SYSTEMATIC REVIEW

Surgeon Referral for Extraction of Inadvertent Deep and Nonpalpable Contraceptive Implants That Place Major Peripheral Nerves at Risk: A Systematic Review of Case Reports and Case Series

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Received: 27 June 2025 *Accepted: 18 October 2025*

Abstract

Objectives: Implantable contraceptive implants placed at the medial arm are often misapplied relatively deep, sometimes in muscle or adjacent to neurovascular structures. We reviewed the available evidence regarding non-palpable medial arm implants and factors associated with deep application to help inform specialists who may be asked to assist with removal in order protect nearby nerves.

Methods: Following PRISMA guidelines, the authors systematically reviewed PubMed, Embase, and Cochrane Library for case series and reports of complications associated with the removal of nonpalpable contraceptive implants in September of 2025. Rates and features of routine and problematic implant removal were studied. Factors potentially related to deep placement were identified. The NIH tool for case series (2021) was used to assess study quality.

Results: We identified 16 case series and 10 case reports related to problematic implant removal from an initial search of 219 publications. In a series of routine insertions and removals, nonpalpable surgical implant removal was uncommon. Compared to routine removal, problematic removal was associated with subfascial implants, intramuscular implants, and previous attempts. A subset of implants was removed in the operating room. Transient paresthesia of the ulnar, median, and medial antebrachial cutaneous nerves was common after surgical removal of deep nonpalpable implants. Factors potentially associated with non-palpable implants included provider training, time since insertion, greater BMI, and weight gain during implant use. Among the 10 case reports, 6 orthopedic surgeons and one plastic surgeon performed removal.

Conclusion: Hand surgeons may receive requests for assistance removing deep, nonpalpable contraceptive implants in order to limit the potential for neurovascular damage given that the medial arm insertion site is associate with the possibility of injury to adjacent to major nerves.

Level of evidence: IV

Keywords: Errant implant insertion, Nonpalpable contraceptive implants, Peripheral nerves, Risks of extraction

Introduction

A temporary implantable contraceptive device is designed for insertion at the medial arm (Nexplanon, Jersey City, New Jersey). The implant is designed for subcutaneous placement but is occasionally placed more deeply than intended. Temporary contraceptive implants placed in the intended, palpable subcutaneous position can be removed through a small incision in the outpatient setting by the inserting provider. Implants that cannot be felt, are in muscle, or are near a nerve may be more safely removed by specialists familiar

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THE ONLINE VERSION OF THIS ARTICLE ABJS.MUMS.AC.IR

Arch Bone Jt Surg. 2026;14(2):90-97 Doi: 10.22038/ABJS.2025.88821.4033 http://abjs.mums.ac.ir

with operating in this region and handling major peripheral nerves.[1-3] Hand specialists are nerve specialists and may be asked to remove devices that were placed too deep and in proximity to important neurovascular structures. This review is intended to document published experiences to inform and prepare surgeons that may to be asked to remove deep, non-palpable implants in risky locations. The published data regarding contraceptive implant removal was reviewed to address the following questions: 1) What are the types and incidence of difficult contraceptive implant removal? And 2) What factors are associated with subspecialist removal of a contraceptive implant?

Materials and Methods

We followed the PRISMA guidelines in preparing this systematic review.[4] The systematic review was registered on PROSPERO (CRD42024562019).

Search Strategy and Criteria

In September 2025, we identified case series or case reports of nonpalpable contraceptive implant removals. We searched PubMed, Embase, and the Cochrane Library using the following search criteria: Search 1: (deep contraceptive implant OR non-palpable contraceptive implant OR impalpable contraceptive implant AND [removal]); Search 2: (complications related to deep contraceptive implant removal). Both search strategies were performed as described in each database. The search was supplemented by reviewing the citation list of identified studies [Figure 1].

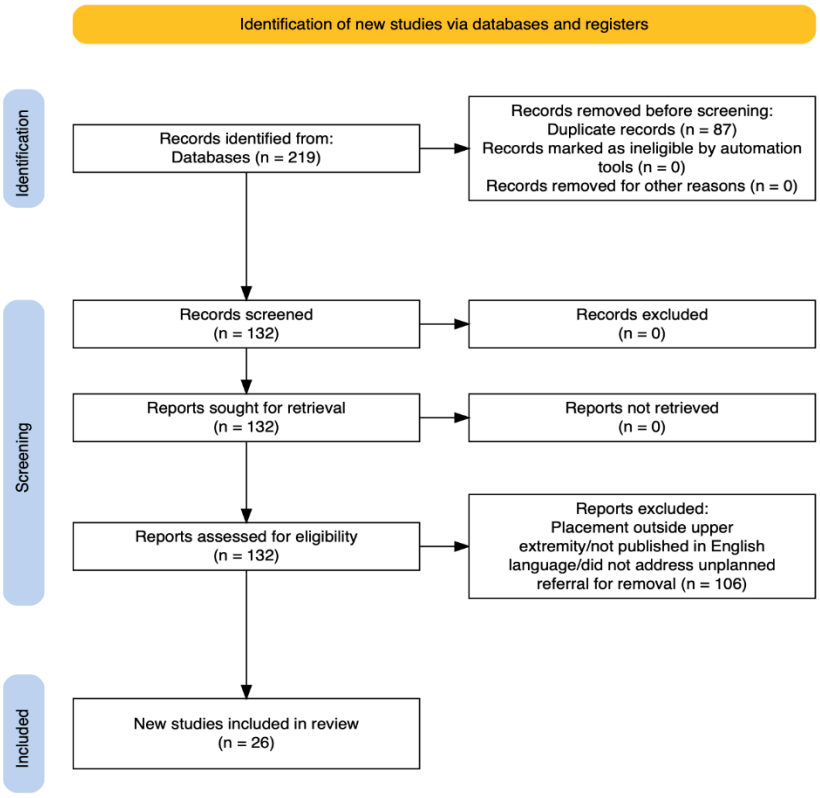

Figure 1. Flow chart representing the search strategy and results

Inclusion/Exclusion Criteria

Published English-language case reports and case series addressing unplanned referral for removal of temporary contraceptive implants related to deep or errant placement were included. Reports and series not published in the English language and studies with implant placement outside the upper extremity were excluded.

Data Collection Process and Data Items

The authors independently reviewed each case series to extract the rates of complications associated with nonpalpable temporary contraceptive implant removal. Additionally, case series and case reports were reviewed to determine the reasons for specialist referral and unplanned complicated removal for nonpalpable or problematic implants. Problematic removal was defined as any removal that could not be performed in the office under local anesthesia without imaging. Among the case series we sought potential factors associated with nonpalpable or

problematic placement including duration since implant placement, specialty of inserter, specialty of remover, patient age at insertion, patient age at removal, and patient Body Mass Index (BMI).

Assessment of Study Quality

The risk of bias is high with case reports. We found no suitable tool to assess case reports. For case series, the NIH tool for case series (2021) was used to assess study quality, eliminating non-applicable questions. A total of 9 questions were answered as "yes" or "no" by two raters. The percentages of "yes" answers were then quantified as a percentage. Percentages 0-33% were recorded as poor quality, 34-66% as fair quality, and 67-100% as good quality. The questions are included in [Table 1] and the results of the quality assessment are included in [Table 2].

Table 1. Quality assessment tool questions for case series

Was the study question or objective clearly stated?	Was the study population clearly and fully described, including a case definition?	Were the cases consecutive?	Were the subjects comparable?	Was the intervention clearly described?	Were the outcome measures clearly defined, valid, reliable, and implemented consistently across all study participants?	Was the length of follow-up adequate?	Were the statistical methods well-described?	Were the results well-described?
Yes or No	Yes or No	Yes or No	Yes or No	Yes or No	Yes or No	Yes or No	Yes or No	Yes or No

Table 2. Results of quality assessment tool for case series

Title	Author	Quality Rating	Percentage of Yes after eliminating NA: 0-33%=poor, 34-66%=fair, 67-100%=good
Removal of non-palpable Implanon® with the aid of a hook-wire marker	Nouri et al.	Fair	50%
Removal of deeply inserted, nonpalpable levonorgestrel (Norplant) implants	Sarma et al.	Fair	43%
Hormone-releasing contraceptive implants: our experience of complex removals using preoperative ultrasound	Vollans et al.	Fair	50%
Real world data on Nexplanon® procedure-related events: final results from the Nexplanon Observational Risk Assessment study (NORA)	Reed et. al	Good	75%
Localization and removal of nonpalpable contraceptive implants: Experience from a teaching hospital in Ethiopia: A case series	Abubeker et al.	Good	71%
Location and removal of non-palpable subdermal single-rod contraceptive implant.	Buitrón-García-Figueroa et al.	Good	71%
Difficult etonogestrel implant removals in South Africa: A review of 74 referred cases	Petro et al.	Good	71%
Removal of nonpalpable etonogestrel implants after fixation with a curved needle-A case series	El-Hadad et al.	Good	71%
US referral center experience removing nonpalpable and difficult contraceptive implants with in-office ultrasonography: A case series	Mastey et al.	Good	71%
Referral Center Experience With Nonpalpable Contraceptive Implant Removals	Matulich et al.	Good	75%
Characteristics of patients requiring surgical removal of subdermal contraceptive implant: A case control study	Katabi et al.	Good	75%
Factors associated with removal difficulties of etonogestrel-containing contraceptive implants (Nexplanon®)	Chevreau et al.	Good	75%
A retrospective analysis of factors associated with deep contraceptive implant removals compared to superficial removals	Kendall et al.	Good	75%
Difficult removal of subdermal contraceptive implants: a multidisciplinary approach involving a peripheral nerve expert	Odom et al.	Good	71%

Table 2. Continued			
Subfascial-located contraceptive devices requiring surgical removal	Hellwinkel et al.	Good	71%
Removal of etonogestrel contraceptive implants in the operating theater: report on 28 cases	Vidin et al.	Good	71%

Study Selection and Characteristics

We identified 10 case reports and 16 case series that met inclusion and exclusion criteria. A brief summary of the included case series is included in [Table 3] and a summary of the case reports in [Table 4].

Data Reporting

Case series of routine insertion, routine removal, and problematic removal were addressed separately. Problematic removals include any removal that requires an incision of more than a few millimeters, ancillary imaging, dissection of nerve or muscle, unsuccessful removals, or removals that resulted in adverse outcomes. Types of problematic removal, incidence of problematic removal, and factors associated with subspecialist removal were reported as a percentage of patients undergoing insertion or removal within each category. We attempted to group studies with cohorts of patients presenting with similar implant issues.

Table 3. Brief summary of included case series

Author	Year of publication	Country	Description
Nouri et al.	2013	Austria	Twenty-seven patients were referred to OB/GYN for nonpalpable contraceptive implant removal. Four implants required ultrasound.
Sarma et al.	1996	USA	Forty-eight nonpalpable implants referred to radiology for removal.
Vollans et al.	2015	United Kingdom	Ten patients with nonpalpable implants that had previously failed attempts at removal. Referred to orthopedic surgeon for removal under ultrasound.
Reed et. al	2019	Germany	Out of 4,373 removals, 65 were nonpalpable.
Abubeker et al.	2024	Ethiopia	Sixty-eight patients referred to OB/GYN for removal of nonpalpable implants. Twenty-seven removed below fascia and 2 removed in the operating room.
Buitrón-García-Figueroa et al.	2020	Mexico	One hundred and sixty-four nonpalpable implants removed by OB/GYN. Eighteen found in fascia and 94 in muscle.
Petro et al.	2021	South Africa	Sixty-eight of seventy-four referrals for removal were nonpalpable. Removed by OB/GYN.
El-Hadad et al.	2021	Switzerland	Eighty-one out of ninety-five implants referred for removal were nonpalpable. Three patients experienced perioperative paresthesia in the region of the median nerve.
Mastey et al.	2021	USA	Forty-eight out of fifty-four implants referred for removal were nonpalpable. All were located with ultrasound, thirteen were subfascial, and all were removed by OB/GYN.
Matulich et al.	2019	USA	Forty-eight nonpalpable implants referred to OB/GYN for removal. Twenty-two were above fascia, twenty-five were below fascia, and one was within fascia.
Katabi et al.	2022	USA	Thirteen of six hundred and sixty-nine patients required operating room removal by plastic surgeon.
Chevreau et al.	2018	France	Sixty-three out of six hundred and thirty referrals for removal had a previous attempt. Fifteen of the sixty-three were below the brachial fascia.
Kendall et al.	2024	USA	One hundred and sixty-two out of seven hundred and forty-seven removals were deep. Referred to OB/GYN for removal.
Odom et al.	2017	USA	Five out of twenty-two implants required surgical removal by peripheral nerve surgeon. One was within biceps muscle and four were near the neurovascular bundle.
Hellwinkel et al.	2021	USA	Six implants referred to upper extremity surgeon for removal. All were subfascial and one was within muscle.
Vidin et al.	2007	France	Eleven out of twenty-eight implants referred for removal were intramuscular and three were perivascular.

Table 4. Brief summary of included case reports.

Author	Year of publication	Country	Description
Amann et al.	2003	Switzerland	Thirty-three-year-old female with nonpalpable contraceptive implant that experienced failure of removal by OB/GYN provider. Referred to Interventional Radiology for removal under ultrasound guidance.
Belyea et al.	2017	USA	Thirty-nine-year-old female that experienced two failed nonpalpable implant removals by OB/GYN providers. Referred to Orthopedic Surgeon for removal under fluoroscopy. Patient endorsed median nerve paresthesia before implant was removed from brachial artery sheath.
Gillies et al.	2011	Australia	Forty-four-year-old female with failed removal that caused sudden pain and paresthesia. Referred to hand surgeon for removal. Median nerve laceration repaired at removal, however patient experienced persistent paresthesia and thenar weakness.
Guiahi et al.	2014	USA	Thirty-year-old female with referred by OB/GYN for nonpalpable implant. Interventional Radiology performed removal from biceps muscle with fluoroscopy.
Kong et al.	2021	USA	Twenty-one-year-old female referred by OB/GYN for nonpalpable implant. Orthopedic surgeon removed implant under fluoroscopy and ultrasound. Implant found to be below biceps muscle fascia.
Lefebvre et al.	2018	USA	Twenty-one-year-old woman referred from nurse practioner to upper extremity surgeon for nonpalpable Nexplanon with paresthesia in the ulnar distribution and intrinsic hand muscle wasting. Implant removed under fluoroscopy, where it was found to be in direct contact with the ulnar nerve. Neuroma of the ulnar nerve was excised and nerve repaired.
Rivera et al.	2020	Italy	Thirty-five-year-old female presented with paresthesia in the ulnar nerve distribution and history of nonpalpable contraceptive implant for 2 months. Orthopedic surgeon located the implant on the ulnar nerve with ultrasound and performed removal.
Sarma et al.	1998	USA	Thirty-six-year-old female with nonpalpable implant removed by OB/GYN from brachial artery sheath under fluoroscopy.
Wechselberger et al.	2006	Austria	Twenty-four-year-old female referred from OB/GYN for nonpalpable implant and paresthesia in ulnar distribution. Plastic surgeon removed implant with ultrasound and repaired nerve.
Wang et al.	2025	USA	Twenty-six-year-old female referred from OB/GYN for nonpalpable implant. Orthopedic surgeon removed implant from within biceps muscle with use of C-arm.

Results

Our initial search in September 2025 yielded 219 publications including both case series and case reports. Once duplicates were removed 132 publications remained. One hundred and two publications were removed for not being published in the English language, for including contraceptive implants placed outside of the upper extremities, or for not addressing unplanned referral for removal. Thirty publications were then reassessed for inclusion criteria to ensure that unplanned referral for removal of a temporary contraceptive implant related to deep or errant placement was addressed. Ultimately, 26 publications, comprised of 16 case series and 10 case reports, were included in our review.

Results of quality assessment for case series

Three case series[5-7] were rated fair quality and 13 good quality.

What are the types and incidence of difficult contraceptive implant removal?

Routine implant insertion:

A case series from the manufacturer identified 0.9% (65 of 7364) insertions from December 2011 to October 2017 as non-palpable.[8]

Routine implant removal:

Among a case series of 4373 routine removals documented by health care providers, 60 (1.4%) removals were rated as problematic, and 5 (0.1%) had surgical consultation for deep removal, one of which was infected.[8]

Problematic implant removals:

Among 4 case series of 307 nonpalpable implant removals, 18% (54 of 307) implants were removed from within muscle, 8.8% (27 of 307) were removed from below fascia, 7.8% (24 of 307) had a previous unsuccessful removal attempt, and 2.6% (8 of 307) were removed in the operating room.[5,6,9,10]

A case series of 10 implants referred for ultrasound guided removal after at least one unsuccessful attempt reported 90% (9 of 10) below fascia. Among those below fascia, 56% (5 of 9) were along the ulnar nerve and 44% (4 of 9) were within muscle.[7]

A case series of nonpalpable, deep migrated, or damaged implants, or unsuccessful removals identified 92% (68 of 74) of implants as nonpalpable, among which 31% (21 of 68) were subfascial and 1.5% (1 of 68) were within muscle. Among the 74 implant removals, 4 (5.4%) had a previous unsuccessful removal, 72 were (97%) removed in office with ultrasound assistance, and 2 (2.7%) implants were removed in the operating room.[11]

A case series of people referred for ultrasound guided, open surgical removal of deeply located implants reported that 85% (81 of 95) were nonpalpable, 19% (18 of 95) had a previous unsuccessful removal attempt, 45% (43 of 95) were below fascia, 9.5% (9 of 95) were within muscle, and 1.1% (1 of 95) were removed in the operating room.[12]

A case series of patients referred for ultrasound guided implant removal reported that 89% (48 of 54) were nonpalpable, 52%% (25 of 48) of nonpalpable implants had a previous unsuccessful removal attempt, 25% (12 of 48) of nonpalpable implants were below fascia, 2.1% (1 of 48) were within muscle, and 4.2% (2 of 48) of nonpalpable implants were removed in the operating room.[13]

A case series of 61 patients referred for ultrasound localization, 55 attended the appointment. Of the 55, 53% (29 of 55) had a previous unsuccessful removal attempt and 87% (48 of 55) were nonpalpable. Among the 48 nonpalpable implants, 52% (25 of 48) were below fascia, and 6.3% (3 of 48) of nonpalpable implants were removed in the operating room.[14]

A study comparing cohorts of uncomplicated office removal (326 implants) and surgical removal (13 implants) reported that 62% (8 of 13) of surgical removals were nonpalpable, 54% (7 of 13) had a previous unsuccessful removal attempt, and 15% (2 of 13) were in muscle.[15]

A study comparing a cohort of 63 problematic removals (removals with at least one previous unsuccessful removal attempt) and 660 standard removals found that among difficult removals, 24% (8 of 63) were subfascial and 13% (8 of 63) were eventually removed surgically.[16]

A study comparing cohorts of deep ultrasound-guided removal in office (162 implants) and superficial removal in office (585 implants) reported that 2.5% (4 of 162) of deep removals were referred to a surgeon. Deep implants in this context were defined as nonpalpable or minimally palpable implants that could not be removed by manufacturer recommended technique.[17]

Among the 10 reports of surgical implant removal from a single patient,[18-27] 80% (8 of 10) were nonpalpable, 1 was migrated and fragmented during previous removal attempts,[19] and 1 was irritating the patient's median nerve.[25] Nine of 10 were removed in the operating room, 4 were below fascia, and 2 were in muscle. The procedure was associated with post-operative paresthesia in 5 of 10 patients (1 median, 2 ulnar, 1 medial antebrachial cutaneous, 1 unspecified).

What factors are associated with subspecialist removal of a contraceptive implant?

Among the 10 case reports of surgical removals of deeply placed implants that identified the specialty of the remover,[18-27] 7 were surgeons (6 orthopedic, 1 plastic), 2 interventional radiologists, and 1 obstetrician-gynecologist.

A comparative cohort study of office removal and surgical removal reported that implants inserted by obstetricians (0 removals out of 116) had fewer surgical removals compared to other physicians and non-physicians (6 of 109).[15]

A comparative cohort study of deep ultrasound-guided removal and superficial removal reported that 9.3% (30 of 323) were placed too deep by a physician and 25% (23 of 93) by a non-physician.[17]

One case series of 5 surgical removals reported that 3 had a time from insertion greater than the recommended 3 years.[28]

Among 7 case series of removals (including superficial, deeply located, nonpalpable, surgical, office, ultrasound-guided, and difficult removals) that recorded BMI,[12-15,17,29,30] 43% (3 of 7) reported that the median BMI for patients that underwent a deep implant removal was overweight or obese (BMI 25 or over). A comparative cohort study of deep ultrasound-guided removal and superficial removal noted that lower BMI at insertion was associated with deep removals (median BMI of 23 and more likely to have a BMI < 18.5).[17]

Weight gain during implant use was associated with deep implants in 2 comparative cohort studies, one with a mean increase of 3.7 kg,[16] and one with a median increase of 6.6 kg.[17]

Discussion

Temporary contraceptive implants that are placed in the medial arm and not kept subcutaneous can be difficult and, on occasion, risky to remove. Arm and nerve specialists such as hand and upper extremity surgeons may be asked to remove them when they cannot be felt or are deep enough to be close to a nerve. We systematically reviewed the evidence on this topic to understand the incidence and risk factors for problematic removal and to increase hand and upper extremity surgeon awareness. We also hope to inform modifications to the implant, inserter, and technique that can limit or eliminate these complications even in the hands of non-surgeons and less experienced clinicians.

A limitation of this study is that we were limited to case series and case reports of problematic removals. Case reports and case series introduce bias that cannot be controlled for. The majority of the included reports and series must be interpreted with a high risk of bias in mind. Since this systematic review addressed evidence that nerve surgeons are likely to be asked to remove these devices and did not address evidence regarding effectiveness or other factors requiring higher level evidence, the risk of bias may be less relevant. The single case series of routine implantation and removal was from the manufacturer. Our data cannot estimate the incidence of problematic insertion or removal as we had hoped, but it does provide a representation of the types of problems, adverse events, and associated factors.

Based on published reports, most insertions are associated with palpable implants that are easily removed in the office without imaging, but many others are non-palpable. There is sometimes a need for ultrasound guided removal in the office or open removal in the operating room. Such problematic removals arise from the fact that the implant was placed too deep (below the fascia or in muscle) or possibly migrated after insertion. Removal of nonpalpable implants is relatively risky with direct medial placement where a deep implant can

be adjacent to the ulnar and median nerves and the brachial artery. More than half of the reports of surgical removal included post-operative paresthesia as an adverse event. Placing implants in a palpable location away from neurovascular structures (such as just under the dermis in the posteromedial arm over the triceps) can limit proximity to the nerves. The manufacturer now recommends posteromedial placement. The manufacturer also modified the inserter so that it has a shorter handle that can help limit how deeply the implant is placed (NEXPLANON-etonogestrel implant. Manufactured by: N.V. Organon, Oss, The Netherlands, a subsidiary of Organon & Co., Jersey City, NJ 07302, USA). Additional safety could theoretically be added by using a blunt tipped inserter that could be pushed upward against the dermis from the subcutaneous space, with direct palpation by the non-insertion hand, to ensure direct subcutaneous placement.

There was limited evidence on factors associated with nonpalpable implant insertion and surgical removal, but possibilities to consider inadequate training regarding the potential for problematic insertion, removal after the manufacturer recommended three years (which may have been, in part, due to the difficulty of removal), BMI of 25 or over, and weight gain after insertion. The one study that identified a BMI less than 18.5 as a risk factor for deep insertion might reflect difficulty of superficial insertion when there is little subcutaneous adipose tissue. The insertion technique and device could be evolved to techniques that are more reproducible even in less experienced or less trained hands.

Conclusion

Hand and upper extremity surgeons are nerve specialists and may be asked to remove errant contraceptive implants when are deep enough to place an important nerve at risk. We hope this report helps prepare surgeons. We support a more posteromedial insertion site, away from the medial neurovascular structures. We also suggest design modifications such as a blunt tipped inserter that will allow subcutaneous tunneling of the implant.

Acknowledgement

N/A

Authors Contribution:

JN finalized protocol, performed search, extracted data, draft manuscript. SP finalized the protocol, oversaw the search, evaluated the data, helped draft the manuscript, and approved the final draft. DR initiated the study and protocol, oversaw the search and data extraction, helped write the draft, and approved the final draft.

Declaration of Conflict of Interest: N/A
Declaration of Funding: N/A
Declaration of Ethical Approval for Study: N/A
Declaration of Informed Consent: N/A

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