Intracranial lesions, including neoplastic, inflammatory, and cerebrovascular, are relatively frequent brain diseases encountered in dogs and cats.\(^1,2\) Despite the increasing availability of MRI over the past decade in veterinary medicine, several studies have demonstrated a significant overlap in MRI findings between different intracranial lesions in dogs. In a recent study\(^3\) using conventional high-field MR to compare gliomas and cerebral infarcts in dogs, 47% of the presumed cerebrovascular accidents were misdiagnosed as gliomas, and 12% of the gliomas were misdiagnosed as cerebrovascular accidents. In another study\(^4\) evaluating the accuracy of the MRI to differentiate neoplastic, inflammatory, and cerebrovascular brain disease in dogs, the sensitivity and the specificity for detecting a brain lesion were 94.4% and 95.5%, respectively, but the sensitivity was only 38.9% for classifying lesions as cerebrovascular in dogs and cats, without complications.

OBJECTIVE
To develop an innovative process for stereotactic brain biopsies in dogs and cats that would provide a definitive diagnosis and optimize the management of patients with brain lesions.

ANIMALS
4 dogs and 1 cat diagnosed with 1 or more brain lesion(s) underwent brain biopsies between March 24, 2023, and October 25, 2023.

METHODS
Based on trajectories selected on images of MRI and CT scan performed on each patient, a computerized software program was used to design a 3-D–printed patient-specific device with maxillary dental impression located on a baseplate to secure the patient’s head and with insertion ports for the biopsy instrumentations located on a C-arm. As proof of concept, the device was successfully used in 2 cadavers before being used on clinical patients. All biopsy samples were submitted for histopathological examination.

RESULTS
Histological diagnosis was obtained in 80% (4/5) of the cases (choroid plexus tumor, astrocytoma, meningioma, and chronic meningoencephalitis of unknown origin). In 1 patient, the results of biopsy were nondiagnostic; postmortem diagnosis was consistent with a low-grade oligodendroglioma. All the patients were discharged within 24 hours after the procedure without complications. This novel stereotactic system allows the surgeon to perform safe, easy-to-use, inexpensive, and minimally invasive precise brain biopsies in dogs and cats, without complications.

CLINICAL RELEVANCE
This unique technique could be applied to any size and type of skull and for any type of brain lesions and would provide diagnostic information that would be valuable for future treatment planning and prognosis.

Keywords: stereotactic brain biopsy, brain lesion, maxillary dental impression, dog, cat
nature, and the sensitivity for detecting the specific tumor type was variable and ranged between 0 to 66%. Considering these findings, obtaining a histological diagnosis would appear to be a crucial step when providing prognosis and optimal treatment options to the pet owner, especially when treatment options and prognosis can vary greatly depending on the type of intracranial lesion.

Brain biopsy is one of the most frequently performed brain surgeries in neurosurgical centers in human medicine. Techniques and innovations are constantly being improved to meet all the objectives of this type of biopsy, such as minimizing the risk of complications, ensuring the success of the procedure leading to a histological diagnosis, and increasing patient satisfaction and limiting costs by performing minimally invasive biopsies as safely as possible on an outpatient basis. In veterinary medicine, the first stereotactic brain biopsy technique was described in the dog in 1982. Since then, several techniques have been utilized in dogs, including open and minimally invasive free-hand, several frame-based stereotactic biopsy techniques with or without image guidance, and frameless image-guided neuronavigational procedures, mostly tested on cadavers. All techniques were deemed safe when performed on live patients and resulted in an accurate histological diagnosis, but the majority of the techniques were considered to be somewhat invasive procedures, with, for example, the need for a burr-hole craniectomy, or 3 or 4 bone anchors to keep the head stable, or the need for a large skin incision, and were not suitable for all variations of breeds and species’ shapes and sizes. In some cases, long manufacturing times as well as increased costs limited routine surgery for these types of patients. Thus, the development of a brain biopsy technique that meets all the necessary criteria set out above for both veterinary medicine and human medicine appears fundamental in the era of current major medical advances.

The aim of this experimental study was to create an inexpensive, easy-to-use 3-D-printed patient-specific device that would facilitate diagnostically accurate, minimally invasive stereotactic biopsies of brain lesions in dogs and cats. The manufacture, use of the device, and first preliminary data, including complications and histological results, are described.

Methods

Ethical consideration

This experimental study was approved by the ethics committee of the National Veterinary School VetAgro Sup (Lyon, France; approval No. 2405). Written owner consent was obtained for participation in the study after owners were fully informed orally of the entire procedure and the possible associated risks, including possible deterioration and/or death at the time of the procedure or in the following days/weeks and the possibility that the biopsies will not be diagnostic.

Inclusion criteria

All client-owned patients included in this study were presented to the Neurology Department of the Veterinary Hospital Center FréGIS IVC Evidensia, Paris, France, between March 2023 and October 2023. All patients had neurological signs consistent with an intracranial lesion (seizures, central vestibular syndrome, and left circling). For inclusion in the experimental protocol, the patient had to have 1 or more fairly well-defined brain lesion(s) diagnosed on MRI images; any lesion located in the brainstem and deep brain was not included in this primary trial. For each patient, the following data were available: signalment (breed, age, sex, body weight), historical clinical signs, neurological examination at admission, blood analysis (CBC, serum chemistry, and ionogram), and medical therapy.

The biopsy procedure was performed from 6 days to 30 days after the imaging diagnosis, mostly dependent on owners’ schedule and time to fabricate the stereotactic device. Operative time was recorded for each animal.

Preoperative diagnostic imaging

All patients were diagnosed with a brain lesion using an MRI scan (1.5 Tesla; Vantage ELAN; Canon Medical Systems). Each MRI scan included at least T1-weighted transverse views before and after intravenous administration of contrast medium (gadoteridol; ProHance; 0.2 mL/kg), T2-weighted transverse and sagittal views, and T2-weighted fluid attenuation inversion recovery dorsal view. Some had additional sequences such as T2*-weighted transverse view and diffusion transverse views.

Immediately after the MRI examination, a noncontrast-enhanced CT scan (64-slice helical; Lightning Aquilion; Canon Medical Systems) of the head including the complete maxillary and mandibular structures was performed, using equipment such as a roll of cohesive bandage (medium-sized vet-wrap [7.5 cm high] in our cases) inserted between the animal’s upper and lower jaws to obtain a mouth opening of sufficient amplitude for the subsequent dental impression (Figure 1).

Regions of interest (ROIs) were manually generated on the MRI images using a DICOM viewer (RadiAnt viewer) in each of the 3 planes, transverse, dorsal, and sagittal, to target the area of the lesion to be reached with the biopsy needle. Two to 3 ROIs were drawn for each lesion.

Biopsy device planning, design, and manufacturing process

Once the ROIs had been generated on the MRI images, the trajectories of the biopsy needle were drawn manually in the transverse and sagittal planes for each ROI (Figure 1). The angulation was chosen to cross as little brain parenchyma as possible, avoiding the zygomatic arches and the temporomandibular junction and taking care not to cross any ventricles, while passing through the thinnest
possible thickness of calvaria. The trajectories were then transposed onto the scanner images.

All the CT and MRI DICOM data, and the images containing the drawn trajectories, were transmitted for processing and production of the customized device. The patented processing is conducted through the Arion platform, a digital suite developed by the INFINEIS Corporation. The procedure is predicated on the extraction of key landmark points in the CT images via a proprietary algorithm for segmentation and automatic localization. The anatomical structures of interest are converted into mesh models akin to STereo-Lithography (STL) format. A visual inspection of this processing is performed to ensure the integrity of the outcome.

The coordinates of the planned trajectories are exported as digital data to be integrated into the treatment process. The system amalgamates the anatomical data and trajectory coordinates to facilitate a preliminary positioning of the 2 constituent elements of the device, namely the baseplate and the C-arm. The basal part (baseplate), containing the specific maxillary dental negative impression of each patient (Figure 2), is precisely aligned to ensure optimal anchorage and stability of the device relative to the targeted regions. The C-arm, containing...
the numbered insertion ports, is then positioned on the baseplate, and angulations of the different insertion ports are determined using the digital data derived from the planned trajectories. Depending on the size of the lesion to be biopsied, a total of 2 (for smaller lesions) or 3 (for larger lesions) insertion ports are designed on the C-arm. The system manages the insertion depth of the biopsy instrument and the trephination depth. These depth measurements are calculated on the digital models extracted from the imaging and are constrained by removable stop systems (guides) that are inserted on the C-arm ports. Two guides are designed for a single insertion port: 1 for the trephination pin and 1 for the biopsy needle. The pin guide has 2 numbers printed on it, a single number corresponding to the number of the insertion port (eg, number 1 corresponds to insertion port number 1) and a number with a letter corresponding to the distance to be measured through the thickness of the skull (yellow arrow; 6c = 6 mm in this case). Once the correct measurement has been taken (B), the pin attached to the Jacobs chuck is then inserted to trephinate through the thickness of the skull (C). The pin guide is then replaced by the biopsy guide into which the biopsy gun needle is inserted up to the guard (D).

Figure 2—Example of a biopsy device and its principle of use. Disassembled parts (A): C-arm with insertion ports for the biopsy instrumentations (1), baseplate with maxillary dental impression and zip tie insertion holes on both sides (2), zip tie (3), nose support (4), biopsy needle guide (5), and pin guide (6). The pin guide shows the number corresponding to the port number (blue arrow) and the number with the letter corresponding to the distance to be pre-measured through the thickness of the skull (yellow arrow; 6c = 6 mm in this case). Once the correct measurement has been taken (B), the pin attached to the Jacobs chuck is then inserted to trephinate through the thickness of the skull (C). The pin guide is then replaced by the biopsy guide into which the biopsy gun needle is inserted up to the guard (D).

Stereotactic biopsy procedure

Preliminary cadaveric study

In a proof of concept study, the device was used to biopsy brain lesions in 2 dogs that were euthanized (barbiturates [pentobarbital; Dechra; 0.35 mL/kg] administered IV after general anesthesia with propofol [propofol injection; Abbott;
titrated to effect] because of their brain disease. Both dogs were Boxers weighing 28.8 kg and 33 kg and had lesions located in the left parietal cortex in 1 dog and in the right frontal cortex in the other dog, respectively. Assembly of the device and attachment to the 2 support brackets was carried out without difficulty and the maxillary jaw fitted perfectly into the maxillary impression on the baseplate, which means that each tooth fits into its own corresponding hole in the maxillary impression, providing a stable, fixed anchorage for the head (Figure 3). Using the appropriate guides, the skull was trephinated and the lesion was biopsied successfully in both cadavers. Intraoperative CT scans confirmed that the biopsy needle was in an appropriate location. As the cadavers were frozen and the intracranial material was probably damaged, no histological analysis was carried out on the cadavers, the aim being solely to study the feasibility of the procedure.

Clinical cases: details of the procedure

All patients were placed under general anesthesia using the same protocol. They were premedicated with an opioid (fentanyl citrate; Renaudin; 2 µg/kg IV) and a benzodiazepine (midazolam injection; Viatris; 0.2 mg/kg IV), followed by induction with propofol (propofol injection; Abbott; titrated to effect). They were then intubated and anesthesia was maintained with isoflurane in 100% oxygen. An intravenous injection of cefalexin (sodium cefalexin; Viatris; 22 mg/kg) was administered just before the procedure.

The surgical site in each patient was clipped of hair and aseptically prepared for surgery and the patients were positioned in sternal recumbency on the operating table. The basal portion of the device, which was not sterile, was then screwed onto the 2 support brackets provided. The animal’s mouth was then opened, and the maxillary jaw was placed on the device, with the maxillary teeth correctly anchored into the patient-specific mold of the maxillary arcade for each patient (Figure 4). A zip tie was then placed to encircle the nose, passing through 2 ports on the basal plate provided for this purpose on either side of the animal (Supplementary Video S1), with the use of a small support adapted to the patient’s nose (thin or wide) when possible. The animal’s body was then draped up to the base of its head. Once the patient was securely fixed in place, the surgical site was again aseptically prepared. The surgeon then attached the removable C-arm to the baseplate while a nonsterile assistant screwed the C-arm on the baseplate using an Allen key (Supplementary Video S2). The animal was then ready for the biopsy procedure.

The first pin guide was placed in the corresponding numbered insertion port on the C-arm. A scalpel was used to make a facilitating incision in the skin and underlying muscles directly under the end of the pin guide. A 3- or 4-mm pin (depending on the size of the animal) was inserted into this guide and the facilitating skin incision until it encountered the cranial bone. The precise distance of skull thickness to be traversed, written on the guide, was measured on the portion of pin emerging from the guide, and the Jacobs chuck was tightened so that the exposed pin length corresponded to the thickness of the skull. The cranial bone was then trephinated by applying pressure and a twisting motion to the pin chuck perpendicular to the pre-determined trajectory angle of the guide until the end of the pin chuck encountered the end of the pin guide (Figure 4). Once through the skull, the pin and the pin guide were removed and replaced with the biopsy needle guide. The biopsy needle was inserted until the biopsy gun handle touched the outer end of the guide, indicating the

Figure 3—Example of a first try of the biopsy procedure on 1 of the 2 cadavers, an 11-year-old Boxer dog. The dog had an intra-axial nonenhancing mass lesion in the right frontal cortex (A). The maxillary jaw fitted properly into the maxillary impression made in the device (B), and the dog was perfectly immobilized using a zip tie passing through a nose support. The device was successfully assembled (C; blue material) and attached to the 2 support brackets (C; green material). After having trephinated the skull, the biopsy needle could be inserted into the appropriate guide provided (C). On the intraoperative CT scan image, the biopsy needle adequately penetrated the lesion (D).
The tip of the biopsy needle was positioned within the lesion to be biopsied (Supplementary Video S3). Once appropriately positioned, the biopsy gun was fired to obtain the biopsy, the biopsy instrument was withdrawn from the brain and the guide, and the specimen was manually collected from the biopsy instrument and placed in formalin.

One or 2 additional biopsies were taken from the same port and other biopsies were performed from the 1 or 2 other ports provided for this purpose, depending on the initial design of the C-arm and the number of insertion ports it contains, trying to pass through the same hole in the skull if possible or in a new one if necessary. Once all the biopsies had been obtained, the entire device was removed. Once all the biopsies had been obtained, the entire device was removed.

The animal was then awakened from anesthesia and placed directly in the intensive care unit to monitor its recovery. The procedure took less than 30 minutes (from 19 to 28 minutes).

**Processing of biopsy samples**

All the samples were sent to the histopathological laboratory (Anydiaq Laboratory). Specimens were fixed for 24 hours in 10% neutral buffered formalin and then paraffin embedded and stained with H&E for histological examination. All samples were reviewed by a board-certified veterinary pathologist.

**Statistical analysis**

Data were compiled in an Excel spreadsheet, using Microsoft 365 Excel Online Version 16.0. Only descriptive statistics were used owing to the small sample size of the case series. Numerical data were expressed as median and range.

**Results**

**Signalment and clinical signs**

The study population included 4 dogs (2 French bulldogs, 1 Belgian Malinois, and 1 Chihuahua) and 1 cat, a Domestic Shorthair. The median age of the dogs was 4.4 years, and the cat was 13 years old. The median body weight of the dogs was 9.9 kg, and the cat weighed 6.5 kg. There was 1 intact male dog, 1 neutered male dog, 1 intact female dog, 1 spayed female dog, and the cat was a neutered male cat.

All of the dogs and the cat had intracranial clinical signs before admission. All the animals with structural epilepsy (n = 3) received antiepileptic drugs (phenobarbital; Dechra; 2.5 mg/kg twice a day) and all the animals received oral prednisolone therapy (prednisolone; Ceva; from 0.25 to 1.5 mg/kg/day) before the biopsy procedure. All the animals had normal CBC, including platelet counts within reference ranges (> 150,000/mm³).

**Magnetic resonance imaging findings**

One dog had multifocal intra-axial lesions mainly affecting the 2 cerebral hemispheres, with 1 lesion in the brainstem and 1 in the thalamus. One dog had multifocal extra-axial supra- and infratentorial lesions, with the main lesion located in the left cerebellopontine angle. Two of the dogs had a solitary well-defined intra-axial forebrain lesion, both on the left side. The cat had a suspected extra-axial lesion in front of the left frontal cortex.
The median volume of the lesions was 2.53 cm³. The smallest lesion to be biopsied was in the Chihuahua dog and measured approximately 0.5 cm X 0.9 cm X 1 cm (height X width X length), representing a mass volume of 0.45 cm³. The largest lesion to be biopsied was in the Malinois dog and measured approximately 1.75 cm X 1.5 cm X 2.05 cm, representing a mass volume of 5.38 cm³. All the MRI findings, sizes, and volumes of the biopsied lesions are listed (Supplementary Table S1).

**Histological diagnosis**

The number of biopsies obtained for each patient ranged from 3 to 6. A definitive histological result was obtained on 4 of the 5 patients; 1 result was nondiagnostic in 1 of the French bulldogs due to insufficient sample size. A necropsy was performed on this dog 3 months later, and findings were consistent with a grade II oligodendroglioma. The mass was gelatinous and friable, which may explain the difficulty in obtaining interpretable samples (Figure 5). The other histological findings were consistent with neoplastic processes in 3 cases, including a meningioma in the cat, a tumor of the choroid plexus presumed to be metastatic, and a low-grade astrocytoma in 2 of the dogs. Chronic meningoencephalitis of unknown origin was diagnosed in the remaining dog. These results are summarized (Supplementary Table S1).

**Outcome and adverse effects**

All patients were monitored postoperatively in the intensive care unit and were discharged from the hospital within 24 hours after the biopsy procedure. No complications were observed during the procedure or in the 24 hours of hospitalization following the procedure in any of the patients. The patient diagnosed with chronic meningoencephalitis is currently still receiving immunomodulatory treatment and is in clinical remission. The French bulldog diagnosed with an astrocytoma underwent radiotherapy, which resulted in a significant reduction in the size of the tumor, enabling him to live a normal life to date. The other French bulldog (patient with nondiagnostic biopsy) was unable to undergo radiotherapy for financial reasons and was euthanized (barbiturates [pentobarbital; Dechra; 0.35 mL/kg] administered IV after general anesthesia with propofol [propofol injection; Abbott; titrated to effect]) 3 months later due to an increase in the frequency of seizures after being well controlled for more than 1.5 months after the biopsy procedure. A CT scan performed immediately after the procedure in this patient because of the poor quantity of material retrieved showed the presence of a moderate pneumocephalus within the biopsied lesion without signs of intracranial hemorrhage (Figure 5). The postmortem examination performed

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**Figure 5**—Example of one of the clinical patients necropsied 3 months after the procedure, a 10-year-old French Bulldog. He had an intra-axial nonenhancing mass lesion in the left frontotemporal cortex (A), biopsied using a device fabricated with a half C-arm (B). The CT images taken immediately after the biopsy procedure showed a suitable biopsy site and a moderate pneumocephalus within the mass (C and D). Necropsy showed no degradation of the brain parenchyma and no visible bleeding (E). The mass appeared gelatinous and friable (E; white arrows).
after euthanasia showed no degradation of the brain parenchyma due to the biopsy procedure.

The cat was euthanized 15 days postoperatively due to a sudden deterioration in condition after experiencing a generalized seizure. As his brain mass was very large and the owners did not elect surgery and did not want a necropsy, it is difficult to know whether the sudden deterioration was due to the biopsy procedure or solely to the lesion itself and the subsequent seizure. The dog with the choroid plexus tumor was neurologically stable but developed marked side effects from the prednisolone and was therefore euthanized 1.5 months later.

Discussion

This report describes a stereotactic brain biopsy (SBB) procedure, both on cadavers and on living patients, using an innovative device consisting of a maxillary dental impression plate to secure the position of the skull and a C-arm containing the biopsy ports, which were determined using an amalgam of computerized anatomical data and trajectory coordinates. To the best of our knowledge, this has never been previously reported.

Differences between species and breeds, particularly regarding variations in weight, size, and conformation of the skull and muzzle, have limited the manufacture and development of devices and techniques for the biopsy of intracranial lesions and are particularly challenging in the brachycephalic breeds. The round shape and maxillary malformations in brachycephalic dogs caused problems with the use of a dental bite block and relocatable reference markers placed during the MRI examination performed on 17 dogs.20 Another technique for performing brain biopsies using a 3-D-printed patient-specific face mask has been described,21 but the need to use the bridge of the nose and the nasal planum to support the facemask appeared to be a hindrance when used in brachycephalic breeds. Despite the small number of patients in this study, the use of each patient’s own maxillary dental impression enabled us to perform the biopsy procedure on 2 different species, dog and cat, and on patients with a wide variation in weight and skull conformation. The smallest patient was a 3.5-kg Chihuahua with a dome-shaped skull, while the heaviest patient weighed 21.8 kg. The previously reported problems cited for brachycephalic breeds were not encountered in our brachycephalic patients due to the use of a very thin zip tie to secure the patient’s head to the device and to the use of the C-arm, which accommodated various skull conformations.

Although an antemortem histological diagnosis was obtained in 4 of the 5 clinical patients in our study, our sample is too small in size to establish a diagnostic yield. However, we can highlight the ability of our technique to obtain a histological diagnosis on very small size lesions, since it enabled us to biopsy lesion volume as small as 0.45 cm³, suggesting a high degree of precision in the technical gesture. This offers the hope of achieving a degree of accuracy in the biopsy as high as that of previous published studies9,16,23,25,30–34 in dogs and humans undergoing frame-based SBB, which reported diagnostic yield for neoplastic lesions ranging from 80 to 99% and diagnostic accuracy of 63% to 90%. In addition, previous reports highlight the need to sample multiple areas within a lesion11 and to obtain more than 1 sample27 to limit the risk of obtaining non-diagnostic specimens and to avoid biopsying areas of peripheral gliosis and necrosis. The C-arm of our biopsy device offers the advantage of having between 1 and 3 entry points for biopsy, oriented in different directions, while penetrating through the same or another point in the cranial skull, permitting biopsy of multiple areas of the lesion while remaining as minimally invasive as possible, to obtain the best possible diagnostic accuracy.

Although MRI has been shown to fall within acceptable ranges for SBB in people35 and the accuracy of MRI-designed 3-D-printed skull contoured brain biopsy guides has been shown to be similar to CT in dogs,20 MR and CT images coregistration and fusion are currently used for SBB design and fabrication. Both MRI and CT were used in this study where MRI enabled us to obtain images offering better contrast resolution for identifying the lesions, particularly in the case of small multifocal lesions, whereas the CT scanner was crucial for precise measurements of the trajectory angulations, thickness of the skull and for accurate reconstruction of the maxillary jaw impression. Furthermore, for lesions of sufficient size, we assumed that only the use of a CT scanner would be sufficient for the manufacture of our biopsy device in cases where MRI is not available.

In the few previous studies of stereotactic biopsies performed on live canine patients, intraoperative and postoperative adverse events, characterized by the appearance or exacerbation of neurological signs, were observed in 27% of the dogs23,37 and 88% of these adverse events were transient.7 Significant risk factors for SBB-associated adverse events include decreased platelet count (< 150,000/mm³) and heterogeneous T2-weighted tumor signal, which may be associated with higher grade tumors, increasing the risk of intratumoral hemorrhages.37 Neither of these risk factors was present in the patients included in this study. The CT scan performed immediately after the procedure in the French bulldog with inadequate biopsy samples revealed no evidence of intracranial or intratumoral hemorrhage but did identify pneumocephalus, a common finding on imaging studies after SBB, which is frequently asymptomatic15,23. While postbiopsy CT scans were not routinely performed, a scan could help to determine when a patient can be safely discharged from the hospital after the procedure. Indeed, in humans, some reports38 suggest that in the absence of hemorrhage visualized on postbiopsy imaging examinations, discharge from the hospital within 8 hours of SBB is safe. Moreover, our biopsy procedure offers some other advantages. To the best of our knowledge, this is the least invasive technique described to date, using small skin incisions (< 1 cm) for each specific biopsy site. The technique also appears to be particularly easy to...
perform. Patient preparation and positioning are quick and simple, and the procedure can last less than 30 minutes. It requires only 2 people with only minimal training to perform the procedure. However, as in all previous reports, the biopsy device was fabricated using an external manufacturing company; production time appeared nevertheless to be short (<1 week), during which time the patient could be medically stabilized before the biopsy procedure. The device can also be produced somewhat inexpensively making it more feasible for routine veterinary use.

Major limitations of this study included the small number of patients and the lack of necropsy information on 4 of the patients, which did not allow for a complete assessment of the possible complications associated with this procedure. Although no complications were encountered in our clinical patients, potential complications include inadvertent ventricular compromise and biopsy-induced hemorrhage.15-21 Although the use of a CT scan alone may be sufficient to plan this type of procedure, the use of MRI provides superior images of the brain, which allows greater precision in the planning process as well as minimizing the risk of potential complications.

In conclusion, the 3-D-printed frame-based stereotactic brain biopsy using maxillary dental impression is a safe, highly precise, inexpensive, and minimally invasive innovative way of sampling brain lesions in dogs and cats. Variations in the size and shape of the skull and muzzle do not hinder the manufacture and use of the device. However, further studies with a larger population should be performed to establish a diagnostic yield and complication rates associated with the procedure. Moreover, future studies in which instantaneous histopathological results are obtained during the procedure could allow for the development of novel treatment strategies in which the biopsy guide is used to deposit a potential therapeutic agent directly inside the lesion.

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Supplementary Materials

Supplementary materials are posted online at the journal website: avmajournals.avma.org.