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Uncomplicated fractures of the cervical vertebrae in children and adolescents

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Abstract

Introduction Various aspects of uncomplicated fractures of the cervical vertebrae in children and adolescents remain topical. **Purpose** To study incidence, character and type of uncomplicated fractures of the vertebrae of the cervical spine in children and adolescents. **Materials and methods** Out of 1000 children who had uncomplicated vertebral fractures, 27 (2.7 %) people were diagnosed with fractures at the cervical level. There were more boys among the injured – 77.77 % of the injured. 29.63 % of the patients were under the age of 12, and 70.37 % of – aged 12–17. Traditional methods for emergency traumatology were used for clinical diagnostics. **Results** In 17 (62.96 %) of the patients only the cervical vertebrae were compressed, in 10 (37.04 %) patients – both the thoracic vertebrae and the cervical vertebrae. Among the cervical vertebrae, compression of C7 vertebral body was most often observed – in 30.64 % of cases, less often – the body of C3 – in 4.08 % of cases. The main mechanism of injury was falling on head from a height of 2 m and more – 25.98 % of cases. Analysis of the character of C2 fractures showed that four patients had fractures of the odontoid process (three patients – type I, one – type III), one patient – fractures of the arches of this vertebra corresponding to type I. Fractures of subaxial location mainly corresponded to group "A" (subgroup I (36 compressed vertebrae), subgroup II (6 injured vertebrae)). In 2 cases, vertebral fractures were referred to group "B" (subgroup I). In 25 (92.59 %) clinical cases conservative treatment was used, in 2 (7.41 %) – there were indications for surgical treatment. The average duration of in-patient treatment for fractures of the cervical vertebrae was 9.4 days. Evaluation of long-term treatment results showed "good" results in 83.33 % of cases, satisfactory – in 16.67 % of clinical observations. **Discussion** The results that we have received are mainly comparable with the literature data on the main aspects of cervical trauma in children. At the same time, it is necessary to mention some differences. For example, many authors report that younger children most often get fractures of the C2 vertebra. According to our data, the average age of patients with these fractures was 14.8 years.

Keywords: uncomplicated fractures of the cervical vertebrae, children and adolescents

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INTRODUCTION

Various aspects of such an important problem as uncomplicated cervical spine fractures in children and adolescents are not so extensively described in modern medical literature as publications on fractures of the thoracic and lumbar spine. This problem is particularly important not just because of that, but because the published information is often contradictory and there are differences even of such an indicator as prevalence of cervical fractures in children. For example, some authors report that these injuries predominate in the structure of total number of spinal injuries in the pediatric population [1, 2]. Other researchers report an insignificant proportion of cervical fractures among all diagnosed uncomplicated vertebrogenic fractures in pediatric patients [3–5]. Practical issues related directly to pediatric vertebral trauma also require solution [6]. Thus, there is an increasing number of publications on the need to improve diagnostic methods, optimize methods and terms of treatment of vertebral fractures in children, taking into account the realities of the modern development of trauma and orthopedic science and practice [7–10].

Purpose To study the prevalence, nature and type of uncomplicated fractures of the cervical spine in children and adolescents.

MATERIALS AND METHODS

We have experience in the dynamic monitoring and treatment of 1000 patients aged 2 to 17 years inclusive, who were diagnosed with uncomplicated compression fractures of the vertebral bodies in the period from 09.01.2010 to 09.18.2019.

Among 1000 injured children, 27 (2.7 %) children had uncomplicated fractures of the cervical vertebral bodies, which constituted the clinical material, the analysis of which served as the basis for this study. There were 21 (77.77 %) boys and 6 (22.23 %) girls in the studied cohort. There were 8 (29.63 %) patients under the age of 12 years, 19 (70.37 %) patients were at the age of 12–17 years. The average age of children and adolescents in the group was 13.8 ± 2.9 years.

Traditional research methods of diagnostics for emergency traumatology were used: collection of complaints and anamnesis, clinical examination according to generally accepted methodology, and radial diagnostics. Radial

diagnostics of the spine consisted of plain radiography of the cervical spine (n = 27), CT (CT, n = 24) and MRI (MRI, n = 20). Upon clinical indications, allied specialists were involved in the examination of the injured children.

The nature and severity of the resulting vertebrogenic fractures in the studied patients were determined based on the classifications of Anderson I.D. et al. [11], Effendi et al. [12] (with injuries of the CII vertebra) and Argenson C. et al. [13] (for fractures of the CIII–CVII vertebrae).

For statistical data processing, the Microsoft Excel and Statistuca 6.0 software package were used. The share of each of the variants of the studied indicators is presented as P ± m, where P is the relative value of the indicator variants in %, m is the representativeness error of the relative value.

The study was approved by the Ethics Committee of the Tyumen State Medical University of the Russian Ministry of Health (protocol No. 59).

RESULTS

The study showed that 17 (62.96 %) patients had only the cervical vertebrae compressed, 10 (37.04 %) patients had the cervical and the thoracic vertebrae compressed.

Of the cervical vertebrae, compression of the body of the CVII vertebra was most often detected – in 15 (30.64 %) cases, least often – of the body of the CIII vertebra – in 2 (4.08 %) clinical cases. Damage to the atlas was not recorded in any of the cases. In total, fractures of 49 cervical vertebrae were diagnosed. The prevalence of fractures of each of the cervical vertebrae and their ranking in the structure of these injuries are presented in Table 1.

More than half of the children in the studied cohort, namely 15 (55.58 %) patients, were diagnosed with a fracture of one vertebra. Two compressed vertebrae were identified during examination in 5 (18.51 %) patients. Three injured vertebrae were also identified in 5 (18.51 %) children. Fractures of four vertebrae were observed in 1 (3.7 %) patient. Five compressed vertebrae were also found in 1 (3.7 %) patient.

The most important stage of diagnostics is studying the circumstances of the spinal injury. It allows us to conclude that the children sustained cervical fractures even before objective examination with a high degree of probability. Table 2 shows the mechanisms of spinal injuries, established during questioning of the patients, their relatives and eyewitnesses of the incidents, members of the ambulance teams.

In the structure of established causes of trauma of the cervical spine, as we can see from the data presented in Table 2, falls on the head from a height of 2 m or more prevailed – 7 (25.98 %) cases. The least common cause of fractures of the cervical vertebrae was hitting the back of the head or when performing somersaults – 1 (3.7 %) case each.

The injuries of the cervical vertebrae received by children were classified depending on their location. The severity of injuries of the cranio-vertebral region was assessed separately (fractures of CII vertebra in 5 children) and subaxial fractures (fractures of 44 vertebrae at the level of CIII–CVII spinal motion segments in 22 children) were also assessed separately.

Table 1

Percentage of fractures of each of the cervical vertebrae and their ranking in the structure of cervical trauma in patients of the studied cohort

No	Vertebra	Proportion		Ranking
		Absolute number	P ± m, %	
1.	CI	–	–	–
2.	CII	5	10.2 ± 4.28	V
3.	CIII	2	4.08 ± 2.79	VI
4.	CIV	6	12.24 ± 4.64	IV
5.	CV	9	18.36 ± 5.48	III
6.	CVI	12	24.48 ± 6.1	II
7.	CVII	15	30.64 ± 6.54	I
8.	Total	49	100.0	

Table 2

Proportion of the main mechanisms of cervical trauma in the patients of the studied cohort

No	Mechanism of trauma	Proportion	
		Absolute number	P ± m, %
1.	Falling on the head from a height of 2 meters or more	7	25.98 ± 8.44
2.	Hitting the head on the water bottom when diving or on the hockey rink boards	5	18.51 ± 7.39
3.	Road-traffic accident	4	14.8 ± 6.87
4.	Falling from the swings	4	14.8 ± 6.87
5.	Falling from a height of one's own body	3	11.11 ± 6.02
6.	Falling off a bike	2	7.4 ± 4.91
7.	Blow on the back of the head	1	3.7 ± 3.63
8.	Roll over when doing somersault	1	3.7 ± 3.63
9.	Total	27	100.0

An analysis of the nature of fractures of the CII vertebrae received by 5 children showed that four (80.0 %) patients had fractures of the odontoid process (three victims – type I, one – type III), 1 (20.0 %) patient had fractures of the arches of this vertebra corresponding to type I.

Three-degree classification C. Argenson et al. [13] was used to assess the fractures. In most of the clinical cases, the fractures of subaxial localization corresponded to group A (subgroup I (36 compressed vertebrae), subgroup II (6 injured vertebrae)). In 2 cases, vertebral fractures were classified as group B (subgroup I).

Two (7.4 %) patients in addition to fractures of the cervical vertebrae received other fractures, which allowed these clinical cases to be attributed to multiple traumas. So, in one case, a 16-year-old teenage girl, a passenger in a car, had fractures of the cervical vertebrae and of the right pubic and ischial bones. In another case, an 8-year-old girl who fell into a stairwell from the 2nd floor had fractures of the facial bones diagnosed. Concomitant trauma was also diagnosed in 2 (7.4 %) children, and the injuries were characterized by concomitant cervical fractures with mild severity brain concussion.

The severity of fractures of the cervical vertebrae determined the treatment tactics. Totally, in 25 (92.59 %) clinical cases conservative treatment tactics were used, in 2 (7.41 %) cases there were indications for surgical treatment.

Conservative treatment of 25 patients was performed by stretching the head with a Glisson loop along an inclined plane, prescribing analgesics in an age-specific dosage and physiotherapy. After relief of vertebrogenic pain, the cervical spine was immobilized using orthopedic devices. Among the latter, 17 (68.0 %) patients most frequently used Philadelphia type head holders. When only cervical fractures were diagnosed head holders were used to fix only this part of the spine – 10 clinical cases. In situations where there was a combination of compression of the cervical and upper thoracic vertebrae, the Universal Size Ossur PhiladelphiaThoracic Stabilizer was used in 7 cases. In 3 (12.0 %) clinical cases, a thoracocranial plaster cast was used to treat fractures of the cervical vertebrae. The average period of use of this fixator for immobilization purposes was 6 weeks. Individually made cardboard-cotton-gauze cervical collars were used for therapeutic purposes in 5 (20.0 %) injured children.

Surgical treatment of fractures of the cervical vertebrae was performed in 2 adolescent patients. In one case, a 16-year-old boy was hit by a moving vehicle, resulting in a comminuted uncomplicated fracture of the CV vertebral body. In the second case, a 17-year-old girl carelessly performed somersaults on a trampoline, which resulted in traumatization of the bodies of CVII, ThI, ThII, ThIII vertebrae with damage to the intervertebral discs CVI–CVII, CVII–ThI. In both patients, the amount of the operation performed consisted of subtotal resection of the bodies of damaged cervical vertebrae and anterior interbody fusion with a nickelide titanium implant and additional fixation with a plate. The postoperative period was uneventful, there were no complications; no neurological symptoms were recorded.

The average length of in-patient treatment for all 27 patients with fractures of the cervical vertebrae was 9.4 bed-days.

Clinical case

As an example illustrating diagnostics and treatment of fractures of the cervical vertebrae in a child, we present the following case. Patient M., 13 years old, was admitted to the emergency department of a large multidisciplinary hospital, he was brought by an ambulance team. On admission, the child complained of pain in the cervical and upper thoracic spine. Circumstances of injury: according to the boy, about 1 hour ago he fell from a tree about 3 meters high, hitting his head and body on the ground. Immediately after admission, the child was examined by a team of doctors at the children's hospital: an orthopedic trauma surgeron, a general surgeon, and a neurosurgeon. The plan of examination included an ultrasound examination of the abdominal organs (without pathology), electrocardiography (age norm), clinical minimum (age norm), biochemical blood test (age norm), skull radiography, radiography of the cervical region, MRI of the cervical and thoracic spine were performed. Based on the results of the clinical and para-clinical study, acute surgical and neurosurgical pathology was excluded.

Local status of the spine: the position of the child on a stretcher on the back, the cervical region is fixed with a head holder. Before the examination, the patient was verticalized, the head holder was removed. Visually, the position of the head is correct. There was no damage of the skin, edema, bruising in the scalp in the area of the face, cervical and thoracic spine. On palpation of the spine, there was pain along the spinous processes, interspinous spaces and paravertebral pain throughout the middle and lower cervical, upper thoracic regions. Axial load on the cervical spine is moderately painful. Vascular and neurological disorders in the upper extremities were not observed. According to the results of radiography of the cervical spine in the lateral view, compression of the bodies of the CIV, CV vertebrae, ossification of the atlanto-occipital membrane of the CI vertebra was diagnosed (Fig. 1a). According to the results of the MRI examination of the cervical and

thoracic spine, compression of the bodies of CIV, CV vertebrae was confirmed, and compression fractures of the bodies of ThIII, ThIV, and ThV vertebrae were observed (Fig. 1, b, c).

On the basis of the complaints, anamnesis, results of clinical and radiographic diagnostics, the diagnosis was: "Compression uncomplicated fractures of the bodies of CIV, CV, ThIII, ThIV, ThV vertebrae. Contusion to the scalp. Ossification of the atlanto-occipital membrane of the CI vertebra".

The child was hospitalized in the trauma and orthopedic department of the children's hospital, where he was put in a functional bed with traction behind his head along an inclined plane with a Glisson loop, and analgesics were prescribed in an age-appropriate dosage. From the second day of stay in the hospital, the child was prescribed physical exercise therapy and ultra-high-frequency therapy No. 8 in the projection of the middle cervical spine vertebrae.

Cervical pain was completely arrested on the 4th day of in-patient treatment. The child continued strict orthopaedic regime and underwent physiotherapy treatment. Neurosurgeon followed the patient in dynamics. On the 8th day after trauma the cervical spine of the patient was fixed with an orthopaedic head holder (Fig. 2).

In two days after the end of the course of physiotherapy the boy was discharged for outpatient treatment by a trauma and orthopaedic surgeon. The in-patient treatment was 10 days. Duration of spine immobilization by the head holder was 10 weeks; after removal of the head-holder the immobilization continued using cardboard-cotton-gauze cervical collar for another 2 weeks. During all this time the child continued physical exercise therapy; after the end of immobilization with the cardboard-cotton-gauze cervical collar there was one more course of physiotherapy (electrophoresis 2.4 % euphylline solution No. 10) in the projection of upper thoracic vertebrae.

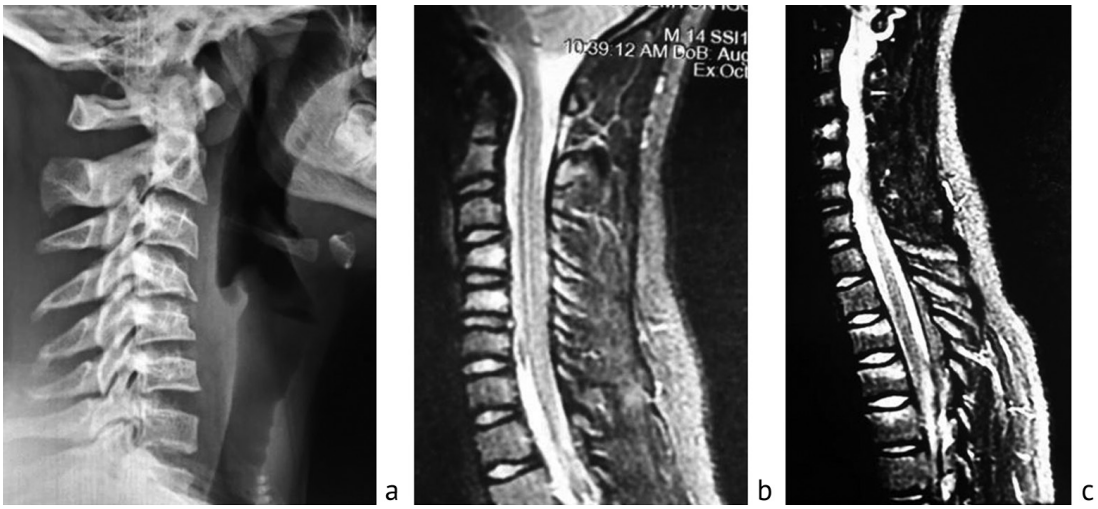

Fig. 1 Results of radial diagnostics of the cervical and upper thoracic spine in patient M., 13 years. Compression fractures of bodies CIV, CV, ThIII, ThIV, ThV vertebrae. Ossification of atlanto-occipital membrane CI vertebrae

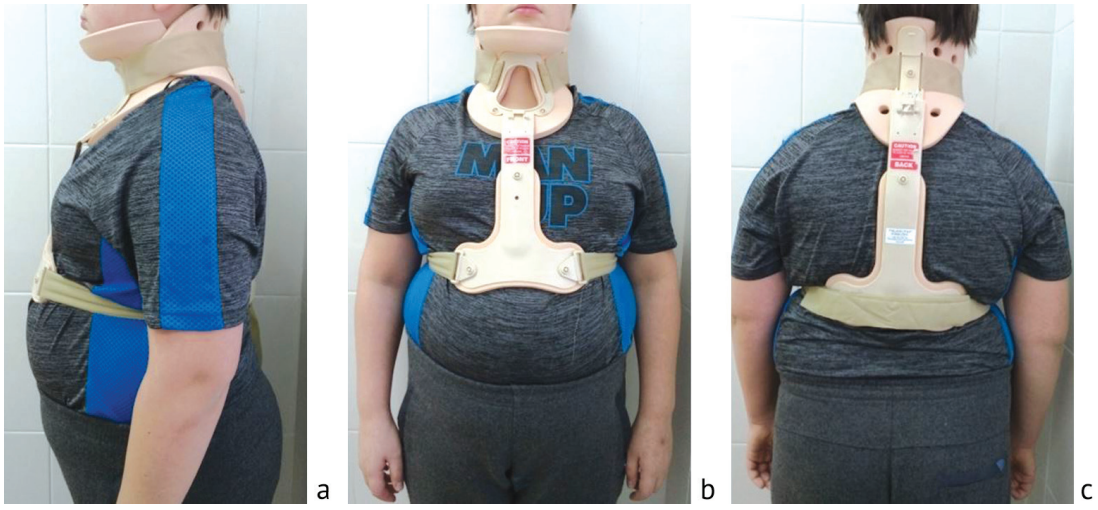

Fig. 2 Photo of patient M, 13 years, front view (a), side view (b) and view from behind (c). Cervical and upper thoracic spine of the child are fixed with a thoracic fixator "Össur Philadelphia Stabiliser", universal size

Studying short-term follow-up showed that the children did not have any complaints. Head position was correct. Axis of the cervical spine was not affected; there was no muscular defense. There was full function of the cervical spine in terms of active flexion, extension, side tilts and rotation. There was no pain in the cervical and thoracic spine on palpation; axial load on the spine was painless. Short-term clinical results of treatment were evaluated as "good". The child received recommendations on continuing physical exercise therapy, swimming in the pool, eating a whole-food diet containing microelements, courses of general massage of the posterior body muscles, being followed by a trauma surgeon.

DISCUSSION

It is a paradox, but even in scientific publications of the last two decades in the period of active introduction into the clinical practice of emergency trauma CT and MRI the authors give different data on the incidence of diagnosing uncomplicated fractures of the cervical vertebrae in children and adolescents.

So, A.G. Baindurashvili et al. report fractures of the cervical vertebrae in children in 0.16 % of the total number of all fractures [14]. V.A. Sorokovikov et al. report that among 85 children with spinal fractures the cervical location of the injuries was diagnosed in 1 child, which is 1.17 % of the total number of the clinical observations [15]. According to data of S.Ia.Diachkova et al. cervical fractures constitute 1.6 % of the total number of spinal fractures in pediatric patients [16]. Our data indicate that among 1000 children younger than 18 years of age uncomplicated cervical fractures were diagnosed in 2.7 % of the patients, which is the closest to the results published by Iukhnova O.M. et al. [17]. The authors when studying intra-natal injuries in newborns and post-natal spinal traumas in older children stated that compression fractures of bodies of cervical vertebrae constitute 2.8 % in the entire spinal pediatric trauma [17].

In the international literature J.I. Shin et al. [18] and M. Blauth et al. [19] report results close to ours. The first group of authors report data from the national medical database of the USA over a decade, which indicates that incidence of the cervical spine trauma in pediatric population is 2.07 % of cases [18]. According to the data of German researchers, the incidence of cervical fractures in children constitutes 3.0 % of clinical observations, thoracic and lumbar locations constitute 97.0 % of the vertebral fractures [19].

So, the scientific literature contains extensive data on the incidence of cervical factures in children not exceeding 3 % of the clinical observations. At the same time a number of scientist report predominance of cervical fractures in the total number of injuries of the entire pediatric spine. So, M.A.Abdulkhabirov reports injuries of cervical vertebrae as the most frequent location [20]. P. Liu et al., having analyzed annual reports of the nationwide database of China in 2001–2007, report that children in the age less than 10 years most frequently sustain fractures of the cervical vertebrae versus thoracic and lumbar vertebrae [21]. M.M. Mortazani et al. specify results of own clinical observations and report isolated cervical injuries in 31.2 % of injured children; isolated thoracic location of fractures – in 12.5 % of patients, isolated lumbar location – in 20.8 % of patients. The authors diagnosed multiple trauma of the thoracic and lumbar spine in 35.5 % of children [22].

According to the results of our study 77.77 % of the patients were male and 22.23 % – female. Most of the researchers studying spinal cervical trauma in children report predominance of boys among the patients. So, E.R. Kokoska et al. [23] report that among the injured 59.0 % were male, J. Stulik et al. [24] – 60.9 %, R.L. Brown et al. [25] – 62.1 %, A.V.Gubin et al. [26] – 65.0 %. At the same time Australian researchers P. Platzer et al. report data on prevalence of uncomplicated cervical fractures in female children in 55.0 % of cases [27].

Average age of the injured patients in our study was 13.8 ± 2.9 years. Table 3 shows some of the literature data on the average age of children who sustained cervical fractures.

Table 3

Combined literature data on the average age of children who sustained cervical fractures

No	Authors	Average age of children
1.	Platzer P. e al. [27]	8 years 9 months
2.	Murphy R.F. et al. [28]	15 years
3.	Poorman G.W. et al. [29]	16 years 6 months

Shin J.I. et al. states that older age groups of children are "high risk factors" for cervical trauma compared to thoracic and lumbar parts [18].

Our previous studies dedicated to analysis of multiple spinal trauma in 744 children and adolescents allowed us to determine the average age of children with spinal fractures throughout the entire spine as 9 years and 2 months [8]. So, patients with cervical fractures were on average 4 years older than those diagnosed with similar spinal traumas throughout the entire spine. An explanation to this fact, in our opinion, is the trauma

mechanism, which leads to vertebral fractures in children.

The data in table 2 indicate that the most common trauma mechanism, observed in 25.98 % of children with cervical fractures was falling on the head from a height of 2 meters or more. Most often the children and adolescents fell from wall bars (in apartments), pull-up bars or ladders out-doors when working out. In one clinical case an adolescent fell from the 4-storey height, which was evaluated as a suicide attempt after consultation of a doctor-psychiatrist [30]. In multiple vertebrogenic fracture cases the leading trauma mechanism was falling on the back or buttocks from a height of one's own body, so called "arch-key mechanism" – 36.96 % of the clinical observations [8].

Analysis of references on the aspect of "cervical trauma mechanism in children" showed that many authors indicated road-traffic accidents as the leading mechanism. So, J.I. Shin et al. [18] report that 57.51 % of the vertebral trauma is caused by road-traffic accidents. R.L. Brawn et al. [25] report somewhat smaller numbers – 52.0 %, G.W. Poorman et al. [29] – 50.5 %, E.R. Kokoska et al. [23] – 44 % of the clinical observatins. According to the results of our study road-traffic accidents caused cervical fractures in children and adolescents in 4 (14.8 %) cases; and at the moment of trauma three children were inside the vehicles as passengers, while one injured was hit by a passing vehicle at the pedestrian crossing.

Clinical symptoms of cervical fractures in children of the studied cohort were typical and in general did not differ from manifestations described in literature both by Russian [17, 31] and international [32, 33] authors. We made sure there were no neurological symptoms by examining the injured children involving a neurosurgeon, who was on call in the admission-diagnostic department of the hospital,

The amount of radiographic examination of the spine in children of the studied cohort consisted of plain radiography, CT and MRI. Radiographic study is considered the basic method of diagnostics according to recommendations of reputable Russian spinal surgeons [26, 34]. CT and MRI, as a rule, did not make any significant influence on the frequency of diagnosing cervical fractures; however they made it possible to determine the number of compressed bodies, degree of compression and plan the treatment in details. It was especially relevant for those clinical cases, when upper thoracic vertebrae were involved. The presented clinical case provides a good demonstration of the need for radial diagnostics not only of the cervical spine in the injured children but also upper thoracic. Many authors reported the necessity to study these two parts of the spine together [35, 36].

When conducting radiographic study we have always kept in mind the words of A.J. Schoenfeld et al. that the probability to diagnose all injuries of the cervical spine increases by 8–10 % of cases if CT and MRI methods are included into the examination process [37]. There are no publications indicating that there is no need for CT and MRI diagnostics of the cervical spine in injured children, however it has been pointed out that clinical value of these methods needs further study [38, 39]. According to Burtsev A.V. et al. at present there is no optimal diagnostic algorithm for verification of cervical spine trauma [34]. At the same time lately there have been attempts at development and introduction into clinical practice of a universal pediatric algorithm intended to decrease radiation exposure of the children with cervical spine trauma [40].

Results of radial diagnostics allowed us to reliably identify location of the fractured vertebrae, their number, type of injuries, dysplasia associated with the fractures and maldevelopment of spinal motion segements. Analysis of the spinal X-rays and tomograms of the entire cohort of the children made it possible to determine that out of 49 fractured vertebrae in 5 (18.51 %) cases the traumas were located at the level of CII, in 44 (81.49 %) clinical cases at the level of CIII–CVII. These data, in general, coincide with the data published in literature on the prevalence of fractures of the upper-cervical spine and subaxial trauma. So, E.A.Ramikh reports incidence of CII fractures in 15 % of the cervical fracture patients [41]. Subaxial trauma is reported in 75 % of the total number of all cervical injuries [31, 42]. According to N.M. Beckmann et al. this king of injuries was diagnosed in 53 % of children at the age less than 16 years who sustained cervical fractures [42].

Our study results do not confirm data that the upper-cervical spine is injured mostly in younger children, which was reported, for instance, by R.L. Brawn et al. [25] and P. Platzer et al [27]. The average age of five children with CII injuries, according to our data, was 14.8 ± 3.9 years, while the average age of all 27 patients of the studied cohort was 13.8 ± 2.9 years.

The number of injured vertebrae, their location and severity determined the tactics of treatment and, first of all, type of immobilization of the cervical spine in the injured children. The chosen treatment considered the opinion formulated by reputable Russian spinal surgeons that there are no exact criteria on choosing the tactics of treatment, and the tactics often depends on preference and skills of the doctors [43]. Although all the children of the studied cohort sustained uncomplicated traumas,

the high degree of probability of mechanical and (or) neurological instability in future led us to choose surgical treatment in 2 (7.4 %) children with injured spinal motion segments of subaxial level – anterior interbody fusion using nickelide titanium implant and plate. The literature data indicate that various variants of anterior stabilization found the widest application in surgical treatment of fractures of the middle and lower cervical spine [24, 28, 31, 43].

In the rest 25 (92.6 %) of the clinical cases conservative treatment of the vertebrogenic fractures was conducted. Immobilization of the cervical spine with external fixators was performed before discharging the patients from the hospital for out-patient treatment. Certified head-holders of Philadelphia type were most commonly used – in 17 (68.0 %) clinical observations. For treatment purpose two types of these head-holders were applied: "Philadelphia" – for isolated cervical spine fractures and "Thoracic fixator Ossur Philadelphia Stabiliser" for combined fractures of bodies of cervical and upper thoracic vertebrae. Both these products found wide application in clinical practice in patients with cervical pathology [24, 44, 45]. Application of thoraco-cranial plaster cast was the most infrequent of all – in 3 (12.0 %) clinical cases – for treatment of cervical spine fractures in children. This application in clinical practice was fully in line with the program of state guarantees of providing free medical care for citizens in injuries of the locomotor system. Another important reason for immobilization of the cervical spine with this type of plaster cast was that doctors in charge were not completely sure that after discharge from the hospital the patients would follow the requirements for immobilization of the injured spine segment and would not cease application of head-holders of their own accord.

It should be noted that application of various external fixators for treatment of compressed cervical vertebrae in patients of different age groups remains topical and is discussed in multiple publications of Russian and international authors [17, 45, 46].

An important and unsolved problem of emergency pediatric vertebrology is absence of unanimous approach to evaluation of results of conducted treatment of vertebral fractures including cervical spine fractures in children and adolescents [8]. Taking into account this fact we developed "An individual map of evaluation of results of clinical and radial examination of cervical spine in 6 and 12 months after trauma. We succeeded in studying long-term follow-up within specified time of 6 (22.22 %) out of 27 children in the studied cohort.

The result of treatment was evaluated as "good", "satisfactory" and "poor". The evaluation was based on presence (or absence) of the following criteria in the cervical spine:

1) clinical (complaints of pain and headache, which appeared after the trauma; head position, whether there was its fixed tilt after the trauma; defense of extensor muscles; pain on palpation of spinous processes, inter-osseous spaces and paravertebrally; painful axial load; painful limited amount of active flexion, extension, side tilts and rotation);

2) radial (affected axes in the frontal and sagittal planes with the apex of deformity in projection of the consolidated vertebrae; height loss of the bodies of the consolidated vertebrae and shape defects of the intervertebral discs).

Presence of each of the enumerated symptoms was evaluated in points. The result depended on the total points. From 0 to 3 points – corresponded to a good result; from 4 to 6 points corresponded to a satisfactory result, 7 and more points indicated a poor result of the therapy.

When evaluating X-rays of the cervical spine and studying long-term results a special attention was paid to presence of dysplasia and maldevelopment of the spinal motion segments: non-closure of the posterior vertebral arches, ossification of atlantooccipital membrane, assimilation of the atlas, anomaly of tropism of articular processes of the spinal motion segment CII–CIII, concrescence of various parts of adjacent vertebrae; cervical ribs of CVII vertebra. In our opinion, the enumerated peculiarities of the cervical spine development in children, which were often latent before trauma, could manifest by clinical symptoms after sustaining fractures. These clinical symptoms could be mistakenly interpreted as a consequence of the sustained cervical spine fractures.

According to the presented criteria good results of the conducted therapy were observed in 5 (83.33 %) children, satisfactory – in 1 (16.67 %) child. No poor results of the conducted treatment were registered in any of the clinical observations.

CONCLUSION

1000 clinical cases, children and adolescents with uncomplicated spinal fractures throughout the entire spine were analysed in order to achieve the goal of the study. In this numerous group of children cervical fractures were diagnosed in 27 patients; that is the incidence of fractures of the cervical vertebrae was 2.7 % of the total number of clinical observations. The study group consisted of these injured 27 patients with cervical fractures and number of

male patients prevailed – 77.77 %. More than 70.0 % of patients were older than 12 years. According to location of the injury compression of the body of CVII vertebra was the most frequently observed – in 30.64 % of the cases. Among 44 compressed vertebrae of subaxial location the larger part of them corresponded to group "A" – 42 clinical cases. In 2 cases the vertebral fractures received by the children were referred to subgroup "B". Analysis of CII fractures in 5 patients showed that the I type of injury was registered in 3 children, the III type – in 1 child. Fracture of the CII arch was diagnosed in 1 patient; the fracture corresponded to I type.

The tactics of treatment depended on the severity of the cervical fractures. Conservative tactics of treatment was used in 92.59 % of the total number of clinical cases in the studied cohort; indications for surgical treatment were found in 7.41 %. The average duration of in-patient treatment in these 27 patients with cervical fractures was 9.4 days. According to the developed criteria of evaluation described above, good results of the conducted therapy were achieved in 83.33 % of the children, satisfactory – in 16.67 % of the patients.

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