



NOTE

Internal Medicine

Preliminary report of spinal cord injuries resulting from inappropriate microchip implantation in two puppies

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ABSTRACT. Since the revised Animal Welfare and Management Law in Japan became effective on June 1st, 2022, it became mandatory for pet dogs and cats to have microchips implanted and registered prior to be sold. Two cases of spinal cord injury as the result of inappropriate microchip implantation in puppies were referred to our facility, of which were diagnosed by cervical spinal radiography and computed tomography (CT). While adverse reactions following microchip implantation are rare, the possibility of iatrogenic spinal cord injury remains a serious complication. This is the first report of adverse reactions following microchip implantation in Japan, and it alerts the possibility of iatrogenic spinal cord injury secondary to inappropriate microchip implantation, where adequate training and extra caution is crucial especially in small light-weight animals.

KEYWORDS: dog, microchip, pet identification, spinal cord injury

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The revised Animal Welfare and Management Law in Japan became effective on June 1st, 2022, which became mandatory for pet dogs and cats to have microchips implanted and registered prior to be sold [1]. Likewise, pet owners who welcome dogs and cats into their family are also required to register their information.

Microchip is an electronic identification device encoded with a unique 15-digit ISO standard individual identification number, which can be read using a dedicated reader [10]. It is encased in cylindrical biocompatible glass or polymer, with approximately 1.2 mm in diameter and 8 mm in length. Microchip is implanted subcutaneously using a dedicated disposable applicator with a large bore hypodermic needle, which can be implanted as early as two-weeks of age in dogs and four-weeks of age in cats, and in Japan microchip implantation can only be performed by a veterinarian [1]. Once implanted, there is less concern that it will fall off like a collar or a name tag, and it is designed to be used semi-permanently. According to the report by the Ministry of Environment, since the microchip is encased in biocompatible material, microchip related adverse effects have rarely been reported [10].

This is the first report of adverse reactions following microchip implantation in Japan, which describes two cases of spinal cord injury as the result of inappropriate microchip implantation in puppies. Both cases were identified and referred from Kyushu to our facility at the same time, just two weeks after the revised Animal Welfare and Management Law became effective.

Case 1: An 8-week-old, female Toy Poodle and Maltese mix weighing 830 g was presented with 24-hr history of an acute onset of paresis immediately following microchip implantation to the dorsal cervical region. The microchip was implanted the day before at the pet auction site, which was then brought to our facility on the following day. On physical examination, the dog was slightly depressed and non-ambulatory. Soft tissue swelling and pain were observed at the site of implantation, where there was an approximately 2 cm surgical incision, which suggested that a previous attempt was made to retrieve the microchip the day before.

Neurological examination revealed presence of some voluntary movement in the thoracic limbs but absent in the pelvic limbs. Proprioception was reduced in the thoracic limbs but absent in the pelvic limbs, and nociception was present in all limbs. Spinal reflexes and cranial nerve examination were unremarkable. The bladder was full and difficult to express, but there was no problem with defecation.

Radiograph of the cervical region showed a horizontally oriented microchip proximal to the spinal canal at the level of T1-T2 and slightly to the left of midline (Fig. 1A and 1B). The microchip was 1 mm in diameter and 8 mm in length, which appeared to be inserted in the caudal to cranial direction. Subsequently, CT scan of the spine was taken with the dog under general anesthesia. On the CT scan, the microchip appeared to be located within the vertebral canal, embedded within the spinal cord at the level of T1-T3,

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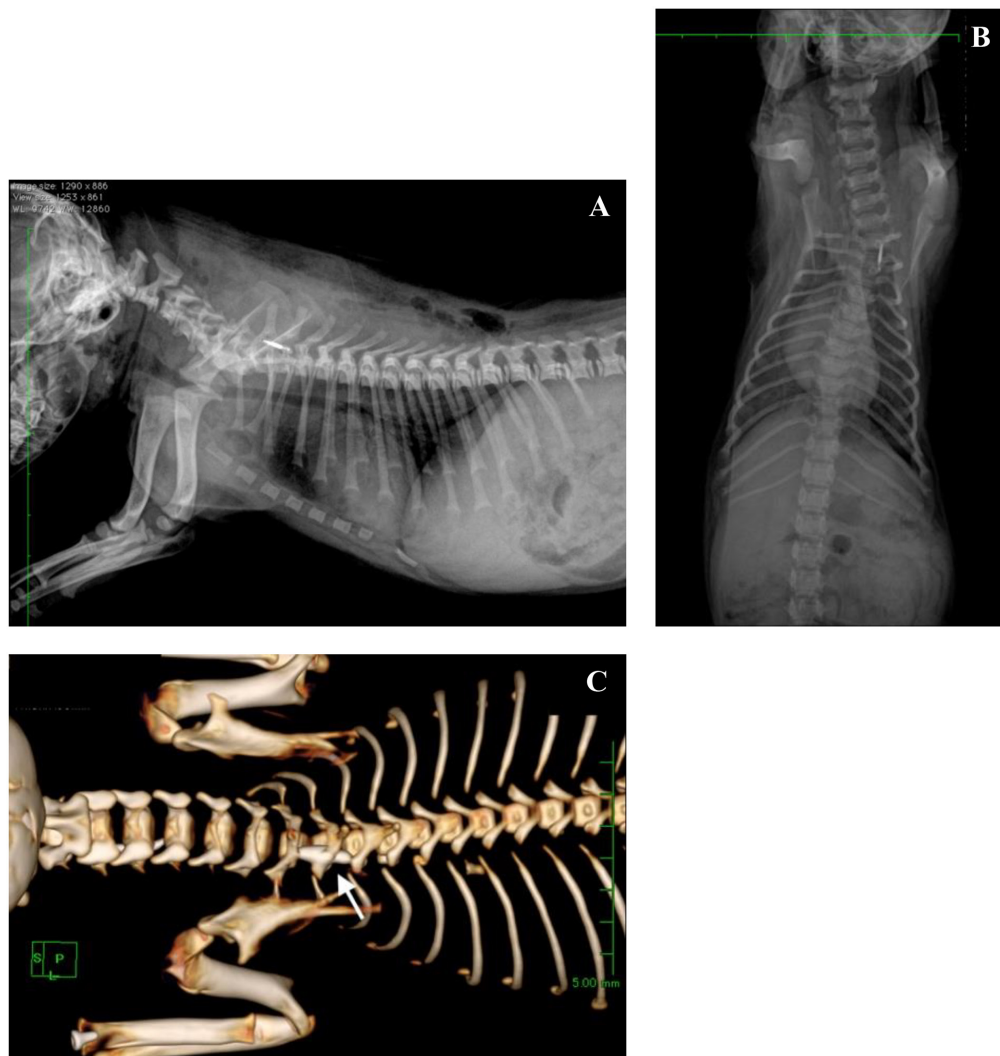


Fig. 1. A) Lateral and B) ventro-dorsal radiographic views of cervical region, and C) dorsal CT three-dimensional reconstruction of cervical region of Case 1.

causing severe spinal cord compression (Fig. 1C). Due to the location of the microchip, there were greater concern of further iatrogenic spinal cord injury through surgery, therefore, surgical removal of the microchip was not attempted.

At two-week follow-up, progressive neurological improvement of the limbs and voluntary bladder function were observed. Furthermore, at one-month follow-up, although there was residual weakness of the left pelvic limb, the dog was ambulatory and was able to resume normal activities. However, due to the incident, the dog was unfit for sale.

Case 2: An 8-week-old, female Chihuahua weighing 420 g was presented with 24-hr history of an acute onset of paresis following microchip implantation to the dorsal cervical region. As with Case 1, the microchip was implanted the day before at the pet auction site, which was then brought to our facility on the following day. On physical examination, the dog was alert and only weakly ambulatory. There was no soft tissue swelling nor pain observed at the site of implantation.

On neurological examination, normal voluntary movement was observed in the thoracic limbs, but reduced in the right pelvic limb and absent in the left pelvic limb. Proprioception was reduced in the right pelvic limb and absent in the left pelvic limb, whereas nociception was present in all limbs. Spinal reflexes and cranial nerve examination were unremarkable, and there was no problem with urination or defecation.

Radiograph of the cervical region showed a horizontally oriented microchip proximal to the spinal canal at the level of T1-T2 in the midline (Fig. 2A and 2B). Size of the microchip was 1 mm in diameter and 8 mm in length, and it appeared to be inserted in the cranial to caudal direction. CT scan of the spine was obtained under general anesthesia. On the CT scan, the microchip was diagonally situated within the vertebral canal at the level of T1-T2, causing spinal cord compression (Fig. 2C).

An attempt was made to retrieve the microchip via hemilaminectomy with dorsal approach to the T1-T2 vertebra, where the dog was positioned in sternal recumbency. Dissection of the dorsal lamina and its removal caused leakage of the cerebrospinal fluid, which further dislodged the microchip caudally. The caudal shifting of the microchip made it difficult to retrieve, and since it was judged

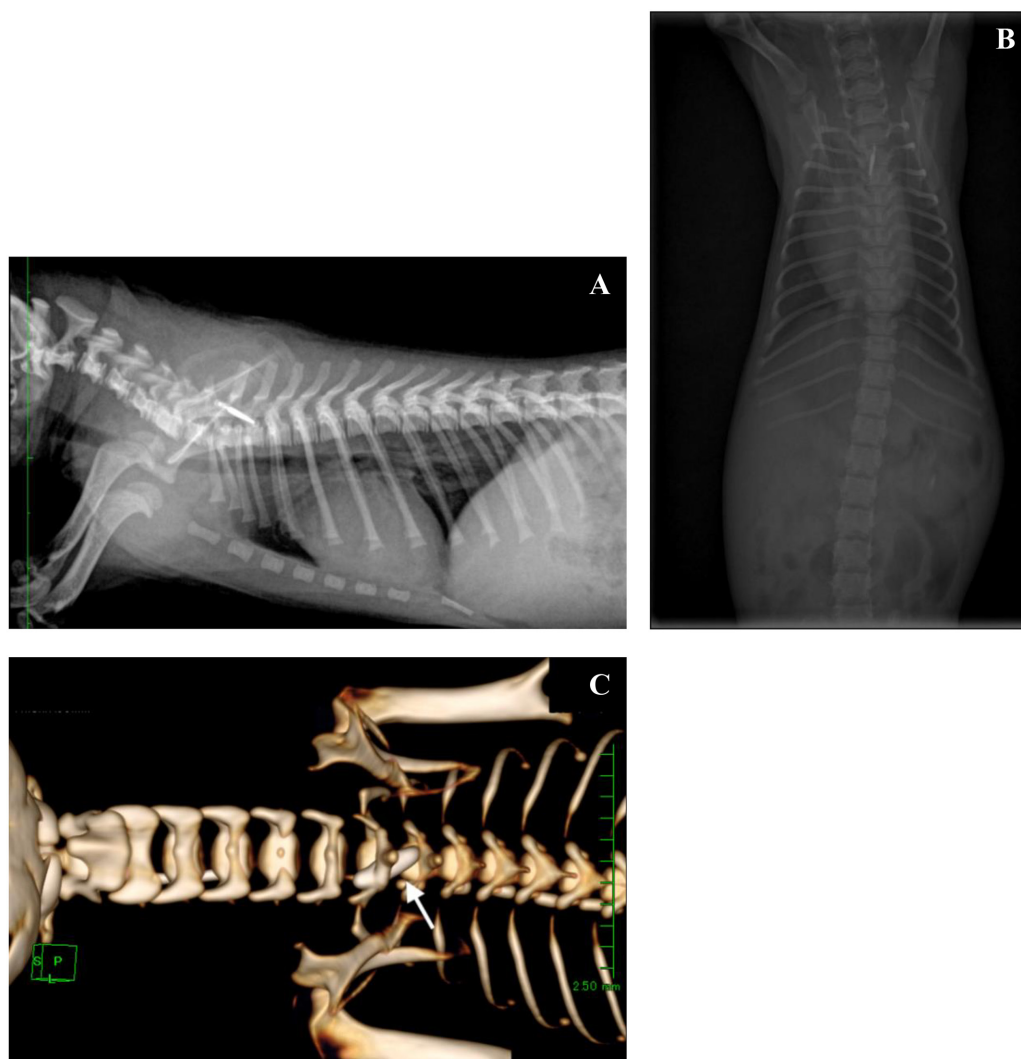


Fig. 2. A) Lateral and B) ventro-dorsal radiographic views of cervical region, and C) Dorsal CT three-dimensional reconstruction of the cervical region of Case 2.

that adequate decompression of the spinal cord was achieved, decision was made to leave the microchip as is. Recovery from the anesthesia was uneventful.

At two-week follow-up, the dog had made a good recovery with slight residual weakness of the left pelvic limb. However, similarly to Case 1, the dog was unable to be sold due to the incident.

Until recent, individual identification of pet animals in Japan had been performed on voluntary basis, primarily by the animal welfare organizations and pet owners. The aims of the revised Animal Welfare and Management Law are to clarify the responsibility of owners, to discover escaped or stray animals, and to facilitate animal rescue activities in the event of disasters. In countries such as Australia and United Kingdom, compulsory microchip legislations require pet animals to be microchipped by specified age [9, 14]. Studies on animals entering animal shelters and a report of a local authority have shown that animals with microchips had a greater chance of being reunited with their owners in comparison to the non-microchipped animals [7, 8, 14].

Recommended location of microchip implantation is between the caudal shoulder blade, slightly to the left of mid-line, and the microchip is inserted in the caudal to cranial direction, horizontal to the body as the head is positioned down [1]. Initially after the microchip implantation, a localized foreign body reaction is observed as infiltration of cells including neutrophils, macrophages and plasma cells occurs, which disappears within three months, and granulation tissue formation and encapsulation of the microchip by fibroblasts, collagen fibers and elastic fibers complete by 12 months after implantation [11]. Subcutaneously implanted microchip is encapsulated in connective tissue membrane which is isolated from surrounding tissues, therefore, unlikely to cause systemic effects [11]. Veterinary organizations such as British Small Animal Veterinary Association and World Small Animal Veterinary Association claim that a microchip is a safe and effective means of pet identification with minimal adverse reactions, and the benefits of microchips outweigh the possible adverse reactions [2, 16, 17]. The types of adverse reaction reported include migration or loss, failure to work, and reaction at the injection site such as swelling and infection, where migration being the most reported [16, 17].

The two cases in this report were presented with acute onset of paresis following inappropriate microchip implantation. Similarly, there has been at least five reports of inappropriate implantation of microchip which caused spinal cord injuries, of which three cases were in dogs, and 2 cases in cats [4, 5, 12, 13, 15]. These iatrogenic spinal cord injuries are often presented as acute onset of ambulatory or non-ambulatory tetraparesis following the microchip implantation. Most of these cases underwent surgical treatment, except for one case in a cat. These surgical cases resulted with good outcome, while the cat was also successfully managed with medical treatment. In both humans and dogs, there is no indication of surgical treatment being the better option for the treatment of spinal cord injury in comparison to medical treatment [3, 6]. While removal of the microchip was not possible for both cases in this report, significant neurological improvements were observed. It has been shown that intact nociception in the pelvic limbs at the time of presentation and young age are associated with good prognosis, which were the cases in this report [3].

Reports of spinal cord injury following microchip implantation are rare, but it appears that small breeds and light in weight are common factors observed, as were the cases in this report. According to the guideline by the Ministry of Environment, when performing microchip implantation by oneself, a fold of skin is lifted using the thumb, index and middle fingers, and the remaining fingers and the palm are used to restrain the animal while using the other hand to insert the microchip. While performing microchip implantation by a single person is not an uncommon practice, it is extremely challenging especially in hyperactive, small, juvenile animals which are not easy to restrain. Inadequate restraint will result in unsuitable positioning of the animal, leading to unintended insertion of the microchip in the undesirable angle, which was mostly likely the case for Case 1.

Another point to note is that the direction of microchip implantation was inconsistent in the cases of this report. In Case 1, the microchip was directed cranially as described in the guideline by the Ministry of Environment, however, in Case 2, the microchip was implanted in the opposite direction [1]. While migration of the microchip has been commonly reported, considering the size of the dog weighing only 420 g, it is unlikely in this case. Furthermore, since paresis was observed immediately following implantation, it is most likely that the microchip was directed towards the spine in the cranial to caudal direction. Such lack of consistency in the method could speculate the possibility of inadequate training. Likewise, a case reported in cat by Platt *et al.* was in fact implanted by the owners themselves, which suggests inadequate or lack of training increases the likelihood of iatrogenic spinal cord injuries [12].

Implantation of microchips in puppies prior to be sold has become more common in the last few years in regions such as Tokyo. On the other hand, in more rural regions such as Kyusyu, the practice of microchip implantation has just begun at the same time as the revision of the Animal Welfare and Management Law. As the result of the revision, the veterinarians, in particularly at the pet auction sites, are required to perform the microchip implantation to a large population of dogs and cats in a restricted amount of time with limited number of staffs. Several factors may have attributed to the two cases of iatrogenic spinal cord injuries in this report. First is the lack of training and experience of the veterinarians performing the microchip implantation. Second is the inadequate restraint of the puppies resulted from performing the microchip implantation by a single person. Third is the small, and light weight size of the puppies. Adequate training such as hands-on training workshops for the inexperienced veterinarians and having two people to perform microchip implantation in hyperactive and small animals to ensure adequate restraint should be considered to avoid further incidences.

Reports of adverse reactions following microchip implantation are rare and mostly non-fatal, and a microchip is considered as a safe and reliable method of pet identification. However, iatrogenic spinal cord injury may result from improper implantation technique, which may affect the well-being of a pet animal. While the chances are rare, the possibility of inappropriate implantation of a microchip remains a serious complication. Veterinarians who implant microchips should be adequately trained, and extra caution should be taken especially in small light-weight animals. It should be emphasized that the occurrence of such incidents has reduced not only the commercial value but the welfare of animals as well. This report alerts veterinarians for the possibility of iatrogenic spinal cord injury secondary to inappropriate microchip implantation.

CONFLICT OF INTEREST. The authors declare no conflict of interest.

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