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ARTIFICIAL INTELLIGENCE EFFECTIVITY IN FRACTURE DETECTION

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Ключові слова: *травматологія, радіологія, клінічні дослідження, флюороскопія, ортопедична діагностика*

Abstract. Artificial intelligence effectivity in fracture detection. Boginskis V., Zadoroznijs S., Cernavska I., Beikmane D., Sauka J. *The scientific study aimed to explore the practical implementation of artificial intelligence (AI) technologies in radiology and traumatology for fracture detection, as well as evaluate their overall effectiveness in modern medicine. In recent years, AI has gained significant traction in the healthcare industry, enabling the analysis of patients' clinical data and facilitating disease diagnosis, monitoring, risk assessment, and surgical intervention possibilities. The relevance of the scientific work is in the gradual expansion of practical applications of artificial intelligence technologies in medicine, particularly in radiology for diagnosing fractures. The study aimed to investigate the practical effectiveness of AI technology in fracture detection on example of Hospital of Traumatology and Orthopaedics in Riga, Latvia. The methodological approach combined system analysis of AI system implementation in modern medical institutions for creating X-ray images with a clinical study of fracture diagnosis experience at the Hospital of Orthopedics and Traumatology in Riga, Latvia. Fractures were detected by radiologists, attending physicians, and the AI program, with comparisons made between them. Results were analyzed to assess the program's efficacy. The results of the study demonstrated the high effectiveness of AI technologies in fracture detection. The application of these systems in clinical practice led to a significant reduction in diagnostic errors (by 2-3 times) and an increase in diagnostic accuracy (from 78.1% to 85.2%). Moreover, AI systems proved to be capable of detecting fractures that were not initially identified during routine examinations by paramedics and medical practitioners. This emphasized the practicality of expanding the use of these systems in clinical practice. The practical significance of the obtained results is in their potential use in the development of software systems based on AI, aimed at enhancing fracture diagnosis in medical institutions. These findings provided valuable insights for further advancements in AI-based technologies for fracture detection.*

Реферат. Ефективність штучного інтелекту у виявленні переломів. Богінскіс В., Задорожніс С., Чернавська І., Бейкмане Д., Саука Я. *Наукове дослідження мало на меті дослідити практичне застосування технологій штучного інтелекту (ШІ) в радіології та травматології для виявлення переломів, а також оцінити їхню загальну ефективність у сучасній медицині. В останні роки штучний інтелект набув значного поширення в галузі охорони здоров'я, дозволяючи аналізувати клінічні дані пацієнтів і полегшуючи діагностику, моніторинг, оцінку ризиків та можливості хірургічного втручання. Актуальність наукової роботи полягає в поступовому розширенні практичного застосування технологій штучного інтелекту в медицині, зокрема в радіології для діагностики переломів. Метою дослідження було вивчення практичної ефективності технології штучного інтелекту у виявленні переломів на прикладі лікарні ортопедії та травматології в м. Рига, Латвія. Методологічний підхід поєднував системний аналіз впровадження системи ШІ в сучасних медичних установах для створення рентгенівських зображень з клінічним дослідженням досвіду діагностики переломів у Лікарні ортопедії та травматології в м. Рига, Латвія. Переломи виявляли рентгенологи, лікарі та програма зі штучним інтелектом, а потім порівнювали їхні результати. Результати були проаналізовані для оцінки ефективності програми. Результати дослідження продемонстрували високу ефективність технологій штучного інтелекту у виявленні переломів. Застосування цих систем у клінічній практиці привело до значного скорочення* *діагностичних помилок (у 2-3 рази) і підвищення точності діагностики (з 78,1% до 85,2%). Крім того, системи ШІ виявились здатними виявляти переломи, які не були спочатку ідентифіковані під час рутинних оглядів парамедиками та лікарями-практиками. Це підкреслює доцільність розширення використання цих систем у клінічній практиці. Практичне значення отриманих результатів полягає в можливості їх використання при розробці програмних комплексів на основі ШІ, спрямованих на покращення діагностики переломів у медичних закладах. Отримані результати надали цінну інформацію для подальшого розвитку технологій на основі ШІ для виявлення переломів.*

The problem of this scientific work is in the need to study the possibilities of practical introduction of artificial intelligence technologies in radiology and traumatology in fractures detection, as well as to assess the overall effectivity of this technologies use in modern medicine. Artificial intelligence (AI) has become widespread in the healthcare industry in the past few years. AI-based applications are being used to analyse patients' clinical data, which makes it much easier for healthcare institutions to diagnose diseases, monitor their condition, assess the degree of risks and possibilities for surgical interventions [1]. In the practice of medical institutions in Latvia, the artificial intelligence systems use has not yet become widespread. The first institution that applied this technology was the Daugavpils Regional Hospital, where in 2020 the program for reading X-ray images GLEAMER BoneView was introduced [2]. Hospital employees note that this has saved up to 3500 hours per month on image processing, while one image is now processed no longer than 3 minutes. The six-month time savings for servicing 400 patients currently is 21 hours.

A team of research scientists represented by Duron et al. in a joint scientific study considered a number of problematic aspects of assessing the artificial intelligence aid in adults' appendicular skeletal fractures detection by emergency physicians and radiologists [3]. The authors note that the lack of qualified radiologists is a significant problem that makes it expedient to introduce artificial intelligence systems for fractures diagnosis in medical institutions around the world.

The raised issues were elaborated by Boginskis in a scientific work aimed at studying the practical effectivity of artificial intelligence technologies application in the fracture's diagnosis [4]. The scientists note that the artificial intelligence application in radiology is justified by the high quality of image recognition, which is extremely important in the fracture's diagnosis. According to Yokota et al., over the next 15-20 years, AI technologies will largely take over the functions of radiologists and other medical specialists in diagnosing and treating the whole range of diseases, among which fractures have a special place [5].

In turn, Hayashi et al., in a joint scientific work aimed at practical study on automatic detection of acute appendicular fractures in children, pay attention to the fact that the AI diagnostic effectivity is consistently high in anatomical localisations of all types, practically studied by the authors [6]. Such conclusions are based on the analysis of fractures in a group of children in the amount of 300 people (167 boys, 133 girls) whose average age was 10 years, 8 months.

At the same time, a group of scientists consisting of Guermazi et al. jointly studied the issues on how to increase the productivity and effectivity of X-ray fracture detection using artificial intelligence technologies [7]. It is noted that the AI-based systems application in radiology reduces the probability of errors in the fracture's interpretation, which is extremely important in fractures diagnosing.

Aung et al. in the scientific study of the practical application of possibilities of artificial intelligence systems in healthcare note that the first experience of application of AI systems in medicine was noted in 1976, since then systems of this kind have been widely used in its various areas [8]. At the same time, special effectivity of the artificial intelligence was noted in radiology in fractures diagnosing, because such systems significantly increase the diagnosis accuracy that is important in treatment prescription.

The main purpose of this scientific work is to study the application effectivity of artificial intelligence technologies in fractures detection on the example of the Hospital of Orthopaedics and Traumatology in Riga.

MATERIALS AND METHODS OF RESEARCH

The method of logical approach basis in this retrospective study is a combination of methods of system analysis of the practical experience of application of artificial intelligence systems in emergency department with the clinical study of the experience of application of this kind of technologies in fractures detection in patients of the Hospital of Orthopaedics and Traumatology in Riga (Latvia). The theoretical basis of this scientific work is the results analysis of scientific studies in the area of evaluating the effectivity of using artificial intelligence-based systems in emergency department.

The use of the system analysis method of the accumulated experience of the practical application of artificial intelligence-based systems in the radiology and radiography area made it possible to distinguish the main AI advantages in the study of simple X-ray images. In addition, it made it possible to note the potential directions for optimising this kind of systems to improve the process of fractures detection and reducing the number of AI reduced emergency physical errors.

The clinical study of the experience of artificial intelligence systems application in fractures detection on the example of the Hospital of Orthopaedics and Traumatology in Riga assumed the presence of a number of inclusion criteria. The first inclusion criteria group consisted of patients who were treated in emergency department during the period from 18.06.2020 to 18.07.2020, as well as the category of different patients in different time periods, who came for help in the emergency department. During this period of time, an artificial intelligence-based program was operating in the city Hospital of Orthopaedics and Traumatology. The second inclusion criterion is detected fracture by radiologist or emergency physician assistant of AI program.

During radiographic studies of fractures, the GLEAMER BoneView® program was used, which is based on an artificial intelligence system. This algorithm helps to detect fractures, dislocations and other bone injuries and provides three options for labelling before diagnosis establishment after image processing: positive (the probability of bone damage is 90% or more), doubtful, negative (in all other cases) [2].

In the study patients were divided into two groups:

1. Study group patients from 2021 (AI program was used in the hospital).

2. Control group from 2020 (AI program was not used in the hospital).

At the initial stage, the clinical study was conducted during the period from 18.06.2020 to 18.07.2020, when 2803 patients were examined, and during the period from 18.06.2021 to 18.07.2021 when 3046 patients were examined. In total, 5849 patients of the Hospital of Orthopaedics and Traumatology in Riga were examined during the clinical study. In both groups (control group and study group) radiologists, an attending physician assistant, and AI identified 745 fractures in the control group and 742 fractures in the study group.

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. Ethics Committee approval is not required for this kind of study in the country where the study was conducted. Informed consent was obtained from all patients included in this study. The purpose and procedures of the study were clearly explained to each participant, including the potential risks and benefits. Participants were assured that their personal information would remain confidential and would only be used for the purpose of this research.

Also, during the study, the INSIGHT MMG™ and INSIGHT CXR™ programs were utilized. The "INSIGHT MMG™" program, developed by Lunit Company, employs artificial intelligence to enhance the quality of screening mammography, offering high-resolution imaging capability of up to 96% through continuous improvement based on analysis of numerous mammography images. On the other hand, "INSIGHT CXR™" is an artificial intelligence algorithm specifically designed for evaluating Lung X-Rays. It has undergone extensive trained using more than 3,500,000 X-ray images, resulting in an exceptional accuracy of 97-99% in detecting various lung pathologies using the fluoroscopy method. Additionally, the study also utilized the "Brain Scan™" product, developed by BRAIN SCAN Polish company, which utilizes computed tomography and artificial intelligence to accurately assess the risks associated with stroke occurrence and progression. For statistical analysis, we used the Microsoft Excel 7.0 software suite, where the Student's t-test was calculated for independent samples. Differences at $p<0.05$ were considered statistically significant.

Each individual fracture detected in patients included in the study was treated as a separate case. Suspected fractures identified by the GLEAMER BoneView® program were classified as fractures, as were doubtful fractures diagnosed by doctors, doctor-residents, and doctor assistants. Each fracture was assigned a specific code based on the Latvian fracture SSK-10 classification. The study compared fracture codes between radiologists and attending physicians for all participants, as well as between radiologists and the AI program. In cases where the radiologist suspected a fracture but the diagnosis was unclear, the X-rays were re-evaluated by another radiologist with a minimum of 5 years of experience in the field.

Re-evaluation was necessary to ensure accurate diagnoses, considering the assumption that radiologists have 100% correct diagnoses. The primary objective of the study was to determine the percentage of missed fractures in the emergency department, while the secondary objective was to identify the percentage of over-diagnosed fractures. These objectives were analyzed among different emergency physician subgroups, including certified traumatology doctors, 4-5 year residents in traumatology, 1-3 year residents in traumatology, and doctor-assistants. The data was evaluated using the Chi-squared test and IBM SPSS software. Based on the obtained data, conclusions were drawn regarding the effectiveness of the AI-based program in diagnosing fractures.

RESULTS AND DISCUSSION

The first artificial intelligence-based programs that have been tested in Latvia and are successfully operating are distributed by Datamed Company [9]. Among the artificial intelligence-based programs, which were previously used in medical practice and are used up to the present, the following programs should be noted.

GLEAMER ChestView® is an artificial intelligence-based program for fluoroscopic lungs study, to determine a variety of pathological conditions. ChestView® provides radiology and clinical studies specialists the ability to quickly and automatically receive a chest X-ray. The image reading process is fully integrated into the working process of the radiology specialist [4].

The GLEAMER BoneView® program was developed in France in 2017. The developer company takes a leading position in the implementation of artificial intelligence-based software solutions in radiology. GLEAMER BoneView® is an AI-based system for bone fracture detection in GLEAMER X-rays using BoneView® are unique in that they can detect any bone fracture in both adults and children. The first version of the program was released in 2018.

INSIGHT MMG™ is an artificial intelligence algorithm from Lunit Company. This system allows receiving high quality screening mammography. The INSIGHT MMG™ software has gone through a stage of continuous improvement through the creation of several hundreds of thousands of mammography images, which provides a high-resolution imaging capability of up to 96% [4]. INSIGHT CXR™ is an artificial intelligence algorithm for Lung X-Ray evaluation. INSIGHT CXR™ is a program that has passed the stage of "computer-assisted learning;" on the processing of more than 3500000 X-ray images. This provides this program with a leadership in its group with an accuracy of 97-99% in the detection of various lung pathologies by fluoroscopic method [4].

Brain Scan™ is a product of BRAIN SCAN Polish company. It is an artificial intelligence-based algorithm, which gives the possibility of establishing the real risks of the occurrence and development of stroke through computed tomography [4]. Since July 2021, there have been four updates to the GLEAMER BoneView® program. Currently, the AI-based program for taking X-rays of the spine and chest area has been validated.

Figure 1 shows an X-ray image analyzed by AI showing tibia malleolus and fibula lateral malleolus fractures.

Fig. 1. X-ray image analysis of the patient's ankle joint using the GLEAMER BoneView® artificial intelligence program [4]

Figure 2 shows X-rays analyzed by AI showing a suspected fracture of the greater tuberosity of the humerus. In this case, a fracture was confirmed by the radiologist (diagnosis S42.2). The diagnosis by AI was established correctly. At the level of the emergency department AI establishes a diagnosis, after that radiologist check if is it correct or not.

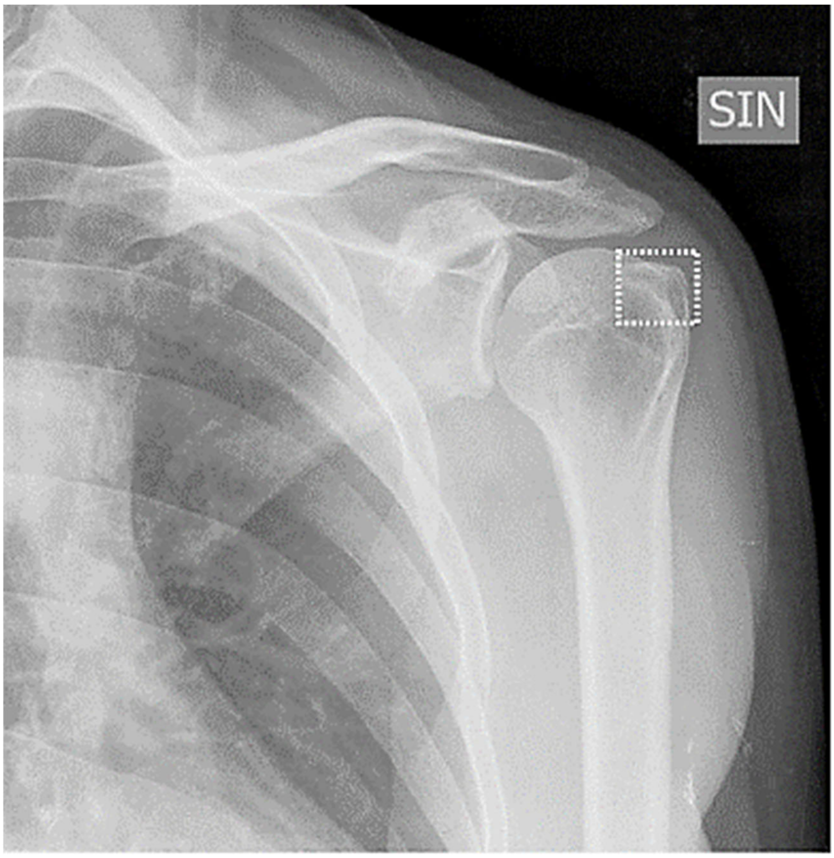

Fig. 2. X-ray image analysis of the patient's shoulder joint using the GLEAMER BoneView® artificial intelligence program [4]

Because the GLEAMER BoneView® program has only been tested on limbs and pelvis (extremity skeleton or validated fractures), the results were separately analyzed for only the limbs and pelvis, additionally checking them on for other fractures in the chest, spine and skull (axial skeleton or non-validated fractures). Data on the fractures distribution by groups are presented in Figure 3 and Table 1.

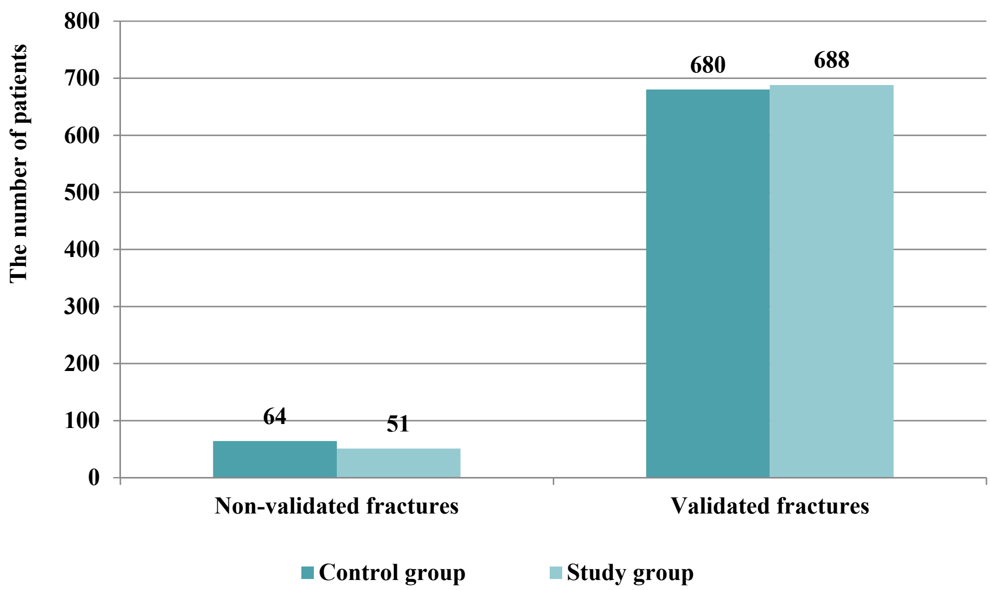

Fig. 3. Distribution of detected fractures by groups of validated and non-validated fractures

Table 1

Distribution of validated and non-validated fractures

Analysis of	Study group	Control group	Mean value	p-Value
detected fractures by groups of validated	688	680	8	p<0.05
and non-validated fractures	51	64	13	

For all fractures, both validated and non-validated in the control group, versus the study group when the AI program was used, fractures not noticed on X-ray were detected (Fig. 4). Using GLEAMER BoneView® the number of program errors decreased by 5%, diagnostic accuracy increased by 6.8% and hyper-diagnosis decreased by 1.6% (Table 2).

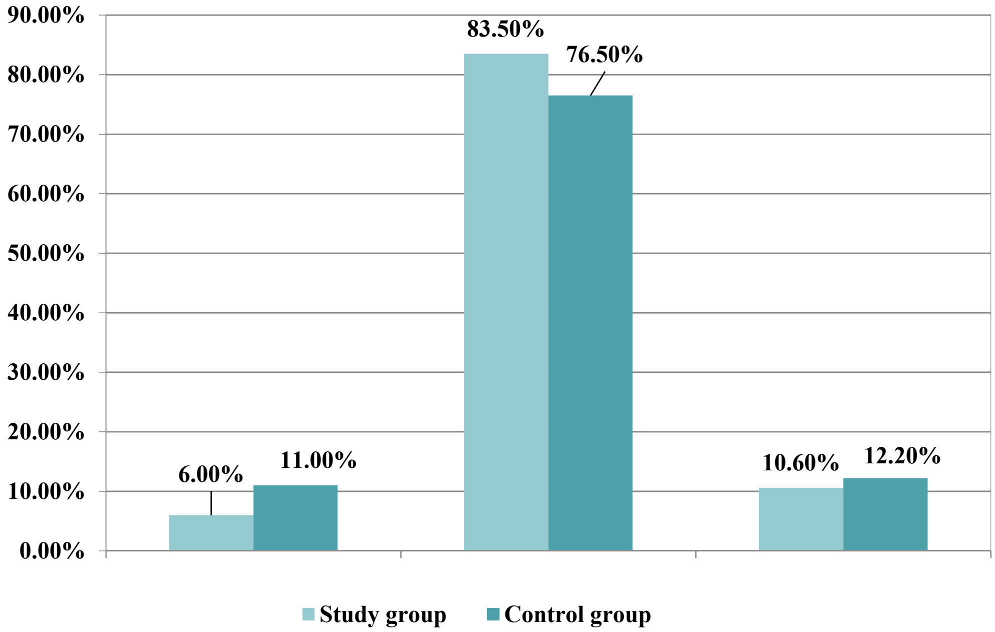

Fig. 4. Analysis of all detected fractures

Table 2

Analysis of the accuracy of the tests versus the study group when the AI program was used Fractures not noticed on X-ray were detected

Analysis of the	Study group, %	Control group, %	Mean value, %	p-value
number of program errors	6	11	5	p<0.05
diagnostic accuracy	83.5	76.5	7	p<0.05
diagnostic accuracy	10.6	12.2	1.6	p<0.05

The clinical study was also conducted on the fracture detection statistics by medical specialists (paramedics/qualified physicians) in the study groups. In addition, data on the indicated groups of patients were taken into account for the periods of their observation over a period of time from one to three years and from four to five years. In the control group, the distribution of detected fractures among doctors/physician assistants is not uniform. Conversely, in the study group, fractures are evenly distributed among doctors/physician assistants. Fracture detection statistics in these groups are presented in Figure 5 and Table 3.

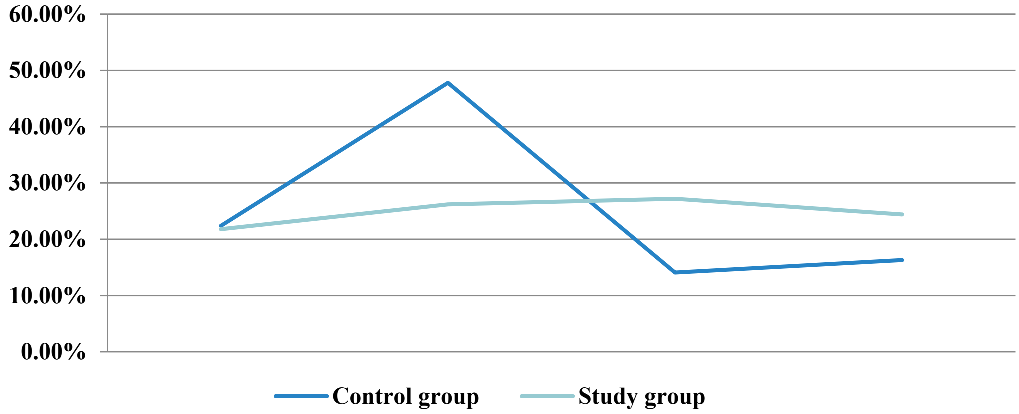

Fig. 5. Distribution of the number of validated fractures by groups of doctors/physician assistants

Table 3

Analysis of the accuracy of the tests GLEAMER BoneView® program

Data for group of patients	Study group, %	Control group, %	Mean value, %	p-value
1	21.8	22.4	0.6	$p<0.05$
2	26.2	47.8	-21.6	$p<0.05$
3	27.2	14.1	13.1	$p<0.05$
4	24.4	16.3	8.1	$p<0.05$

For the control group without using the AI program and the study group with the AI program, validated fractures were compared (Fig. 6). Using the GLEAMER BoneView® program, the number of errors decreased by 6% more than half, diagnostic accuracy increased by 7.1% and hyperdiagnostics decreased by 1% (Table 4).

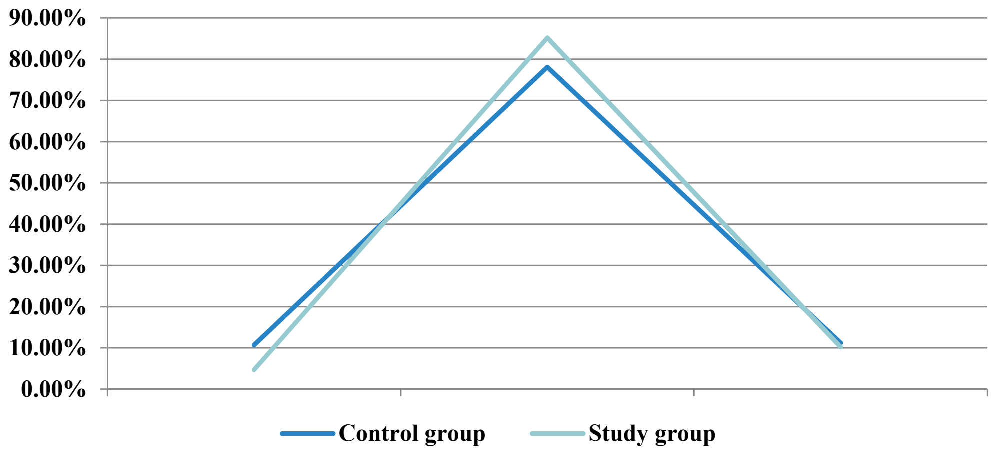

Fig. 6. Analysis of validated fractures

Table 4

Analysis of the accuracy without using the AI program vs study group

Analysis of the	Study group, %	Control group, %	Mean value, %	p-value
number of errors	4.7	10.7	6	$p<0.05$
diagnostic accuracy	85.2	78.1	7.1	$p<0.05$
hyperdiagnostics	10.2	11.2	1	$p<0.05$

Physician assistants in the control group versus the study groups (Fig. 7). Using the GLEAMER BoneView® program, the number of errors decreased by 9.8% almost tripled, diagnostic accuracy increased by 2.9% and hyperdiagnostics increased almost twice 6.9% (Table 5).

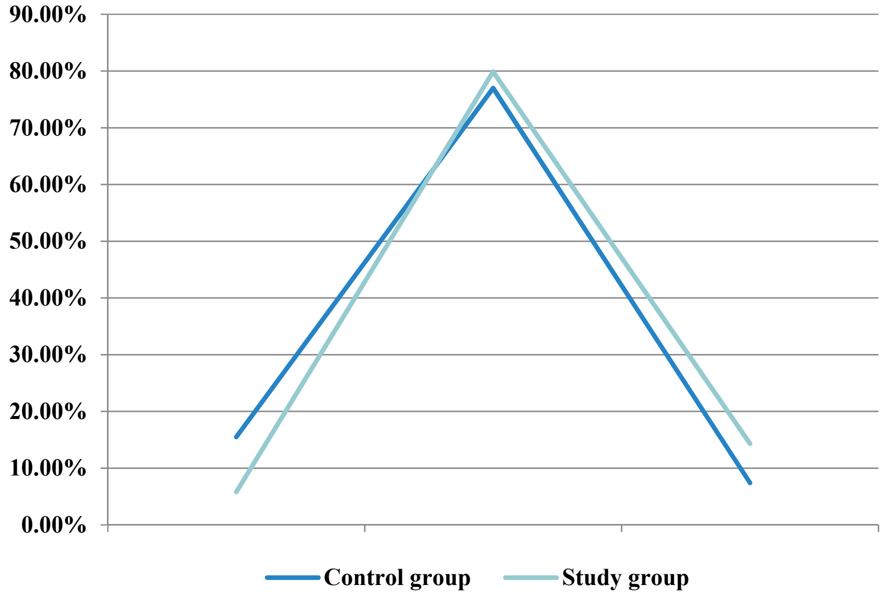

Fig. 7. Analysis of fractures detected by medical assistants in validated fractures

Table 5

Analysis of the accuracy of the tests without using the AI program, versus the study groups, using GLEAMER BoneView® program

Analysis of the	Study group, %	Control group, %	Mean value, %	p-value
number of errors	5.8	15.5	9.7	$p<0.05$
diagnostic accuracy	79.9	77	2.9	$p<0.05$
hyperdiagnostics	14.3	7.4	6.9	$p<0.05$

In the study group, radiologists identified 607 fractures. Of these, AI did not detect 55 (9.1%), accurately diagnosed 492 (81.1%), and marked 60 (9.9%) as suspected fractures. Additionally, in the study group, radiologists did not validate 81 (11.8%) fractures initially diagnosed by the attending physician/assistant physician. Of these, AI confirmed 13 (16%) as fractures, flagged 7 (8.6%) as suspected fractures, and in 61 (75.3%) instances, AI concurred that no fracture was visible on the radiograph.

The presented data testify to the high effectivity of using artificial intelligence-based systems in clinical practice for fractures detection. The artificial intelligence programs effectivity is due to the fact that standard radiography, which is mainly used for fracture diagnosis, usually misses up to 20% of cases in contrast to the AI programs that provide additional imaging [10, 11]. In addition, the correct X-rays interpretation requires the appropriate experience of the radiologist and time to study images, the absence of which can lead to undetected fractures and errors in diagnosis establishment [12]. As it follows from the provided results, artificial intelligence programs can significantly reduce the number of errors in diagnosis establishment and improve the diagnosis quality. The latter fact is expressed in the possibility of fractures detecting in cases where it is difficult or impossible to do with standard X-ray equipment.

The scientific team represented by Al-Sani et al. aimed at studying side effects from emergency care in terms of the paediatric X-rays interpretation, note that, as practical experience shows in documenting the results interpretation of radiological studies, the artificial intelligence systems application in fractures detection significantly increases the diagnosis accuracy [12]. The scientists concluded that integrating AI systems into fracture diagnosis for both children and adults significantly aids radiologists and may offer new insights into the causes of complications associated with fractures [12]. The results obtained by scientists are fundamentally consistent with the results of this scientific work.

In turn, a group of scientists represented by Alberich-Bayarri et al., in scientific work aimed at studying 2D and 3D measurements of the fractal dimension of trabecular bone based on high-spatial magnetic resonance images came to the conclusion that further studies in the artificial intelligence systems application area to refine the sample sizes of X-ray images data are of fundamental importance for clarifying the real potential of 2D and 3D in the study of osteoporosis development causes and the prospects for its treatment [14]. The researchers' results correlate with the results of this scientific work, especially in terms of expanding the understanding level of 2D and 3D technologies.

The topic of using artificial intelligence-based systems in fracture diagnostics area is raised in the joint scientific study by Kuo et al. [15]. According to the group of authors, the practice of using artificial intelligence-based systems as a means of supplementing clinical practice in the fracture diagnosis area is increasingly spreading in medical institutions. It is noted that such systems allow obtaining X-ray images with a higher resolution level, which reduces the probability of a statistical error in a diagnosis establishment [15]. The scientists' conclusions are consistent with the results of this scientific study, while covering the prospects for reducing the number of errors in diagnosis when using AI.

At the same time, the scientific team represented by Aliaga et al. [16] studied the general principles of automatic calculation of mandibular indices on panoramic X-rays. According to scientists, the introduction of the method of automatic detection of fracture lines and points (curves and straight lines) on panoramic X-ray images using artificial intelligence technologies has significant prospects for fractures diagnosing. This technology allows fully automate the procedure for X-ray images processing, which, in turn, provides the ability to detect fractures even with subtle indications [16]. The conclusions made by scientists correspond to the results of this scientific study in terms of assessing the role of artificial intelligence systems in the automating process of X-ray images processing.

Reichert et al. note that the AI-based deep learning algorithms can significantly improve the fracture screening quality by physicians and emergency medical service personnel [17]. The researcher's conclusions fundamentally correspond to the results obtained in this scientific work, while being of interest from the point of view of assessing the value of artificial intelligence-based systems in facilitating the doctors' work in a diagnosis establishment.

The scientific team represented by Rosenberg et al. considered the features of the use of artificial intelligence using in the detection of traumatic fractures of thoracolumbar spine region on sagittal X-rays [18]. The authors note that in X-ray practice, up to 67% of bone fractures in this area are not detected during the first examination. This fact determines the significant importance of the development and introduction of artificial intelligence systems to improve the effectivity of fracture detection, while the existing AI-based applications can be optimized to create an effective tool for solving such problems [18]. The scientists' conclusions are consistent with the results of this scientific study in terms of assessing the effectiveness of AI-based systems when optimally configured for the tasks of fractures detection.

In turn, a group of scientists consisting of Tarantino et al. [19], in the scientific study of the principles of professional liability in orthopaedics and traumatology, pay attention to the fact that over the past 10 years there has been an increase in the number of statements regarding doctors' negligence in fractures detection . According to scientists, the expansion of the area of artificial intelligence systems application in radiology will contribute to a significant reduction in the total number of errors by doctors during X-rays reading and correct diagnoses establishment, which is important from the point of view of the early treatment [19]. The results of the group of scientists correlate with the results of this scientific work, fundamentally corresponding to them in terms of assessing the prospects for reducing medical errors during AI-based systems using in radiology.

The subject of doctors' mistakes in the fractures diagnosis was developed by Rebours [20]. The researchers pay attention to the fact that among the entire range of facial bones fractures, a fracture of the nasal bones is one of the most common. At the same time, the artificial intelligence use largely removes the difficulties of conducting X-ray studies and images reading that arise due to the presence of haematomas characteristic of the described type injuries [20]. The researchers' conclusions are fundamentally consistent with the results obtained in this scientific work.

At the same time, the scientific team consisting of Khan et al. [21] studied the features of the artificial intelligence use in orthopaedic surgery in the joint scientific work. The authors also note an increase in medical negligence lawsuits in the Great Britain over the past 30 years. According to scientists, the problem solution can be found in the artificial intelligence systems introduction into the X-ray examination procedures to improve the diagnostics quality and prevent the probability of conflict situations [21]. The studies' results do not fundamentally contradict those obtained in this scientific study.

Thus, the discussion of the results obtained in this scientific study, in terms of their comparison with the results of a number of scientific works aimed at studying the experience of the artificial intelligence practical application in fractures diagnosing and assessing its effectivity, confirmed the fundamental compliance of these results with those obtained in other scientific studies. This indicates the scientific results reliability of this scientific work and the possibility of their use in practice during artificial intelligence-bases systems introduction in a medical institution, and to increase of X-ray examination effectivity the fractures.

CONCLUSIONS

1. The clinical study conducted in the city hospital in Riga, Latvia, demonstrated the significant advantage of using artificial intelligence systems for fracture detection compared to conventional methods. This resulted in a notable reduction in diagnostic errors (approximately 2-3 times) and an improvement in diagnostic accuracy (up to 8% in the study patient groups). The ability of AI systems to provide additional visualization of X-ray images and identify subtle aspects not easily detected during medical examinations contributes to these positive outcomes.
2. The prospects for utilizing AI-based systems in radiology are promising, considering that the reliability of X-ray studies is often influenced by the training and experience level of the responsible physician. AI-based programs such as GLEAMER BoneView® can perform automatic fracture diagnosis, mitigating factors such as physician fatigue and potential deficiencies in necessary professional competencies that can affect the accuracy of fracture detection and diagnosis. This highlights the advantages of employing such systems in fracture diagnosis.
3. The practical application of artificial intelligence programs for fracture detection in the Hospital of Orthopaedics and Traumatology in Riga, Latvia, has demonstrated their high effectiveness in addressing the defined objectives. The continued use of these programs is expected to positively impact the overall quality of X-ray examinations and offer new possibilities for fracture detection and diagnosis in medical institutions.
4. Further scientific studies in this field hold promising prospects, as they can explore opportunities to expand the practical use of artificial intelligence systems, ultimately enhancing the fracture diagnosis capabilities in medical institutions of diverse specialties.

Contributors:

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Zadoroznijs S. – methodology, investigation;

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