



## Unique pathological findings in skeletal remains of the monks from the Kladruby Monastery, western Bohemia (17<sup>th</sup>–18<sup>th</sup> centuries)

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**ABSTRACT.** The collection of skeletons from the Kladruby Monastery is remarkable because of the incidence of pathological bone deviations. This collection of 111 skeletons shows a high frequency of hyperostotic changes on bones, corresponding to infliction by DISH – diffuse idiopathic skeletal hyperostosis. These changes on the Kladruby skeletons are interesting because they cannot be ascribed to genetic transmission but only to the influence of living conditions. In addition to the monastery's inner environment, it can be assumed that monks consumed identical food and used water from one source. The health effects of water usage have been historically documented, for instance in the case of the Prague's Emauzy Monastery. Given its demographic characteristics (mostly adult, unrelated men), this collection of well preserved skeletons with a considerable rate of pathological bone changes seems to provide a proof of the influence of living conditions on health status.

■ paleopathology, DISH, Forestier's disease, Bechterew's disease, environment.

### INTRODUCTION

The collection of human skeletons from the Monastery in Kladruby, the history and demographic characteristic, which were described elsewhere (Stloukal & Sekáčová 2006), is remarkable because of the incidence of pathological bone conditions. This is extremely interesting given that the collection is composed solely of adult, mostly male individuals among whom blood relations cannot be assumed.

The greater part of this collection was examined for occurrences of pathologies by our late colleague Luboš Vyhnánek (1928–1999) in 1978. He briefly recorded diagnoses of pathological changes but did not get to undertake a detailed analysis and evaluation. Vyhnánek had worked with the part of the collection which was subsequently taken back to Kladruby and laid in the crypt. Of the 40 skeletons with pathological diagnoses, which have been included in the National Museum's anthropological collections, Vyhnánek described only some, and in many cases he probably had at his disposal only a part of the skeleton. The remaining part of the collection was evaluated pathologically only in 2004.

### PALEOPATHOLOGICAL DIAGNOSES

The overview of individuals that follows includes pathologies as well as inborn anomalies and epigenetic markers. Diagnoses established by Vyhnánek are shown in italics.

1 – spondylarthritis on vertebrae C II/C III right, C III/(C IV) left, (C IV)/C V right, C

VII/Th I right and Th I/Th II right, macro-porosity and distortion of intervertebral discs of C V/C VI, C VI/C VII, double foramen transversarium bilat. C V and C VI, ossification of supraspinous ligaments Th III - Th VII, Schmorl's node mostly in inferior vertebral faces Th VI - Th XII, spondylarthritis of thoracic and lumbar vertebrae, arthritic changes of glenoid cavity and on clavicular facet, enthesopathy on great and lesser trochanter of femurs, osteoarthritis of the first metatarsophalangeal joint bilat.

**2** – *synostosis of body of sternum and xiphoid process, xiphoid process perforation, ossification of costal cartilages, plantar and dorsal calcaneal calcar left, on vertebra L I with accessory rib right.*

**3** – *destruction of the first metatarsophalangeal joint bilat., most probably caused by gout (Figure 1).*

**4/I** – *synostosis of body of sternum and xiphoid process, healed fracture of three true ribs in anterior axillary line right, without dislocation.*

**4/II** – *synostosis of manubrium and body of sternum.*

**5** – *synostosis of body of sternum and xiphoid process, xiphoid process perforation, spinal bifida of vertebra S I (or L V – probably sacralization of vertebra L V).*

**6** – *healed bilateral impressive fracture in supraorbital region, with post-traumatically deformation of supra-orbital margin left, C I spina bifida posterior, spondylarthritis of vertebra C VII and on thoracic and lumbar vertebrae, on vertebrae Th IX - Th XII predominantly on right side of vertebral bodies, healed fracture of six left and five right ribs (together with one floating rib) in posterior axillary line, without dislocation.*

**7/I** – *synostosis of body of sternum and xiphoid process, osseous appositions on both epicondyles bilat. and on iliac crest bilat, Forestier's disease on vertebrae Th IV - Th XI (Figure 2); fused vertebrae C VII/Th I.*

**7/II** – *calcaneal calcar left.*

**8** – *synostosis of body of sternum and xiphoid process, xiphoid process perforation, post-traumatic deformation of one proximal phalanx of hand, massive osseous appositions on both trochanters (striking left) and on iliac crest bilat., degenerative changes on vertebrae C I - C II (facet for dens and dens), spondylarthritis on vertebrae C IV - C VI (Figure 3), intervertebral disk osteochondrosis on C VI/C VII; compressive fracture of vertebral body Th III; Forestier's disease on vertebrae Th V - Th XI (Figure 4), spondylarthritis of the rest thoracic and lumbar vertebrae, probably inflammatory changes of metacarpal base.*

**9/I** – *atlas bridging posterior right, healed fracture of one of three true ribs in posterior axillary line right, without dislocation, Schmorl's nodes in superior and inferior terminal facet in vertebrae Th X - Th XII and L I - L II.*

**10/I** – *bilateral atlas bridging posterior, synostosis of body of sternum and xiphoid process, perforation of body of sternum, ossification of cartilaginous parts of ribs, healed fracture in sternal end of one true rib, Schmorl's nodes in superior terminal facet on vertebrae L II - L IV, Schmorl's nodes in both superior and inferior terminal facets on Th IX - Th XII, osseous appositions on iliac crest bilat.*

**10/II** – *synostosis of body of sternum and xiphoid process, shortened left radius (c. 1 cm difference), non-post-traumatic morphological changes of carpal articular surface.*

**11/I** – *bilateral atlas bridging posterior, degenerative changes on vertebrae C I - C II (facet for dens and dens); intervertebral disk osteochondrosis on C VI/C VII; fused vertebrae Th II/Th III; spondylarthritis mostly on thoracic vertebrae, inflammatory changes of lateral and dorsal surface of tibia left, synostosis of body of sternum and xiphoid process, healed fracture of two true ribs right, one left, without dislocation.*

**12/I** – osteoma on frontal bone (16x13 mm), biparietal atrophy, reduction (perforation) of orbital roof, probably secondary fused vertebrae C V - C VII, *Schmorl's nodes in both superior and inferior terminal facets of vertebrae Th VII - Th IX, Schmorl's nodes in inferior terminal facet of vertebrae Th XII, in superior terminal facet of L I, periostitic changes on fibula, without deviation.*

**15** – *atlas bridging posterior left, synostosis of body of sternum and xiphoid process, xiphoid process perforation, ossification of cartilaginous parts of ribs, healed fracture without dislocation in lateral part of two ribs left, scoliosis of lumbar section of spine, arthritic articulation between articular process of vertebrae L V and lamina of L IV, spina bifida in S I.*

**16/I** – *synostosis of body of sternum and xiphoid process, degenerative changes of left superior costal facet on vertebra Th XII, vertebral body L I depression, deformation of radius head with deficient fusion of metaphysis (Figure 5).*

**16/II** – *synostosis of body of sternum and xiphoid process, complete ossification of cartilaginous parts of first rib bilat.*

**17/I** – *healed fracture of one of true ribs in midaxillary line right and left, without dislocation.*

**17/III** – *healed fracture of body of tibia right, osseous bridge between tibia and fibula.*

**18/I** – *synostosis of body of sternum and xiphoid process, perforation of inferior half of body of sternum, deviation of body of sternum to the right.*

**18/II** – *synostosis of body of sternum and xiphoid process, xiphoid process perforation, Schmorl's nodes in both superior and inferior terminal facets of Th VIII - Th XII, spondylolysis of vertebra L V in isthmus with rugged surface.*

**19** – *synostosis of manubrium and body of sternum, degenerative changes of dens, spondylarthritis on vertebrae Th VI - Th VII and L IV - L V, intervertebral disk osteochondrosis on C VI/C VII, double foramen transversarium left on vertebra C VII, bridging osteophytes on vertebrae Th X - Th XII; bridging with striking apposition on L II/L III right.*

**21** – *cribra orbitalia bilat., atlas bridging posterior bilat., synostosis of manubrium and body of sternum, perforation of body of sternum.*

**22** – *synostosis of body of sternum and xiphoid process.*

**23** – *synostosis of body of sternum and xiphoid process, spina bifida of S I.*

**24** – *cribra orbitalia bilat., synostosis of body of sternum and xiphoid process, ossification of cartilaginous parts of ribs, fused vertebrae C VI/C VII, ossification on ventral side of vertebral bodies L III - L V without bridging of intervertebral space, spinal bifida occulta (fused only vertebral arch of S II).*

**25** – *ossification of cartilaginous parts of ribs.*

**27** – *healed fracture of one true rib in anterior axillary line, without dislocation.*

**28** – *deformation of anterior surface of maxilla right, most probably corresponding to inflammatory process in alveolus of M1 right with communication to maxillary sinus, with expression of temporal lines left, synostosis of body of sternum and xiphoid process, ossification in continuation of xiphoid process (to linea alba), bridging osteophytes on Th VIII - Th IX and Th X - Th XI, spondylosis of the rest thoracic and lumbar vertebrae, ossification of supraspinous ligaments (mostly on Th V - Th VII), insinuation of degenerative changes in glenoid cavity left, osteophyte (7x14 mm) on auricular facet right, signs of degenerative changes of hip joint (striking right), osseous appositions on iliac crest bilat (striking left), bend of diaphysis of femur right, degenerative changes of knee joint right.*

- 29** – atlas bridging posterior left, lumbarization of vertebra S I.
- 30** – metopic suture.
- 31** – specific (tuberculosis) process in trochanters of femur right with inflammatory reaction around acetabulum.
- 32** – Schmorl's node in superior terminal facet of L I.
- 33** – complete anodontia in maxilla and mandible, cricoid cartilage ossification (Figure 6), synostosis of body of sternum and xiphoid process, xiphoid process perforation, healed fracture of two true ribs left, without dislocation, ossification of cartilaginous parts of ribs, synostosis of the first rib with manubrium of sternum, degenerative changes striking in lower section of cervical spine, osteophyte on inferior margin of vertebral body C VII, fused vertebrae C V/C VI, supraspinal ligaments ossification on Th III - Th VIII, degenerative changes of glenoid cavity bilat., and carpal articular surface of radius, and on head of ulna bilat., arthritic changes of head of third metacarpal, ossifications on gluteal lines bilat., striking right, and on pubis right (Figure 7).
- 34** – synostosis of body of sternum and xiphoid process, xiphoid process perforation, ossification in costovertebral joints, fused vertebrae L III - L V, ossification on sacral horns (sacroterous ligament) (Figure 8), exostosis on anterior face of greater trochanter left, interphalangeal joint of thumb right.
- 34/I** – synostosis of body of sternum and xiphoid process, complete sacralization of vertebra L V, ossification of sacrotuberous ligament, ossification of insertion of sacrospinal ligament bilat., insinuation of bridging in the sacro-iliac joint area right.
- 35** – metopic suture, atlas bridging posterior bilat., spinal bifida occulta with paramedial spina bifida S I right, deviation of sacrum to the right, supratrochlear foramen on humerus right, inflammatory changes of surface of tibia and fibula left (chronicle osteomyelitis?), inconspicuous periostitis on medial side of medium of tibia right, osteoarthritis of first metatarsophalangeal joint.
- 36** – metopic suture, Schmorl's nodes in both terminal facets of vertebrae C VII - Th X, spina bifida of S I, healed fracture (?) of surgical neck of humerus right, healed fracture of distal third of ulna left and under coronoid process.
- 37** – Forestier's disease on vertebrae Th VI - Th XI (Figure 9), spondylarthritic of the rest thoracic and lumbar vertebrae, deviation of sacrum to the left; sacralization of vertebra Co I, bilateral synostosis of the first rib with manubrium of sternum (Figure 10), ossification of cartilaginous parts of ribs, synostosis of ribs and body of sternum (preserved on ribs IV, V left, V right), osseous appositions on iliac crest bilat. (Figure 11), exostosis on insertion of sacroiliac ligament, suprascapular foramen, degenerative changes of glenoid cavity left, and on proximal articular facets of radius and ulna bilat., exostosis (35x19 mm) on anterolateral side of superior third of femur sin., healed fracture of distal tibia left and synostosis with fibula left, ossified muscle insertions.
- 38** – bridging osteophytes on vertebra Th VI - Th X (not Forestier's disease), changes on both epicondyles of humerus bilat., ossification on linea aspera and osseous appositions on iliac crest bilat., partial ossification of ligament of fibular head right.
- 39/I** – synostosis of body of sternum and xiphoid process, xiphoid process perforation, Forestier's disease on vertebrae Th VI - Th XI, spondylarthritic of lumbar vertebrae, Schmorl's node in terminal facet of Th XII.
- 39/II** – synostosis of body of sternum and xiphoid process, ossified anterior ligament of fibular head left (Figure 12).

- 40/II** – *Schmorl's nodes in inferior terminal facet of vertebra Th XI and in both superior and inferior terminal facets of vertebrae Th VIII - X, lumbarization of vertebra S I.*
- 44/I** – *degenerative changes mostly in cervical section of spine, Schmorl's node in inferior terminal facet of vertebra Th VII, Forestier's disease on vertebrae Th V - Th XII, synostosis of the first rib and manubrium of sternum left, ossified cartilaginous parts of ribs fused with sternum (II - VI left, II, III right), xiphoid process perforation (Figure 13), signs of degenerative changes of glenoid cavity bilat., osteomyelitic changes of distal half of humerus and proximal half of ulna left, synostosis of sacro-iliac joint right, ossifications appositions on iliac crest bilat., incipient degenerative changes of knee joint bilat., healed fracture of distal fibula and medial malleolus of tibia left.*
- 45/I** – *spinal bifida occulta (Figure 14).*
- 45/II** – *metopic suture, bilateral spondylolysis L V bilateral.*
- 46/I** – *cribra orbitalia left.*
- 47** – *opening of cranium during dissection, completely ossified thyroid cartilage (Figure 15), intervertebral disk osteochondrosis in C VI/C VII, spondylarthritis (with maximum in middle thoracic section of spine), ossification of cartilaginous parts of ribs, osseous appositions on iliac crest, osteoarthritis of first metatarsophalangeal joint right.*
- 48** – *healed fracture of one true rib in lateral part right, without dislocation, the same rib with bifurcation (Figure 16), striking of impression for costoclavicular ligament and of conoid tubercle on clavicle right, fused vertebrae Th III/Th IV, depression of the left side of vertebral body Th V, Forestier's disease on vertebrae Th VI - Th X, of the rest vertebrae, deviation of sacrum to the left, spinal bifida occulta S I.*
- 50/I** – *cribra orbitalia right, Forestier's disease on vertebrae Th V - Th XII (Figure 17), calcaneal calcar right.*
- 50/II** – *smooth depression in the side of insertion of sternocleidomastoid muscle, unilateral sacralization of vertebra L V left.*
- 52** – *healed fracture of ulna left in distal third.*
- 53** – *synostosis of manubrium and body of sternum, Bechterew's disease with fusion of vertebrae C VII - L IV, synostosis of sacro-iliac joint right, arthritic changes acromioclavicular joint bilat.*
- 54/I** – *synostosis of body of sternum and xiphoid process, atlas bridging posterior right, ossifications of muscle insertions on femur bilat.*
- 54/II** – *incompletely bilateral atlas bridging posterior, extended transverse process C VII, striking right.*
- 55** – *asymmetry of clavicles, 1 cm shorter right.*
- 56** – *Schmorl's nodes on vertebrae Th VI, Th VII a Th XI, healed fracture of true ribs left in anterior axillary line, without dislocation.*
- 56/I** – *synostosis of body of sternum and xiphoid process, osteoarthritis of subtalar joint bilat.*
- 58/I** – *synostosis of body of sternum and xiphoid process, deformation of vertebral body of Th VII – Th IX, spinal bifida occulta, supratrochlear foramen on humerus left.*
- 58/II** – *amylogenesis imperfecta of teeth, probably healed fracture of femoral neck right, changes of knee joint right (probably caused by luxation with inflammatory complications).*
- 59** – *synostosis of body of sternum and xiphoid process, C VI bilateral double foramen transversarium, spondylarthritis (striking right) on C VI/C VII, Th IV/Th V, Th V/Th VI and Th VI/Th VII, Schmorl's nodes in superior terminal facet of vertebrae Th XI, Th XII*

*a L I, asymmetrically closed arch of vertebra S I, sacralization of vertebrae Co I, Co II, healed fracture of true rib right in posterior axillary line, without dislocation.*

**60** – *synostosis of manubrium and body of sternum and xiphoid process, xiphoid process perforation, ossification of cartilaginous parts of ribs, Forestier's disease on vertebrae Th IV – Th X, Schmorl's nodes in both superior and inferior terminal facets of vertebrae Th XI and Th XII, spina bifida S I, synostosis of sacro-iliac joint bilat. (Figure 18), bilateral bridging of suprascapular notch.*

**61/I** – *lumbarization of vertebra S I.*

**62/I** – *atlas bridging posterior right, bilateral bridging of suprascapular notch, supratrochlear foramen on humerus left.*

**62/II** – *synostosis of body of sternum and xiphoid process, perforation of xiphoid process, degenerative changes of sacro-iliac joints bilat.*

**63/I** – *synostosis of manubrium and body of sternum, ossification of cartilaginous parts of ribs, Schmorl's node in superior terminal facet of vertebra Th IX, L II and L IV, both terminal facets in Th X - Th XII, L I and L III.*

**63/II** – *metopic suture, atlas bridging posterior bilat, spina bifida posterior C I.*

**64/I** – *cribra orbitalia bilat.*

**64/II** – *flat osteoma (8 x 6 mm) in occipital part of parietal bone right, opened foramen of atlas bilat., osteophytes on vertebral body Th VII and Th VIII, on ventral surface of body of vertebrae Th II - Th V.*

**65/II** – *asymmetric synostosis of body of sternum and xiphoid process.*

**66/I** – *C I bilateral incomplete costotransverse bar C I, Schmorl's nodes in both superior and inferior terminal facets Th VI a Th VII.*

**68/I** – *atlas bridging posterior bilat., synostosis of body of sternum and xiphoid process, xiphoid process with double perforation, synostosis of the first rib and manubrium of sternum, ossifications in costal notches (Figure 19), degenerative changes of C I - C II (facet for dens and a dens), unilateral double foramen transversarium left on vertebra C IV, right on vertebra C VI, bilateral on vertebra C VII, intervertebral disk osteochondrosis on vertebra C VI/C VII; Forestier's disease on vertebrae Th VII - Th IX, spondylarthritis lower section of thoracic and lumbar spine, osseous appositions on iliac crest bilat., osteoarthritic changes of acetabulum bilat., synostosis of sacro-iliac joint bilat., osteoarthritic changes on glenoid cavity, striking right, osteoarthritic changes of proximal articular facets of radius and ulna, striking right, ossification of muscle insertions on long bones of lower limbs, degenerative deformation of head of femur bilat., calcaneal calcar (plantar and dorsal) left.*

**68/II** – *synostosis of body of sternum and xiphoid process, body of sternum and xiphoid process with perforation, unilateral incomplete costotransverse bar of C I left, enthesopathy and degenerative changes on patella bilat.*

**69/I** – *flat osteoma on frontal tuber, relatively small foramen magnum, osteoarthritis of atlantooccipital joints bilat., large paramastoid process left, with articulation to transversarium process of C I left, degenerative changes of facet for dens, osseous appositions on iliac crest bilat., synostosis of sacro-iliac joint right, productive changes in sacro-iliac joint area left, without synostosis.*

**69/II** – *synostosis of body of sternum and xiphoid process, divided occipital condyle facet, synostosis of costovertebral joints Th V – Th VII left, inflammatory changes in thoracic spine (tuberculosis not possible) with fusion of vertebrae Th V - Th XI on the left side with deformation of vertebral bodies and with dextroconvexity (Figure 20) – this*

finding has some similarities with kyphoscoliosis caused by rickets (cf. Aufderheide and Rodríguez-Martín 1998, p. 308).

**70/I** – *synostosis of manubrium and body of sternum and xiphoid process, xiphoid process perforation, compressive fracture of vertebral body L I* (Figure 21).

**70/II** – *synostosis of manubrium and body of sternum and xiphoid process, healed Colles' fracture of radius left with typical configuration of ulnar epiphysis.*

**71** – *synostosis of body of sternum and xiphoid process, xiphoid process perforation.*

**72** – *patellar bipartite left (segment is lost)* (Figure 22), *tibia right shorter and reduced than left.*

**73/I** – *synostosis of manubrium and body of sternum and xiphoid process, perforation of body of sternum, complete ossification of cartilaginous parts of ribs* (Figure 23), *ossification of laryngeal cartilages and tracheal cartilages, synostosis of ribs V and VI right in costovertebral arch, bridging synostosis of lower ribs bilat, fused vertebrae C V/C VI, intervertebral disk osteochondrosis C VI/C VII, Bechterew's disease of vertebrae Th II - Th XII, bridging of the right side of vertebral bodies Th VIII - Th XII similar to Forestier's disease and synostosis of rib and vertebra Th VIII right* (Figure 24), *synostosis of sacro-iliac joint bilat., rugged apposition on symphysis and on iliac crest bilat., ossifications of inserts of muscles on long bones (markedly on linea aspera and on tibial tuberosity), signs of osteoarthritis on glenoid cavity* (striking right).

**74** – *metopic suture, atlas bridging posterior of C I bilat, opened right; osteophytes on dorsal surface of vertebral bodies C V - C VI, bilateral double foramen transversarium on vertebra C VI, Forestier's disease on vertebrae Th VII - Th XI, spina bifida S I.*

**75/I** – *synostosis of body of sternum and xiphoid process, bilateral symmetric spondylolysis L V in isthmus, with rugged surface, spina bifida in S I, degenerative changes of styloid process of ulna right, probably caused by osteoarthritis of carpal joint (carpal bones not preserved).*

**76/I** – *elongated, in the front unclosed atlas bridging posterior right, double perforation of body of sternum.*

**76/II** – *synostosis of manubrium and body of sternum, xiphoid process perforation.*

**77** – *unilateral lumbarization of vertebra S I right, healed fracture of surgical neck of humerus left, osseous apposition on ulnar epicondyle of humerus right, healed spiral fracture of both tibia and fibula left with fibular rotation and anticurvation* (Figure 26).

**78/I** – *metopic suture, spina bifida on S I.*

**78/II** – *synostosis of manubrium and body of sternum and xiphoid process, xiphoid process perforation, ossification of cartilaginous parts of ribs, doubled foramen vertebrae C VI right, fused vertebrae Th II/Th III, Schmorl's nodes in both superior and inferior terminal facets of vertebrae Th IX, Th X and Th XI.*

**79** – *synostosis of manubrium and body of sternum and xiphoid process, double xiphoid process perforation, ossification of sternocostal joints I and II left, atlas bridging posterior right, cervical rib, Forestier's disease on vertebrae Th V - Th XI* (Figure 27), *spondylarthritis on vertebrae Th XII - L I, L III, synostosis of sacro-iliac joint right* (Figure 28), *osseous appositions on iliac crest and ischiac tuberosity, osteoarthritic changes on acetabulum right, ossifications on distal third of linea aspera.*

## DISCUSSION

This collection of 111 skeletons is remarkable because of the high incidence of hyperostotic bone changes – mostly bridging of vertebrae combined with ossification of longitudinal ligaments corresponding to Forestier's disease; enthesopathies; ossification of cartilaginous parts of ribs; in a few cases adhesion of pelvic bones with the sacrum through a bridging in the sacro-iliac joint area. These changes generally correspond to affections by DISH – diffuse idiopathic skeletal hyperostosis (Aufderheide & Rodríguez-Martín 1998).

The infliction of the Kladruby skeletons by DISH is interesting because one cannot assume blood relations among these individuals. All lived in identical conditions – but the length of exposure to these conditions depended on when they joined the Benedictine Monastery in Kladruby, or more precisely how much time they had spent in the monastery before they died. In addition to the peculiar environment of the monastery buildings, with a specific air humidity or temperature, it can be presumed that the monks consumed identical food and, most importantly, used water from the same source, either directly for drinking or indirectly for cooking food or brewing beer. The effect of water usage on health status has been historically documented, for instance in the case of the monks of the Emauzy Monastery in Prague. In 1756, the Teresian Land Register stated that the brewery in Suchdol near Prague had not been brewing beer for two years because the water used for beer production was contaminated by saltpetre and caused health problems among the Emauzy monks, who owned the brewery (Burdová et al. 1970).

The classification of the hyperostotic infliction is not completely unified – in rheumatology Forestier's disease is considered synonymous with DISH (Havelka 1990), yet in paleopathology it is regarded as a separate manifestation of DISH on the spine (e.g. Vyhnánek 1999). The categorization of the disease is ambiguous, too. In the past it used to be ranked with degenerative changes, but the latest practice is to rank it with metabolic osteopathies (Havelka 1990). A link is postulated between the genesis of hyperostosis and diabetes, where a prevalence of 13-49 % is reported (Štolfa 2001), in the etiology the effect of external environment is believed to play a role. The findings from Kladruby would seem to confirm such assumptions.

Of additional interest is the coincidence of changes on the spine corresponding to Bechterew's disease and pathological hyperostoses with an effectively complete ossification of cartilaginous parts of ribs, including a bridging of the right side of the vertebrae bodies corresponding to Forestier's disease, or DISH, in the case of the individual 73/I.

Also interesting is the prevalence of traumatic changes, which is higher than in other skeletal collections. Among fractures, the fractures of ribs predominate (12 individuals), while most of them are healed without dislocations.

Many skeletons display well expressed degenerative, or degenerative-productive, changes, especially on the spine. The Schmorl's nodes, a common diagnosis in many individuals aged over 45 years (Aufderheide & Rodríguez-Martín 1998), are present in a number of cases, as are signs of the intervertebral disk osteochondrosis which represent a predisposition for the genesis of peripheral osteophytes (Vyhnánek 1999).

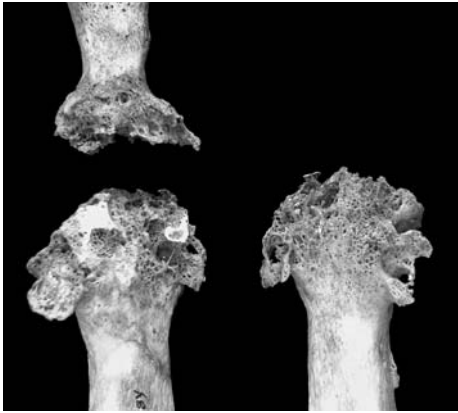
Most of the anatomic varieties identified in the collection – e.g. atlas bridging posterior is present in 16 cases – belong to those that are not rare in a population (Velemínský 1999). In addition, despite the considerable quantum of epigenetic markers recorded, one cannot assume blood relationships within this group of monks.



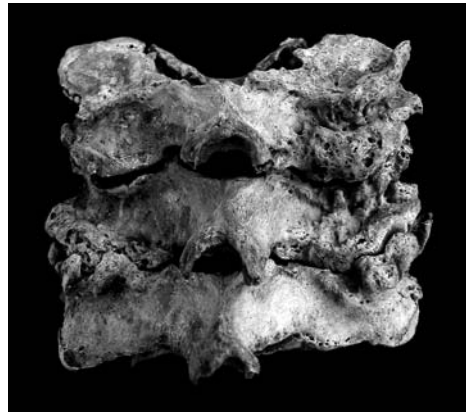
This collection of well preserved skeletons with a considerable rate of pathological bone changes can, given its demographic characteristics, be regarded as paleopathological proof of the effect of living conditions on health status – in the case of the skeletons from Kladruba, the effect is manifested primarily in ossifications of ligament structures (muscle insertions, ligaments, cartilaginous parts of ribs).

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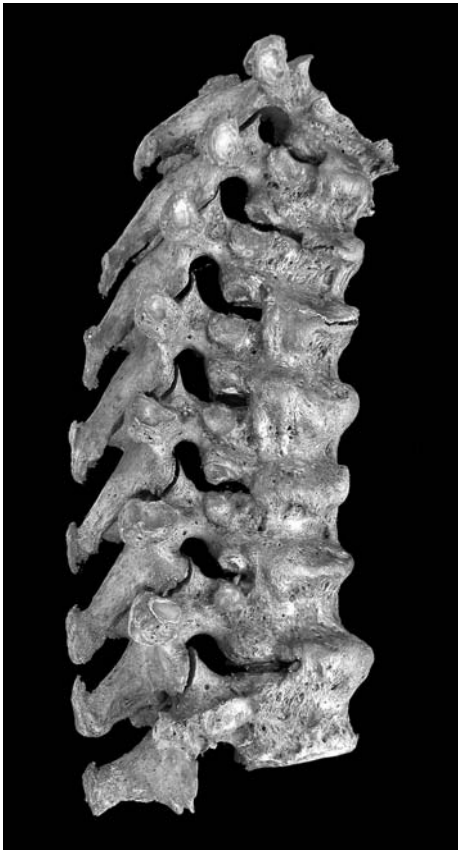
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**Fig. 1.** Individual No 3 – destruction of the first metatarsophalangeal joints most probably caused by gout.



**Fig. 3.** Individual No 8 – spondylarthritis on vertebrae C IV - C VI.



**Fig. 2.** Individual No 7/I – Forestier's disease on vertebrae Th IV - Th XI.



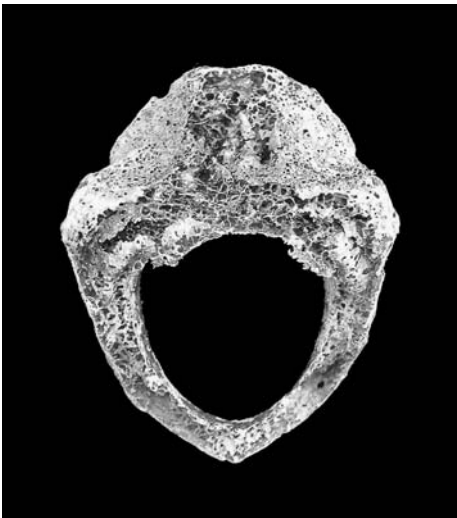
**Fig. 4.** Individual No 8 – Forestier's disease on vertebrae Th V - Th XI.



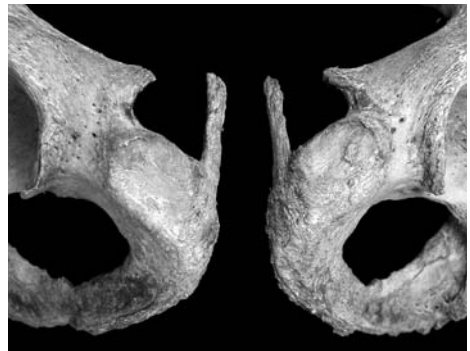
**Fig. 5.** Individual No 16/1 – deformation of radius head with deficient fusion of metaphysis.



**Fig. 7.** Individual No 33 – osseous appositions on on pubis right.



**Fig. 6.** Individual No 33 – cricoid cartilage ossification.



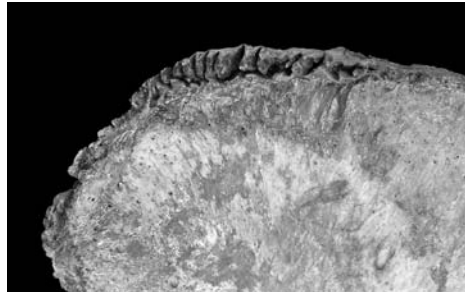
**Fig. 8.** Individual No 34 – ossifications on sacral horns (ossified sacrotuberous ligaments).



**Fig. 9.** Individual No 37 – Forestier's disease on vertebrae Th VI - Th XI.



**Fig. 10.** Individual No 37 – bilateral synostosis of the first rib with manubrium of sternum.



**Fig. 11.** Individual No 37 – bilateral osseous appositions on iliac crest.



**Fig. 12.** Individual No 39/II – ossified anterior ligament of fibular head left.



Fig. 13. Individual No 44/I – synostosis of the first rib and manubrium of sternum left, ossified cartilaginous parts of ribs fused with sternum, xiphoid process perforation.

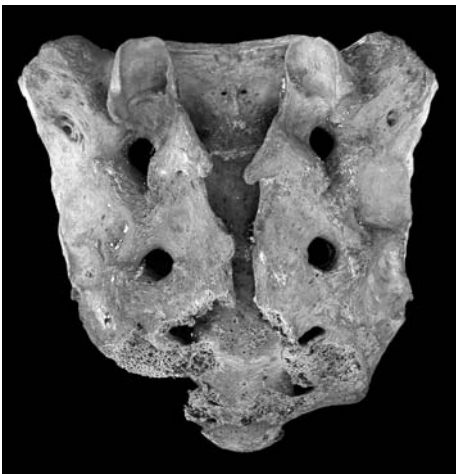


Fig. 14. Individual No 45/I – spinal bifida occulta.

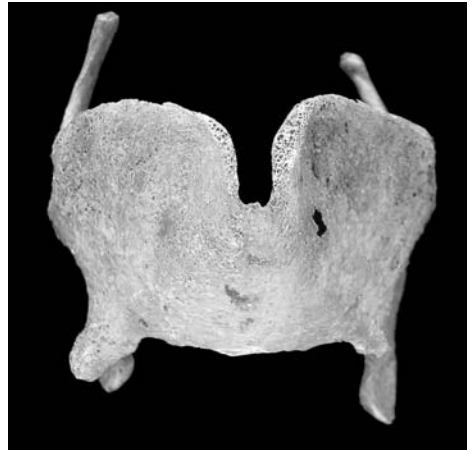
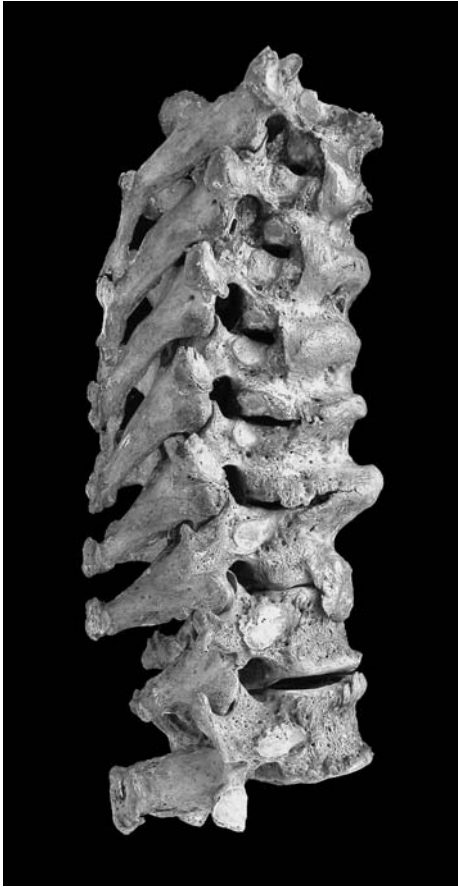


Fig. 15. Individual No 47 – completely ossified thyroid cartilage.



Fig. 16. Individual No 48 – healed fracture and bifurcation of one true rib right.



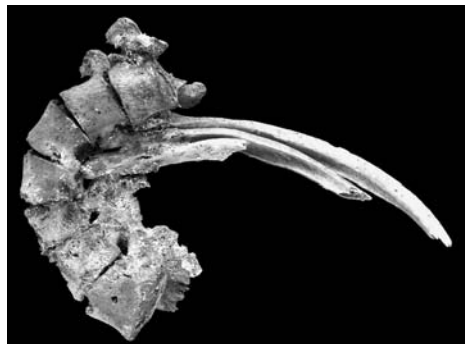
**Fig. 17.** Individual No 50/I –Forestier’s disease on vertebrae Th V - Th XII.



**Fig. 19.** Individual No 68/I – synostosis of body of sternum and xiphoid process, xiphoid process with double perforation, synostosis of the first rib and manubrium of sternum, ossifications in costal notches.



**Fig. 18.** Individual No 60 – bilateral synostosis of sacro-iliac joint.



**Fig. 20.** Individual No 69/II – inflammatory changes in thoracic spine with fusion of vertebrae Th V - Th XI with deformation of vertebral bodies and with dextroconvexity.



Fig. 21. Individual No 70/I – compressive fracture of vertebral body L I.

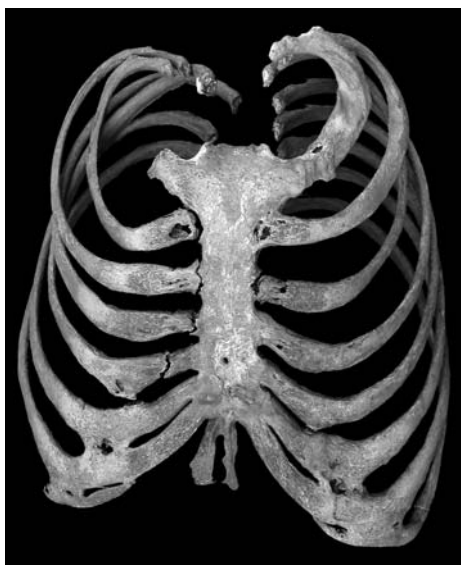


Fig. 23. Individual No 73/I – synostosis of manubrium and body of sternum and xiphoid process, perforation of body of sternum, complete ossification of cartilaginous parts of ribs.

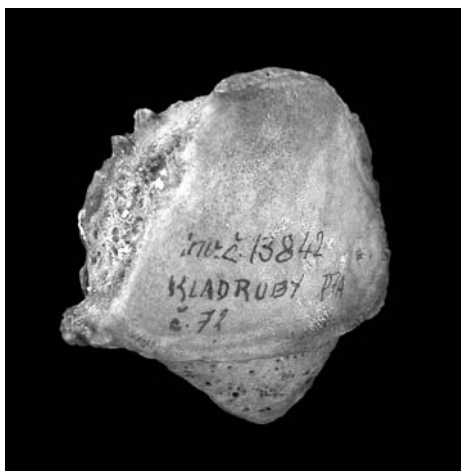
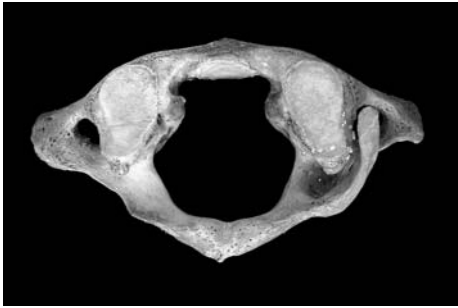


Fig. 22. Individual No 72 – patellar bipartite left.



Fig. 24. Individual No 73/I – Bechterew's disease of vertebrae Th II - Th XII, bridging of the right side of vertebral bodies Th VIII - Th XII similar to Forestier's disease and synostosis of rib and vertebra Th VIII right.



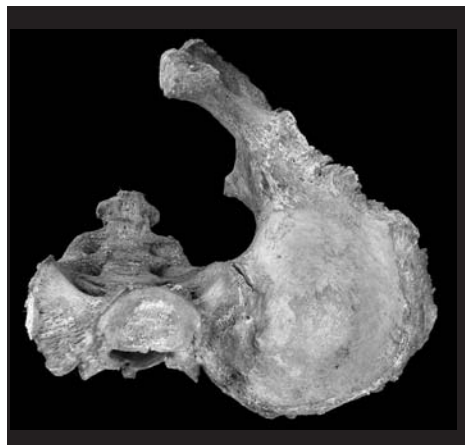
**Fig. 25.** Individual No 76/1 – elongated, in the front unclosed atlas bridging posterior right.



**Fig. 26.** Individual No 77 – healed spiral fracture of both tibia and fibula left with fibular rotation and anticurvation.



**Fig. 27.** Individual No 79 – Forestier’s disease on vertebrae Th V - Th XI.



**Fig. 28.** Individual No 79 – synostosis of sacro-iliac joint right.