AGE RELATED CHANGES IN THE CERVICAL BACKBONE

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ABSTRACT
By using macroscopic inspection, x-ray, histological methods and contrast filling of the blood vessels, investigated were human cervical backbones of grown-up individuals 15 to 88 years old, and of fetuses, newborns and children. Besides to the vertebrae themselves, special attention was paid to the intervertebral disks and joints, as well as to the blood vessels. In the backbones of humans in the age after the fourth decade, alterations were observed in the structure of the vertebrae (mainly in the form of exostoses) and of the backbone as a whole (decrease of the cervical lordosis), in the intervertebral disks (reduction of the highness, loss of the homogeneity, destruction), and in the vertebral artery (firmness of the wall, narrowing of the lumen, and undulations).

Key words: Cervical vertebrae, intervertebral disks, intervertebral joints, cervical lordosis, vertebral artery

INTRODUCTION
We chose the topic “Cervical backbone” for it illustrates as to how the anatomical investigations contribute to the clinics. Although the topic concerns studies carried out half a century ago, it has not loosed its actuality. The changes of the cervical backbone affect lot of other structures, as a result of which complex pain and vascular syndromes appear. The present communication demonstrates results from investigations on the normal structure and the age related alterations in the cervical backbone. The main reason for these investigations was the great practical interest and the absence of relevant anatomical studies.

MATERIALS AND METHODS
Investigated was a great amount of material - 200 human backbones (100 non-fixed) of grown-up individuals 15 to 88 years old distributed in three age groups, and 30 of fetuses, newborns and children up to 15 years of age. Subject of the investigation were the bone skeleton, the intervertebral disks, the intervertebral joints and the blood vessels, including their age related alterations. In addition to macroscopic inspection, applied were conventional x-ray controls, contrast filling of the blood vessels and histological examinations.

RESULTS
The bone skeleton exhibits characteristic features. In addition to those of the first two cervical vertebrae, the remaining ones possess small wedge-like bodies with processus uncinati (unci corporis) arising from their upper end. The intervertebral foramens formed by the vertebral notches are wide, the joints are oriented obliquely frontally, and also a canal exists, canalis transversarius, passing through which are the vertebra artery and vein.

Processus uncinati are one of the important features of the cervical vertebrae. They ossify individually, are highest (6-7 mm) at C5 and C6, surround from lateral the intervertebral foramens, and are well visualized in facial x-ray pictures. The processes play an important role in the cervical backbone mechanics. With advancing age they undergo deformations, and as a result become leading in the backbone pathology, by changing the relationships with the spinal nerves and the vertebral artery.

The cervical intervertebral disks make up 45 % of the length of the cervical backbone. Aside

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they come to the processus uncinati, and backwards - to the vertebral canal. In horizontal sections they are oval, with macroscopically homogenous structure and the nucleus pulposus protruding to the bodies of the neighboring vertebrae. As a result of the great absorbing capacity of the disk, pressure exists inside it. A normal disk immersed in water increases twice its volume and weight. In individuals older than 50 years the absorption decreases, and transverse clefts are frequently observed extending up to the procc. uncinati. Microscopically the disk exhibits polymorphic structure. Nucleus pulposus contains remnants of chorda dorsalis, and electron microscopically a three-dimensional network of thin fibers with globular structures (glycosaminoglycans) included in it is visualized. Annulus fibrosus is composed of collagen lamellae inserted in the cartilage of the terminal plates. They play an important role in the trophicity of the disk for it is avascular.

The intervertebral joints have several characteristic features. They are oriented in the frontal plane with a slight side deviation. The articular surfaces of the two joint outgrowths are oval in shape. The articular cartilage is thicker at the periphery, and there the synovial membrane frequently forms meniscoid folds. With x-ray, the joints are best demonstrated in side projection.

Intervertebral foramen play an important role in the cervical backbone pathology. They are outlined by the vertebral notches, the proc. uncinatus and the intervertebral joint, and medial to them the vertebral vessels pass. The foramen are best demonstrated in semi-side (oblique) x-ray pictures. In female they are oval in shape, and in male - rectangular, with their highness depending on the one of the disk. In our studies the content of the foramen was examined in horizontal and vertical sections. The lower 2/3 of the foramen were found by means of labeling with wire to be occupied by the spinal nerves, and the upper part - by the blood vessels.

The development of the cervical backbone follows the enchondral osteogenesis, with the ossification of the vertebrae starting up from five bony nuclei - two in the vertebral arches, one in the body and two in the procc. uncinati. The ossification proceeds fastest in C4, C5 and C6. The intervertebral disks are visualized before the bone nuclei. As a remnant of the horda dorsalis, nucleus pulposus develops faster than annulus fibrosus (whose lamellae appear later). The cartilaginous plates are a part of the cartilaginous anlagen of the bodies and do not essentially change heir structure.

The blood supply of the cervical backbone is provided by branches of the vertebral artery (the latter going up through the foramina transversaria of the vertebrae and, after getting the atlas, situated in the canalis transeversarius). In the intervertebral segment it is aside the relevant foramen, in close proximity to the proc. uncinatus and the joint. In addition to branches for the spinal cord running along the roots of the spinal nerves, the artery gives small arteries for the vertebrae (four per each vertebra), branches for the joints and the surrounding muscles. These vessels are well visible after contrast filling.

Age related alterations of the cervical backbone are observed from the fourth decade on. Leading of them are those of the intervertebral disks. The degeneration starts with reduction of the highness of the disk, loss of its homogeneity, and appearance of clefts between the processus uncinati and the upper vertebra - i.e. unco-vertebral joints (Figure 1). At advanced degeneration the structure of the disk is completely destroyed. In 400 disks investigated of individuals 35-80 years old, it was established in our studies that after 65 years of age almost all of the disks have lost their normal structure, with the C4-C5 and the C5-C6 segments being most frequently, and the last cervical disk - most rarely, affected. Age related alterations of the cervical backbone occur also in the bones themselves, and are manifested in the lateral x-ray pictures with decrease of the lordosis (Figure 2). They affect the bodies of the vertebrae, the processus uncinati, and the joints. Characteristic of the cervical backbone are the unco-vertebral exostoses (Figure 3). They protrude to the intervertebral foramen and the transversal canal, as a result of which deformation of the foramen and compression of the spinal nerves and of the vertebral artery occur.

The morphological alterations of the a. vertebralis play an important role in the cervical pathology. As a result of unco-vertebral exostoses the artery undulates, its wall becomes firmer, and the lumen narrower.
CONCLUSION
Finally, we are finishing our “stroll throughout the old movies” by again demonstrating a cervical backbone with age-related alterations and by asking what would the situation be if we had had a neck as that of the giraffe.

Figure 1. Frontal (a) and sagittal (b) sections of cervical backbones, demonstrating the presence of clefts between the processus uncinati of the lower and the bodies of upper adjacent vertebrae.

Figure 2. Cervical backbones with decreased lordosis (lateral x-ray view).
Figure 3. Cervical backbone exhibiting unco-vertebral exostoses (black spots).

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