Case Report

Diagnosis of toothpick-induced chronic intramuscular abscess using fistulography in a dog

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Abstract

A ten-year-old, 16.7 kg mixed-breed dog presented with chronic lameness and delayed healing of discharging wounds in the right pelvic limb following a puncture injury for approximately 6 months. Debridement surgery had been performed, but the tissue infection was persistent. Plain radiographic examination showed neither increased soft tissue opacity nor foreign body (FB) existence near the discharging wound of the right pelvic limb. After the second debridement surgery, closed drainage tubes were placed, and susceptible antibiotic therapy was prescribed in an attempt to control the persistent infection, but the fluid draining from the wound was still purulent. Therefore, fistulography was performed using a closed drainage tube, the radiopaque contrast medium successfully outlined a linear FB, approximately 6 cm long, present cranial to the right femoral greater trochanter and parallel to the ilium body. A wooden toothpick, approximately 6 x 0.2 cm, was subsequently retrieved from the sartorius muscle, and the dog had a subsequent full recovery. Here, we describe successful presurgical diagnostic imaging and treatment of a chronic intramuscular abscess caused by toothpick retention.

Keywords: intramuscular abscess, dog, fistulography, toothpick, foreign body

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Introduction

Toothpick, a foreign body of mostly wooden material, is rarely seen to cause injury in small animals and usually presents as a pinpoint in radiology examination that is easily neglected and eventually leads to severe complications due to delayed management (Jackson and Degner, 2002; Moon *et al*., 2012). Other than the toothpick, wooden foreign bodies (WFBs) that cause penetrating wounds are not uncommon in dogs, mostly resulting in oropharyngeal and/or esophageal soft tissue injuries associated with chasing or carrying sticks or playing in the woods (Doran *et al*., 2008; Griffiths *et al*., 2000).

The diagnosis and treatment of WFB-induced penetrating wounds involve eliciting the history, examination of the clinical signs and imaging findings, and debridement surgery (Cherry *et al*., 2019; Doran *et al*., 2008). The possibility of WFB retention in the injured area and retrieval by surgical exploration accounts for approximately 27% to 36% of oropharyngeal and esophageal stick injury cases (Doran *et al*., 2008; Griffiths *et al*., 2000). Proper image diagnosis and immediate retrieval of foreign bodies (FBs) from penetrating wounds are thus essential. It is challenging to identify a WFB with plain radiography because of the natural characteristics of wooden materials, which have the same opacity as soft tissue and fluid. The margins of the wooden materials appear silhouetted unless there is gas accumulation between the FB and the soft tissue, surrounding the FB on a radiograph (Clarke and Ferguson, 2012; Doran *et al*., 2008; Griffiths *et al*., 2000).

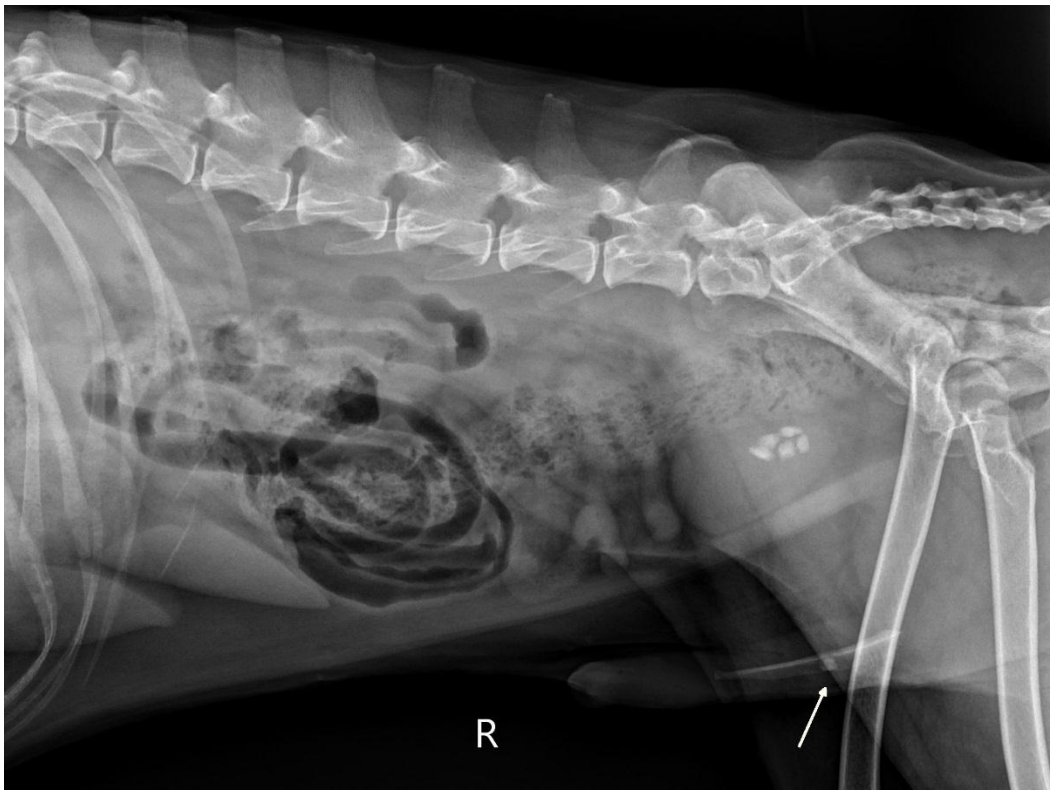
To the best of the authors' knowledge, this case is the first report to describe the diagnosis and treatment of a pelvic limb intramuscular abscess caused by toothpick penetration and retention in a dog by the use of fistulography for a more precise diagnosis and FB localization.

Case description

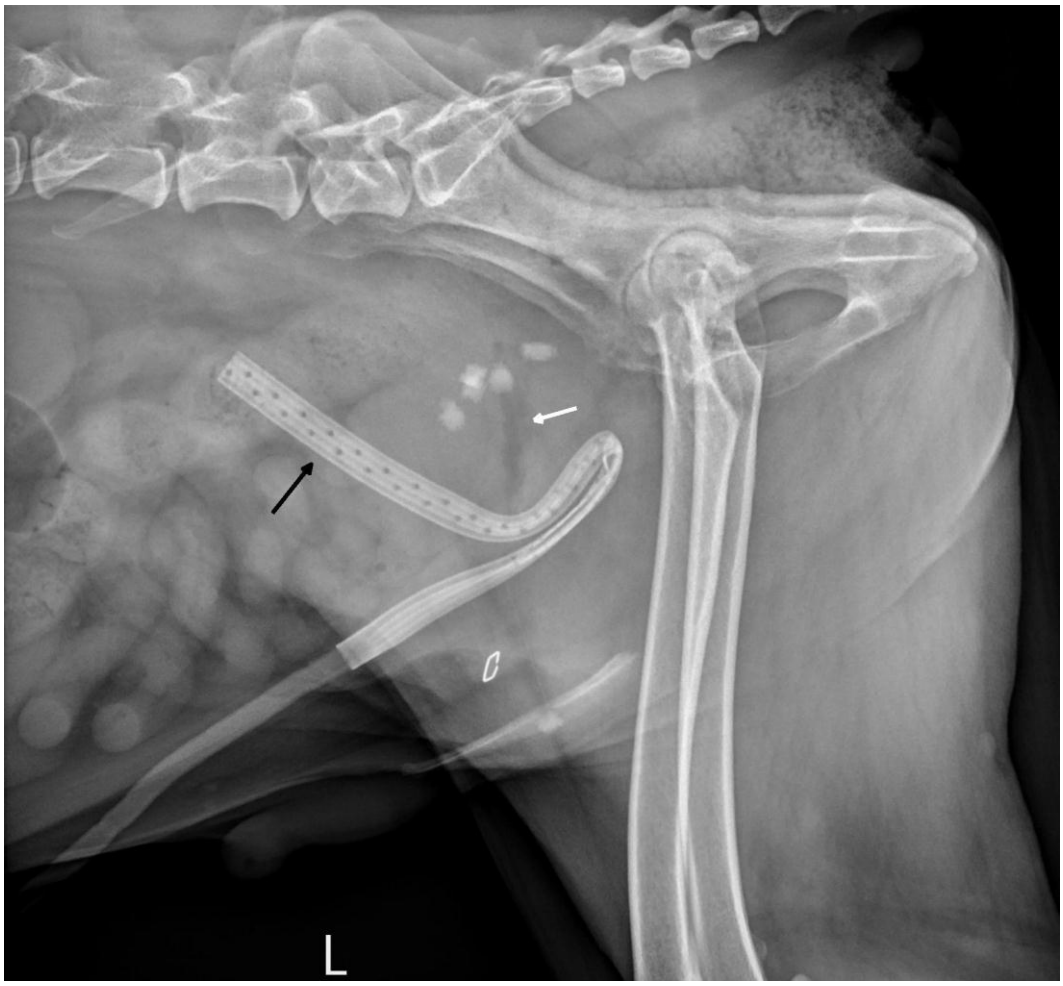
A ten-year-old neutered male, mixed-breed, outdoor-living dog had clinical signs of right hind limb lameness and soft tissue swelling of the entire limb without any apparent open wound. The dog was then taken to a regional animal hospital, where the antibiotic cephalexin was prescribed initially. The soft tissue swelling subsided but revealed a small open wound at the medial thigh, with persistent lameness of the right pelvic limb. Debridement surgery was conducted, and intermittent hospitalization treatment of the surgical wound was performed for approximately 6 months. However, the wound did not heal, and a new wound developed on the right lateral thigh; both were small nonhealing wounds with purulent discharge.

The dog was subsequently taken to the Veterinary Medicine Teaching Hospital, National Chung-Hsing University (VMTH, NCHU) for further examination and treatment. Upon physical examination, two small open wounds (approximately 0.3 × 0.7 cm) that presented with yellow to brown discharge were found on the right thigh. The lateral wound was located cranial to the greater trochanter, and the other wound was located in the medial inguinal area (Fig. 1). Weight-bearing of the right hind limb was mildly affected. Vital signs, including heart rate, respiratory rate, and body temperature, were normal. Hematology only showed mild eosinophilia (1.87 K/μL, reference range 0.06-1.23 K/μL) but without systemic inflammation (white blood cell count, 12.28 K/μL; neutrophil count, 7.38 K/μL). The serum biochemical examination results were all within the normal range. Urine examination indicated trace red blood cells, and cellular casts were present with no obvious crystals in the urine sediment. The bacterial culture of the urine sample obtained through cystocentesis was negative. Abdominal radiography revealed several calculi within the urinary bladder and one in the penile urethra. With the consent of the owner, treatment of urinary lithiasis was postponed until after recovery of the intramuscular abscess. On radiographic examination of the right hind limb, neither a suspected FB nor increased soft tissue opacity around the nonhealing wounds was observed (Fig. 2A).

Figure 1 Delayed healing wound on the medial right thigh. The wound was close to the inguinal area and a brownish discharge was found around the wound. No draining tract was detected when investigating the surrounding area with an aseptic thin swab.



A



B

Figure 2 **A:** Lateral view of the abdominal radiography examination. Calculi are evident in the urinary bladder and penile urethra (white arrow). Heterogeneous opacity with soft tissue striations was visible at the inguinal region. **B:** Lateral view of the hind limb before the contrast radiography examination. The black arrow indicates the Jackson-Pratt drainage tube placed at the medial side of the wound. Subcutaneous gas (white arrow) was superimposed with the urinary bladder. **C:** Lateral view of caudal abdominal radiography with fistulogram. One thin and long (approximately 6 cm) stick-like foreign body (black arrow) was evident after contrast radiography. **A:** A Foley catheter was inserted into the opening of the lateral wound, **B:** Jackson-Pratt drainage tube placed at the medial side of the wound.

Irrigation and debridement surgery were then performed. The dog was premedicated with morphine (0.5 mg/kg; Taiwan Food and Drug Administration, New Taipei, Taiwan), midazolam (0.3 mg/kg; Genovate Biotechnology Co., Ltd., Xinzhu, Taiwan), and ketamine (2 mg/kg; Ketamine hydrochloride Imalgene 1000, Merial, Lyon, France) intramuscularly. Anesthesia was induced with intravenous propofol (6 mg/kg; Fresofol 1%; Fresenius Kabi, Germany) and maintained with 1.5-2.5% isoflurane (Isoflurane USP; Halocarbon Products Corp., GA, USA) in oxygen. The surgical approach was through both lateral and medial delayed healing wounds; concurrently, Jackson-Pratt (JP) drainage tubes (7 mm in width) were placed on both sides of the wounds. The subcutaneous and muscle tissue at the wounds had a fresh color without pseudomembranous covering. A piece of deep soft tissue was sampled from the medial wound and sent to the Animal Disease Diagnostic Center College of Veterinary Medicine, NCHU, for bacterial examination and antibiotic susceptibility test. Owing to the previous usage of cephalexin for a period of time, intravenous administration of 15 mg/kg Augmentin® (GlaxoSmithKline, Brentford, UK) twice daily was tentatively prescribed for infection control. The skin surrounding the JP drain was disinfected using 0.1% chlorhexidine and the wound was bandaged using cotton roll to stabilize the JP drain twice daily. The volume of draining fluid collected from the JP tube decreased 2 days after surgery, especially from the wound on the lateral side. Thus, the drainage tube placed at the lateral wound was removed. The cultured pathogens from deep soft tissue included *Escherichia coli*, *Streptococcus* sp. Viridans group, and *Enterococcus* sp. However, the discharge from the medial wound was still mucoid and pus-like 4 days post-surgery, even though an effective antibiotic, Augmentin®, was prescribed based on the antibiotic susceptibility examination (Table 1). Notably, the discharge fluid had increased percentage of gram-negative rod bacteria cells.

The persistent pus-like discharge indicated the possible existence of a sinus tract or FB. Therefore, fistulography was performed under general anesthesia. The skin around the lateral remaining open wound was initially scrubbed by Hibiscrub® (4% Chlorhexidine gluconate, Ri Ming Enterprises Co., Ltd., New Taipei, Taiwan) and subsequently rinsed by diluted 0.1% chlorhexidine solution. Fistulography was performed by first injecting approximately 10 ml of nonionizing iodine contrast medium (Omnipaque, 350 mgI/mL, GE Healthcare Inc, Cork, Ireland)

through a 6 Fr Foley catheter, which was pre-lubricated by sterile water lubricating gel, inserted into the remaining lateral open wound, and cuffed by injecting 1.5 ml saline into the balloon; however, there was leakage of the contrast medium during injection, and subsequent radiography revealed insufficient contrast medium in the area to be inspected. The same volume of contrast medium was then injected into a JP drainage tube, which was placed on the medial side. Subsequent radiography showed one linear FB, approximately 6 cm in length, outlined by contrast medium, located anterior to the greater trochanter and ventral to the iliac crest under the right lateral view (Figs. 2B and 2C). Secondary irrigation and debridement surgery was performed to retrieve the FB. A toothpick, of approximately 6 x 0.2 cm, was discovered in the proximal sartorius muscle and was subsequently sent for bacterial examination (Fig. 3). To improve infection control, the antibiotics were switched from Augmentin® to imipenem (5 mg/kg three times a day). *E. coli*, *Enterobacter* sp. and *Klebsiella pneumonia* cultured from the toothpick were all shown to be susceptible to imipenem in the bacteriology examination (Table 1). After surgery, the draining fluid from the medial side of the wound maintained a serosanguineous texture with a gradual decrease in volume. The drainage tube was removed 6 days post-surgery, and the dog was discharged on the same day. The remaining wound healed well, and all sutures were removed 10 days after the surgery. The walking ability of the right pelvic limb was fully restored two weeks after discharge.

Table 1 Bacteriology examination and antibiotic susceptibility test results

Cultured bacteria	**First surgery (draining fluid)** **1. *Escherichia coli*** **2. *Streptococcus* sp. Viridans group** **3. *Enterococcus* sp.**			**Second surgery (toothpick)** **1. *Escherichia coli*** **2. *Klebsiella pneumoniae*** **3. *Enterobacter* sp.**		
Antibiotic	1	2	3	1	2	3
Amoxicillin	R	S	S	I	R	R
Amoxicillin-clavulanic acid	S	S	S	S	S	S
Cephalexin	S	S	R	I	S	S
Cefixime	S	R	R	S	S	S
Enrofloxacin	S	I	I	S	S	S
Ciprofloxacin	S	I	I	S	S	S
Doxycycline	S	R	R	ND	ND	ND
Clindamycin	R	S	R	ND	ND	ND
Imipenem	S	S	S	S	S	S

S = susceptible, I = Intermediate, R = resistance, ND = not detected

Figure 3 Retrieved toothpick foreign body. An approximate 6 cm long dark black wooden toothpick foreign body was retrieved from proximal sartorius muscle presented sharp on one end and blunt on the other.

Discussion

At the time of writing this report, there are no other reports on a pelvic limb injury due to toothpick penetration. On the PubMed search engine, only four reports appeared with the keywords "toothpick" and "dog" or "cat". Of these, two case reports were related to soft tissue infections in dogs but not in cats, involving a chronic bronchocutaneous fistula or a cutaneopulmonary fistula (Jackson and Degner, 2002; Moon *et al*., 2012). The relevant literature is associated more with "stick penetration" that mainly occurred in upper digestive tract or neck area often resulting from chasing sticks (Doran *et al*., 2008; Griffiths *et al*., 2000). Unlike these injuries located in the upper digestive tract or neck, the penetration injury located relatively proximal to the pelvic limb described in this report, was less likely to have resulted from self-caused injuries. Based on the shape and location of the toothpick, combined with the possible migration route transverse to the proximal hindlimb in this case, we suspected that the FB was accidentally inserted by a child playing with a toothpick crossbow. Because the thigh is covered by abundance of muscle tissue, unlike the oropharyngeal or neck area, the toothpick can be easily neglected during routine debridement or exploratory surgery. Thus, in a case with suspected penetration or a sinus tract wound, appropriate imaging assessment is vital for a precise diagnosis.

The application of different imaging modalities to diagnose stick-like FB retention has already been done for small animals (Armbrust *et al*., 2003; Cherry *et al*., 2019, Lamb *et al*., 2017; Moon *et al*., 2012). Apart from fistulography, ultrasonography (US), computed tomography (CT), and magnetic resonance imaging (MRI) could be used to diagnose injuries following WFB penetration and retention. CT is reported to possess 79% sensitivity and 93% specificity for diagnosing WFBs (Lamb *et al*., 2017). MRI also demonstrated excellent visualization of the inflammatory tissue reactions and has been used to successfully diagnose a wedge-shaped WFB in cervical area (Young *et al*., 2004). If accessible, CT or MRI examinations could be exploited prior to debridement surgery for immediate diagnosis of WFB. US was also used to successfully identify FBs with soft tissue opacity in five of six (83%) dogs with FB-induced chronic draining tracts, except in one case of an FB (5 cm x 2 mm) present close to a rib (Armbrust *et al*., 2003). Considering the bony structure of the femur and that a closed draining tube was placed during the previous debridement surgery, the resonance may have encountered interference, leading to an inaccurate US evaluation similar to the aforementioned case in which the proximity of the FB with the rib may have caused interference. Therefore, US was not chosen as a diagnostic tool in this case. Conversely, a closed draining tube can serve as a convenient tract for contrast medium injection to the infection site. Therefore, fistulography was suitable to aid the detection of a WFB in this case. Foley catheter, instead of the JP drainage tube, was initially chosen for contrast medium injection because the possible infectious material collected in the JP tube might get injected along with the contrast medium. However, the FB was not revealed until the contrast medium was injected through the JP tube into the medial wound. The leakage of contrast medium injected through the Foley catheter may be attributed to insufficient pressure for injecting adequate contrast medium to infiltrate and outline the FB. Inadequate insertion of the contrast medium would also cause a false negative result (Armbrust *et al*., 2003). Application of a purse string suture at the skin opening, in combination with a cuffed catheter, might effectively prevent the leakage of the contrast medium (Lamb *et al*., 1994).

Toothpick or stick-caused penetration often results in wound infection (Armbrust *et al*., 2003; Cherry *et al*., 2019; Clarke and Ferguson, 2012; Jackson and Degner, 2002; Moon *et al*., 2012). Upon penetrating the skin, the pathogens existing on the skin and the surface of the FB are introduced into the injured tissue. Surgical debridement provides tissue samples or fluid from deeper sites for accurate bacteriology examination. When routine debridement surgery accompanied by treatment with susceptible antibiotics fails to control the infection, as in this case, it is essential to consider possible FB retention with subsequent localization and retrieval. Furthermore, closed drainage system placement can provide crucial information on infection control in deep or penetrating wounds. It is worth noting that pathogens cultured from the drainage fluid and the toothpick in the present case were not consistent, but all were susceptible to Augmentin®. The difference may be attributed to the destruction of the bacteria in the drainage fluid by susceptible antibiotics, while the remaining bacteria on the surface of toothpick FB may have survived the action of antibiotics and cellular phagocytosis because of the production of biofilm. This phenomenon is similar to post-traumatic osteomyelitis which occurs due to bacteria producing slimy biofilm and adhering to medical implants (Stewart and Costerton, 2001). In view of the bacteria cultured from the FB, *E. coli*, genus *Klebsiella* and *Enterobacter*, all belong to the family Enterobacteriaceae and are capable of biofilm production, which is often isolated from patients with complicated infections and only comprises a small percentage of the normal flora of canine skin (Dowling, 1996; Hoffmann *et al*., 2014; Ludwig *et al*., 2016). Thus, the causative Enterobacteriaceae pathogens isolated here were most likely from the contaminated toothpick. Regarding the selection of antibiotics in the present case, the antimicrobial susceptibility test indicated that Augmentin® alone might be sufficient to control intramuscular infection. However, according to the findings of increased purulent texture of the draining fluid with prominent gram-negative bacteria post-surgery, a possible antibiotic resistance was suspected. The antibiotic was thus switched from Augmentin® to imipenem after the second debridement surgery.

This report suggests a diagnostic imaging method to confirm and locate FBs in muscular tissue, which is cost-effective compared to CT or MRI. Successful treatment can be subsequently achieved *via* surgical irrigation, debridement and FB retrieval, efficient postsurgical monitoring of the infection status, and adjunctive susceptible antibiotics.

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