JÁN LIETAYA

A DIFFERENTIAL DIAGNOSTICS OF THE RIGHT SHOULDER GIRDLE DEFORMITY IN THE SHANIDAR I NEANDERTHAL

ABSTRACT — This study presents a theoretical differential diagnostics of the etiology of the right shoulder girdle deformity in the Shanidar I Neanderthal specimen. The study was based on an examination of plaster casts and x-rays of Shanidar I right humerus and on the study of published literature.

The paper focuses on a comparative evaluation of the consequences of growth defects, poliomyelitis, and traumatic injuries in recent populations compared with the Shanidar I remains. More detailed information cannot be fully evaluated because of missing diagnostically important parts, especially of the axial skeleton.

The results revealed some discrete signs suggesting either a traumatic amputation or an intentional amputation in the fracture some years before the individual’s death:

1. Polytraumatic nature of the changes: fractures of the right humerus, of the left orbit’s lateral wall and of the V. metatarsus, an injury to the frontal bone, osteomyelitis of the right clavicle;
2. Partially preserved mobility of the right humerus documented by:
   a) proximal diminution of atrophic alteration in separate bones of the right shoulder girdle;
   b) a better preserved architecture of bone beams in the proximal right humerus;
   c) differences in the cortical wall thickness of the right humeral diaphysis, very likely due to toning effects of intact muscle groups;
3. An atypical left fibula configuration as a result of the organism restructuring in its maladaptation to the altered biostatics.

To verify the amputation possibilities several practical amputation trials were performed with original stone tools and their experimental imitations. The resulting amputation time ranged within 25—30 minutes. The results have confirmed that the determining factors in amputation are not the tools employed but rather the grade of necessary medical practice in performing intervention or in treating injury.

The shape and surface of the bone breakage experimentally produced prove that the Shanidar I amputation could not be done by sawing, the method usual nowadays; some other mechanisms were possibly used.

A reason for the amputation could have been an ischaemia of the right forearm after double fracture of the humerus.

KEY WORDS: Homo sapiens neanderthalensis — Shanidar I — Right shoulder girdle deformity — Differential diagnostics — Experimental amputation.
INTRODUCTION

Amputational interventions performed in prehistoric times are rare paleoanthropological findings. In Palaolithic skeletal remains this may be due to a lower number of finds, especially from earlier periods or, on the other hand, due to presumably lower levels of medical knowledge needed for operative interventions.

The find of the Shanidar I Neanderthal with double shoulder girdle and a missing right forearm was unexpected from the viewpoint of the supposed origin of orthopædics, and opened broad field of speculations. In spite of the justly cautious opinion of the specialists, the missing parts of the right upper extremity indicate the possible amputation.

Contemporary physician accustomed to operations room technology and extensive pharmacological background finds it difficult to accept the idea of both indicated and successful arm amputation in Middle Palaolithic. The idea of growth defect with similar pathological-anatomical picture seems to be more probable.

The resembling appearance and simultaneous discrepancy between the shoulder girdle deformity and the possible forearm amputation, and the resulting shoulder girdle deformity resembling a congenital defect or a juvenile trauma consequence, led us to the theoretical study of the pathological processes in the brachial region, and to an experimental verification of amputation possibilities.

The study comprises therefore two parts. The first, theoretical one, based on the research results of specialists describing the Shanidar I osteological material with the author's own diagnostic analysis.

The second, experimental part, contains the results of amputations performed with original stone tools and with their imitations to verify the resulting appearance of bone amputations surfaces and to determine the time factor. Summary: The presented study provides a differential diagnostics of nosological units which in recent populations result in a picture similar to Shanidar I find, and gives the results of experimental amputations performed with stone tools

THEORETICAL PART

The circumstances of the discovery

The Shanidar I Neanderthal, from the Shanidar cave (North-East of Iraq), dates back to the period of 40,000 - 1,500 years B.C. (Solecki, 1957; Vogel et Waterbolk, 1965;)

The find was made in the depth of 4.54 m, inside a monolithic layer.

The skeleton lay on its back, twisted partially to the right, with the head and the trunk building a non-physiological angle, which led Solecki (1969) to speculate on sudden death under a stone avalanche. The left side of the skeleton had suffered more damage than the right one; the lower extremities exhibited an evident detachment of the feet with distal part of the Shank from the rest of the limb (Solecki, 1972).

The remains belonged to a 40-45 years old man, whose height was estimated on 1.73 m according Trotter and Glaser's regression formulas for the Euro-Americans. Typologically they were close to the classic type of H. sapiens neanderthalensis (Trinkaus, 1983).

The osteopatological findings

Except for peri- and postmortal changes, the skeletal remains bear traces of a multiple traumatic insult with subsequent asymmetry in the adaptation or maladaptation to the disturbed biomechanical status of the posture.

A brief summary of pathological changes in cranio-caudal direction gives a review of findings which form the essence of the Shanidar I's clinical picture (see Fig. 1). The sources used are cited in the References.

B) The clavicle and scapula. Following the proximal direction the difference between the bones diminishes, and between the right and the left clavicles it makes ca. 10%. The clavicle dystrophy or hypotrophy presents a picture of a more proportional reduction of the mediolateral diameter and of the cortical bone thickness. The quantitative indicators of the scapula reduction lie between the clavicle and humerus parameters.

The lateral cavity around the tuberositas coronoides had been affected by an osteomyelitis which drained through an orifice on the upper surface

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missing skeletal parts
preserved skeletal parts

Figure 1. Skeletal condition and review of pathological changes in Shanidar I.

X - ray 1. The Shanidar I right and left humerus.
of the diaphysis medially from the tuberculum condileum. The remissus process is documented by the calus surrounding the claus.

The lower finds. The right knee is affected by a degenerative joint disease manifested through exostosis on the femoral condyle and on the patella. The later, moreover, is also enlarged and exhibits signs of remodeling.

The left tibial shaft is pathologically bent, with the convexity in anterior and medial direction. The right tibial joint and metatarsal I and II joints exhibit exostoses with an evident talar remodelling. On the right fifth metatarsus there was diagnosed a diaphyseal fracture healed ad integrum. (Solecki, 1960, 1972; Stewart, 1958, 1959, 1962, 1977; Trinkaus, 1978, 1983; Trinkaus et al., 1979, 1982).

Physical reconstruction of the Shanidar I

The several pathological features make it possible to reconstruct a physical profile of the individual which is necessarily limited due to actual level of medical knowledge and to subjective interpretation.

This is a case of an individual which is severely handicapped by polytrauma and degenerative alterations of the articular system.

The most severe affection was the right arm deformity, with which the man had lived long enough to develop reparation processes. The developed muscular attachments on the left upper limb bones and the pronounced trabecular architecture of the humerus (see x-ray 2b) prove a left-sided compensation of the right-sided manual insufficiency. The unusually abraded teeth support the idea of further compensation of the defect by tooth use (Kerbl, 1963; Stewart, 1977; Wallace, 1983).

The fracture of the left orbit’s lateral wall and the orbit’s narrowing justify the assumption that the man should have been blinded in his left eye (Trinkaus, 1983). A doubtless effect of the defective lower limb biomechanics was limping, although it is difficult to hypothesize a traumatic cause or restructuring as a result of disproportions in the global biostatics.

More evidence on the grade of the disorder would be obtained from the condition of the axial skeleton and when comparing the absolute length of extremities, but the fragmentary preservation of the vertebras and the missing parts of the lower extremities preclude an estimation of the asymmetry extent.

The portait of the Shanidar I individual can be completed by Trinkaus’ hypothesis (1983) which, on the basis of an uncommon skull configuration, anticipates an artificial deformation.

X-ray 2.

1. Osteolysis of the right distal humerus.
2. Partially preserved architecture of spongy bone structure in the right proximal humerus.

The differential diagnosis

The objective finding suggests a primary importance of a correct diagnosis and differential diagnosis of the etiology of the right shoulder girdle deformity in distinguishing 1. an inborn dysplasia or dystrophy in contrast to 2. atrophy due to trauma suffered in adult or juvenile age.

If we accept the first alternative, then the healed fracture of the shoulder in an almost physiological position with a common malregeneration associated with dystrophic processes is an unusual finding, and a considerable concern of the social community in the survival of a mortally afflicted individual may be assumed.

TABLE 1. Neurological units affecting the brachial region analogically with the Shanidar I picture

<table>
<thead>
<tr>
<th>PRIMARY DEFORMITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Congenital defect</td>
</tr>
<tr>
<td>A. Dysplasia of humerus and forearm (premalign, akromegal)</td>
</tr>
<tr>
<td>B. Dysplasia of humerus or shoulder girdle</td>
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<tr>
<td>- Dysplasia of humerus on proximal (chondroosteoelastic fracture)</td>
</tr>
<tr>
<td>- Chondrolysis of humerus or shoulder girdle</td>
</tr>
<tr>
<td>- Metaphyseal chondrolysis</td>
</tr>
<tr>
<td>- Fibrous dysplasia</td>
</tr>
<tr>
<td>- Osteochondritis dissecans (familiar)</td>
</tr>
<tr>
<td>- Osteochondromatosis (chondroosteal - M. Officer)</td>
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<tr>
<td>C. Hypoesthesia</td>
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<tr>
<td>- Hypoesthesia of the distal part of the upper extremity with other polyostitis diagramm of hyperostosis polyostitis |</td>
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<tr>
<td>- Hypoesthesia in neuroosteolysis</td>
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<td>- Hypoesthesia in neuroosteolysis</td>
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<tr>
<td>D. Osteolysis disorder</td>
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<tr>
<td>- Osteosarcoma</td>
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<tr>
<td>- Osteoarthritis</td>
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<tr>
<td>- Osteal or subjacent of art. humeri</td>
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<tr>
<td>- Scapula alta</td>
</tr>
<tr>
<td>2. Polyarthry</td>
</tr>
<tr>
<td>A. Congenital</td>
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<tr>
<td>- Postural polyarthry of Elle-Darbre type</td>
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<tr>
<td>- Dysplasia of separate muscle groups</td>
</tr>
<tr>
<td>- Polyarthry of separate muscles</td>
</tr>
<tr>
<td>- M. deltoideus</td>
</tr>
<tr>
<td>m. biceps brachii</td>
</tr>
<tr>
<td>m. triceps brachii</td>
</tr>
<tr>
<td>B. Acquired</td>
</tr>
<tr>
<td>- Polyostitis anterior acetabula</td>
</tr>
<tr>
<td>C. Edematous</td>
</tr>
<tr>
<td>- Polyostitis anterior chronic</td>
</tr>
<tr>
<td>3. Juvenile trauma</td>
</tr>
<tr>
<td>A. Fracture</td>
</tr>
<tr>
<td>B. Amputation, traumatic amputation</td>
</tr>
<tr>
<td>C. Supporting factors</td>
</tr>
</tbody>
</table>

PRIMARY TRAUMA

1. Fracture and its complications
   A. Isolation of fracture
   B. Immobilization
   C. Decompensation and osteogenesis
   D. Disorders of interiorization of trauma - Volkman symptom
   E. Algodystrophic syndrome (M. Sócek)
   F. Fracture syndrome
   2. Amputation
As to the trauma and the loss of the intact antecedents in adult age, the grade of dystrophic changes of the right humerus, of the scapula and clavicle increases.

An attempt to a medical analysis and a differential diagnosis may be carried out from two principal aspects:

a) progression of the anatomical-pathological picture in a primary deformity of the right shoulder in a juvenile age with secondary traumatic trauma;

b) progression of the anatomical-pathological picture in trauma on an intact humerus with associated secondary complications in adult age or adolescence.

Possible neoskeletal units are addressed in Table 1.

### PRIMARY DEFORMITY

#### 1. Congenital defects

They are carefully reviewed in medical literature due to uncertain patient's prognosis and to restricted intervention possibilities. They were virtually irreversible up to the time of modern surgery. In etiologies we find chromosome and gene aberrations, toxie effects, and often idiopathic genesis, i.e. factors which in the given case cannot be detected, for which reason and related to the differential diagnosis and development viewpoints have been preferred in the present literature.

A. *Dysplasia* (peremelia, ekstremila). They represent a relevant grade of dysgenesis with a global growth disorder, and a hypoplasia of several cortical bones in the right shoulder region and the humeral joint, anomalies of cranial configuration or, as the case may be, microcephaly (Störing, 1968).

B. *Dysplasia*. Severe forms are diagnosed as part of generalised affection of the organism, with growth retardation and a pronounced skeletal deformation (achondroplasia, dyschondroplasia punctata, metaphyseal chondrodystrophias and its subtypes) (Spranger et al., 1974; Weil, 1982).

In some etiologies, severe forms of dysplasia, fibrous osteodystrophy, a lighter form of dysplasia may exceptionally proceed in a monostotic or least often in a polyostotic form (Mekhilef, 1980; Smyth, 1982), and is accompanied by changes in the shoulder girdle region: hypoplastie changes in articulating bones, subluxation of humeral head with resulting varus position (Weil, 1939).

The Shneiderk lacks a typical dysplasia x-ray finding of a limited bone erosion with thinned compact bone and eventual sclerosis or cystic changes in the affected region (Beighton & Cremoin, 1980).

C. *Congenital defects*. They are characterized by ossification disorders in the epiphyseal and subchondral areas, hypoplasias of humeral head and humeral joint, changes in the joints of hands and feet with marked growth retardation. The shoulder girdle is usually affected only in severe case, when there are clearly seen global changes (Gottlieb & J. Helberg, 1982).

Dysostoses in mepokeyauarchoedoses and neu-

The postmortem destruction of the majority of ribs it is impossible to pronounce upon a possibility of isolated palsy or muscle aplasia in the Shneiderk I.

### B. Acquired. *Polymyalgia rheumatica*. Polimyalgia is ascribed among more sporadic osteological findings to the polyarthrosis of the humerus (see Rids, 1962; Wells, 1964). As to affection of the limb, the most incidence is due to monophasia or polyphasia on lower limbs; yet there is also evidence of monophasia damage to upper limbs (Wickman, 1953).

In the x-ray picture of recent population predominates an evolving "atrophia ex inactivitatem", demineralization, suppression of bone growth in children, both lengthwise and breadthwise, due to premature closing of the growth plates (Greinacher, 1983; Curرارине, 1966), and in general we see gradually evolving maladaptive deformities of the spin, ribs, shoulderblades and clavicles. Decreased bone growth is due to more factors: absence of load stimul, frequent muscle contractions, loss of central control of trophiées, and circulation disorders (Bernaeker et Dahmen, 1983). Pathological fractures are frequent.

Calcium losses and general demineralization increases in parallel with persisting limb immobility, the anomaly enlarges at the expense of the compact bone (Eichler, 1970; Lindholm, 1981).

The resulting thickness of bone depends on the position of muscles and the grade of secondary activity (Johnson, 1964), i.e. factors that are difficult to establish for Neanderthal community and can only be roughly estimated. With this regard it is interesting to compare some morphological parameters and indices of the affected and healthy limbs in the Shneiderk I and In an adult Japanese affected by juvenile polyarthritis ante. ae. (Ishida et Suzaki, 1985), table 2.

Comparing the Shneiderk I contralateral indices available in the literature (Solec, 1980; Ste-

wart, 1977, Trinkhaus, Zimmermann 1982) with well documented recent case exhibiting a paralysis of the left body side shows a worse functional stimu-

lation in the Japanese case with the known disease.

The result of this simple comparison cannot be taken as a whole and considered as pathogenetic, as information, however, it has some utterance viability.

| TABLE 2. Osteometric humeral and clavicle indices in the Shneiderk I and a recent Japanese individual — comparison of the affected and healthy side |

<table>
<thead>
<tr>
<th>Measurement area</th>
<th>Index ratio of affected and healthy side [%]</th>
</tr>
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<tbody>
<tr>
<td><strong>Japanese</strong></td>
<td><strong>Shneiderk I</strong></td>
</tr>
<tr>
<td>clavicle M4</td>
<td>62.6</td>
</tr>
<tr>
<td>sternum M5</td>
<td>86.6</td>
</tr>
<tr>
<td>humerus M3</td>
<td>50.6</td>
</tr>
<tr>
<td>humerus M6</td>
<td>69.8</td>
</tr>
</tbody>
</table>

It may be stated that in spite of the visual resemblance of both humeri there is a difference in parameters characterizing the build and thickness of the right clavicle and the left shoulder motoric activity in the Neanderthal man.

C. *Iliopathia*. Polymalgie anteriotor chronicia. This condition should be characterized by an acadi-

somal scheme as Hrno-Medlin disease. The affection starts in 25-35 years old men, with palettes affec-

ting. The most common hypertrophic atrophic changes begin acrally (ape's hand) and proceed prox'mally (Barto, 1982). The typical bilateral progression of affection is not conform with the unilateral stigmatization in the Shneiderk I.

### Juvenile trauma

A. Fracture. The progression of complications and consequences due to the fracture has received a closer description in the second part of our analysis. At this point we only remind that pathologi-

cal processes in case of fracture healing are fully manifested in younger age as well (only perhaps with the exception of the algodystrophy syndrome (Blumenzus, 1956).

Fracture healing during the period of the ske-

eton growth has a better prognosis due to increased growth potential. In this case the other side, damage to the growth plates cause growth retardation in the limbs and in younger age the localised or progressive maladap-

tive changes (Tołoszkov, et al., 1967).

B. Amputation. According to the Soviet ortho-
pedical descriptions of the thirties, the main type in an amputation stump (in the case of amputation in juvenile age) is its conical shape (age constancy). Amongst other particularities of later postoperati-

tion period, a slower growth of soft tissue in compar-

ison with the bone stump is dominant and also the slower growth intensity. Negative influence on healing are due to specifically lower epiphyseal growth intensity, and disproportional growth of the lower limbs

The discrepancy in the biostatistics becomes evident by the asymmetry of overall growth in sagittal plane and through spine scooter. Significant are the shoulder girdle joint articulation disorders as well as the frequent deformity of the scapula, clavicles, or of the thorax (Najaova, 1978).

The given changes are analogous to the palaeo-

pathological finding and are of interest.

C. *Supporting factors*. The compressive syndrome

(accuracy, osteocavalerous) causes innervation and blood supply disorders, if not thera-
petrical it may cause irreversible bone atrophy, seldom in bone tissue, depending upon the length and duration of nutrition insufficiency of the limb (Hipp et Ziehle, 1981; Bartko, 1982).

The most marked symptom of the right clavicle indicates a traumatic insult, and the compressive syndrome might have evolved as a direct result of it. In any case, the consideration of the compressive...
syndrome can be real only as a supporting factor of bone atrophy during unfolding bone changes (Kaiser, 1982).

PRIMATE TRAUMA SECONDARY ATROPHY

1. Fracture and its complications

Complicated or multiple fractures of long bones at present period are dealt with mostly by surgical treatments to prevent a deformity or a dysplasia of limb. During a therapeutically untouched fracture the healing of the limb is potentially endangered by complications, especially in case of an open fracture. The result is doubtful without proper medication and expert knowledge. Despite the fact that reposion and fixation are not "conditio sine qua non" retsetialis, yet in the past the ratio of healed to complicated fractures was more unfavourable than today. The therapeutic drawback is proved by the sceptical attitude of ancient and medieval physicians toward open fracture therapy (review by Robid et al., 1972).

1. Dislocation of fragments. Dislocation belongs to the most frequent fracture complications. From the introductory description we see that in the proximal fracture there was only minimal shift by 5 mm ad latum which may be assessed as a physiologic position and an intermural fracture rotation around the long axis of the humerus by about 30° in clockwise direction. The position of the peripheral stab cannot be determined. The placing of muscle attachments on separate fragments and the vector analysis of the pulling direction of appropriate muscles permits at least an orientative understanding of the fracture status.

In the fracture, the huge m. biceps pulls the forearm cranially and posteriorly; the m. biceps, the m. brachialis and m. brachioradialis form a muscle crest enveloping the distal fracture. The sharp ends of the distal fracture and condyles endanger the neurovascular supply in the elbow. The proximal attachment of the m. brachialis, the medial head of m. triceps and the proximal attachment of the m. brachioradialis should stabilize the proximal fracture.

B. C. Immobilization, denervation and osteoporosis. A pain stimulus due to fracture produces in recent Mediterranean populations a reflex bone immobilization with subsequent osteoporosis and a depolarization up to 80% local calcium losses which are possible if the uncomplained course normalizes to a self within a few months (Lemperg, 1957). While the denervation process in the initial stages of the "atrophia ex insensibilitae" advances from the bony sponge towards the endostome with subsequent cavitation (Eichler, 1970), the subperisomal resorption, which is necessary during production, causes bone diameter reduction (Mora, 1962).

D. a) Invagination disorder. Disorders of invagination and reversion from the "atrophia ex insensibilitae" in living humans are complicated advances from the known lower osteogenesis of cortical bone, lead to impediment fracture healing (Schneck et al., 1980). The lesion leads to further immobilization of the shoulder during acute healing stage of humeral fractures reflected in a higher incidence of pseudoarthroses. Bruns (1888) presumes that 1/3 of all humeral fractures in the last century resulted in pseudarthrosis.

A dislocation of fragments, and a vascularization disorder or an interposed muscle, induce hypotrophic, atrophic or avascular pseudarthrosis. These symptoms are to be seen in a status characterized by the thinned compact bone, the distally thinning diameter of the bone and by pointed end (Beek, 1973; Bircher, 1978; Bohm and Lies, 1984). Evident articular surfaces do not form if both fragments do not come into direct contact.

2. Amputation

After an amputation the loosed forearm ceases to fulfill its toning function and several important muscles lose their distal attachments, the most important being the m. biceps, m. triceps brachii, the m. brachioradialis and m. brachialis. The predominance would fall to the m. coracobrachialis holding the limb in the intrarotated and adducted position together with the mm. humeri.

The loss of the attachments of the m. biceps brachii induces a gradual loosening of the humeral articular in the glenoidal fossa and produces a multifunctional position (Rogojaviski, 1970). The damaged muscle groups lose their functional retractor and retractant, connective tissue modifications set in but, due to adaptation and the functional interplay with other muscle groups, the function does not fully disappear.

The loosening of the tonization of the cortical bone becomes the most evident in the distal parts, where muscles suffer the most damage. This is confirmed radiologically in both bone and soft tissues of the distal right humerus showing chaotically arranged bone trabeculae and cystical changes in radiodensitometry suggesting to a decreased muscle tone and or through incomplete atrophy as compared with the trabeal in the proximal humerus which may also be thinned but may have an outlined correct trabeculation (see x-rays 2).

EXPERIMENTAL PART

Several amputation experiments were performed with original amputation tools and modern surgical techniques. The ones. The trial embraces two parts. The aim of the preparatory phase was to determine an optimal working angle and suitable instruments.

In this phase the first three amputations were performed on human cadavers, (experimental amputation on human cadavers were performed by Handl and with active participation of Ass. Prof. Mrkko Mego, M.D., (C, Department of Forensic Medicine, Technical School of Anatomy, Bratislava, Czechoslovakia.) for other three experiments whole pork thighs were used.

In the second group (physicians and on autopolytechnician) could freely choose a working procedure and stone tools (see Tab. 3 for their list). The subjec-
4. The most suitable for efficient sawing proved to be instruments with the edge of at least 7–8 cm length, wedge-like in shape. The tools with shorter edges were too difficult to saw with.

Another alternative was a tool of reverse "V" shape. Shorter, reverse "V" tools, finally used, the bone circumference penetrated fast into the compact bone (see Fig. 2).

5. The empirical evidence revealed that the time-optimal mode of amputation was to incise 1.5–2 cm deep round the whole circumference and then by a light blow to detach the peripheral part of bone.

6. Cutting across the soft tissues took 3–6 minutes on average. Sawing fully across the bone lasted about 45–60 minutes. Procedure ascribed in item 5 almost doubled the speed of amputation.

The second part of the experiment ensued from the preparations of the preparatory one. Considering the minor labour during cutting of the soft tissues, the trial with cadavers and whole pork thighs was abandoned. Only raw pork thigh bones were used. Limestone fragments collected in a quarry served as tools, the only condition for selection being suitable working edge. The experiment was executed by only one examiner.

Results might be summed up briefly as follows:

1. The mean time to file through one bone was 20 minutes and 20 seconds. (Table 4 shows time needed for filing through the parameters of the bone saw, and the total number of tools used).

2. The proposed mode of amputation — incision and breaking off the epiphysis by blow — produced smooth breakage surfaces parallel to the long axis of the diaphysis. The edges of the breakage surfaces were finally serrated.

3. As number of amputations increased, the saw circumference of 3.6 mm/min grew larger to 4.0 mm/min.

**Discussion**

The performed experiment was undertaken by the modern medical apprehension of considerable amputation. The differentiated choice of tools and the gradual crosscutting of the soft tissue and the bone reflects the knowledge of today's specialists and may diametrically differ from the methods used by Palaeolithic man. The obtained results are valid only with respect to this limitation.

**Conclusion**: The different condition of the Shanidar I right humerus substantially limits possible consideration of the sawing mechanism and intentional intervention could be explained only by different amputation procedures (hacking) or by amputation inside fracture or pseudarthrosis.

From the analysis of the time factor it follows that filing through soft tissues and bone in the suprascapular area of the humerus takes about half an hour. Shorter amputation time depends on the experience and choice of optimal tools, as well as on higher skill.

**Table 4**

<table>
<thead>
<tr>
<th>Number of trial</th>
<th>TIME (min.)</th>
<th>CIRCUMFERENCE (mm)</th>
<th>AP DIMENSION (mm)</th>
<th>ML DIMENSION (mm)</th>
<th>MAXIMAL THICKNESS</th>
<th>A — W - M — W (mm)</th>
<th>NUMBER OF TOOLS</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>26</td>
<td>66</td>
<td>23</td>
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<td>77</td>
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<td>4.</td>
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<td>19</td>
<td>82</td>
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The oldest known amputation is the intervention performed on a woman from Murzh-Koba (Crimea, USSR) dating back to 9000–10,000 years B.C. (Bibikov, 1940). The symmetrical bilateral removal of parts of the fifth phalanges testifies to an artificial intervention, and the absence of secondary complications suggests a post-operative treatment (Rochlin, 1965).

**Etnographic observations**

There are generally accepted axioms that ethnographic parallels to Palaeolithic societies are at best debatable. Since the application of historical notes and of ethnographic observations in recent times is doubtful for Père-Lo., analyses of ethnographic cases are often subject to determination by study points. We have decided not to advance separate positive or negative references but to generalize from the accessible literature the response to following questions:

1. What were the indications for amputation in the past?
2. What instruments were used to carry them out?
3. How was the post-operative care?

A fleeting review fully confirms the mentioned doubts about possibilities of comparisons between the cultures of different historical epochs.

1. Amputation indications range widely from ritual amputations of fingers spread over the world, in the sense of punitive amputations like in North-American Semaec Indians, up to rationally indicated removal of unhealing complicated limb fractures among African Masai tribes and resection of frozen limbs in Arctic nations.

2. Choice of amputation instruments presents as well a wide variety of materials and shapes ranging from the stone tools — flint, obsidian, quartzite — over bamboo knives through to metal ones.

3. Post-operative care in several nations differs strongly and comprises clearly rational measures as injury ligature, blood stopping, dressing, hygiene care, maintaining injury purity; also common practices directly or indirectly endangering patient’s life such as laying on feaces, massive extermination of injuries, premature mobilization... (Ackerknecht, 1967; Fortune, 1985; Graspov, 1956; Hamada et Hida, 1972; Hofschlaeger, 1929; Janoff, 1970; Siegel, 1973; Tauben, 1973; Terry, 1992; Wells, 1946; and others).

The current pragmatical approach to therapy is not only a result of a long-term empirical selection of knowledge: mainly it is a consequence of evolving rational medicinal thought. The documented survival after amputation, often carried very drastically and made under septical conditions by primitive instruments, indicates that the basic problem of survival was not only the process of limb ablation itself, but mainly the question of individual resistance of the organism to operational stress and the grade of conscious prevention of possible complications.

Decisive for preserving life is basic knowledge of inevitable therapeutic and aseptic measures, i.e. factors which are indispensable for a Neandertal community.
A prevailing portion of congenital diseases mentioned in the review are accompanied by uni- or multifocal cranial malformations (Ott, Putschar, 1981). Poliomyelitis affection is characterized by a thinning cortical bone and broadened medullary cavity which is in direct variance with the Stanislaw I finding as shown by Trinkus (1983). Healing of the fracture in almost physiological position is extremely improbable without a specialist’s intervention, because the muscle crest is reduced. Moreover, there is a negative coaction of an atypical muscle tone incapable to stabilize the thinned bone. Recent analogies point out a larger extent of atrophy but in the Stanislaw I case we ignore the exposition period. The primary deviation allows apprehending the basic level of motility determining the rate of bone metabolism (Truet, 1964).

Muscle palsies/dysplasias are difficult to diagnose because of the fragility condition of the axial skeleton; moreover they are contradictorily limited by partially maintained shoulder motoric activity.

The extensive polytraumatic affection points to a traumatic genesis. Attractive is the possibility of fracture complications, i.e. Sudeck’s disease. The objective evidence displays some basic differences in comparison with its course in recent populations. Stage II of the disease is manifested by typical cystic radioactivity in the x-ray picture appearing months after the trauma. This is accompanied by decomposition of the viable corpus cancellus, but the cortex is clearly manifested in Stanislaw I (see x-ray 2). Atrophic changes and thinning of the compact bone (stage III) come some years later and they are not accompanied by cystic changes which otherwise occur on the right distal humerus of the Stanislaw I.

Among the presented alternatives the last contradicting one to known facts is the hypothesis of a traumatic amputation or an amputation inside the fracture. A double humerus fracture may quickly induce ischaemia of the forearm requiring an amputation. Further process of adaptive changes has been already proposed.

Regarding the origin of the amputation, the basis of right humerus trauma(s) indicates an existence of some severe somatic allowings permitting survival of life-threatening injury (is), and perhaps also, suggests presence of some therapeutic knowledge.

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