This report reviews a radiographic study of the spine that was carried out in practice using a step-by-step approach to appraise each image in an attempt to recognise where improvements are required and how future studies can be approached.

Species: Canine  
Breed: Border Collie  
Age: 8 years 7 months  
Sex: Male  
Weight: 28.8 kg

**Presenting problem/clinical history**

This Border Collie had trouble rising and a gradual worsening of general stiffness. Clinical examination localised his discomfort to the lumbar–sacral areas with bilateral hip and cervical pain. A short trial on meloxicam improved his comfort levels and general demeanour.

**Discussion of nursing intervention**

**Care of the patient**

The patient was prepared for radiographic imaging of the spine (*Tables 1* and *2*). The patient was anaesthetised, as supported by McKee (1996) and Kirberger (2006), who advise that this will allow relaxation of the spine and reduce muscle spasms; this enables accurate positioning, which is essential to achieve good radiographs. The anaesthetic protocol involved a pre-medication of 30 μg/kg acepromazine maleate (Calmivet, Vetoquinol) and 20 μg/kg buprenorphine (Vetgesic, Alstoe limited) subcutaneously. Anaesthesia was induced with intravenous propofol (PropoFlo plus, Abbott Animal Health) given to effect. Anaesthesia was maintained with isoflurane (Isoflo, Abbott Animal Health) vapourised in 100% oxygen.

Preventive measures were taken to minimise heat loss during the procedure. These included use of bubble-wrap socks, placement onto a covered heat-pad and covering whenever possible. This prevents peri- and post-operative hypothermia that can have consequences such as depression of the cardiovascular system, increased risk of cardiac arrhythmias and increased shivering, which decreases effective ventilation and increases pain levels (Clark, 2003; Dix et al, 2006; Archer, 2007; Lamb, 2009). The temperature was monitored every 15 minutes throughout the procedure.

Care was taken when manoeuvring the patient. Two veterinary nurses were always involved in turning the patient, which was achieved in one movement; this prevented twisting of the spine, which could result in further damage. Dewey (2008) advises that sedation or anaesthesia increase this risk as a result of the laxity of the paraspinal musculature, which causes instability of the spine.

The patient's anaesthesia became unsettled during all attempts to position him. His respiratory rate and...
the intensity of his breaths increased, his pupils dilated and his heart rate and reflexes increased. These signs indicated that the patient was not reaching a suitable plane of anaesthesia, which was most likely because of discomfort. Jolliffe (2011) advises that radiography may be a painful procedure for some animals, and suitable levels of analgesia are required to ensure a more stable plane of anaesthesia.

The consequences of the patient’s discomfort were that he required high levels of volatile gas to maintain his anaesthetic, which heightened the chance of vasodilation, myocardial depression and hypotension (Smith, 2012). It also meant that positioning was more problematic as is apparent from the resulting images. The veterinary surgeon was informed of the problem, and her decision was to position as best as possible in order to minimise anaesthetic time.

As well as adequate analgesia, simple measures such as use of a radiolucent foam mattress may have improved the patient’s comfort in this case. Corzo-Menéndez (2007) advises that these positioning aids have many benefits, including increasing patient comfort and decreasing patient movement, therefore reducing the need for multiple exposures and decreasing the likelihood of hypothermia.

**Positioning**

Achieving good radiographs is dependent on precise positioning; failure to attain such an outcome can have significant consequences on the diagnostic value of the image, which can lead to pathology that is missed or over interpreted (Ewers, 2007; Agthe, 2008). Standard positioning of the affected anatomy is important, as this makes interpretation easier and future radiographs more easily comparable (Corzo-Menéndez, 2007; Ewers, 2007; Agthe, 2008). Standard positioning of the spine is shown in Box 1.

Sagging and rotation of the spine will cause geometric distortion of the vertebrae. Pettet (2008) warns that this is a common reason for overdiagnosis of intervertebral disc disease, as the beam passes through at an oblique angle causing a false impression of narrowing. This can be prevented by positioning the spine so that it lies parallel to the film, which was attempted in this case. Foam wedges were used as detailed in Box 1 to correct areas of sagging, and in between the limbs to prevent rotation; items such as cotton wool or bandages can also be used (McKee, 2000; Varga, 2012). Sirotis et al (2010) recommend placing a piece of tape along the spinal column at the start of the procedure to help highlight any rotation.

Accurate positioning was not achieved very well in this case; evidence of rotation can be seen on most exposures (Table 3). The veterinary surgeon did not want any of the exposures repeated; however, if this was required, it is recommended that the patient is

<table>
<thead>
<tr>
<th>Number</th>
<th>Radiographic view</th>
<th>kV</th>
<th>mAs</th>
<th>Anatomical landmarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lateral cervical spine</td>
<td>70</td>
<td>6.0</td>
<td>Centre over C4–C5 Collimate from base of skull to spine of scapula</td>
</tr>
<tr>
<td>2</td>
<td>Lateral thoracic spine</td>
<td>82</td>
<td>14.0</td>
<td>Centre over caudal border of scapula/T7 Collimate from spine of scapula to halfway between xiphoid and last rib. Include C7 and L1</td>
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</tr>
<tr>
<td>4</td>
<td>VD cervical spine</td>
<td>70</td>
<td>6.0</td>
<td>As lateral</td>
</tr>
<tr>
<td>5</td>
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**Box 1. Positioning for views of the spine**

**Lateral**
- **Patient is in lateral recumbency**
- **Foam wedges/cotton wool/bandages should be placed to ensure the vertebral column is parallel to the table; most commonly this is under the nose, neck, lumbar region, sternum and in between the limbs**
- **Exact placement of positioning aids varies between patients, and they should be placed after visual assessment. For example, a barrel-chested breed such as a Greyhound will require more support under the sternum, and a large-skulled breed such as a Staffordshire Bull Terrier will need extra support of its head to prevent cervical rotation**
- **The support in between the limbs should ensure the limbs lay parallel to each other and the horizontal plane, which will prevent ventral rotation**
- **Extend pelvic limbs caudally and secure if exposing the cervical vertebrae, and cranially for all other sections**
- **Extend hind limbs caudally and secure**

**Ventrodorsal**
- **Patient is in dorsal recumbency secured by trough or sandbags**
- **The sternum and the spine must be in the same vertical plane**
- **Extend pelvic limbs caudally, and secure if exposing the cervical vertebrae, and cranially for all other sections**

There are no significant deviations from the standard positioning of the spine that was attempted in this case. However, there were some consequences of the patient’s discomfort, which led to the need for high levels of volatile gas to maintain anaesthesia, and this increased the chance of vasodilation, myocardial depression and hypotension. This resulted in positioning difficulties, and therefore the need for multiple exposures and an increased risk of hypothermia. It is recommended that future positioning should aim to reduce these risks by ensuring adequate analgesia and using positioning aids such as foam wedges and tape to help highlight any rotation.

**Table 2. Anatomical positioning of the radiographs**

<table>
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**VD, ventrodorsal**
not moved until the images have been evaluated, as this makes corrections to positioning easier to achieve (Agthe, 2008).

**Clinical**

**Table 3. Radiographic images of the spine and their appraisal**

<table>
<thead>
<tr>
<th>View</th>
<th>Radiograph</th>
<th>Film appraisal</th>
</tr>
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</table>
| Lateral cervical      | ![Image](image1) | Positioning  
  - Sagging of vertebrae towards plate. Transverse processes should be superimposed  
  Required positioning corrections  
  - Use of wedges/bandages under neck to correct sagging  
  Collimation  
  - Too wide  
  Centring  
  - Too dorsal  
  Exposure  
  - Good  
  Other  
  - Positional marker and ruler included |
| Lateral thoracic      | ![Image](image2) | Positioning  
  - Rotated. Rib insertion point should be superimposed  
  Required positioning corrections  
  - Ensure spine and sternum on same horizontal plane by use of correct size radiolucent wedges  
  Collimation  
  - Could have moved cranially to include all of T1 and fewer lumbar vertebrae. Ideally should be split into smaller sections as x-ray beam diverged at edges  
  Centring  
  - Could be improved  
  Exposure  
  - Good  
  Other  
  - Positional marker and ruler included |
| Lateral lumbar        | ![Image](image3) | Positioning  
  - Good  
  Collimation  
  - Good — includes landmark vertebrae T13 and S1  
  Centring  
  - Good  
  Exposure  
  - Good  
  Other  
  - No markers |

**Centring and collimation**

Close collimation and precise centring is vital for any radiographic study to ensure accurate representation of the anatomy. Excessive collimation will increase the amount of scattered radiation and therefore compromise the quality of the image (Corzo-Menéndez, 2007; Agthe, 2008). It also increases the amount of radiation received by the patient, which is an unnecessary health hazard (Ewers, 2007). This was not achieved well in this case, as both excessive collimation and inaccurate centring is seen on the exposures (Table 3).

The radiographs were taken as instructed by the veterinary surgeon, which was in line with McKee (2000) and Pettett’s (2008) recommendations that the spine should be radiographed in sections rather than as one exposure. However, a more diagnostic image would have been achieved by sectioning even further, as areas such as the thoracic vertebrae show narrowing of the vertebral spaces towards the edges of the image. This is unlikely to be a true representation of the joint spaces, but rather caused by the divergence of the primary beam at the periphery of the collimated area (Ewers, 2007; Agthe, 2008).

Agthe (2008) recommends using the information gained from the clinical examination to localise the problem areas as accurately as possible when planning a radiographic study. In this case, the problem areas were known to be lumbar–sacral and cervical; it may have been advantageous to section the cervical area into cranial and caudal and focus on lumbar–sac-
Table 3 (continued). Radiographic images of the spine and their appraisal

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<tr>
<td>VD cervical</td>
<td>![VD cervical image]</td>
<td><strong>Positioning</strong>&lt;br&gt;• Rotated and not straight. Transverse processes should look symmetrical&lt;br&gt;• Spinal processes should be central&lt;br&gt;<strong>Required positioning corrections</strong>&lt;br&gt;• Ensure no longitudinal rotation from tip of nose to tail by adjusting traction on limb ties or body support. Ensure patient lying straight in primary beam&lt;br&gt;• Support under neck if sagging evident&lt;br&gt;<strong>Collimation</strong>&lt;br&gt;• Too wide vertically&lt;br&gt;<strong>Centring</strong>&lt;br&gt;• OK&lt;br&gt;<strong>Exposure</strong>&lt;br&gt;• Good&lt;br&gt;<strong>Other</strong>&lt;br&gt;• No markers&lt;br&gt;• Endotracheal tube visible</td>
</tr>
<tr>
<td>VD thoracic</td>
<td>![VD thoracic image]</td>
<td><strong>Positioning</strong>&lt;br&gt;• Rotated, especially cranially&lt;br&gt;• Spinal processes are deviated laterally&lt;br&gt;• Sternum should be superimposed. Ideally should be split into smaller sections&lt;br&gt;<strong>Required positioning corrections</strong>&lt;br&gt;• As above&lt;br&gt;<strong>Collimation</strong>&lt;br&gt;• Good&lt;br&gt;<strong>Centring</strong>&lt;br&gt;• Good&lt;br&gt;<strong>Exposure</strong>&lt;br&gt;• Good&lt;br&gt;<strong>Other</strong>&lt;br&gt;• No markers</td>
</tr>
<tr>
<td>VD lumbar</td>
<td>![VD lumbar image]</td>
<td><strong>Positioning</strong>&lt;br&gt;• Rotated, especially caudally&lt;br&gt;• Not straight&lt;br&gt;<strong>Required positioning corrections</strong>&lt;br&gt;• Ensure no longitudinal rotation from tip of nose to tail by adjusting traction on limb ties or adjusting body support. Ensure patient lying straight in primary beam&lt;br&gt;<strong>Collimation</strong>&lt;br&gt;• Good&lt;br&gt;<strong>Centring</strong>&lt;br&gt;• Good&lt;br&gt;<strong>Exposure</strong>&lt;br&gt;• Under exposed&lt;br&gt;<strong>Other</strong>&lt;br&gt;• No markers&lt;br&gt;• Edge of trough is overlying L1/</td>
</tr>
<tr>
<td>VD, ventrodorsal</td>
<td>![VD, ventrodorsal image]</td>
<td></td>
</tr>
</tbody>
</table>

McKee (2000) recommends that the whole vertebral column is radiographed regardless of the problem area, as he advises that failure to do this may miss any ‘silent’ lesions; however, smaller sections would have been beneficial in this study. Pettett (2008) advises that up to six films is a suitable number for a large dog.
Conclusion

The images achieved from this study were of a substandard quality, showing evidence of rotation, excessive collimation and inaccurate centring. It is questionable whether these exposures had much diagnostic value; however, the veterinary surgeon was satisfied that they ruled out any major pathology such as tumours.

The author’s recommendations to improve the quality of the images would be to provide better analgesia to the patient to facilitate a smoother anaesthetic, to use a wider range of positioning aids and to increase the number of exposures taken to enable focusing on smaller sections of the vertebral column in each exposure. VN

Conflict of interest: none.

References


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