515 obese individuals — the majority of cases come from Brazil — 5874 Orbera balloons from only 4 centers/cities, which is unsurprising considering the size of their population.

A similar collaboration is that of USA institutes and private practice centers, leading to a valuable number of cases with the Obalon — 387 cases in the 2018 publications and 1343 in the following year, all balloons in the initial year of US commercialization. Half of the pioneering research into intragastric balloons has come from European countries and started with the Orbera. However, as newer balloons appeared on the market, research evolved apace to include these new models: The ReShape Duo, presented in the REDUCE pivotal trial [13], in 326 cases has been of significant impact on the knowledge of newest balloon technology;

### Table 5 Top 10 publications according to the number of citations received

| First author name [ref] | Country      | Title                                                                 | Journal                                                                 | Journal impact factor | Balloon type | Number of citations |
|-------------------------|--------------|----------------------------------------------------------------------|-------------------------------------------------------------------------|----------------------|--------------|---------------------|
| Genco A [3]             | Italy        | BioEnterics intragastric balloon: the Italian experience with 2,515 patients | Obes Surg.2005                                                          | 4.129                | Orbera       | 441                 |
| Milone L [9]            | USA          | Laparoscopic sleeve gastrectomy is superior to endoscopic intragastric balloon as a first stage procedure for super-obese patients (BMI > or = 50) | Obes Surg. 2005                                                       | 4.129                | Orbera       | 302                 |
| Mathus-Vliegen EM [10]  | Netherlands  | Intragastric balloon for treatment-resistant obesity: safety, tolerance, and efficacy of 1-year balloon treatment followed by a 1-year balloon-free follow-up | Gastrointest Endosc. 2005                                               | 9.427                | Orbera       | 284                 |
| Sallet JA [11]          | Brazil       | Brazilian multicenter study of the intragastric balloon              | Obes Surg. 2004                                                       | 4.129                | Orbera       | 244                 |
| Genco A [12]            | Italy        | BioEnterics intragastric balloon (BIB): a short-term, double-blind, randomized, controlled, crossover study on weight reduction in morbidly obese patients | Int J Obes 2006                                                      | 5.095                | Orbera       | 232                 |
| Ponce J [13]            | USA          | The REDUCE pivotal trial: a prospective, randomized controlled pivotal trial of a dual intragastric balloon for the treatment of obesity | Surg Obes Relat Dis. 2015                                              | 4.734                | ReShape Duo  | 210                 |
| Roman S [14]            | France       | Intragastric balloon for “non-morbid” obesity: a retrospective evaluation of tolerance and efficacy | Obes Surg. 2004                                                       | 4.129                | Orbera       | 208                 |
| Totté E [15]            | Belgium      | Weight reduction by means of intragastric device: experience with the BioEnterics intragastric balloon | Obes Surg. 2001                                                       | 4.129                | Orbera       | 182                 |
| Kotzampassi K [16]      | Greece       | 500 intragastric balloons: what happens 5 years thereafter?          | Obes Surg. 2012                                                       | 4.129                | Orbera       | 165                 |
| Busetto L [17]          | Italy        | Obstructive sleep apnea syndrome in morbid obesity: effects of intragastric balloon | Chest. 2005                                                           | 4.129                | Orbera       | 153                 |
this is clear from the number of citations \( n = 211 \) of only the one publication.

It is well known that the number of times an article is cited is a good way of measuring its impact over a period of time on a specific field of science, and this in turn allows evaluation of both the authors and the journal itself [24]. However, it is important to understand that gathering citations is a time-dependent process, a new study requiring at least 2–5 years accumulating enough citations to be used as a reliable bibliometric indicator [25]. Thus, in the present analysis, 8 out of 14 and 5 out of 12 publications of the years 2021 and 2020, respectively, have still gained 0 citations.

It is also of interest to mention that despite the large number of journals used — 48 journals for 164 publications — just one, Obesity Surgery which published 86 articles, accounted for 52.44% of the total number of papers, while 32 journals accounted for 66.7% of the total number of journals hosting only one article each, i.e., publishing 19.51% of the total number of publications. It can thus be argued that Lotka’s law [6] applies also to the authors of the articles under study, although being over-estimated; however, this analysis is outside the main topics of our study.

The present study has some limitations. First, the Scopus and the PubMed databases were only used for data extraction, and the PubMed only for the citations of the articles under analysis; this decision being based on the finding that PubMed presents more citations in relation to Scopus for the same articles [25]. Second, we unfortunately excluded 4 articles written in non-European-language journals, only because of our inability to understand these languages. Third, we manually collected all the authors’ names and credited them as authors, rather than only the first or the corresponding author, as the bibliometry software suggests.

Fourth, we tied to map the countries/cities where there are scientifically valuable centers dealing with the application of intragastric balloons through their scientific productivity. This, in no way means that there are no other trustworthy centers, worldwide, which do the same, but do not like or do not have time to present their results through publication in reliable medical journals — unfortunately, there is no other method of identifying them; and fifth, our purpose was to identify these centers through their scientific publications. Finally, except in rare cases, we generally named cities and not institutes, which is why some authors’ affiliations changed over time.

In conclusion, through the present bibliometric analysis of scientific publications, we identify the productive centers in various countries/cities and classify them in relation to the number of published articles, collaboration, number of cases reported, and number of citations gained. Of the 164 publications considered eligible for analysis, the lists are topped by: Italy with 37 publications; the USA, as having participated as collaborators with 9 different countries; the fluid-filled Orbera balloon used in 126 studies; the journal Obesity Surgery with 86 publications; Brazil with 5874 cases; Lorenzo M and Genco A, co-authors from Italy, with 14 and 12 publications, respectively; and the article by Genco A, et al. published in Obesity Surgery 2005 [3] having been cited 441 times. All other balloon types are related to much lower productivity; unsurprising since their history begins only from 2007.

**Author Contribution** Each of the above authors contributed substantially to the design of the work, the drafting of the manuscript, and the final approval of the manuscript.

**Declarations**

**Ethics Approval** This article does not contain any studies with human participants or animals performed by any of the authors.

**Conflict of Interest** The authors declare no competing interests.

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