

A FORENSIC-MEDICAL ANALYSIS OF FRACTURES OF THE LONG BONES OF THE LOWER EXTREMITY

I.H.Savka, V.L.Vasiuk, P.Ye.Koval'chuk, ¹O.I.Zin'kiv

Bukovinian State Medical University, ¹Regional Clinical Hospital (Chernivtsi)

СУДОВО-МЕДИЧНИЙ АНАЛІЗ ПЕРЕЛОМІВ ДОВГИХ КІСТОК НИЖНЬОЇ КІНЦІВКИ

Резюме. На підставі судово-медичного аналізу 318 переломів довгих кісток нижньої кінцівки висвітлено їхній розподіл за статтю, віком, локалізацією, орієнтацією лінії перелому, характером і видом зовнішньої дії та умовами виникнення. Окреслені перспективи судово-медичних досліджень довгих кісток нижньої кінцівки.

Ключові слова: переломи, довгі кістки, нижня кінцівка.

Fractures of the long bones of the lower extremities are accompanied with a high rate of invalidism, considerable expenses on their treatment, a relatively high case fatality rate and a permanent attention on the part of inquest organs, executing investigatory measures [1-3]. The number of road accidents, as a result of which the bulk of fractures of the long bones of the lower extremity takes place, is on the rise annually by 7-10% [4]. A skeletal injury diagnosed in over a third of victims is placed second after neuroinjuries within the pattern of a severe mechanical injury. The share of fractures, for example, of the crural bones reaches 36,6%. Therefore, fractures of the long bones of the lower extremities occupy a leading place in the practical activity of medical specialists and are the object of investigatory actions. Forensic-medical experts should give answers to important questions of the inquest bodies based on a detailed familiarizing themselves with the circumstances of the case, postmortem findings, a study of the roentgenological picture or an investigation of the plane of a fracture [5-7].

The object of the research: to carry out a forensic-medical analysis of clinical cases of fractures of the long bones of the lower extremity and substantiate long-range trends of corresponding scientific investigations.

Material and methods. We have studied 318 clinical cases of fractures of long bones of the lower extremity (117 – of the femoral bone, 106 – of the tibia, 95 – of the fibula) by means of the methods of the statistical and comparative analyses with due regard for the gender ratio, a distribution based on the age, localization, the orienta-

tion of the fracture line, the type of a physical action, the facts of the case and the participation of outsiders. All the fractures have been subdivided by us into such groups based on the presence and number of bone fragments: 1) noncomminuted – two fragments are divided by the fracture line without accessory bone fragments; 2) comminuted – these is an accessory fragment among splinters; 3) multifragmental – there are two and more accessory bone fragments in the region of the fracture. Interrelations between the point of the force application and the place of tubular bone destruction were determined. If a fracture corresponded to the place of the force application it was characterized as local; if outside the point of the force application – constructional; if a fracture conformed to the point of the force application, but with the formation of accessory capillary fractures beyond it on the bone (as a construction) – locally constructional.

Results of the research. A sex – related distribution of fractures of the femoral bone has established that 67 (57,3%) of them fall on men, 50 (42,7%) – on women. The largest number of such fractures falls on persons of elderly – 39 (33,3%) and senile – 37 (31,7%) age, less – on persons of the second period of mature age – 28 (23,9%), the lowest number – persons of the first period of mature age and youths – 11 (9,4%) and 2 (1,7%) respectively. The right leg was injured in 60 (51,3%) cases, whereas the left one – in 57 (48,7%) cases. Hereat, 114 (97,4%) fractures were closed, 3 (2,6%) – open.

The findings, illustrating the distribution of fractures of the femoral bone based on the localization are very demonstrative. As it appears from the data of figure 1, the bulk of fractures was identified

at the level of the proximal metaepiphysis of the femoral bone – 79 (67,5%), the rest at the level of the middle one-third – 18 (15,4%), the upper and lower one-thirds – 8 each (6,8%) and the distal metaepiphysis – 4 (3,5%). It has been established that 57 (48,7%) fractures were noncomminuted, 47 (40,2%) – comminuted, 13 (11,1%) – multifragmental. The results of the research demonstrate that the majority of fractures of the femoral bone were constructional – 95 (81,2%), the minority – local and locally constructional – 19 (16,3%) and 3 (2,5%) respectively.

Fractures of the femoral bone arose as a result of various physical actions and their combinations. As it follows from the data of figure 2, the greatest number of fractures of the femoral bone arose due to the action of force along the bone axis – 92 (78,6%), fractures formed as a result of blows (collisions) with blunt objects were 5,7 times less as far as their number was concerned with the development of a flexural deformity – 16 (13,6%). In isolated cases fractures of the femoral bone occurred as a result of squeezing – 4 (3,4%), the action of force along the bone axis combined with twisting – 3 (2,6%), twisting and striking combined with twisting – 1 each (0,9%). The basic direction of the fracture line in relation to the longitudinal axis of the femoral bone is obliquely transverse – 54 (46,2%). In 29 (24,8%) and 26 (22,2%) cases fracture lines with a transverse and oblique orientation have been established respectively, in 5 (4,3%) – with a longitudinal orientation, in 3 (2,5%) – with a spiral one.

We have determined the conditions of the

onset of thigh fractures. It has been established that the greatest number of fractures of the femoral bone arose as a result of falling while walking – 73 (62,4%). A considerably smaller number of these fractures occurred under other circumstances: 23 (19,6%) – due to road accidents, 18 (15,4%) – while falling from a height, 3 (2,6%) – due to a direct action of blunt solid objects. It should be noted that in 90 (76,9%) cases femoral bone fractures ensued through a victim's carelessness or an unfavourable concatenation of circumstances, in 27 (23,1%) fractures were caused by outsiders.

When distributing fractures of the tibia based on the sex, it has been found out that 78 (73,6%) out of them fall on men, 28 (26,4%) – on women. An analysis of these particular age-related injuries evidences that half of the fractures of the tibia falls on persons of the second period of mature age – 54 (50,9%), less on persons of the first period of mature age – 29 (27,4%), least of all on persons of adolescent and elderly age – 12 (11,3%) and 11 (10,4%) respectively. The right leg was injured in 55 (51,9%) cases, the left one in 51 (48,1%); 88 (83,0%) fractures were closed, 18 (17,0%) – open.

As it follows from the data of figure 3, the bulk of fractures of the tibia occurs within the range of its lowest and middle midshafts – 50 (47,2%) and 41 (38,7%) respectively; 11 (10,4%) fractures were localized in the upper one-third, 4 (3,7%) – at the level of the metaepiphysis. The following data based on the presence of accessory bony fragments and of their number in region of

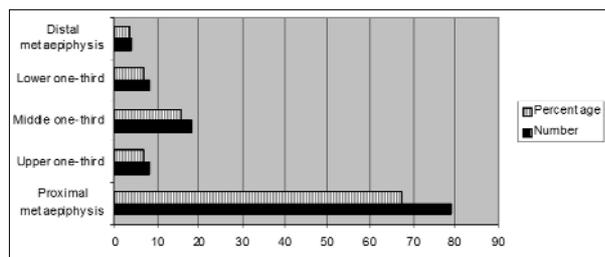


Fig. 1. The distribution of fractures of the femoral bone based on the localization.

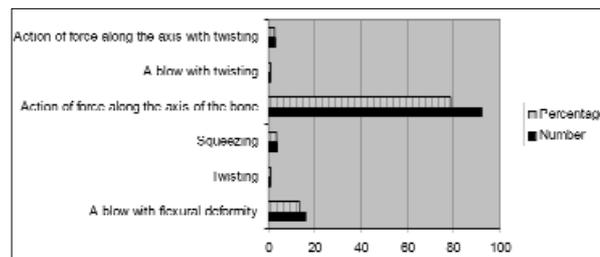


Fig. 2. The types of physical actions, that caused fractures of the femoral bone.

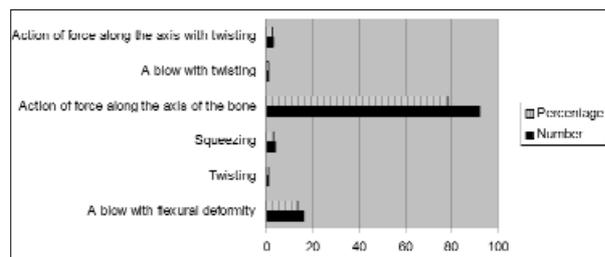


Fig. 3. The distribution of fractures of the tibia based on the localization.

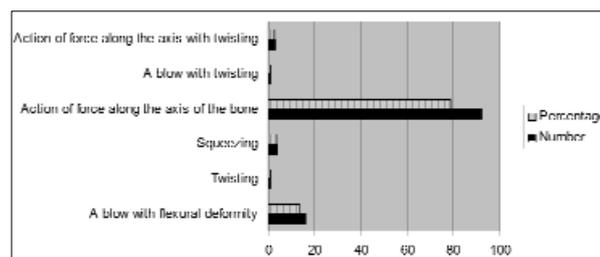


Fig. 4. The types of physical actions, that caused fractures of the tibia.

the fractures were obtained: 57 (53,8%) fractures were comminuted, 28 (26,4%) – noncomminuted and 21 (19,8%) – multifragmental. It has been found out by means of an analysis of the interrelations of the point of applying force and the fracture site, that 57 (53,8%) fractures of the tibia were local, 45 (42,4%) – constructional, 4 (3,8%) – locally constructional.

As it appears from the findings of figure 4, fractures of the tibia in a half of the patients – 54 (50,9%) arose due to the action of blunt objects with the development of a flexural deformity. A considerably lesser quantity is caused by the rest of the physical factors: due to the action of force along the axis of the bone – 20 (18,9%), due to twisting – 13 (12,3%), due to the action of force along the axis combined with twisting – 5 (4,7%), from squeezing – 4 (3,8%). The line of a fracture is oriented obliquely-transversely and transversely in relation to the longitudinal axis of the tibia with almost identical frequency – 34 (32,1%) and 33 (31,1%) respectively. The line of a fracture had a spiral orientation in 21 (19,8%) cases, an oblique one – in 15 (14,2%), a longitudinal one – in 3 (2,8%).

An analysis of the conditions of the onset of fractures of the tibia evidences that the greatest number of such fractures occurred as a result of road accidents – 43 (40,6%), a lesser one through a fall while walking – 29 (27,4%) and due to a direct action of blunt objects – 19 (17,9%), the lowest one in consequence of falling from a height – 15 (14,1%). It should be noted that in 58 (54,7%) cases tibial fractures ensued through patients' own carelessness, in 48 (45,3%) cases injuries were inflicted by outsiders.

When distributing fractures of the fibular bone based on the sex it is established that 71 (74,7%) out of them are ascribed to men, 24 (25,3%) – to women. Half of the fractures of the fibula is established in persons of the second period of mature age – 49 (51,6%), almost half of this number – 26 (27,4%) – in persons of the first period of mature

age, the lowest one in persons of elderly age – 11 (11,6%) and adolescent age – 9 (9,4%). The right leg was injured in 46 (48,4%) cases, in 49 (51,6%) – the left one. 80 (84,2%) fractures were closed, 15 (15,8%) – open.

As it ensues from the data of figure 5, the majority of fibular fractures – 43 (45,3%) were located in its lower midshaft, less in the middle – 29 (30,5%) and the upper one-thirds – 22 (23,1%), but least of all in the distal metaepiphysis – 1 (1,1%). The following findings have been established on the basis of the presence and quantity of accessory bony fragments in the region of a fracture of the fibular bone: 42 (44,2%) fractures were non-comminuted, 39 (41,1%) – comminuted, 14 (14,7%) – multifragmental. An analysis of interrelationships of the point of the force application and the site of a fibular fracture has shown, that local and constructional fractures constituted the greatest number, their amount being equal – 46 each, whereas locally constructional ones occurred least of all – 3 (3,2%).

As follows from the findings of figure 6, in a lesser half of the cases fractures of the fibular bone are caused by the action (collisions) of blunt objects with the ensuing origination of a flexural strain – 42 (44,2%), twice less they formed due to the action of force along the axis of the extremity – 22 (23,2%). Fractures arose considerably less seldom due to other physical actions: 11 (11,6%) – due to blows combined with twisting, 10 (10,5%) – from twisting, 6 (6,3%) – due to the action of force along the bone axis combined with twisting, 4 (4,2%) – from squeezing. The fracture line is more often oriented obliquely and transversely in relation to the longitudinal axis of the fibular bone – 31 (32,6%) and 30 (31,6%) respectively, less frequently – obliquely-transversely – 22 (23,2%), least seldom – spirally and longitudinally – 9 (9,5%) and 3 (3,1%) respectively.

An analysis of the conditions of the origination of fractures of the fibular bone evidences that the greatest number of such fractures arose as a

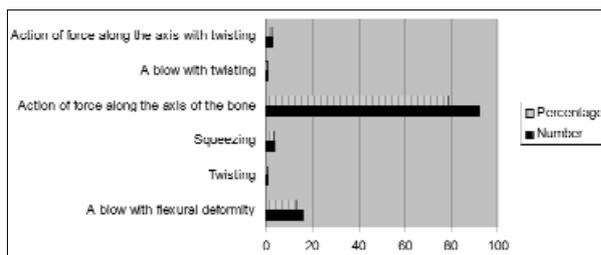


Fig. 5. The distribution of fractures of the fibula based on the localization.

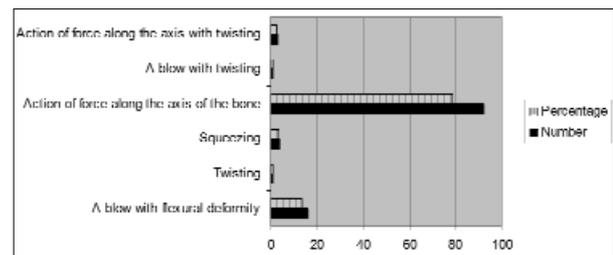


Fig. 6. The types of physical actions, that caused fractures of the fibula.

result of road accidents – 35 (36,8%), a smaller one – due to a fall while walking – 28 (29,5%) and a direct action of blunt objects – 18 (19,0%), the lowest number – 14 (14,7%) – from a fall from a height. It is worth noting, that in 57 (60,0%) cases fractures of the fibular bone ensued through victims' own carelessness and an unfavourable concatenation of circumstances, in 38 (40,0%) injuries were inflicted by outsiders.

Conclusions and prospects of further studies. 1. Based on the character of damage fractures of the long bones of the lower extremities are largely closed. 2. The majority of victims with fractures of the long bones is made up of men on whom 2/3 of fractures of the tibial and fibular bones and over half of the fractures of the femoral bone fall. In the first case these are persons of mature age, in the second one – of elderly and senile age. 3. Fractures of the femoral bone are more often (2/3 of the cases) located at the level of the proximal metaepiphysis, they are largely noncomminuted; fractures of the tibial and fibular bones are almost in half of

the cases localized at the level of the lower one third and are largely comminuted. 4. Over $\frac{3}{4}$ of fractures of the femoral bone are constructional and are caused by the action of force along the axis. Fractures of the bones of the crus very often occur from a direct action of blunt objects and force along the axis; fractures of the tibial bone in half of the cases are local; the frequency of local and constructional fractures of the fibular bone is almost identical. 5. Fractures of the femoral bone in almost half of the patients are short oblique, more often are due to a fall while walking; fractures of the tibia are more often short oblique and transverse, of the fibula – oblique and transverse; almost in half of the cases fractures of the crural bones are caused by outsiders. 6. A fractographic study of the morphologic signs of the plane of fractures of the long bones of the lower extremity and a study of the structural-functional characteristics of those areas of bones prone more often to destruction are considered to be promising in clinical and forensic-medical practice.

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СУДЕБНО-МЕДИЦИНСКИЙ АНАЛИЗ ПЕРЕЛОМОВ ДЛИННЫХ КОСТЕЙ НИЖНЕЙ КОНЕЧНОСТИ

Резюме. На основании судебно-медицинского анализа 318 переломов длинных костей нижней конечности представлено их распределение по полу, возрасту, локализации, направлению линии перелома, характеру и виду внешнего воздействия и условиям образования. Намечены перспективы судебно-медицинских исследований длинных костей нижней конечности.

Ключевые слова: переломы, длинные кости, нижняя конечность.

FORENSIC-MEDICAL ANALYSIS OF FRACTURES OF THE LONG BONES OF THE LOWER EXTREMITY

Abstract. A forensic-medical analysis of 318 cases with fractures of the long bones of the lower extremity has been performed. Their distribution based on the gender, age, localization, orientation of the fracture line, character, the kind of an external action and the conditions of forming have been shown. Long-term ways of further studies of these particular bones in forensic medicine have been presented.

Key words: fractures, long bones, lower extremity.

Bukovinian State Medical University (Chernivtsi)

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