

ORIGINAL ARTICLE

Medicine Science 2021;10(2):416-21

Retrospective analysis of puncture wounds with retained foreign bodies in the extremities requiring surgical intervention **Yucel Bilgin,**  **Fevzi Birisik***University of Health Sciences, Istanbul Education and Research Hospital, Department of Orthopedics and Traumatology, Istanbul, Turkey*Received 31 January 2021; Accepted 11 February 2021
Available online 27.03.2021 with doi: 10.5455/medscience.2021.01.028Copyright©Author(s) - Available online at www.medicinescience.org

Content of this journal is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

**Abstract**

Puncture wounds with retained foreign bodies in the extremities constitute an important part of orthopedic emergency admissions. In this study, we aimed to retrospectively examine the epidemiological data of patients, as well as diagnostic and treatment methods applied and complications that occurred in patients who underwent surgery with the diagnosis of puncture wounds with retained foreign bodies in our clinic. In the present study, 95(44 female - 51 male) patients who underwent surgical intervention with the diagnosis of puncture wound with retained foreign body in our clinic were examined retrospectively. Of the patients, 44.21% were in the pediatric age group (0-17 years), and 55.79% were in the adult age group (18 years and above). The most common foreign body causing puncture wound was needle in 49 patients (51.58%). The most commonly affected anatomical area was the foot area, at a rate of 48.42%. In our patient group, 91.58% could be diagnosed by direct radiography. Ultrasound was required in 8.42% of the patients. Among anesthetic methods, local anesthesia was the most commonly used method (49.47%). Fluoroscopy was sufficient as the imaging method during the surgical procedure in 87.37% of the patients. Puncture wounds with retained foreign bodies requiring surgical intervention in the extremities affect the pediatric population as well as the adult population. The first imaging method to be applied is direct radiography, and if it is insufficient, ultrasound can be used. Although they are usually simple injuries, they may rarely cause complications such as infection, tendon injury, and vascular-nerve injury.

Keywords: Foreign body, extremity, needle, soft tissue, puncture wounds**Introduction**

Puncture wounds with retained foreign bodies can affect many organs and systems in the human body [1,2]. Puncture wounds with retained foreign bodies in the extremities constitute an important part of orthopedic emergency admissions. They can be caused by a simple trauma such as a needlestick injury, but they can also occur as a component of a severe trauma such as a traffic accident or firearm injury. Although puncture wounds with retained foreign bodies in the extremities are usually considered simple injuries, they can lead to serious complications such as septic arthritis, osteomyelitis, tendon injury, and vascular-nerve injury. While the diagnostic and treatment procedures to be applied in puncture wounds due to radiopaque foreign bodies, especially metallic

foreign bodies, are relatively easier, diagnosis and treatment are more challenging in puncture wounds due to radiolucent foreign bodies.

In this study, we aimed to retrospectively examine the epidemiological data, diagnostic and treatment methods, and complications in patients who underwent surgery with the diagnosis of puncture wounds with retained foreign bodies in the extremities in our clinic.

Material and Methods

In the present study, the medical records of patients who underwent surgery in our clinic between January 1, 2015 and December 15, 2020 were retrospectively analyzed. Patients who underwent surgery with the diagnosis of puncture wounds with retained foreign bodies in the extremities and had complete medical records were included in the study. Patients who underwent orthopedic implant removal were not included in the study.

A total of 95 (44 female - 51 male) patients who met the inclusion

*Corresponding Author: Yucel Bilgin, University of Health Sciences, Istanbul Education and Research Hospital, Department of Orthopedics and Traumatology, Istanbul, Turkey, E-mail: yucelbilgin70@hotmail.com

criteria were identified. Characteristics such as age, gender, the anatomical area of the puncture wound with retained foreign body, the type of material of the foreign body, the imaging method used in the diagnosis, the type of anesthesia used during the surgical procedure, the surgical method applied, and the complications that occurred were analyzed retrospectively by using the medical records and radiological images of these patients.

Ethics Committee

Ethics committee approval for our study was obtained from S.B.Ü. Istanbul Training and Research Hospital Clinical Research Local Ethics Committee with the ethic committee form (2011-KAEK-50) numbered 2607 and dated 11/12/2020.

Statistical analysis

In the present study; numbers, percentages, and mean values were used as descriptive statistical methods. Statistical analysis was performed using the software Statistical Package for Social Sciences (SPSS) version 21.0.

Results

Age and Gender

A total of 95 (44 female - 51 male) patients were included in the

study. Of the patients, 44.21% were in the pediatric age group (0-17 years) and 55.79% were in the adult age group (18 years and above).

Type of Material of the Foreign Body Causing the Puncture Wound

When the type of materials of the foreign bodies causing the puncture wounds were examined, they were metallic objects in 73 patients (76.84%) and non-metallic objects in 22 patients (23.16%). The most common puncture wound with retained foreign body was needlestick injury, which occurred at a rate of 51.58%, in 49 patients. (Figure-1) The second most common cause of puncture wounds was metallic objects from firearm injuries in 14 patients (14.74%). (Figure-2) The most common non-metallic objects causing puncture wound were glass objects, which was the case for 12 patients (12.63%). (Figure-3) When puncture wounds with retained foreign bodies were examined according to age groups, needlestick injuries were the most common in both pediatric and adult age groups. In the pediatric age group, puncture wounds due to glass objects were the second most common, whereas in the adult age group, metallic objects due to firearm injuries were the second most common cause of puncture wounds. The types of materials of the foreign bodies causing puncture wound are shown in detail in Table-1.

Table-1 Detailed analysis of the contents of foreign bodies according to age groups

Contents of foreign bodies	Pediatric age group	Adult age group	Total
FOREIGN BODIES CONTAINED IN METAL	30 (%71.43)	43 (%81.13)	73
Needle	27 (%64.29)	22 (%41.51)	49
Firearm injury materials	2 (%4.76)	12 (%22.64)	14
Metal cutting machine injuries		4 (%7.55)	4
Nail	1 (%2.38)	1 (%1.89)	2
Staples		2 (%3.77)	2
Cutting and drilling tool parts		1 (%1.89)	1
Piercing		1 (%1.89)	1
FOREIGN BODIES WITH NON-METAL CONTENT	12 (%28.57)	10 (%18.87)	22
Glass containing materials	8 (%19.05)	4 (%7.55)	12
Wood containing materials	2 (%4.76)	3 (%5.66)	5
Stone containing materials	2 (%4.76)	2 (%3.77)	4
Ceramic containing materials		1 (%1.89)	1

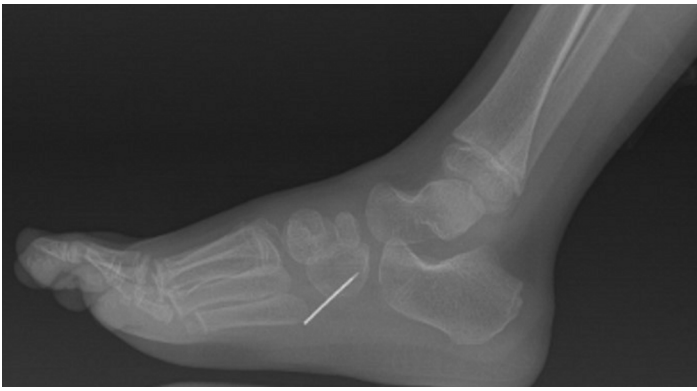


Figure-1 Direct radiography of the patient with a needle detected in his right foot.



Figure-2 Direct radiography of the patient in which material belonging to firearm injury was detected in her left knee.



Figure-3 Direct radiography of the patient with a glass piece in his right foot.

Anatomical Area of the Puncture Wound with Retained Foreign Body

When the anatomical areas of foreign body punctures in the extremities were examined, they were extra-articular in 91 patients (91.79%) and intra-articular in 4 patients (4.21%). All patients with intra-articular puncture wound with retained foreign body were in the adult age group. Puncture wounds with retained foreign bodies occurred in the knee joint in 3 and in the ankle joint in 1 of these 4 patients. When the distribution of extra-articular puncture wounds with retained foreign bodies according to anatomical areas was examined, it was found that the puncture wounds most commonly occurred in the foot area in 46 patients (48.42%) followed by the hand area in 25 patients (26.32%). When the anatomical areas puncture wounds with retained foreign bodies were examined according to age groups, the foot area was the most common area in the pediatric age group, and the hand area was the most common area in the adult age group. The anatomical areas of puncture wounds with retained foreign bodies are shown in detail in Table-2.

Table-2 Detailed analysis of the anatomical regions where foreign bodies are detected according to age groups

Anatomic region	Pediatric age group	Adult age group	Total
Foot	31 (%73.81)	15 (%28.3)	46(%48.42)
Hand	4 (%9.52)	21 (%39.62)	25(%26.32)
Knee	2 (%4.76)	5 (%9.43)	7 (%7.37)
Crus	3 (%7.14)	2 (%3.77)	5 (%5.26)
Thigh		4 (%7.55)	4 (%4.21)
Forearm	1 (%2.38)	1 (%1.89)	2 (%2.11)
Hip		2 (%3.77)	2 (%2.11)
Arm		2 (%3.77)	2 (%2.11)
Ankle		1 (%1.89)	1 (%1.05)
Elbow	1 (%2.38)		1 (%1.05)

Imaging Method Used in Diagnosis

When imaging methods used for the diagnosis were examined retrospectively, it was found that direct radiography was used in 73 patients with puncture wounds due to metallic objects. Additional computed tomography (CT) was used in preoperative planning in 4 patients with intra-articular puncture wounds due to metallic objects. The diagnosis was made by observing radiopacity on direct radiography in 10 of 12 patients with puncture wounds due to glass objects, in 3 of 4 patients with puncture wounds due to stone objects, and in 1 patient with a puncture wound due to a ceramic object, while in patients without radiopacity on direct radiography, the diagnosis was made by ultrasound in 2 patients with puncture wounds due to glass objects, 1 patient with a puncture wound due to a stone object, and 5 patients with puncture wounds due to wooden objects. In other words, the diagnosis could be made by direct radiography in 91.58% of our entire patient group. On the other hand, ultrasound was required in 8.42% of the patients.

Treatment Applied

When the treatments applied to the patients were examined, it was found that 67 of the 96 patients included in our study initially presented to the emergency department of our clinic. Amoxicillin-clavulanic acid (oral administration at 45 mg/kg/day in pediatric patients, oral administration at 2x1gr in adult patients) treatment was initiated in the emergency department in all of these patients, and tetanus prophylaxis was administered. Emergency surgery was performed in 2 patients with intra-articular puncture wound with retained foreign body in the knee, while other patients were given an appointment for surgical intervention. The patients were operated within 17.22 ($\pm$ 29.88) days on average. During this preoperative period, an emergency operation was performed due to development of infection in 4 patients. These patients were operated on the day the infection was detected; on days 5, 8, 9, and 25, respectively. In the other 63 patients, no complications occurred during the preoperative period.

Anesthetic Method Used During Surgery

Regarding the anesthetic method; local anesthesia was used in 49.47%, general anesthesia in 26.32%, sedoanalgesia in 17.89%, and spinal anesthesia in 6.32% of the surgical procedures. While most of the surgical procedures (71.7%) could be performed with local anesthesia in adult patients, an anesthetic method other than local anesthesia (sedoanalgesia and general anesthesia) was required in 78.57% of the patients in the pediatric age group.

Imaging Method Used During Surgery

When the surgical procedures applied to the patients were examined, it was found that 83 patients with extra-articular puncture wound due to a radiopaque foreign body underwent open exploratory surgery under fluoroscopy, and 4 patients with intra-articular puncture wound due to a foreign body underwent an arthroscopic foreign body removal procedure. It was observed that in 8 patients with puncture wounds due to a radiolucent foreign body, skin marking was made with preoperative ultrasound and open exploratory surgery was performed. In 1 patient, the needle was removed during the surgical procedure, but the needle part that entered the metatarsus was broken. The part remaining in the metatarsus was left since it was small and to ensure that no additional complications would develop. The foreign bodies were completely removed in all other patients.

Complications

As mentioned previously, infection developed in 4 patients during the waiting period before surgery. In 1 patient, a needle fragment remained in the metatarsus since the needle was broken during the surgical procedure. Partial injury was detected in the Achilles tendon, and partial repair was performed after foreign body removal in 1 patient. Secondary infections did not develop in any patient after surgery. None of the patients needed a secondary surgical procedure.

Discussion

In our study, when we examined the epidemiological data of patients with puncture wounds with retained foreign bodies in the extremities requiring surgical intervention; 44.21% of the patients were in the pediatric age group, the most common puncture wound with retained foreign body was found to be needlestick injury, and the foot area was the most commonly affected anatomical area in the extremities. Although the needle can be used in the treatment of various diseases, it occurred as a result of home injuries in all patients in our study [3]. There are not many publications in the literature that have made an epidemiological evaluation in this respect. In a study conducted by M. Özer et al. in Turkey with 310 patients, puncture wounds due to deeply located foreign bodies in the extremities were examined retrospectively from an epidemiological perspective. Patients in the pediatric age group constituted 25.2% of all patients. The most common object causing puncture wound was needle and the most commonly affected anatomical area was the foot [4]. When compared with the present study, it was similar in that the most common object causing puncture wound was needle and the most commonly affected area was the foot, although the ratio of patients in the pediatric age group was lower.

The most challenging part of soft tissue puncture wounds in the extremities is the diagnostic phase. While anamnesis and physical examination are usually guiding in adult patients, a complete anamnesis may not be obtained in pediatric patients. Imaging methods come into play in cases where anamnesis and physical examination are not guiding. Typically, the first imaging method to be used is direct radiography. In the present study, 91.58% of the patients could be diagnosed by direct radiography. On the other hand, ultrasound was required in the remaining 8.42% of the patients. In the literature, in a cadaver study by L.K. Horton et al., the diagnostic images obtained with direct radiography and ultrasound of foreign bodies stuck into soft tissues were examined. Radiopacity could be detected and diagnosis could be made via direct radiography in patients who were punctured with pieces of glass belonging to a windshield, bottle glass, sewing needle, galvanized steel, buckshots, and stone pieces. In cadavers punctured with a wooden toothpick and a plastic part from an automobile radio, imaging could not be achieved on direct radiography, and the diagnosis could be made by detecting hyperechogenicity and posterior acoustic shadow in ultrasound [5]. According to another study, the sensitivity of ultrasonography was 87% and its specificity was 97% for a puncture wound due to a 2.5 mm wooden foreign body [6]. In a study conducted by A. Mohammadi et al. in 2011 on a similar subject, 47 patients in whom radiopacity could not be detected on direct radiography were examined by ultrasound. The diagnosis could be made by detecting hyperechogenicity in 45 patients, posterior acoustic shadow in 36 patients, and abscess or halo sign of granulation tissue in 5 patients [7]. In a different study, 120 patients with non-opaque foreign body indentation were examined. Accuracy and sensitivity were determined as 94.16% and 99.08% [8]. According to our study and the current literature, ultrasound can help diagnose puncture wounds with retained foreign bodies that cannot be viewed on direct radiography with high rates of sensitivity and specificity [9,10]. Hyperechogenicity, posterior acoustic shadow, and halo sign are the main findings that suggest foreign body in ultrasound [5,7]. In addition, additional

complications such as abscess, neurovascular injury, and tendon injury that develop secondary to puncture wounds with retained foreign bodies can also be diagnosed by ultrasound [5].

As is known, in abdominal injuries, emergency physicians trained in the relevant area can detect free intraperitoneal fluid. Ultrasound is also guiding in the diagnosis of puncture wounds with retained foreign bodies in the extremities in patients who cannot be diagnosed with direct radiography. A. Nienaber et al. gave a 20-minute ultrasound training to 6 emergency medicine physicians and 13 emergency medicine residents in their study on this topic. Emergency medicine physicians were able to diagnose subcutaneous puncture wounds with retained foreign bodies with a sensitivity rate of 96.7% and emergency medicine residents with a sensitivity rate of 85.7% [11]. In the present study, all ultrasounds were performed by radiologists. However, in health institutions where radiologists are not available in the emergency department, emergency medicine physicians can also make a diagnosis if they are provided with appropriate training.

Imaging methods are often required also during the surgical procedure in puncture wounds with retained foreign bodies. Fluoroscopy is sufficient in puncture wounds due to radiopaque objects, especially metallic objects. Stereotaxic methods have been used in the absence of fluoroscopy. In this method, radiopaque objects such as percutaneous sterile needles are placed and direct radiography is performed to identify the location of the foreign body causing the puncture wound. Then, surgical procedure is performed on the marked area. In the literature, there are two studies in which this method was applied, and foreign bodies could be removed in all 17 patients in one of these studies, and in 14 of 15 patients in the other. This method is a very simple and successful method, and it is also advantageous in terms of providing radiation safety for healthcare personnel [12,13]. Ultrasound can be used in planning the surgical procedure in puncture wounds due to radiolucent foreign bodies. We start the surgical procedure by marking the incision site on the skin with preoperative ultrasound in puncture wounds due to radiolucent foreign bodies. Generally, surgical exploration of radiolucent objects is more difficult, and larger incisions may be required. A. Blankstein et al. examined 21 patients in their study examining the use of ultrasound in the treatment of puncture wounds due to radiolucent foreign bodies. In these patients; methods such as skin marking, depth measurement, preoperative needle marking of the area of the foreign body, and peroperative ultrasound-guided foreign body detection with the help of hemostats were used, and successful results were obtained [14]. Ultrasound has an important place in the treatment as well as in the diagnosis of puncture wounds due to radiolucent foreign bodies [15].

While general anesthesia or sedoanalgesia is usually required in pediatric patients during the surgical procedure, local anesthesia is usually sufficient in adult patients. Local anesthesia is not sufficient and spinal or general anesthesia should be preferred in deeply located and intra-articular puncture wounds with retained foreign body adjacent to the veins-nerves.

Puncture wounds with retained foreign body in the soft tissues of the extremities can lead to various complications. Cellulitis, abscess, lymphangitis, bursitis, osteomyelitis, septic arthritis, pseudotumor formation, allergic reactions, and toxic reactions

have been reported in the literature [16]. Rare complications have also been presented in various case reports. In a case report by M. Günday et al., radial artery pseudoaneurysm was detected in one patient after a puncture wound due to a piece of nail, and it could be treated with pseudoaneurysm excision and reconstruction with cephalic vein [17]. Although serious complications may occur, their incidence is very low. In our patient group, there were no complications other than soft tissue infection and partial Achilles tendon injury. There was no need for additional interventions other than the primary treatments applied.

The limitations of our study included its retrospective and single centered nature. Multicentered studies are needed in the literature for more reliable epidemiological analyses.

Conflict of interests

The authors declare that they have no competing interests.

Financial Disclosure

All authors declare no financial support.

Ethical approval

Ethics committee approval for our study was obtained from University of Health Sciences Istanbul Education and Research Hospital Clinical Research Local Ethics Committee with the decision numbered 2607 and dated 11/12/2020.

References

1. Cagin Y, Atayan Y, Erdogan M, et al. An Unusual Foreign Body in the Upper Cervical. Esophagus: A Case Report. *Med Sci | Int Med J.* 2016;5:284.
2. Patmano M, Cetin D, Gumus T, Yildirim S. A rare foreign body during colonoscopy: Headpiece of enema kit. *Ann Med Res.* 2018;25:493.
3. Kurt I, Kalender A, Sevimli R, Korkmaz M. Percutaneous surgery using Admix NoKorTM Non-Coring 16 G needle in cases with trigger finger. *Med Sci | Int Med J.* 2017;6:1.
4. Turker M, Basbug V, Kesik K, et al. Evaluation of deep-seated soft tissue foreign bodies according to gender and age groups. *Selcuk Tip Derg.* 2019;1:24-30.
5. Horton LK, Jacobson JA, Powell A, Fessell DP, Hayes CW. Sonography and radiography of soft-tissue foreign bodies. *Am J Roentgenol.* 2001;176:1155-9.
6. Jacobson JA, Powell A, Craig JG, Bouffard JA, Van Holsbeeck MT. Wooden foreign bodies in soft tissue: Detection at US. *Radiology.* 1998;206:45-8.
7. Mohammadi A, Ghasemi-Rad M, Khodabakhsh M. Non-opaque soft tissue foreign body: Sonographic findings. *BMC Med Imaging.* 2011;11:9.
8. Tantray MD, Rather A, Manaan Q, et al. Role of ultrasound in detection of radiolucent foreign bodies in extremities. *Strateg Trauma Limb Reconstr.* 2018;13:81-8.
9. Hiremath R, Reddy H, Ibrahim J, Haritha C, Shah RS. Soft tissue foreign body: Utility of high resolution ultrasonography. *J Clin Diagnostic Res.* 2017;11:14-6.
10. Davis J, Czerniski B, Au A, et al. Diagnostic Accuracy of Ultrasonography in Retained Soft Tissue Foreign Bodies: A Systematic Review and Meta-analysis. *Acad Emerg Med.* 2015;22:777-87.
11. Nienaber A, Harvey M, Cave G. Accuracy of bedside ultrasound for the detection of soft tissue foreign bodies by emergency doctors: Original Research. *EMA - Emerg Med Australas.* 2010;22:30-4.
12. Çinçin TG. Yumuşak doku içindeki radyoopak yabancı cisimlerin stereotaksik yöntemle çıkarılması. *Kartal Eğitim ve Araştırma Hastan Tıp Derg.* 2005;XVI:59-62.
13. Yıldırım C, Sözüer EM, Avşaroğulları L, et al. Yumuşak doku içindeki radyoopak yabancı cisimlerin stereotaksik yöntemle çıkarılması. *Ulus Travma Derg.* 1999;5:213-6.
14. Blankstein A, Cohen I, Heiman Z, et al. Ultrasonography as a diagnostic modality and therapeutic adjuvant in the management of soft tissue foreign bodies in the lower extremities. *Isr Med Assoc J.* 2001;3:411-3.
15. Young AS, Shiels WE, Murakami JW, et al. Self-embedding behavior: Radiologic management of self-inserted soft-tissue foreign bodies. *Radiology.* 2010;257:233-9.
16. Lammers RL. Soft tissue foreign bodies. *Ann Emerg Med.* 1988;17:1336-47.
17. Günday M, Tükenmez M, Erinanç H. Yabancı cisim batması sonrası radial arterde gelişen psödoanevrizma. *Kosuyolu Kalp Derg.* 2014;17:72-5.