

Basic Science

Validation of cone-beam computed tomography and magnetic resonance imaging of the porcine spine: a comparative study with multidetector computed tomography and anatomical specimens

Ricardo Miguel Costa de Freitas, MD^{a,b,*}, Celi Santos Andrade, PhD^a,
José Guilherme Mendes Pereira Caldas, PhD^a, Alexandre Fligelman Kanas, MD^a,
Richard Halti Cabral, PhD^c, Miriam Harumi Tsunemi, PhD^d,
Hernán Joel Cervantes Rodríguez, PhD^e, Said Rahnamaye Rabbani, PhD^e

^aRadiology Department, Instituto de Radiologia-InRad, Faculdade de Medicina da Universidade de São Paulo, Av. Dr. Enéas de Carvalho Aguiar, s/nº - Rua 1 - Cerqueira César, CEP: 05403-900, São Paulo, SP, Brazil

^bRadiology Unit, Instituto do Câncer do Estado de São Paulo-ICESP, Avenida Doutor Arnaldo, 251, Cerqueira César, 01246-000, São Paulo, SP, Brazil

^cAnatomy Department, University of São Paulo Institute of Biomedical Sciences, Av. Prof. Lineu Prestes, 2415 - Cidade Universitária, Butantã, 05508-900, São Paulo, SP, Brazil

^dBiostatistics Department, Universidade Estadual Paulista Júlio de Mesquita Filho Biosciences Institute, Dist. Rubião Jr, 18618-970, Botucatu, SP, Brazil

^eMagnetic Resonance Imaging Laboratory, Instituto de Física da Universidade de São Paulo, Rua do Matão, Travessa R, 187, Cidade Universitária, 05508-090, São Paulo, Brazil

Received 22 January 2014; revised 10 October 2014; accepted 8 January 2015

Abstract

BACKGROUND CONTEXT: New spinal interventions or implants have been tested on ex vivo or in vivo porcine spines, as they are readily available and have been accepted as a comparable model to human cadaver spines. Imaging-guided interventional procedures of the spine are mostly based on fluoroscopy or, still, on multidetector computed tomography (MDCT). Cone-beam computed tomography (CBCT) and magnetic resonance imaging (MRI) are also available methods to guide interventional procedures. Although some MDCT data from porcine spines are available in the literature, validation of the measurements on CBCT and MRI is lacking.

PURPOSE: To describe and compare the anatomical measurements accomplished with MDCT, CBCT, and MRI of lumbar porcine spines to determine if CBCT and MRI are also useful methods for experimental studies.

STUDY DESIGN: An experimental descriptive-comparative study.

METHODS: Sixteen anatomical measurements of an individual vertebra from six lumbar porcine spines (n=36 vertebrae) were compared with their MDCT, CBCT, and MRI equivalents. Comparisons were made for the absolute values of the parameters.

RESULTS: Similarities were found in all imaging methods. Significant correlation ($p<.05$) was observed with all variables except those that included cartilaginous tissue from the end plates when the anatomical study was compared with the imaging methods.

CONCLUSIONS: The CBCT and MRI provided imaging measurements of the lumbar porcine spines that were similar to the anatomical and MDCT data, and they can be useful for specific experimental research studies. © 2015 Elsevier Inc. All rights reserved.

Keywords:

Anatomy; Porcine; Lumbar spine; Cone-beam computed tomography; Multidetector computed tomography; Magnetic resonance imaging

FDA device/drug status: Not applicable.

Author disclosures: **RMCF:** Grant: FAPESP Government agency (No. 2011/51222-8) (B, Paid directly to institution). **CSA:** FAPESP Government agency (2012/00398-1) (B, Paid directly to institution). **JGMPC:** FAPESP Government agency (No. 2011/51222-8) (B, Paid directly to institution). **AFK:** Nothing to disclose. **RHC:** Nothing to disclose. **MHT:** Nothing to disclose. **HJCR:** Nothing to disclose. **SRR:** Nothing to disclose.

The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

This study was supported by government research grant and the authors disclose no conflict of interest.

* Corresponding author. Radiology Unit, Instituto do Câncer do Estado de São Paulo, Avenida Doutor Arnaldo, 251-Cerqueira César, São Paulo 01246-000, SP, Brazil. Tel.: (55) 113893-2945.

E-mail address: ricardomcfreitas@gmail.com (R.M.Costade Freitas)

Introduction

Experiments in animals have been performed as a model to preclinical essays to test the safety of new techniques or devices in surgical or interventional image-guided methods before they are carried out in humans. The more appropriate models comparable with human spine samples are obtained from porcine or canine spines [1]. Porcine spines are easily available, and spinal interventions or implants have been tested on ex vivo or in vivo swine models [2–4].

A database of anatomical measurements of porcine spines is important to provide anatomical references when developing such implants or techniques. Comparisons among porcine spine anatomy and other animal models or between human and swine spines have been previously described [5–7].

Interventional procedures of the spine are mostly guided by fluoroscopy in clinical practice. Moreover, these procedures can also be carried out with multidetector computed tomography (MDCT), particularly when high precision is crucial for more difficult or complex cases [8]. Cone-beam computed tomography (CBCT) and magnetic resonance imaging (MRI) are also available to guide interventional spine procedures [9,10]. In the experimental spinal research field, high precision images may also be essential in the development and evaluation of new techniques or devices, such as disc punctures, lumbar interbody fusion, or tumor ablation [11–15].

Although some MDCT data from porcine spines are described in the literature [5], its comparison with CBCT or

MRI is lacking. The aim of this descriptive study was to compare the anatomical and MDCT dimensions of the individual vertebrae from six lumbar porcine spines with their CBCT and MRI measurements to determine if the last two methods are also useful in porcine spine experimental studies.

Materials and methods

This work was approved by our institutional Animal Use and Care Committee (registry number: 239/11). Six fresh skeletally immature spines from healthy 3- to 4-month-old farm bred domestic Landrace pigs (*Sus scrofa domesticus*) with average weight of 35 kg (range 32–38 kg) were obtained from cadavers. These swines were euthanized after abdominal surgery at the Experimental Surgery Laboratory of our institution, following the ethics and management welfare criteria applied to the experimental animals [16].

All spines were dissected from L1–L6 and only paravertebral musculature was initially removed. The specimens were then kept in formalin and imaging was obtained (Fig. 1).

Multidetector computed tomography scans (GE Dual Energy 64-slices Discovery CT; GE Healthcare, Waukesha, WI, USA) were obtained with a slice thickness (ST) of 0.625 mm and a reformatted resolution of 0.35 ± 0.05 mm protocol.

Cone-beam computed tomography scans (GE Innova 4100; GE Healthcare, Inc., Waukesha, WI, USA) were performed with the following protocol: fluoroscopy frame rate: 30 images/s; filter: 0.2 mmCU; 87 kV; and 0.5 mA.

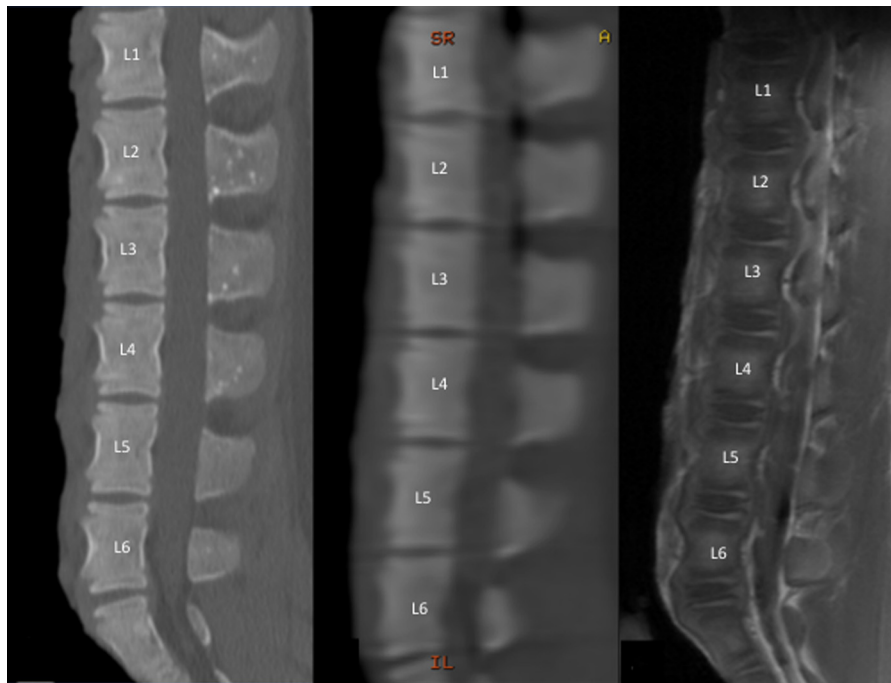


Fig. 1. Sagittal views from lumbar porcine spine imaging: (Left) multidetector computed tomography, (Middle) cone-beam computed tomography, and (Right) T1-weighted magnetic resonance imaging. Lumbar vertebral levels were indicated from L1–L6. After imaging acquisition, the vertebrae were dissected for anatomical study.

Download English Version:

<https://daneshyari.com/en/article/6212039>

Download Persian Version:

<https://daneshyari.com/article/6212039>

[Daneshyari.com](https://daneshyari.com)