Radiological and imaging techniques

and

Pattern of normal adult lumbar spine

Thesis

Submitted in partial Fulfilment for

master degree in radiodiagnosis

by

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ACKNOWLEDGEMENT

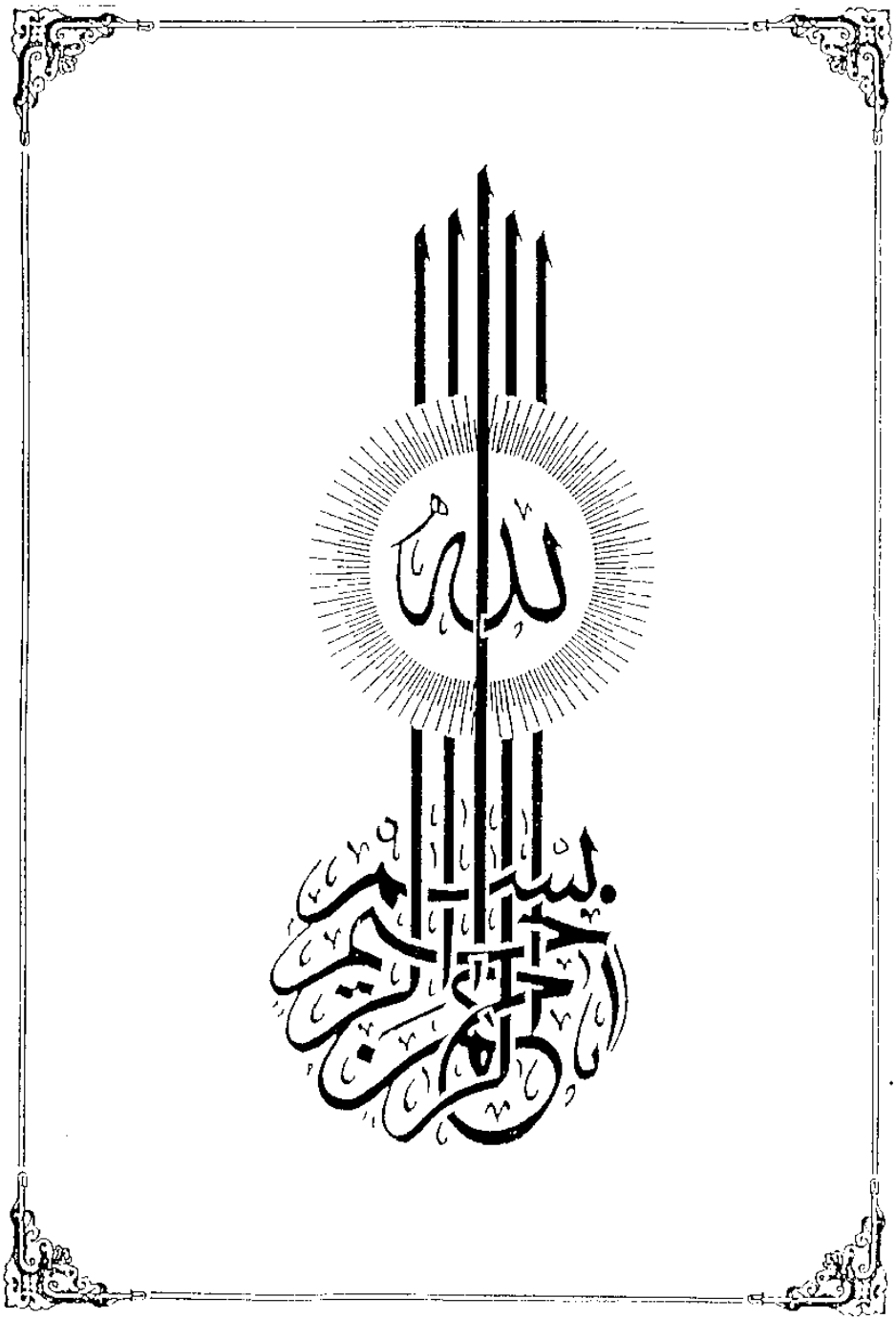
I would to express my deep thanks to all those who participated in giving their golden knowledge, to those who honoured me and gave glints of lights on my way to knowledge.

I am grateful to professor Dr. ZENAB ABDALLAH Professor of Radiodiagnosis , Ain Shams University for her unfailing advice, supervision, constructive encouragement and guidance, .

I am also grateful and I wish to express my deep gratitude and thanks to professor Dr. FAHMY ABU AHMED Professor of Radiodiagnosis , MILITARY MEDICAL ACHADEMY for his generous help, kind advice and continu-'ous supervision.

My appreciation is extended to my teaching staff, colleagues and technical staff for their kind help.

SAID ABD EL-GHANY AHMED.



INTRODUCTION AND AIM OF WORK

This work is aimed to study the normal adult lumbar spine, using different radiological and imaging techniques. Our study aims at examining a sample of the patients about 33, establishing the radiodiagnostic techniques for examining such cases, correlation of radiologic data, recording the results and comparison of our results with those of other authors in different countries. Inspite of the small sample examined, and the need four further studies, we hope that we have achived even a small step for the advance of medical science.

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CONTENTS

REVIEW OF LITERATURE

GROWTH AND DEVELOPMENT

" GROWTH AND DEVELOPMENT OF THE LUMBAR SPINE

Following the early mesenchymal stage, in which the sclerotomes grow and segment into primitive connective tissue vertebrae and intervertebral discs, centeres of chondrification begin to appear in the connective tissue vertebrae at approximately the seventh fetal week(Rene Louis 1982) .Two cartilaginous centers develop in each vertebral body and one appears on each side of the incomplete vertebralarch. These four primary centeres grow and fuse into a single cartilaginous vertebrae. Failure of development or hypoplasia of one of the two chondrification centeres in the vertebral body is though to be the principal cause of Hemivertebra (Epstein,B.S. 1976).

The open vertebralarch continues to grow posteriorly around the spinal cord until after the second fetal month,when the two sides of the cartilaginous arch unit and enclose the cord completely.

The transverse,articular and spinous processes grow from the edges of thearch.(John Caffey,A.B..1967)./The best evidence indicates that the vertebral body grows in length exclusively from the proliferating cartilage plates at the cephalic and caudal ends,just as a long bone grows in length. The vertebral ring cartilage,long miscalled or ring epiphyseal cartilage, is outside the zone of growth and endochondral bone formation.The longitudinal growth of eachvertebral body and the total composite longitudinal growth of the whole spine are modified by

the stress of weight - bearing in the lumbar levels, where the normal stress of weight - bearing is greatest,excessive lengitudinal growth and transverse hypoplasia of the vertebral bodies were maximal. (Rene Louis) 1982.

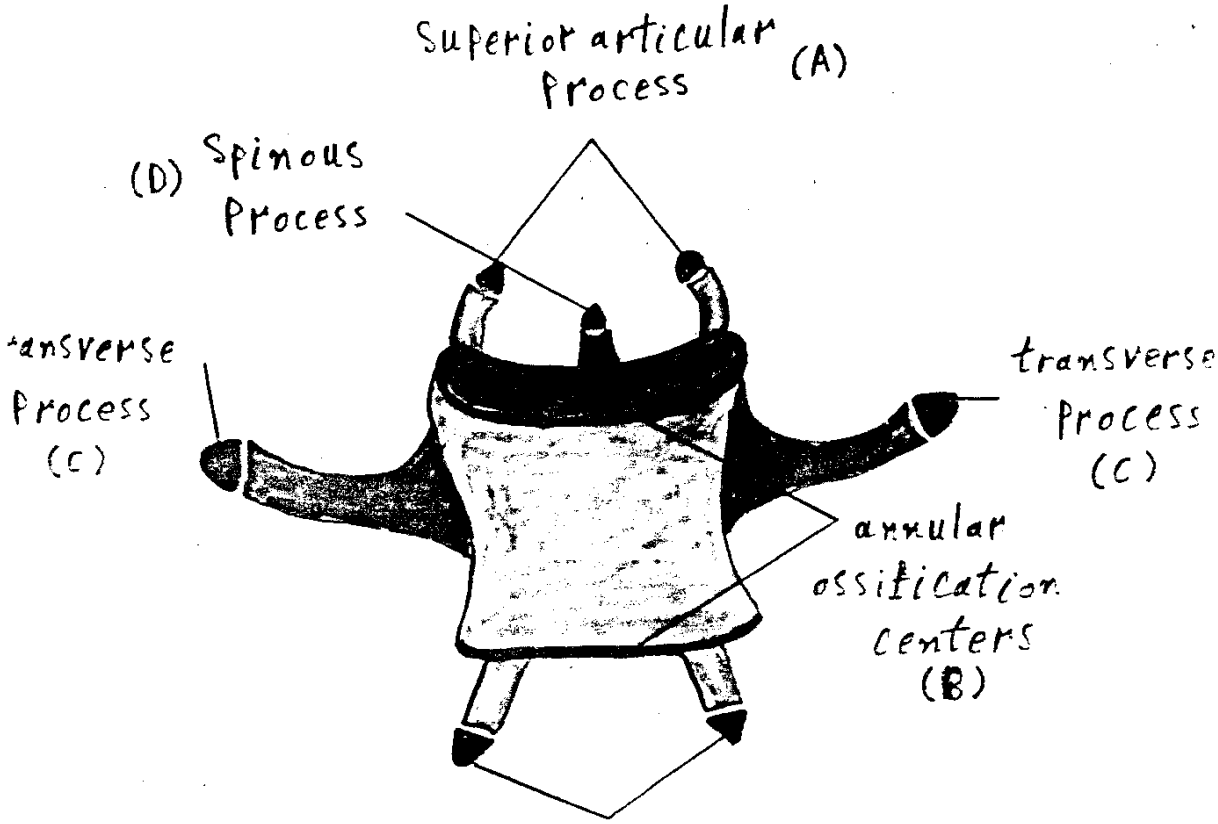
A. Primary ossification centers :-

Ossification centers first make their appearance in the cartilaginous vertebrae at about the tenth fetal week.There are three primary centers : a single osseous nucleus in the body and two nuclei in the arch, one of which is in each pedicle.These primary ossification centers continue to extend into the cartilaginous vertebra during embryonic life but are still separated from one another by cartilaginous bridges at birth. The fusion of the ossification center in the body with the center in each side of the arch takes place at the neurocentral sutures between the 3rd and the 6th year. The two bony centers in the arch extend posteriorly towards the midline and complete the bony neural arch during the first two postnatal years. (Caffey, A.B., 1967).

B. Secondary Ossification centers :-

Secondary ossification centers begin to appear in the annular cartilages shortly before pulberty in females . in males they develope somewhat later. Normally they fuse with the vertebral body 5 - 10 years after their first appearance. The longitudinal growth of the spine after birth (postnataly) in due to the proliferation of cartilage on the upper

the Secondary vertebral ossification centers
(Antero-posterior)



A + C + D + E

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all apper at approximatly 16 years and fuse with their respective process at approximatly 25 years.

B

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appears at as early as 7th year in females and fuse with the main mass of the body at approximatly 25 years.

and lower zones of the primary ossification center in the vertbral body.

This ring of cartilage, often miscalled an epiphysis, ossifies independently of the primary center, which constitutes the body of the vertebra. It merely fuse with the body when growth of the body is complete . At birth the average length of the spine without sacrum is 20cm. during the first two years the length is about 45cm. At puberty the lengitudinal axis is about 50cm. The final adult length is 60-75cm between the 22nd and 24th year. At birth the lumbar spine makes up one quarter of the total length of the spinal column. in the adult the lumbar segment is increased until it comprises nearly one third of the whole length. The normal curves of the spine do not become fixed untill after puberty. At birth the vertebral column forms a single long shallow curve with its concavity directed anteriorly. The lumbar curve develops when erect posture is assumed at begining of the 2nd year and gradually becomes more prominent during the years of childhood (Johncaffey 1967).

RADIOLOGICAL ANATOMY

RADILOGICAL ANATOMY OF THE LUMBAR SPINE.

Radiological anatomy is going to be discussed according to the following planes of examination of the lumbar spine :-

1. Anteroposterior diagram.
2. Lateral diagram.
3. Oblique diagram.
4. Axial diagram.

1- Anteroposterior Diagram :

The A.P. view shows the bodies, laminae, spinous processes, interlaminar spaces transverse processes, pedicles, superior and inferior articular processes, and the intervertebraldisc spaces clearly. The bodies of the lumbar vertebrae appear as rectangular structures with concave lateral margins.

The superior and inferior surfaces of the vertebral bodies are seen as a single horizontal line when the x-rays are parallel to them, but as two liplike lines when the x-rays are oblique. (Vinita Merill 1975). The component structures of the vertebral arch are visible through the trasparent shadow of the vertebral bodies. The pedicles are projected at the level of the superior angles of the vertebral bodies, and are oval vertical structures above L 4 but triangular at L 4 and L5. (K.C. clark 1974). On each side of the vertebral bodies the transverse processes are projected onto the lateral surface of the pedicles. The posterior tubercle of the spinous process is visible in the region of

the inferior surface of the vertebral body. The articular processes and laminae form a characteristic X-shaped image.The superior articular processes are projected above the pedicles and the inferior articular processes can be identified below the inferior margin of the vertebral bodies.

The center of the X is located over the spinous process with the laminae lying on each side. The interlaminar space is clearly visible between the spinous processes.(Rene Louis 1982).

2. Lateral Diagram :

The lateral view shows the lumbar vertebral bodies,intervertebral disc spaces, spinous processes, intervertbral foramina,superior and inferior vertebral notches, and the lumbosacral junction.The vertebral bodies appear as quadrangular structures with concave sides.The superior and inferior surfaces of the lumbar vertebral bodies appear as two lemniscus like lines.(Philip W.Ballinger,M.S.1982).

The porterior arches begain at the pedicles arising from the upper half of the posterior margin of the vertebral bodies.The superior and inferior articular processes occupythe superior and inferior angles of the posterior edge of the pedicles, constiuting a vertical pillar whose middle region corresponds to the pars interarticularis (isthmus). The laminae appear superimposed over the images of the isthmus.The spinous processes extend horizontally behind the articular pillar at the level of the inferior surface of the vertebral body.(Epstein,B.S.1976). The semilunar intervertbral foramina project between the pedicles, the posterior margin of the intervertebral spaces, and the posterior articulations.

(C.K.Warrick 1979).

3. Oblique Diagram :

The oblique view shows an oblique view of the lumbar bodies, pars interarticularis (isthmus),superior and inferior articular processes and the last lumbar intervertebral foramen.(Glenda.T.Bryan 1982). The isthmus,the narrow part of the vertebral arch between the articular processes and lamina,appears at the inferior and medial margins of the pedicles.The image of the posterior arch in fact resembles that of a little dog on oblique films.The snout corresponds to the transverse process, the eye to the pedicle,the collar to the isthmus and the forelimb to the inferior articular process.(C.K.Warrick 1979). The posterior articulations clearly show their interface due to the posterolateral obliquity of the joints.

4- Axial Diagram:

Viewed transversely , the lumbar vertebrae clearly display the vertebral bodies and posteriorarches comprising the pedicles,the lamina,and the articular,spinous and transverse processes .(Rene Louis 1982).

The cross section of the vertebral canal can be measured in the antero posterior, transverse and oblique directions. Finally, the posterior articulations are well visualized, (Zygapophyseal joints).(Epstein 1976).