



# Pericapsular Nerve Group Block (PENG Block); Rising Value in Anesthesia

## Perikapsüler Sinir Grubu Bloğu (PENG Blok); Anesteziye Yükselen Değer

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### Abstract

**Objective:** Pericapsular nerve group block (PENG block) emerges in the search of effective methods in hip joint block. It was aimed to analyze the bibliometric analysis of publications related to this method and to examine the world literature.

**Methods:** Articles, case reports, conference presentations, papers, and letters to the editor published in peer-reviewed journals published in the PubMed database about PENG block were examined.

**Results:** This new block was first implemented in Canada, followed by Japan and India. It was seen that case series and original research started to be done worldwide, while only case reports were made from Turkey. It was seen that 65% of the publications on this subject were published in Science Citation Index (SCI) and SCI-Expanded (SCI-E) journals. While the average number of citations per publication related to the PENG block was 5.75 in SCI and SCI-E journals, it was found to be 1.42 in other indexed journals ( $p<0.05$ ). The mean number of cases in the publications was higher in case series (17.07) in SCI and SCI-E journals than in other indexed journals (10.14) ( $p<0.05$ ). It was revealed that more cases were required to publish case series in SCI and SCI-E journals ( $p<0.05$ ).

**Conclusion:** Although the method is new and effective, it is important that it be published in well-indexed journals for citation. We think that because of understanding why and how this block is implemented in which countries, the number of publications on this subject will increase in our country.

**Keywords:** Pericapsular nerve block, anesthesia, pain management

### Öz

**Amaç:** Kalça eklemi bloğunda etkin yöntem arayışları içinde Perikapsüler Sinir Grubu Bloğu (PENG blok) karşımıza çıkmaktadır. Bu yöntemle ilgili yayınların bibliyometrik analizinin yapılması ve dünya literatürünün incelenmesi amaçlanmıştır.

**Yöntem:** PENG blok ile ilgili yapılmış PubMed veri tabanında yayınlanan hakemli dergilerde yayınlanmış makaleler, olgu sunumları, konferans sunumları, bildiriler, editöre mektuplar incelemeye alınmıştır.

**Bulgular:** Bu yeni bloğun ilk Kanada'da uygulandığı, Japonya ve Hindistan tarafından takip edildiği görüldü. Dünyada olgu serileri ve özgün araştırmaların yapılmaya başlandığı, Türkiye'den ise yalnızca olgu sunumları yapıldığı görüldü. Bu konu ile ilgili yayınların %65'inin Science Citation Index (SCI) ve SCI-Expanded (SCI-E) dergilerde yayınlandığı görüldü. PENG blok ile ilgili yayın başına düşen atıf ortalaması, SCI ve SCI-E dergilerde 5,75 iken, diğer indeksli dergilerde 1,42 olduğu saptandı ( $p<0,05$ ). Yayınlardaki ortalama olgu sayısı SCI ve SCI-E dergilerdeki olgu serilerinde (17,07), diğer indeksli dergilerden (10,14) oldukça yüksekti ( $p<0,05$ ). SCI ve SCI-E dergilerde olgu serisi yayınlanması için daha fazla sayıda olgunun gerekliliği ortaya çıkarıldı.



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**Öz**

**Sonuç:** Yöntem yeni ve etkili olmasına rağmen, atıf için iyi indekslenmiş dergilerde yayınlanması önemlidir. Bu bloğun hangi ülkelerde niçin ve nasıl uygulandığının anlaşılması sonucu, ülkemizde de bu konudaki yayınların sayısının artacağını düşünmekteyiz.

**Anahtar Kelimeler:** Perikapsüler sinir bloğu, anestezi, ağrı yönetimi

**Introduction**

Hip pathologies are one of the most basic pathologies that result in surgery for both young and old populations. Because of fractures, trauma, tumor surgery, joint pathology, or other reasons, hip joint surgeries are frequently performed and patients suffer severe pain. In a review, increasing age, female gender, living alone, history of falling, physical limitations, and use of walking aids increase the risk of falls and hip fractures. In addition, diseases such as vertigo, Parkinson's, which are often observed in advanced ages, and the use of blood pressure or epilepsy drugs increase the risk of falls and fractures. Fracture surgeries are frequently performed because of falls in the elderly population and high-energy trauma in young adults<sup>(1)</sup>.

Oral or intravenous analgesics are the first choice in the pain management of hip fractures, but adequate pain control can be difficult to achieve. In this case, opioids are preferred because of their stronger analgesic effect. Since more elderly population is affected, these treatments can cause several side effects. Regional anesthesia techniques are also widely used because they have lower complication rates, lower potential for side effects, and provide more effective analgesia than analgesic drugs and opioid therapy. Effective pain management due to hip fractures leads to increased patient satisfaction, accelerated recovery, and reduced hospital stay<sup>(2)</sup>.

The most common regional anesthesia in hip surgeries is lumbar plexus block, femoral nerve block (FNB), and fascia iliaca compartment block (FICB)<sup>(3)</sup>. These blocks alone do not provide adequate analgesia to the hip and may cause the weakness of the quadriceps muscles. Pericapsular nerve group block (PENG) is a new regional anesthesia technique developed for analgesia hip arthroplasty with motor protective benefits. It is an interfacial plane block that targets the articular branches of the femoral, obturator, and accessory obturator nerves in the hip. The block has been found to provide more complete analgesia to the hip by placing the local anesthetic in the myofascial plane of the psoas muscle and the superior pubic ramus<sup>(4)</sup>.

In this study, a bibliometric analysis of the publications on PENG block, a new block technique that has been used in hip surgeries, will be performed. It is aimed to increase the awareness of this new technique in our country and provide its widespread application.

**Materials and Methods**

PubMed database was searched for this study. Articles, case reports, conference presentations, papers, and letters to the editor published in peer-reviewed journals indexed in the PubMed database about PENG block were included in the study. Among these publications, which describe how the block was made or cadaveric studies that include anatomical features were excluded from the study. The publications that were not written in English, which did not have English abstracts, and of which full text could not be reached were excluded from the review. Studies showing the results of the applications performed on the patient were included; among these studies, publications in which single case reports were made were excluded. Publications with four or less cases were considered "case reports", and publications with five or more cases were considered "case series". The following features in the studies were examined: year, country, aim of PENG Block application, number of patients, method of application, drugs used, doses of drugs. In addition, pain scoring systems used in the studies, how the pain scores progressed before and after the block, whether complications developed after the procedure, and the degree of satisfaction of the patient were noted.

**Statistical Analysis**

For statistical analysis, the journals were divided into two groups. Journals indexed in Science Citation Index (SCI) and SCI-Expanded (SCI-E) were in one group, and journals indexed in other international databases were in the other group. The total number of journals in the groups, the total number of citations they receive annually, the number of citations per journal per year, the total number of cases in the publications in the groups, the average number of cases in the publications in the groups were found and the

relationship between them was examined with one-way ANOVA. SPSS 18.0 software was used for analysis.

## Results

Twenty publications meeting the inclusion criteria were included in the study. The studies were conducted between

2018 and 2021, and it was observed that the data of 293 patients were shared. 4 (20%) of the publications were from India, three of them (15%) were from Canada, USA, Japan and Turkey each. There were five original research articles and five case series. All but a publication were made in adult patients (Table 1).

**Table 1. List of publications by year**

First author	Year	Country of origin	Type	Journal	Database	Number of citations	Average number of citations	Number of cases	Type of cases
Girón-Arango et al. <sup>(4)</sup>	2018	Canada	Case series	Regional Anesthesia and Pain Medicine	SCI-E	127	31.75	5	Adult
Ueshima and Otake <sup>(5)</sup>	2018	Japan	Case report	Journal of Clinical Anesthesia	SCI-E	17	4.25	2	Adult
Yu et al. <sup>(6)</sup>	2019	Canada	Letter to the editor	Regional Anesthesia and Pain Medicine	SCI-E	22	7.3	2	Adult
Roy et al. <sup>(7)</sup>	2019	India	Letter to the editor	Regional Anesthesia and Pain Medicine	SCI-E	9	3	5	Adult
Ueshima and Otake <sup>(8)</sup>	2019	Japan	Case report	Journal of Clinical Anesthesia	SCI-E	18	6	2	Adult
Acharya and Lamsal <sup>(9)</sup>	2020	Nepal	Case series	Case Reports in Anesthesiology	Diğer index	7	3.5	10	Adult
Talawar et al. <sup>(10)</sup>	2020	India	Case report	Indian Journal of Anaesthesia	ESCI	2	1	1	Adult
Orozco et al. <sup>(11)</sup>	2020	Colombia	Case series	Journal of Clinical Anesthesia	SCI-E	10	5	5	Adult
Kukreja et al. <sup>(12)</sup>	2020	USA	Original research	Cureus	ESCI	7	3.5	12	Adult
Kukreja et al. <sup>(13)</sup>	2020	USA	Original research	Cureus	ESCI	1	0.5	16	Adult
Sahoo et al. <sup>(14)</sup>	2020	India	Original research	Indian Journal of Anaesthesia	ESCI	1	0.5	20	Adult
Mysore et al. <sup>(15)</sup>	2020	Canada	Original research	Canadian Journal of Anesthesia	SCI-E	2	1	123	Adult
Luftig et al. <sup>(16)</sup>	2020	USA	Case report	American Journal of Emergency Medicine	SCI-E	2	1	3	Adult
Singh et al. <sup>(17)</sup>	2020	India	Case series	A&A Practice	ESCI	2	1	10	Adult
Aydin et al. <sup>(18)</sup>	2020	Turkey	Case report	Journal of Cardiothoracic and Vascular Anesthesia	SCI-E	9	4.5	2	Adult

**Table 1. Continued**

First author	Year	Country of origin	Type	Journal	Database	Number of citations	Average number of citations	Number of cases	Type of cases
Bilal et al. <sup>(19)</sup>	2020	Turkey	Case report	Journal of Clinical Anesthesia	SCI-E	8	4	2	Adult
Aksu et al. <sup>(20)</sup>	2020	Turkey	Case report	Journal of Clinical Anesthesia	SCI-E	5	2.5	1	Pediatric
Del Buono et al. <sup>(21)</sup>	2020	Ireland	Case series	Regional Anesthesia and Pain Medicine	SCI-E	5	2.5	10	Adult
Fujino et al. <sup>(22)</sup>	2021	Japan	Case report	JA Clinical Reports	ESCI	0	0	2	Adult
Lin et al. <sup>(23)</sup>	2021	Australia	Original research	Regional Anesthesia and Pain Medicine	SCI-E	2	2	60	Adult

In only a publication PENG block was applied to patients who were planned to be operated for a reason other than hip pathology. Except for these patients who underwent block due to venous insufficiency, almost all of the patients complained of various hip pathologies; therefore, hip surgery was planned for them. The most common hip surgery was found to be total hip replacement. The anesthetic drugs, concentrations, and total volume administered varied in the PENG block procedure. Bupivacaine (12 publications-60%)

and ropivacaine (4 publications-20%) were the most commonly used agents. In addition to anesthetic agents, various doses and concentrations of epinephrine (5 publications-25%) and steroid agents (3 publications-15%) were applied. In only a publication, the block was applied in the emergency department by an emergency department specialist. In other studies, it was observed that this block was performed by the anesthesia team (Table 2).

**Table 2. List of cases where PENG block was applied, by which team, at what dose**

First author	Patient's complaint	Type of operation	The team that applied PENG block	Drug dose used in the intervention
Girón-Arango et al. <sup>(4)</sup>	Hip fracture and metastatic tumor	Hip arthroplasty and fixation	Anesthesiology	0.25% bupivacaine + epinephrine 1: 400,000 (20 mL)
Ueshima and Otake <sup>(5)</sup>	Hip fracture	Total hip replacement	Anesthesiology	0.25% levobupivacaine (20 mL)
Yu et al. <sup>(6)</sup>	Hip fracture + hip joint pathologies	Hip fracture and hip arthroplasty operation	Anesthesiology	0.25% or 0.5% bupivacaine + 1: 400,000 epinephrine (20 mL)
Roy et al. <sup>(7)</sup>	Hip and femoral pathology	Total hip arthroplasty, dynamic hip screwing and proximal femur surgeries	Anesthesiology	Not specified
Ueshima and Otake <sup>(8)</sup>	Hip joint dislocation	Hip joint repositions	Anesthesiology	1% lidocaine 10 mL
Acharya and Lamsal <sup>(9)</sup>	Hip fracture	Hip fracture surgery	Anesthesiology	0.125% bupivacaine and 4 mg dexamethasone
Talawar et al. <sup>(10)</sup>	Hip joint rheumatism	Arthroscopy of the hip joint	Anesthesiology	2% lidocaine + adrenaline (10 mL), 0.5% bupivacaine (10 mL)
Orozco et al. <sup>(11)</sup>	Femoroacetabular impingement	Total hip arthroplasty	Anesthesiology	For PENG block: 0.75% bupivacaine + 1% lidocaine (20 mL), for femoral nerve block: 1% lidocaine (100 mg) + 0.75% bupivacaine (75 mg) (20 mL)

Table 2. Continued

First author	Patient's complaint	Type of operation	The team that applied PENG block	Drug dose used in the intervention
Kukreja et al. <sup>(12)</sup>	Hip joint osteoarthritis	Total hip arthroplasty	Anesthesiology	0.5% ropivacaine 20 mL
Kukreja et al. <sup>(13)</sup>	Hip joint osteoarthritis	Total hip arthroplasty	Anesthesiology	0.5% ropivacaine 20 mL
Sahoo et al. <sup>(14)</sup>	Hip fracture	Total hip replacement	Anesthesiology	0.25% bupivacaine + 4 mg dexamethasone (20 mL)
Mysore et al. <sup>(15)</sup>	Hip fracture + hip osteoarthritis	Total hip arthroplasty	Anesthesiology	For PENG block: %0.25 bupivacaine + 1: 200,000 epinephrine and 2 mg dexamethasone (20mL), for local infiltration anesthesia (LIA): 0.25% bupivacaine + epinephrine (20-40 mL)
Luftig et al. <sup>(16)</sup>	Hip fracture	Total hip replacement	Emergency Department Specialist	0.5% bupivacaine + epinephrine 20 mL and to expand the volume 10 mL normal saline
Singh et al. <sup>(17)</sup>	Hip fracture	Total hip replacement	Anesthesiology	0.25% bupivacaine 20 mL
Aydin et al. <sup>(18)</sup>	Venous insufficiency	Varicose vein surgery	Cardiovascular anesthesiologist	0.5% bupivacaine 15 mL + %2 lidocaine 15 mL (Total 30 mL)
Bilal et al. <sup>(19)</sup>	Acetabulum fracture	Total hip replacement	Anesthesiology	0.25% bupivacaine 30 mL
Aksu et al. <sup>(20)</sup>	Congenital hip dysplasia	Congenital hip dysplasia	Anesthesiology	0.25% bupivacaine 10 mL
Del Buono et al. <sup>(21)</sup>	Hip fracture	Total hip replacement	Anesthesiology	0.375% ropivacaine (9 patients) or 0.5% lidocaine 20 mL
Fujino et al. <sup>(22)</sup>	Hip joint rheumatism	Total hip arthroplasty	Anesthesiology	For PENG block: 0.5% ropivacaine 20 mL, For LCFN block: 0.375% ropivacaine 5-10 mL
Lin et al. <sup>(23)</sup>	Hip fracture	Total hip replacement	Anesthesiology	0.25% bupivacaine 20 mL

PENG: Pericapsular nerve group

It was observed that PENG block was mostly performed for operation anesthesia in the operating room or for treating pain. In some publications, pain scoring was done with visual analog scale (VAS) and in others with numerical rating scale (NRS). Five publications did not specify the pain score, but pain treatment was stated as "successful" in those.

In terms of side effects, a publication reported quadriceps muscle weakness in 2 cases. Another publication mentioned blood aspiration through the catheter. It was observed that catheters were placed for continuous pain management in 3 (15%) publications. Ropivacaine infusion was applied in two of these and bupivacaine infusion in the other (Table 3).

The number of publications in SCI and SCI-E journals was 13, while the number of publications in other journals was 7. While the publications in SCI and SCI-E journals were cited annually by an average of 5.75, other indexed journals were cited 1.42, and the difference was statistically significant ( $p < 0.05$ ). While the mean number of cases in the

publications in highly cited SCI and SCI-E journals was 17.07, the mean number of cases in other indexed journals was 10.14 ( $p < 0.05$ ), (Table 4).

## Discussion

The elderly population is increasing in all countries. Along with this, pain due to hip fracture and joint disorders, which is frequently encountered in the elderly population, has become a problem that must be dealt with either during surgery or for preoperative and postoperative analgesia. PENG block is gaining increasing popularity in studies on this subject. In this way, patients can be provided with analgesia treatment. In addition, the patient can be positioned to make a comfortable block for the anesthesia team for the block to be applied in the operating room.

In the literature, we see that blocks such as FNB, 3-in-1 femoral block, and FICB are frequently<sup>(3)</sup>. However, it is understood that targeted analgesia cannot be fully achieved

<b>Table 3. How the success of the PENG block was evaluated and the complications that developed</b>					
<b>First author</b>	<b>Reason for the block</b>	<b>The place where the block was made</b>	<b>Pain score before block</b>	<b>Pain score after block</b>	<b>Reported complications and additional information</b>
Girón-Arango et al. <sup>(4)</sup>	Preoperative analgesia	Preoperative waiting room	NRS 4 to 8	NRS 0 to 2	No complications
Ueshima and Otake <sup>(5)</sup>	For postoperative analgesia	Operating room, after anesthesia	Not specified	Specified as successful	No complications
Yu et al. <sup>(6)</sup>	Preoperative analgesia	Before surgery, preoperative or intraoperative	NRS 7/10	NRS 2/10	Quadriceps muscle weakness and loss of sensation
Roy et al. <sup>(7)</sup>	Preoperative analgesia	Not specified	Not specified	Specified as successful	No complications
Ueshima and Otake <sup>(8)</sup>	Anesthesia for the reduction procedure	Operating room	VAS 10/10	VAS 3/10	No complications
Acharya and Lamsal <sup>(9)</sup>	Preoperative analgesia	Before surgery	NRS 6 to 9	NRS 0 to 3	No complications
Talawar et al. <sup>(10)</sup>	Block for operation	Operating room	Not specified	Specified as successful	No complications
Orozco et al. <sup>(11)</sup>	For postoperative analgesia	Operating room, after anesthesia	Evaluated with VAS	Maximum VAS 3	No complications
Kukreja et al. <sup>(12)</sup>	For postoperative analgesia	Operating room, after anesthesia	Evaluated with VAS	4-7 in primary THA patients, 3-10 in revision THA patients	No complications
Kukreja et al. <sup>(13)</sup>	For postoperative analgesia	Operating room, after anesthesia	Evaluated with VAS	1.6-3.5 in PENG + QL Block group; 4.8-6 in the QL block group only	No complications
Sahoo et al. <sup>(14)</sup>	Preoperative analgesia	Before surgery in the preoperative waiting room	VAS, 7.45±1.53 at rest, 9.45±0.75 at passive movement	VAS, at rest 1.1±1.07, passive movement 2.35±1.34	Positioning for spinal anesthesia was optimal in 75%, good in 15%, and satisfactory in 10%. No complications.
Mysore et al. <sup>(15)</sup>	Preoperative analgesia	Operating room, after anesthesia	Evaluated with VAS	PENG + LIA max. 3.8, 4.0 in LIA block only	No complications
Luftig et al. <sup>(16)</sup>	Preoperative analgesia	Emergency department	Not specified	Specified as successful	No complications
Singh et al. <sup>(17)</sup>	For postoperative analgesia	Before surgery in the preoperative waiting room	VAS 8 to 9	VAS 1 to 3	Catheter inserted, held for 48 hours; 0.25% bupivacaine was administered at 5 mL/hour. Positioning for spinal anesthesia was considered comfortable. No complications
Aydin et al. <sup>(18)</sup>	Block for operation	Operating room	Not specified	Specified as successful	No complications
Bilal et al. <sup>(19)</sup>	Block for operation	Operating room	Evaluated with NRS	2/10	No complications

**Table 3. Continued**

First author	Reason for the block	The place where the block was made	Pain score before block	Pain score after block	Reported complications and additional information
Aksu et al. <sup>(20)</sup>	For postoperative analgesia	Operating room, after anesthesia	Evaluated with NRS	Specified as successful	No complications
Del Buono et al. <sup>(21)</sup>	Preoperative analgesia	Emergency department	NRS 7	NRS 2	Catheter inserted, held for 72 hours. 0.2% ropivacaine was infused at 5 mL/hour. Aspiration of blood from the catheter has developed.
Fujino et al. <sup>(22)</sup>	For postoperative analgesia	Operating room, after anesthesia	Evaluated with NRS	NRS 0	Catheter inserted, 0.2% ropivacaine infusion was made at 6 mL/hour. No complications reported.
Lin et al. <sup>(23)</sup>	For postoperative analgesia	Operating room, after anesthesia	Evaluated with NRS	Specified as successful	No complications

VAS: Visual analog scale, NRS: Numerical rating scale, LIA: Local infiltration anesthesia, QL: Quadratus lumborum, THA: total hip arthroplasty, PENG: Pericapsular nerve group

**Table 4. Comparison of citation rates and case numbers of publications according to the journals in which they were published**

Database	Number of journals (n)	Annual total citations	Average number of citations per year	p	Number of cases	Average number of cases	p
SCI and SCI-E	13	74.8	5.75	0.01*	222	17.07	0.02*
Other	7	10	1.42		71	10.14	

\*p<0.05, SCI: Science Citation Index, SCI-E: Science Citation Index-Expanded

with these blocks. Magnetic resonance imaging showed that the drugs moved cephalad and could not go beyond the L5 level. Thus, the accessory obturator nerve and the femoral nerve were not affected and the desired analgesia could not be achieved<sup>(24)</sup>.

Anatomy studies have shown that the higher branches of the femoral, obturator, and accessory obturator nerves provide innervation to the anterior hip capsule<sup>(25,26)</sup>. In an anatomical cadaver study examining the PENG, dye was administered during PENG block. All anterior hip capsule areas related to the articular branches of the femoral, obturator, and accessory obturator nerves were stained<sup>(27)</sup>. Therefore, PENG block was theoretically considered to provide a more complete hip analgesia among all regional analgesia techniques described so far. Afterwards, the method started to be used in hip fracture cases<sup>(4)</sup>.

In 2018, Girón-Arango et al.<sup>(4)</sup> first applied PENG block to 5 patients undergoing hip fracture surgery and published their results. All patients were classified as ASA II. Bupivacaine 0.25% + epinephrine 1: 400,000 (20 mL) was used in four patients, and ropivacaine 0.5% + epinephrine 1: 200,000 (20 mL) and 4

mg dexamethasone were used in one patient. As a result, it was observed that the pain stopped completely during rest in 4 of 5 patients. NRS was used to test the effectiveness. They stated that there was an average of 7 points decrease in the pain scores of the patients, which was a better result than previous studies. Although they were not sure of the diffusion of the drug into the subpectineal area (SPP), which must be reached for obturator nerve block, they achieved effective analgesia and thought that the drug also affected that area. Quadriceps muscle weakness did not develop in any of the patients. It has been stated that this is an advantage over other blocks<sup>(4)</sup>.

Although the results of the above study created some excitement, there were some certain criticisms too. One author commented on patient safety and wondered how elderly and fractured patients awaiting surgery were informed. He stated his hesitations about the reliability of informed consent in a letter to the editor of the journal in which Girón-Arango et al.<sup>(4)</sup> article was published. He also stated that ethics committee approval should have been required for the presentation of these cases<sup>(28)</sup>.

However, Girón-Arango et al.<sup>(4)</sup> case series has inspired many, and the authors have shared their experiences with case reports. Yu et al.<sup>(6)</sup> applied PENG block before or after hip fracture for analgesia in more than a hundred patients. They experienced complications in only two patients and reported this as well. In an obese patient with obstructive sleep apnea, quadriceps muscle weakness developed after the block for postoperative analgesia, which could not be associated with surgery. In the second reported patient, quadriceps muscle weakness and sensory loss developed on the operated side on the first day after a successful block and surgery. They could not associate this with surgery and attributed it to the block. They reported that these symptoms regressed completely on the second postoperative day<sup>(6)</sup>.

Acharya and Lamsal<sup>(9)</sup> published a case series of ten diseases in which they had PENG block. They applied 0.125% bupivacaine and 4 mg dexamethasone in ultrasound-guided blocks. They saw effective analgesia in all their patients. While the NRS scores of the patients before the block were between 6 and 10, they decreased to 3 and below after the block. Moreover, they emphasized that 90% of the patients did not feel discomfort during positioning for the block to be applied by the anesthetist in the operating room. The easy positioning of the patients increased the comfort of the anesthesiologist<sup>(9)</sup>.

Some researchers have applied lateral femoral cutaneous nerve (LFCN) block with PENG block. For example, Roy et al.<sup>(7)</sup> found that when they applied only PENG block, there were patients who complained of pain in the LFCN dermatome. Later, when they applied PENG and LFCN block together to five patients, they stated that analgesia was more effective and there was less analgesic opioid requirement<sup>(7)</sup>. Another researcher provided operative anesthesia for a patient who was going to undergo hip joint arthroscopy with PENG block. PENG block with 2% lidocaine + adrenaline (10 mL), 0.5% bupivacaine (10 mL), and LFCN block with 10 mL of the same combination was also performed. Because of the analgesia, the surgery was performed successfully. No anesthetic agents were given for sedation during the surgery, except for 1 mg midazolam and 50 g fentanyl. The analgesic effect disappeared after 4.5 h and no problems were noted<sup>(10)</sup>.

Researchers have also applied PENG block with FNB. In a case series from Colombia, patients undergoing hip arthroscopy received combined block after general anesthesia. Pain scores evaluated with VAS increased to a maximum of three

after the block, which showed that successful analgesia was achieved<sup>(11)</sup>.

Some researchers, on the other hand, thought that PENG block should be used as a postoperative analgesia method instead of a preoperative preparation or the intraoperative anesthesia method. In one study, the anesthesia team applied PENG block to the patient at the end of the operation before leaving the operating room. They stated that it reduced the need for opioids in the postoperative period and that it could also be used for this purpose<sup>(5)</sup>. In another study, PENG block was applied in two patients who developed the dislocation after total hip replacement and had severe pain. After their pain was relieved, hip repositioning was successfully performed<sup>(8)</sup>. There are few studies and case reports about continuous block. For postoperative analgesia, continuous PENG block and LFCN block were applied by Fujino et al.<sup>(22)</sup>. With the inserted catheter, 0.2% ropivacaine infusion was administered for 48 h at a rate of 6 mL/h. Postoperative pain was controlled with NRS at 2, 12, 24 and 48 h. Motor block was followed by the Bromage Score. With the continuous infusion through the catheter, successful postoperative analgesia was achieved in the patients, and it was stated that no additional opioids were needed. NRS scores, which were zero at rest, increased to a maximum of three with movement. Bromage scores were reported as zero<sup>(22)</sup>. In a series of 10 patients by Singh et al.<sup>(17)</sup>, 0.25% bupivacaine was given as 5 mL/h infusion in hip fracture cases in which they placed a catheter after PENG block. They emphasized that there was no need for additional opioids in the cases they followed up with VAS<sup>(17)</sup>. In another publication of ten series, patients with a mean NRS score of 7 before hip fracture underwent PENG block and later a catheter was inserted. The median NRS in 48 h was 2. During 72 h postoperatively, the patients did not need analgesics other than acetaminophen<sup>(21)</sup>.

Another study on PENG block was conducted in patients who will undergo six primary and six revisions total hip arthroplasty (THA). The block was applied preoperatively with the patients in the supine position. Spinal anesthesia was applied to 2 of the patients and general anesthesia to the others. VAS and oral opioid use were evaluated in the post-anesthesia care unit and at 6, 12, and 24 h postoperatively. The mean pain scores at all times in patients undergoing revision THA were higher than those in the other group. Postop opioid use was higher in the revision group<sup>(12)</sup>. The same first author in another study thought that performing quadratus lumborum (QL) block together with PENG block



would provide more adequate analgesia. For this purpose, a combined block was applied in 8 patients and only a QL block in 8 patients. The mean pain scores and opioid use were lower in the combined block group<sup>(13)</sup>.

Sahoo et al.<sup>(14)</sup>, on the other hand, designed a prospective cohort study rather than a case report. They applied PENG block preoperatively to 20 patients with a VAS value greater than 5 who would undergo hip fracture surgery. After the block, VAS was evaluated at rest and during passive movement (with 15° leg rise). Researchers also evaluated the compliance with spinal anesthesia for surgery. They rated it as follows: 0-not satisfactory, 1-satisfactory, 2-good, 3-optimal. They found a significant decrease in VAS both at rest and during passive movement 30 min after the block. They stated that the mean of patient compliance for spinal anesthesia was 2.65. They did not report any complications<sup>(14)</sup>.

In a double-blind randomized study, PENG block and FN block techniques were compared. 60 cases Pain levels of the patients were evaluated with NRS scoring, and quadriceps muscle strength was evaluated with Oxford muscle strength rating. They stated that there was significantly less pain and better quadriceps muscle strength in the PENG group<sup>(23)</sup>.

Mysore et al.<sup>(15)</sup> retrospectively reviewed the PENG blocks they performed at their center. They compared patients who received only local infiltration anesthesia (LIA) and those who received a combination of LIA + PENG block. They used 0.25% bupivacaine + 1: 200,000 epinephrine and 2 mg dexamethasone (20 mL) for PENG block and 0.25% bupivacaine + epinephrine (20-40 mL) for LIA. They compared the mean and maximum pain scores at rest and with movement, and they did not find any significant difference. Hydromorphone use was found to be low in the combined group<sup>(15)</sup>.

Over time, the PENG block has also been used outside the operating room in different areas or in situations other than hip surgery. In a case report made in the emergency department, a high volume (30 mL) block was applied to 3 patients with hip fracture (20 mL 0.5% bupivacaine + epinephrine and 10 mL normal saline for volume expansion). It is an effective analgesic method in patients undergoing hip fracture surgery<sup>(16)</sup>. Another high-volume PENG block case report was made in Turkey. The researchers presented two cases of acetabulum fracture in which they blocked with 30 mL of 0.25% bupivacaine. They stated that high volume may be effective on wider branches<sup>(19)</sup>.

PENG block was also used in cases other than hip fracture or osteoarthritis. A cardiovascular anesthesiologist, who was looking for a suitable block because of lesions in the femoral and obturator nerve sites, decided to perform PENG block in 2 patients who were going to be operated for varicose veins. They stated that the method provided enough anesthetic effect for patients to successfully complete their surgery and that it could also be used in cardiovascular surgeries<sup>(18)</sup>. In another case, an 8-year-old patient with congenital hip dysplasia underwent PENG block after anesthesia. The analgesic effect was prolonged up to 11 h in the patient who was given only a single dose of ibuprofen in the postoperative period. They stated that PENG block can be used in major pediatric surgeries<sup>(20)</sup>.

Bibliometrics is the study of various elements of academic publications with the help of numerical analysis and statistics. Mathematical and statistical methods are used to measure and analyze scientific publications. Bibliometric analyzes can be descriptive in terms of determining the number of articles published in a given year, or they can be evaluative in terms of citation analysis to reveal how an article has affected subsequent research. The quantitative measurement of scientific knowledge begins with citation analysis. Citation analysis, which provides information about the real impact of the publication, is based on the citation of the ideas produced by the authors by other researchers<sup>(29)</sup>.

### Study Limitations

When all the publications were grouped according to the database in which they were published, the total citation rate and annual citation rate of the publications in SCI and SCI-E journals were significantly higher. New researchers who want to publish on a subject tend to cite original publications in journals indexed in reputable databases. Even if the subject is the same or similar, researchers do not prefer to follow publications in other databases. In journals indexed in databases such as SCI and SCI-E, in order to publish a case series, it is necessary to present a certain number of cases and to analyze the results well. This results in the fact that the number of cases presented in reputable databases is higher than the sum of the cases collected in case series in other databases. When this issue was analyzed for PENG block publications, the average number of patients in the case series in SCI and SCI-E journals was 17.07, whereas it was 10.14 for other journals. This leads to an increase in quality and citations.

## Conclusion

Because of the publications about the PENG block, which started to be implemented in 2018, the method started to become popular and it is observed that there are countries and teams that successfully apply this technique. In time, the PENG block will be adopted more and the teams will become more experienced. There seem to be only a few reported complications as of now, though randomized studies to be conducted will further clarify the issue. Therefore, I think that this bibliometric analysis is valuable to increase the awareness and feasibility of this new technique. Being the first Turkish article in this field will contribute to the spread of this new technique in Turkey.

## Ethics

**Ethics Committee Approval:** The study does not require ethics committee approval.

**Informed Consent:** N/A

**Peer-review:** Externally peer-reviewed.

## Authorship Contributions

Surgical and Medical Practices: P.A., Concept: P.A., Design: P.A., Data Collection or Processing: C.E., Analysis or Interpretation: C.E., Literature Search: P.A., C.E., Writing: P.A.

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