Original Article

Ultrasound-guided minimally invasive removal of deep contraceptive implants: outcomes and challenges

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Background: Contraceptive arm implants, such as Implanon NXT®/Nexplanon®, are reversible methods of birth control that have gained global popularity, with over 20 million worldwide users. While palpable implants can be easily removed, deep or non-palpable implants pose complications during extraction, often requiring open surgery. This ultrasound-guided removal technique offers a minimally invasive, safe, and effective alternative, providing real-time control over the implant and neurovascular structures. Our study aims to evaluate the effectiveness and challenges of this implant removal method.

Methods: In this retrospective observational study, all cases referred to our institution for ultrasound-guided removal of contraceptive implants, from June 2022 to December 2023, were reviewed. Our facility serves as a referral center for handling challenging implants. Twenty-nine women with contraceptive implants were referred for implant removal in this period of time. Thirty implants were sent for removal in total (one patient had a double implant). Data specific to the patients were collected: age and body mass index (BMI). Data specific to the implant were also collected: time since implant insertion (months), history of a previous removal attempt, type of implant (single or double rod), implant palpability, laterality of the implant, supra or subfascial location, success or failure of the ultrasound-guided removal procedure and presence of complications in the post-procedure. Statistical analysis was conducted to determine the relationship between the procedure success rate and these variables, and also between these variables and the supra or subfascial location of the implant.

Results: Twenty-six of the 30 implants (86.67%) were successfully removed with this fully ultrasound-guided technique. In cases where the implant could not be removed, there was a higher rate of subfascial implant location (75%), while in cases where the removal was successful, the rate of subfascial implant

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location was significantly lower at 19.23% (P=0.048). Patients whose implants could be removed had a median BMI of 23.71 kg/m^2, which was higher than the BMI of patients whose implants could not be removed (20.82 kg/m^2), with a P=0.022. No complications were registered.

Conclusions: Percutaneous real-time ultrasound-guided implant removal is effective, safe and offers a minimally-invasive alternative to open surgery. The removal of subfascial implants is also feasible but more challenging, leading to a reduction of success rate in this group. These positive outcomes suggest its potential as a standard initial approach for deep contraceptive implant removal.

Keywords: Ultrasound-guided procedure; contraceptive implant; interventional radiology; musculoskeletal radiology

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Introduction

Contraceptive arm implants are reversible methods of birth control that release a long-acting systemic dose of progestin through a subdermal implant. The use of these contraceptives has been gradually increasing worldwide since the 1990s. Currently, over 20 million women worldwide are using contraceptive implants (1). Implanon NXT® (also marketed in the US and other countries under the name Nexplanon®) is a single-rod subdermal contraceptive implant primarily composed of selective progestin etonogestrel (ENG) and ethylene vinyl acetate (EVA) copolymer, encapsulated within a rate-controlling EVA membrane (2). Implanon NXT® achieves highly effective contraception within 8 hours of insertion, and this effectiveness is maintained for up to 3 years (3), although recent publications support effectiveness up to 5 years from insertion (4). There are also double-rod type implants, extensively marketed worldwide. In this group, the most widely used are Jadelle® and Sino-implant (II)®/Levoplant® (5,6).

The implant is intended to be placed subcutaneously on the non-dominant upper arm's medial side. Palpable implants can be easily removed without the need for imaging guidance through a 2-mm incision near the tip of the rod and the use of grasping forceps (7). However, in up to 1% of cases, the insertion may be too deep (8), making the implant difficult to locate through palpation and leading to challenges during the removal process. Other causes of deep non-palpable implants include migration, fibrosis, and weight gain (9).

The removal of deep implants can be difficult, and complications such as vascular or nerve injuries have been described as secondary to the extraction procedure (10,11). When dealing with a non-palpable implant, it is advisable to send the patient to a specialized referral center with experience in locating and extracting contraceptive implants to reduce the risk of complications (12).

In cases where the implant is situated in a non-palpable deep position, ultrasound is the primary method for localization, specifically evaluating whether the implant is positioned above or below the fascia and its proximity to the surrounding neurovascular structures (13). Through ultrasound, the implant is in most cases easy to find, especially in the transverse plane of the probe relative to the rod. Implanon NXT®/Nexplanon® implants are visualized as an echogenic dot (transverse plane) or linear structure (longitudinal plane) with a diameter of 2 mm and robust posterior acoustic shadow (14). Jadelle® double-rod devices are visualized as tubular hypoechoic structures, also with posterior acoustic shadowing (*Figure 1A-1C*).

Once the implant is located, the most commonly performed procedure is marking its location on the skin for its subsequent surgical removal (15,16). However, surgical interventions require the dissection of soft tissues and, in case of subfascial location of the implant, an average incision size up to 15–20 mm (13). Also, vascular and nerve injuries have been described as secondary to the extraction procedure (10,17).

The objective of this study was to evaluate the effectiveness and potential complications of a minimally invasive method for the removal of deep hormonal contraceptive implants under real-time ultrasound guidance, previously described by Jacques *et al.* (18) and Del Cura *et al.* (19). We present this article in accordance with the STROCSS reporting checklist (available at https://qims.amegroups.com/article/view/10.21037/qims-24-356/rc).

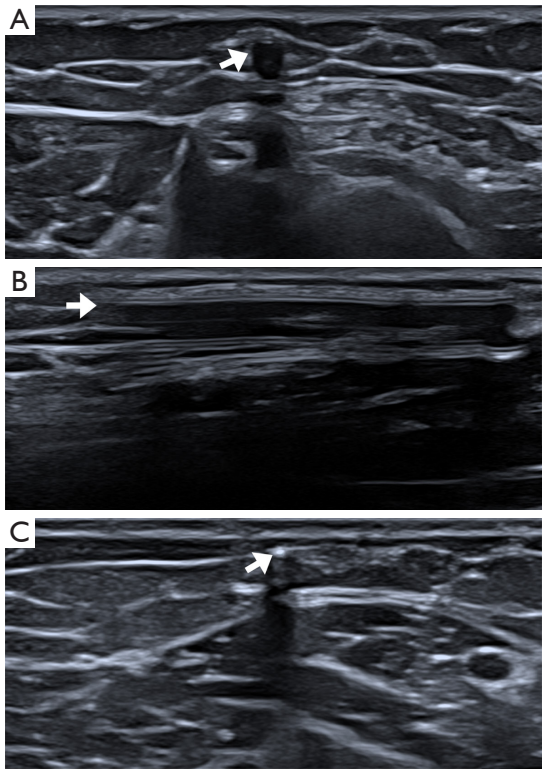

Figure 1 Ultrasound characteristics of Jadelle® (A,B) and Implanon NXT®/Nexplanon® implant rods (C), displayed in the transverse (A,C) and longitudinal (B) planes relative to the rod. The arrows point to the implant. Note the hypoechoic appearance of the Jadelle® rod and the mild posterior acoustic shadow. The Implanon NXT®/Nexplanon® rod (C) appears as a markedly hyperechoic dot (arrow) with a stronger acoustic shadow than the Jadelle® type.

Methods

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by our Institutional Ethics Committee (code HCB/2024/0074). All patients signed the specific informed consent for this procedure.

Procedure

First, in order to facilitate both the localization and extraction of the implant, we position the patient's arm in 90º abduction and external rotation, considering the typical location of the implant on the postero-medial aspect of the upper arm (20). In this position, we proceed to precisely locate the implant, analyzing its position as either supra or subfascial and its relationship with adjacent neurovascular structures. The implant's location relative to the fascia can be easily determined, as the muscular fascia appears as a markedly hyperechoic extensive line, which is easily distinguishable from the implant's dot morphology and acoustic shadow. Adjacent neurovascular structures can also be easily differentiated from the implant. The nerve echo pattern exhibits a honeycomb appearance with dark punctuate areas. Vascular structures are characterized by being markedly hypoechoic with a thin hyperechoic wall; additionally, in case of doubt, the use of Doppler imaging allows for confirmation that it is a vascular structure. Ultrasound localization and procedure guidance were performed using a high frequency transducer (PLT-1005B7, Aplio i800, Canon Medical Systems).

Following skin disinfection and under sterile conditions, local anesthesia (1% mepivacaine) is applied at both the skin access point and along the intended extraction path, using a 25-G needle. Subsequently, we proceed to administer peri-implant anesthesia as well, aiming to minimize potential pain during the extraction process.

Following this step, we switch the syringe to one containing physiological saline solution (NaCl 0.9%), and we proceed to perform hydrodissection around the implant (10 cc is generally enough to achieve proper hydrodissection). This facilitates the extraction by releasing potential adhesions. During this step, hydrodissection can also be used to separate the implant from potential adjacent neurovascular structures, thereby reducing the risk of complications during the extraction (*Figure 2A-2C*).

Afterwards, we introduce the surgical scalpel blade (No. 11 type) at the desired access point for our trajectory and, under direct ultrasound guidance, we advance the scalpel until it almost makes contact with the implant. This action creates an adhesion-free path, which, based on our experience, eases the removal of the implant. If the implant is in a subfascial location, we should also perform a small puncture in the fascia with the tip of the scalpel in order to create an entry point for our surgical forceps (the distal end of the forceps is not very penetrative, so focally opening the fascia with the scalpel greatly facilitates the procedure).

Subsequently, we proceed to insert the surgical forceps (Halsted mosquito forceps or Hartmann grasping micro-forceps, *Figure 3*) through the previously created path and, under direct ultrasound guidance, we open the jaws of the forceps to grasp the implant (*Figure 4A-4C*). After closing the forceps, we then proceed with the extraction.

The implant is always approached with a perpendicular angle, aiming to grasp it at its central part (*Figure 5A,5B*).

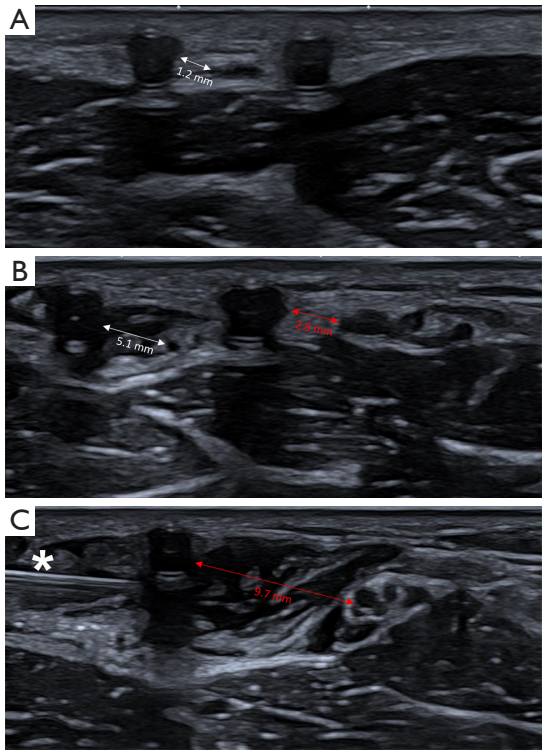

Figure 2 Hydrodissection technique. (A) The ulnar nerve is identified in its subcutaneous course in the medial aspect of the arm, located between two rods of a Jadelle®-type implant. The nerve can be distinguished from the implant by its honeycomb appearance and fusiform rather than round morphology. The use of color Doppler can also be useful for distinguishing possible adjacent vascular structures. The white double-arrow shows the distance between one rod and the ulnar nerve. (B) We can appreciate the increased separation of the ulnar nerve from the rod shown on the left thanks to our hydrodissection. The red double-arrow shows the distance between the other rod and the median nerve. (C) We observe the increased distance between this second rod and the median nerve due to the hydrodissection we have performed. The asterisk indicates the path taken by the needle for the hydrodissection. The needle appears as a hyperechoic line with reverberation artifact, entering from the posteromedial aspect of the arm.

The flexibility of the implant materials allows it to bend upon traction, facilitating its proper removal through this technique through a small skin opening.

It is necessary to apply a certain amount of traction force to properly remove the implant because adhesions and scar tissue may develop over time in its peripheral fibrous sheath. Once the implant is removed, it is advisable to verify that no fragments remain at the extraction site and ensure the absence of acute complications (hematoma, pseudoaneurysm, or sonographic changes in the nerve branches close to the treated area due to possible nerve damage).

In our experience, we have never encountered a fragmented implant during the extraction procedure, although it is documented in the literature (21).

The size of the skin incision corresponds approximately to the width of the scalpel blade used in this procedure (No. 11), which is 6 mm. Finally, we close the skin using wound closure strips.

All procedures were performed by specialized musculoskeletal radiologists with extensive experience in ultrasound-guided percutaneous interventions.

The follow-up of the patients was carried out by the primary care center according to the established system within our referral center (checked by our team through the digital clinical course of these patients). Additionally, the patients were contacted by telephone from our institution one month post-procedure to rule out any complications that might not have been recorded at these centers or that might have been treated at other hospitals.

Population

We reviewed all cases referred from primary care centers to our institution (Hospital Clinic of Barcelona) for ultrasound-guided localization and removal of contraceptive implants, from June 2022 to December 2023. These cases were sourced through the database where we collect all referrals for this type of procedure. Our facility serves as a referral center for handling challenging implants, as recommended in the literature (12).

Before June 2022, the procedure carried out at our center involved marking the skin to indicate the location of the implant for subsequent surgical removal. Since June 2022, we started performing implant removal using the minimally invasive technique with real-time ultrasound guidance previously described in this article.

Patients were referred to our center for implant removal mainly because the implant was not palpable. However, we also received referrals for patients with palpable implants whose removal was not possible at the primary care center.

All patients referred for this type of intervention within the described time period have been included in this

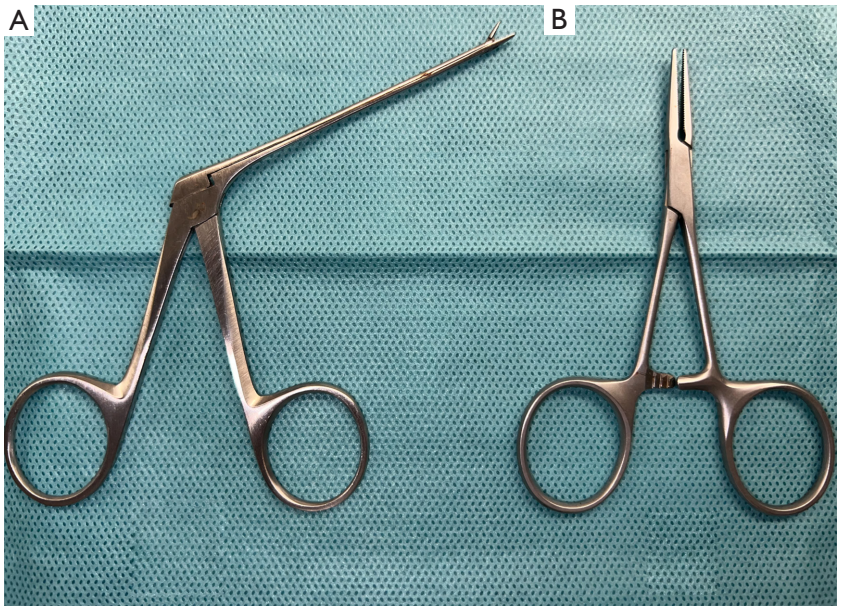

Figure 3 Types of forceps. This figure shows the types of forceps we used in this procedure. (A) Corresponds to the Hartman-microforceps, and (B) corresponds to the Halsted-mosquito. The Halsted mosquito allows for a stronger grip on the implant due to its locking-teeth, facilitating extraction without the implant slipping from the forceps jaws. The Hartmann-microforceps allows access to deeper implants due to its increased length and more penetrating tip.

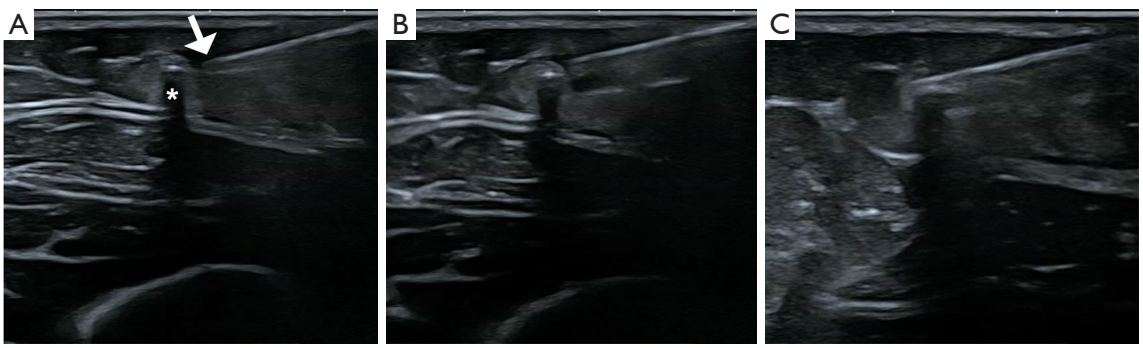

Figure 4 Implant grasping with forceps. (A) An implant is shown in a subcutaneous location (Implanon® type, seen as an echogenic dot with a marked acoustic shadow denoted by the asterisk). No neurovascular structures are observed near the implant. The arrow indicates the tip of the forceps, and the jaws are closed. (B) The jaws of the forceps have been opened to try to advance and position the implant in the mouth of the clamp. (C) Once the implant had been passed, we closed the jaws of the forceps and, at this point, the extraction can be achieved.

analysis.

Study data

Data specific to the patients, including age (years) and body mass index (BMI: kg/m^2), were collected. Regarding contraceptive implant-specific data and characteristics, the following information was gathered: time since implant insertion (months), history of a previous removal attempt, type of implant (single rod or double rod), implant palpability, laterality of the implant, supra or subfascial location (for subfascial implants, the muscle in which they were located was also registered), success of the implant ultrasound-guided removal (complete removal of the

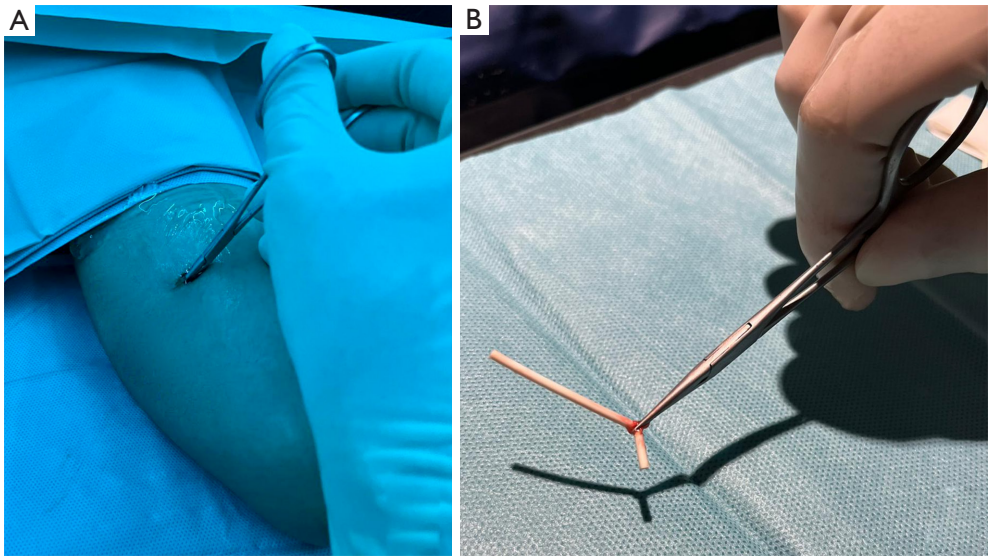

Figure 5 Forceps trajectory and extracted implant. (A) The most common path for implant extraction, directed to the postero-medial aspect of the arm, where the implant is usually located. (B) The extracted implant, perpendicularly gripped (its flexibility allows extraction through a minimal cutaneous opening).

implant) and the presence of complications in the post-procedure (infection, hematoma, pseudoaneurysm or nerve damage).

Statistics analysis

Results were described as median and interquartile range (IQR: 25th, 75th percentiles) or absolute frequencies and percentages for quantitative and qualitative variables, respectively. The relationship between implant or patient characteristics and implant removal success or supra/subfascial location was assessed using the Mann-Whitney U test for quantitative variables or Fisher's exact test for qualitative variables. Due to the characteristics of this retrospective review of all patients during a specific period, the sample size corresponds to the number of patients who required this type of intervention in our center. SPSS v.26 (IBM Corp., Armonk, NY, USA) was used to perform all analyses, and a P value less than or equal to 0.05 was considered statistically significant (two-sided test).

Results

During a 19-month period, 29 women with contraceptive implants were referred for ultrasound-guided removal in our center. One of these patients was referred to remove two implants she simultaneously had, so the total number of implants referred for removal was 30. There were no losses in the follow-up, as all necessary data up to the one-month follow-up was collected. The median age was 29 years (IQR: 25, 37 years). Twenty-nine out of the 30 implants were located in the left arm. Five out of the 30 implants (16.67%) were originally two-rod devices, of which in 4 cases, one of the rods had already been removed previously in primary care. Eleven out of 30 (36.67%) implants referred for removal were palpable by physical examination (in all these cases, they were very subtly palpable, suggesting their deep location).

Twenty-six of the 30 implants (86.67%) were successfully removed with this minimally-invasive technique. We encountered two reasons for the unsuccessful removal of the implant in the four patients in whom the procedure was not successful. In one case, the impossibility to remove the implant was due to the implant being bent upon itself and in intimate contact with the median nerve (*Figure 6*), without a clear separation plane. After unsuccessfully attempting to separate the retracted implant from the median nerve through hydrodissection, we decided not to proceed with its removal. The other three not removed implants were due to the rod being in close contact with the muscle fascia. In these patients, hydrodissection did not allow proper separation of the implant from the fascia, and after grasping the implant with forceps, its removal was not possible due to this fascial adhesion (*Figure 7*).

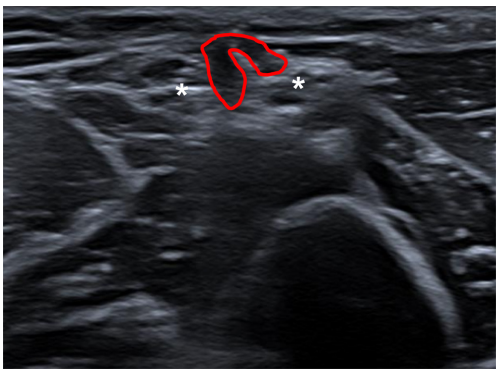

Figure 6 Bent implant. This figure shows a bent implant (outlined by the red line) in contact with the median nerve/cutaneous median branches (asterisks). Hydrodissection was not successful, making safe removal unfeasible.

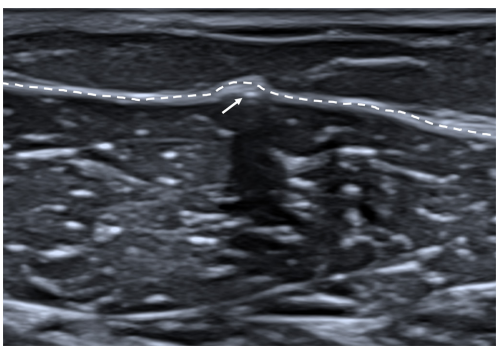

Figure 7 Subfascial implant. This figure shows an intramuscular implant (arrow) located in close contact with the fascia of the triceps muscle. In some of these cases we were able to successfully remove the implant, but in others, hydrodissection and implant removal were not effective, likely due to implant adherence to the muscle fascia.

Twenty-two of the 30 implants (73.33%) were suprafascial, and 8 were subfascial (26.67%). The rate of subfascial implant location was significantly higher in patients where the implant could not be removed (75%) compared to patients where the implant was successfully removed, where the rate of subfascial implant location was only 19.23% (P=0.048). Six out of 8 subfascial implants (75%) were located on the medial margin of the triceps muscle, and 2 (25%) on the medial margin of the biceps muscle.

Median BMI was 22.7 kg/m^2 (IQR: 21.2, 27.3 kg/m^2). The BMI was significantly higher in patients from whom the implant could be removed, with a median of 23.7 kg/m^2 (IQR: 21.7, 27.4 kg/m^2), compared to patients from whom the implant could not be removed, whose BMI median was 20.8 kg/m^2 (IQR: 19.2, 21.5 kg/m^2) (P=0.022). There were no statistically significant differences in BMI between patients whose implant was subfascially located compared to those with suprafascial implant location.

The median time elapsed from implant placement to the date of the removal procedure in our center was 39 months (IQR: 22, 57 months), with a range of 6 to 228 months. We did not find statistically significant differences between the time since implant insertion and removal success.

Thirteen patients (43.33%) had experienced a previous failed attempt of removal in the primary care setting. Twelve of the 13 previous removal attempts were performed in suprafascial implants (92.3%), and one in a patient with a subfascial implant (7.7%). This is likely because subfascial implants are often non-palpable, and therefore, removal is less likely to be attempted in primary care without ultrasound guidance. There were no statistically significant differences in the success rate of the procedure between patients with no previous removal attempt and those who had a previous removal attempt.

The results are summarized in *Table 1* (where the correlation between the collected variables and the suprafascial or subfascial location of the implant is assessed) and *Table 2* (where the correlation between the collected variables and the success or failure of implant removal is assessed).

No complications, such as infection, vessel or nerve damage, related or unrelated to the procedure, were recorded immediately post-procedure or during the one-month follow-up period.

Discussion

The objective of our study was to analyze the effectiveness and complication rate of this innovative method of contraceptive implant removal guided by real-time ultrasound. This interventional technique allows for the localization and removal of the implant in a single procedure. Most patients referred to our center did not have any other prior imaging tests [X-ray or magnetic resonance imaging (MRI)] indicating the device's location. After a quick localization, the procedure can be performed promptly without the need to reschedule the patient and without the need for open surgery in the vast majority of cases. This procedure is performed on an outpatient basis, using local anesthesia and a small incision in the

Table 1 Population and implant characteristics: correlation with supra or subfascial location

Characteristics	Total (n=30)	Subfascial (n=8)	Suprafascial (n=22)	P value
Time since insertion (months)	39 [22, 57]	28 [19.5, 41]	42.5 [32, 61]	0.139†
BMI (kg/m^2)	22.7 [21.2, 27.3]	22.7 [21.5, 25.5]	23.2 [21.2, 27.3]	0.865†
Age (years)	29 [25, 37]	29.5 [28.5, 37]	28 [23, 37]	0.337†
Successful implant removal	26 (86.67)	5 (62.5)	21 (95.45)	0.048*‡
Palpable implant	11 (36.67)	1 (12.5)	10 (45.45)	0.199‡
Previous removal attempt	13 (43.33)	1 (12.5)	12 (54.55)	0.092‡
Double rod device	5 (16.67)	0 (0.0)	5 (22.73)	0.196‡

Data are presented as median [quartiles] or n (%). *, P<0.05; †, Mann-Whitney U test; ‡, Fisher's Exact test. n, number of patients; BMI, body mass index.

Table 2 Population and implant characteristics: correlation with implant successful removal

Characteristics	Total (n=30)	Removed implant (n=26)	Non-removed implant (n=4)	P value
Time since insertion (months)	39 [22, 57]	39 [25, 57]	30.5 [12.5, 75]	0.587†
BMI (kg/m^2)	22.7 [21.2, 27.3]	23.7 [21.7, 27.4]	20.8 [19.2, 21.5]	0.022*†
Age (years)	29 [25, 37]	28.5 [23, 37]	30.5 [29.5, 40]	0.215†
Subfascial location	8 (26.67)	5 (19.23)	3 (75)	0.048*‡
Palpable implant	11 (36.67)	11 (42.31)	0 (0)	0.268‡
Previous removal attempt	13 (43.33)	12 (46.15)	1 (25)	0.613‡
Double rod device	5 (16.67)	4 (15.38)	1 (25)	0.536‡

Data are presented as median [quartiles] or n (%). *, P<0.05; †, Mann-Whitney U test; ‡, Fisher's Exact test. n, number of patients; BMI, body mass index.

skin, and does not require subsequent hospital admission or observation stay. These characteristics of the procedure have a clear positive impact on healthcare spending.

The success rate of this new procedure was high, at 86.67%. Among the not removed implants, 75% were in a subfascial location, demonstrating a significantly greater difficulty in removing these intramuscular implants. In cases where the implant cannot be removed using this technique, they can still be removed using the traditional method of ultrasound localization and open surgery.

While in some patients we didn't encounter issues in separating the implant from the muscle fascia through ultrasound-guided hydrodissection, in others we couldn't achieve adequate fascial separation of the implant, preventing its extraction without also grasping the muscle fascia. It is likely that, in some cases where the implant is placed in close contact with the fascia, the scar tissue/fibrous tissue that typically forms around the implant may contact and adhere to the muscle fascia, posing challenges during extraction.

The lower median BMI we encountered in patients for whom the procedure was not effective is likely due to thinner subcutaneous fat tissue, which tends to increase the probability of the implant being closer to the fascia (even in cases of suprafascial implants), possibly making it easier for the implant to adhere to the muscle fascia. In contrast to other previous studies were a low BMI has been linked to a higher likelihood of subfascial implant location (12,18), we did not find statistically significant differences in BMI between patients whose implant was subfascially located and those with suprafascial implant location. This could be due to the small sample size in our study, which also had a lower mean BMI compared to both cited studies. Few of our patients were obese, among whom, according to the literature, subfascial implant placement seems infrequent.

Complications involving vascular and nerve damage

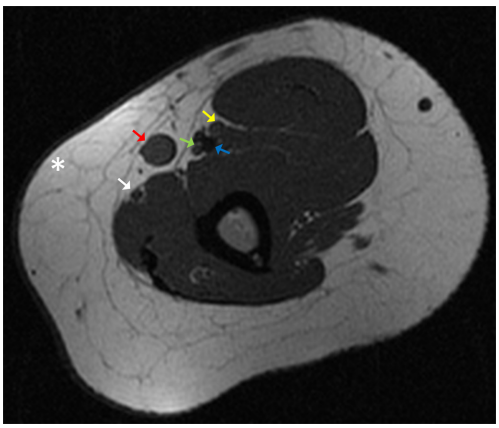

Figure 8 Recommended implant location. This figure shows the recommended implant location (asterisk) 3–5 cm posterior to the medial bicipital groove. This target location is farther away from the medial neurovascular bundle of the arm, primarily comprised of the basilic vein (red arrow), median nerve (yellow arrow), medial cutaneous nerves (green arrow), and the humeral artery (blue arrow). But in this location, especially in patients with low BMI, the implant may be in proximity to the ulnar nerve (white arrow), which we know can exhibit anatomical variations in its course. BMI, body mass index.

have been reported in relation to the removal of non-palpable implants through open surgery (10,11). In our study, no such complications occurred. Manufacturers of subcutaneous contraceptive implants, following some reported cases of implant migration and nerve damage, changed in January 2020 the targeted placement area (22). Previously, the recommended location for implant placement was in the medial bicipital groove (between the biceps and triceps muscles) (23). This target spot was very close to the neurovascular bundle, mainly involving the basilic vein and median nerve/medial cutaneous nerves. At present, the recommended location for placing the implant is 8-10 cm proximal to the medial epicondyle and 3-5 cm posterior to the medial bicipital groove. In this location, the implant is farther away from these nerve structures, but this area is close to the path of the ulnar nerve (*Figure 8*). Cases of ulnar nerve injury have been described in correctly positioned contraceptive implants at the subcutaneous level, where the suspected cause was an aberrant course of the ulnar nerve (24).

In some of the patients we intervened, whose implant were in a subcutaneous location, we had to perform hydrodissection (*Figure 2A-2C*) to separate the implant from adjacent nerves and proceed with the procedure safely. This demonstrates that the removal of contraceptive implants, even subcutaneous ones, is not without risk and highlights the advantage of precise ultrasound localization of the device. Through this minimally-invasive procedure, adjacent nerve branches are constantly monitored using real-time ultrasound.

Also, in our patient series, we found subfascial implants in both the biceps and triceps muscles, suggesting that there may be more variability than desired in the insertion point, considering that the recommended placement site is the posteromedial aspect of the arm (thus away from the biceps). Given these facts, it would be worth considering the possibility of changing the target insertion area to other parts of the body with a lower risk of complications and reduced risk of intramuscular insertion.

We didn't encounter significant complications in any of the procedures performed. Similar to other superficial invasive procedures (such as breast biopsies), some patients experienced mild bruising at the puncture site, which did not necessitate specific treatment, as previously described by Jacques *et al.* (18). The size of the incision following this procedure is small, approximately corresponding to the width of the scalpel used, in our case around 6 mm. Previous studies have already described a smaller incision size with this procedure compared to open surgery, which is relevant given that it is performed in a visible area and in young patients (18).

There are multiple publications on the traditional procedure for the removal of non-palpable implants, where ultrasound is primarily used for implant localization, followed by open dissection for removal (25-28), but there are very few publications in the literature on this real-time ultrasound-guided removal technique.

The ultrasound-guided removal of foreign bodies has been previously published in the literature by Shiels *et al.* (29) and later by Del Cura *et al.* (19). Jacques *et al.* published their first case of real-time ultrasound-guided contraceptive implant removal in 2020 (30). Subsequently, in 2022, they published their cohort in which they reported a successful removal in 100% of the implants in their consecutive case series (18). We do not have, in our study or in the mentioned study by Jacques *et al.*, information on the distance of the implants from the muscle fascia. This may have been relevant in the non-removal of three implants in our study, as they were apparently adhered to the muscle fascia. To our knowledge, there are no other published case series on implant removal using this percutaneous real-time

ultrasound-guided technique.

Our study has several limitations. The main limitation is the small sample size, which can impact the power to detect (or miss) associations between the studied variables, potentially affecting the study's generalizability. Additionally, the rate of successful removal of the implant using this minimally invasive ultrasound-guided technique is high, leading to a low number of non-removed implants analyzed in this unicentric study. This leads to the possibility that, despite finding statistically significant relationships (supra/subfascial localization and BMI with the success of the procedure), these relationships may not be entirely robust. Correlating implant removal success with more accurate anthropometric data, such as the thickness of the subcutaneous adipose tissue in the arm, could be of interest in upcoming research considering the association identified in our study with the BMI.

It is also important to note that this is an operator-dependent technique requiring a learning curve; therefore, the results may not be entirely applicable in other clinical settings. Experience with ultrasound-guided percutaneous interventions is essential for this procedure. This underscores the need for further independent, multicenter, and larger-scale studies to enhance the representativeness of these findings.

Conclusions

In conclusion, our study suggests that this minimally invasive method for removal of deep hormonal contraceptive implants under real-time ultrasound guidance is effective and safe. This technique allows for precise localization and extraction of the implant in a single outpatient procedure, eliminating the need for open surgery in the majority of cases. The success rate of 86.67% highlights the potential of this method in challenging cases where traditional removal approaches may be difficult.

The study also identifies factors influencing the success of the procedure, with a significantly higher rate of subfascial implant localization in cases where removal was unsuccessful.

While complications related to vascular or nerve injuries were not observed in our study, the importance of ultrasound guidance in monitoring adjacent nerve branches during the procedure is emphasized. Despite the study's limitations, the promising results warrant further exploration in larger, multicenter studies. This innovative approach holds the potential to become a standard method for the removal of deep contraceptive implants, offering a more efficient and less invasive option for both patients and healthcare providers.

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Footnote

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