

Research on the Determination of Tort Liability for Human Damage Caused by Surgical Robots

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ABSTRACT

Human beings are constantly pursuing the value of their lives, thus doing constant exploration of the field of biotechnology. Surgical robots are an inevitable product of the development of science and technology to a certain stage, and have been widely used in many fields such as medical surgery and diagnosis. While liberating doctors' hands, it also poses a brand new challenge to the legal system. Along with the surgical robots are widely used in the field of medical treatment, and its related infringement incidents gradually increased, which exposes the traditional tort theory deficiencies, but also highlights the lagging of the traditional tort law system. Compared with the general tort relationship, surgical robots involved in the tort of damage is much more complex, including the subject of tort liability confirmation, tort liability fault determination and causal relationship determination. The issue of defining the subject of tort liability has particularly triggered a heated debate in the academic community. According to the previous research and the characteristics of surgical robots, the article will discuss the issue of tort liability of surgical robots causing human damage.

KEYWORDS

Surgical Robots; Tort Liability; Finding of Liability.

1. INTRODUCTION

With the continuous emergence of cutting-edge technologies such as big data, quantum computers and deep learning algorithms, artificial intelligence (AI) technologies have been widely and deeply utilized in various industries. Among them, biometric identification technology represented by machine vision has become one of the most promising AI technologies at present and is widely used in many industries. Surgical robots, as an important part of the development of artificial intelligence technology brought about by the fourth technological revolution, are all leaps and bounds and unprecedented in its improvement of human living standards. Surgical robots play a vital role in the medical field and are one of the indispensable technologies. At present, a lot of research has been carried out on medical robots at home and abroad, and some results have been achieved and many problems exist. According to the "13th Five-Year Plan" for Health and Health Science and Technology Innovation promulgated in 2017, it aims to actively promote the research and development and promotion of medical products such as medical robots, in order to promote the development of the medical industry. At the same time, the country has also introduced a series of relevant policies to encourage the rapid development of the medical industry. Despite the huge total amount of medical care in China, the shortage and low utilization of medical resources due to the overall insufficient investment in medical and health care as well as the irrational allocation of limited resources is a problem that cannot be ignored. At the same time, with the social and economic development, people's requirements for medical conditions are getting higher and higher, and the

existing medical institutions are unable to meet the diversified needs of patients, so it is necessary to introduce new equipment to make up for the original system defects. According to the data presented, as of 2020, the number of doctors per 1,000 people in China is only 1.49, a figure far below the average level of those developed countries. In this case, how to utilize the existing medical equipment is an important topic that needs to be solved urgently. By utilizing surgical robots, the dilemma of insufficient number of doctors and lack of medical resources per capita can be effectively alleviated. In 2017, the State Council published the New Generation Artificial Intelligence Development Plan, which proposes the promotion of new modes and means of AI treatment in order to build an efficient and accurate intelligent medical system. Therefore, surgical robots are an important part of promoting the construction of the country's intelligent medical care, as well as an inevitable requirement for promoting medical progress and improving people's quality of life. Currently, surgical robot products have been widely used in many aspects of the medical field, including but not limited to disease prevention, medical imaging assisted diagnosis, clinical assistance and rehabilitation therapy. With the deepening of medical research and understanding of the human body structure, more and more scholars are proposing the use of robots as a tool to deal with complex and challenging tasks, thus promoting human beings to move towards a higher level of intelligence. The application of artificial intelligence in the medical field originated in the 1960s, and China only began to get involved in 1978, until 2000, when the da Vinci surgical robot was introduced, and in the following 20 years, the constantly improved da Vinci surgical robot became the most advanced surgical robot in the world. Today, surgical robots have been widely used in the surgical process, not only to replace the doctor to complete complex operational tasks, but also to help surgeons to carry out more accurate positioning, navigation and selection of surgical instruments and other work. The deep integration of surgical robots with medical technology has become a trend in the development of the medical field, as well as an emerging investment area that has attracted the attention of society.

Whether in the early or late stage, the application of artificial intelligence in the domain has been at the forefront. With the rising trend of the application of surgical robots in the medical field, in 1985, the Programmable Universal Assembly 560 Robot (PUMA560) assisted doctors in neurosurgical biopsy surgery, completing the first case of surgical procedures with robotic participation. In 2002, the world's first tort case involving a surgical robot causing human injury occurred. In the United States, a patient died in Florida after his aorta was accidentally severed during kidney surgery using a Da Vinci surgical robot. Surgical robots in the U.S. caused at least 1,391 injuries between 2000 and 2013. A few lives have been lost due to robotic errors - in 2007, a Chicago man died after undergoing a robotic spleen removal surgery, and in 2012, another woman died of blood loss after a robot accidentally punctured a blood vessel during a hysterectomy. According to the U.S. Food and Drug Administration, a medical device company called Intuition has encountered several problems, one of which was that the electrical current that was supposed to go to the surgical robots went to the patients' bodies. The diagnosis of lung cancer by human doctors is only 50% accurate, in contrast, although the artificial intelligence doctor is so "strong", but the probability is not 100%, if because of the 10% misdiagnosis rate of medical malpractice and how to deal with it? The hospital's responsibility, IBM's responsibility, Watson's own responsibility? The author to surgical robots as the object of study, through the Chinese paperwork online with the keyword search "surgery" "robot" "medical" "tort Liability", the time span is from May 2013 to May 2023, a total of 145 related litigation documents were retrieved. Based on the complexity of the cases of surgical robots causing harm to people and the lack of comprehensive coverage of the relevant data on the judging documents website, the actual occurrence of the relevant cases of tort damages continue to emerge. Compared with general medical devices, surgical robots have higher autonomy, so their potential infringement risks are also more hidden. Surgical robots, as a new type of artificial intelligence technology applied to the field of clinical medical care, have caused a huge impact on the traditional legal system. The widespread use of surgical robots may give rise to a series of issues, including, but not limited to, safety, the black box problem of algorithms, the principle of liability attribution after infringement, and the fusion of algorithms and human bias.

At present, there are no legislative provisions in China that specifically address surgical robots. In the tort of surgical robots, determining the subject of liability is a very challenging task that requires in-depth thinking and analysis. Surgical robot belongs to the "thing", can as an independent tortfeasor? Can the tort of surgical robots be adequately regulated under the existing legal framework, which still needs to be further explored? What are the perspectives from which to judge whether a surgical robot constitutes infringement? In the design process of surgical robots, is there any liability for IPR infringement that should be borne by their designers? Can a surgical robot constitute an independent civil subject? Should a surgical robot be considered a legally effective subject? Under what circumstances should a surgical robot be sued as an independent civil subject? How to determine whether there is a causal relationship between the tortious behavior of a surgical robot? What kind of legal relationship exists between a surgical robot and a medical institution in the course of its use? Who should be responsible for the infringement consequences of the behavior of the surgical robot? At present, China has not yet established a perfect liability system and a clear legal liability system, which seriously restricts the further expansion of the application of surgical robots in the field of medical treatment, and is not conducive to the healthy and orderly development of the surgical robot industry. Therefore, it is necessary to sort out the legal relationship, adjust the scope of application of the subject of legal responsibility, and establish clear rules for the subject of legal responsibility, in order to promote the sustainable development of surgical robots and promote industry self-regulation.

2. RESEARCH ON SURGICAL ROBOTICS IN CHINA

2.1. The Legal Subject Status of Surgical Robots

In today's global context, artificial intelligence technology has attracted much attention, and all countries have launched in-depth research on it to varying degrees. Our government also attaches great importance to the development of artificial intelligence, and has introduced relevant policies and regulations to regulate the healthy development of the artificial intelligence industry. However, in solving the legal problems of artificial intelligence, the first challenge is to establish the status of its legal subject. Intelligent robots, as an emerging thing with characteristics and functions completely different from those of ordinary people, can it become a legal subject? The reason for this is the rapid development of artificial intelligence, forcing the academic community in the status of the legal subject of intelligent robots in the necessary re-examination and analysis, to make a logical choice. Then our academic circles for the issue of the existence of a variety of different points of view. In the civil law status of intelligent robots, Professor Yang Lixin pointed out that the personality of intelligent robots should be regarded as a kind of personality, not the personality granted by law, he advocated that intelligent robots can be used as a civil subject, intelligent robots should not be regarded as completely equivalent to the human legal subject, but should be regarded as a kind of independent entity, intelligent robots should not be entitled to enjoy the full meaning of the civil rights and responsibilities, but has part of the civil behavior. Intelligent robots should not enjoy the full sense of civil rights and bear full responsibility, but have the ability to part of civil behavior [][[] Yang Lixin. Artificial class personality: The civil law status of intelligent robots--Another discussion on the civil liability of intelligent robots causing damage to people[J]. Seeking Journal, 2018. Regarding the concept of intelligent robots, Prof. Wang Liming believes that they should not be simply regarded as entities with legal effects. He proposes that intelligent robots should have independent civil rights and obligations, and can exercise their civil rights and assume corresponding civil responsibilities according to their own will. According to him, current intelligent robots already have the ability to solve problems autonomously similar to humans, although their intelligence level has not yet reached the level of humans .Wang Liming. New challenges to civil jurisprudence in the era of artificial intelligence .Oriental Law, 2018(3). According to Professor Zhao Wanwan, intelligent robots do not have the conditions to have an impact on the civil legal subjects of natural persons, so they cannot become the subjects of civil law, and intelligent robots may infringe on the personal or property rights

of others in the process of using them, but their infringing behaviors will not constitute a tort. Zhao Wanwan. Discussion on the Legal Subject Status of Robots--And the Basic Requirements for Legal Regulation of Robots Journal of Guizhou University for Nationalities: philosophy and social science edition, 2018. At present, the research on AI medical tort liability is mainly based on the research results on AI in general civil tort liability. According to Prof. Yang Lixin, the tort liability of intelligent robots should follow the basic principles and rules of the current civil law and be incorporated into the existing legal system in order to find solutions. Yang Lixin. An attempt to solve the legal adjustment problem of artificial intelligence with existing civil law rules. China Trial, 2018. According to Prof. Liu Yunsheng, intelligent robots have not gained the qualification of legal subjects, but can only exist in our daily life in the form of products. He asserts that the tort liability brought about by AI medical robots has similarities with the tort liability arising from product quality defects Liu Yunsheng: Civil Law Positioning of Artificial Intelligence. Modern Audiovisual, 2017. According to Prof. Wu Handong, for the determination of tort liability caused by intelligent robots, we can consider it comprehensively from the perspectives of product quality liability caused by the actor's own negligence as well as the alternative liability arising from the principle of technology neutrality Wu Handong. Institutional arrangement and legal regulation in the era of artificial intelligence. Legal Science: Journal of Northwestern University of Politics and Law, 2017,. According to Prof. Wu Xi or, granting subject qualification to intelligent robots does not provide a more convenient way of resolving legal disputes, nor does it achieve specific legal effects, and at the same time, it cannot solve the problem of compensation related to medical robots' infringement. Wu Xi Yu. On the legal subject qualification of artificial intelligence . Zhejiang Social Science, 2018. According to Prof. Long Wenmao, as a rational individual, the intelligent robot must have the ability to weigh the pros and cons and make wise choices on the basis of this, and bear the corresponding liability for the damages caused by its willfulness or negligence Long Wenmao. Philosophical reflection on the legal subject status of artificial intelligence . Legal Science: Journal of Northwestern University of Politics and Law, 2018,. According to Prof. Zheng Ge, the subject of responsibility for human damage caused by intelligent robots should be chosen between the designer and developer, the producer, the seller and the user, rather than being given a legal personality, because the robot itself lacks the ability to compensate for damages.

2.2. Principles of Attribution of Tort Liability for Surgical Robots

In China's academic circles, there are many different views on the principle of tort liability attribution for artificially intelligent medical robots. According to Prof. Li Xingchen, the liability subject of AI medical robots should be determined based on the damage liability of existing medical products, and since the medical products themselves lack independent consciousness, their liability subject should be determined in accordance with the standard of general medical products, and if the user causes the tort, the liability should be directly pushed to the user of the medical product [][] Li Xingchen. Legal Liability of Artificial Intelligence Medical Services[J]. Medicine and Law, 2018. Professor Meng Yannan advocates adopting the way of medical institutions' fault tort liability to define the responsible body. In terms of the scope of medical damages, fault liability and no-fault liability should be applied separately according to different circumstances. He advocates that medical damage liability is already sufficiently responsive to the existing tort problem, so there is no need to introduce other forms of liability attribution. In this case, medical liability should be redefined in the light of the provisions of the product liability law and new circumstances arising from the application of the product liability law. Despite the existence of other possible solutions, an expansive interpretation remained a viable solution. He also pointed out that the combination of medical damage liability and product liability insurance system is a more feasible solution Prof. Liu Jianli advocated the application of integrated medical damage liability and product liability principles to determine the identity of the responsible subject, and he advocated that medical damage liability should be adopted in product liability, and product liability should no longer be treated as a separate type of liability, and he advocated that on the basis of consideration of medical damage liability and product liability principles, human-made

liability should be minimized. based on minimizing the impact of human factors on it Liu Jianli. Legal Challenges and Responses to the Clinical Application of Medical Artificial Intelligence[J]. Oriental Jurisprudence,. If the injury is caused by the negligence and carelessness of the medical personnel, the medical damage liability shall be applied; if the damage is caused by the patient's own reasons, the medical damage liability shall be applied, taking into account the medical technology, the treatment effect and other factors, and then analyzing and judging with other relevant evidence. If the adverse effects are caused by AI medical products, product liability shall apply. The approach of "qualitative and then quantitative" can be adopted in the specific treatment, i.e., to determine the person and then the object, and to categorize and then attribute responsibility. Through the comprehensive use of a variety of methods, can be more comprehensive solution to the problem of responsibility attribution, so as to achieve more accurate distribution of responsibility. According to Wang Yihan and Wang Zhu, in view of the current situation and stage of development of artificial intelligence robots, it is not suitable for large-scale modification of the rules of artificial intelligence tort liability, but according to the "principle of minimization" and "procedural principles" to modify the law and legal technical modifications. Instead, it is necessary to modify the law according to the "minimization principle" and "procedural principle" and technical modification of the law. As for the issue of tort damages of intelligent surgical robots, it is appropriate to use the existing product liability and medical damages. It is appropriate to take the existing provisions of product liability and medical damage liability as the basis, apply the minimization and procedural modification, according to the different infringement situations between product liability, medical damage liability and high risk liability to select the application, in order to make the optimal choice. Under the framework of the existing legal provisions, it is also advisable to design a new model of rules for different liabilities under various circumstances based on relevant technologies and concepts at home and abroad.

2.3. Legal Regimes Relating to Tort Liability for Surgical Robots

According to Article 103 of the Regulations for the Supervision and Administration of Medical Devices, medical devices refer to instruments, equipment, apparatus, in vitro diagnostic reagents and calibrators, materials and other similar or related items used directly or indirectly in the human body, including the required computer software. The purposes of medical devices include diagnosing, preventing, guarding, treating or alleviating diseases or injuries; providing information for medical or diagnostic purposes by examining samples from the human body, and so on. Meanwhile, Article 25 of the Judicial Interpretation of the Supreme People's Court on Liability for Medical Damage (hereinafter referred to as the "Judicial Interpretation of Medical Damage") stipulates that "medical products" referred to in this interpretation include medicines, sterilized products, and medical devices."

In summary, in China's current legal system, surgical robots as artificial intelligence are medical products. Based on this legal attribute, medical personnel in the use of artificial intelligence medical devices in the process of the occurrence of medical liability, the corresponding legal principles of attribution and compensation in China's current legal system, should be subject to the Civil Code of the People's Republic of China, the Supreme People's Court of the Medical Damage Liability Judicial Interpretation of the People's Republic of China, the People's Republic of China Product Quality Law, and other laws and regulations of the regulation. In China, the traceability system and adverse event reporting system for medical devices have been gradually established, which provides a certain reference basis for the determination of infringement behavior of medical robots. In addition, we need to collaborate on multiple fronts to achieve the best results. In order to meet the development needs of the industry, a series of standards must be formulated, including the evaluation criteria for the degree of intelligence and compliance operation of medical robots. There must also be clear and specific standards and regulations for the judicial determination of medical robot infringement. In order to provide professional support for medical robot administrators and adjudicators, as well as professional guidance for case handling, we need to train a professional appraisal team that will

specialize in determining hidden infringements of medical robots, determining whether minor defective acts are harmful, and determining whether the robot's program needs to be corrected. As AI continues to evolve, a number of areas such as the labor market, education, employment options, and social policy will face unprecedented challenges. For the practical needs after the long-term development of artificial intelligence, simply modifying the tort liability regulation is not enough to meet its requirements. Artificial intelligence, as a new type of technological product, has changed people's traditional way of working to a certain extent, but it has also caused a great impact on the traditional tort theory, especially the tort problems related to people are more complex and diverse. Therefore, in order to ensure that the infringement of intelligent robots is regulated in principle, it is necessary to establish a set of more comprehensive and highly generalized legal framework to guide the direction of the development of artificial intelligence and regulate related behaviors.

3. EXTRATERRITORIAL RESEARCH ON SURGICAL ROBOTS

3.1. Legal Attributes of Artificially Intelligent Robots

In the medical field, the research on the identification of the legal subject status of surgical robots has been developed rapidly in foreign countries, and preliminary research results have been achieved. Summarizing the views of scholars inside and outside the domain on the legal attributes of artificial intelligence robots, mainly including the tool said, the proposed legal personality said, the limited legal personality said, the personality reduction said, the animal said. Such as Russia's "Grishin Act" although affirms the subject status of artificial intelligence, but stipulates that the liability arising from the behavior of artificial intelligence by its owner or possessor. The EU Civil Law Rules on Robotics also states that at this stage the legal liability of AI robots must be borne by humans. According to Bartosz Brozek, Marek Jakubiec and other foreign scholars, despite the fact that robots are regarded as subjects of legal relations at the legal level and are institutionally feasible, it is difficult for us to imagine robots capable of assuming responsibility given their legally bound natural. According to Neil D. Richards and William D. Smart, it is unwise to over-attribute the legal responsibilities incumbent on human beings to automated robots because robots are and will only be potentially utilized by human beings. They argue that robots do not possess the cognitive ability and intelligence possessed by humans, and their actions do not result in harming others or endangering society. With a search of extraterritorial jurisprudence practice, it was found that the Watson medical AI system in the United States was found to be an employee rather than a medical device, with the hospital assuming vicarious liability after it caused damage to a patient. Therefore, we should not popularize machines by comparing the high anthropomorphism of robots with human beings, because regardless of the development of robots, their cognitive and intellectual level cannot reach the same level as that of human beings.

3.2. A Study of the Legal Status of Surgical Robots

The European Union and the United States have jointly established an Ethics Committee on Artificial Intelligence, which has developed regulations and systems to ensure that the legal regulation of surgical robots is professionalized and standardized. In response to the study of the legal status of surgical robots, the Legal Affairs Committee of the European Commission has recommended that the most advanced automated intelligent robots be categorized as "cyborgs" in order to further enhance their level of intelligence. According to Thomas Hoeren (2018), AI has autonomy and is able to deal with related matters to a certain extent independently, even approaching human intelligence, so that AI is regarded as an ordinary object. handle related matters to a certain extent independently, even close to human intelligence, so it is no longer appropriate to regard AI as an ordinary object, and its special legal status should be taken into account. The application of AI in the medical field has achieved initial results, but further regulation and guidance are still needed to protect the legitimate rights and interests of patients. (Although the United States has not explicitly recognized the legal

liability subject status of AI in a series of self-driving car legislation, the International Society of Automotive Engineers has divided AI-driven cars into six different levels and stipulated the way of assigning responsibility for each level, and as the level rises, the responsibility borne by human beings decreases accordingly.) In his research on the issue of infringement of the responsibility of surgical robots, the professor pointed out that the responsibility of surgical robots The principle of attribution combines the dual nature of medical liability for damages and product liability in order to ensure that the rights and interests of patients are adequately protected, and therefore the principle of no-fault liability should be adopted. According to Aishwarya Limaye (2017), the traditional way of attributing liability for medical damages can no longer meet the needs, and it is necessary to clarify the status of the legal subject of surgical robots, or even to grant them basic constitutional rights, and to make them partially liable by establishing a certain property regime, as well as to improve the constituent elements of the attribution of liability for torts. Hans Morawetz (2018) said that artificial intelligence has the ability of application and deep learning, and if it analyzes the huge medical database of human beings, it will bring the level of human medical care to a new stage, so he advocates the vigorous development of artificial intelligence medical robots and responds to the ensuing tort liability.

3.3. Ethical Use of Surgical Robots

The identification of the legal subject status of surgical robots in the medical field has attracted extensive attention from foreign scholars, who have put forward a variety of different insights and suggestions. In their discussions, they have explored the potential for robots to play a subjective role in legal relations, as well as the clear definition of responsibilities between robots and humans. In addition, in order to ensure that the use of surgical robots is in line with ethical norms, the European Union and the United States have jointly set up an Ethics Committee on Artificial Intelligence, and have developed a corresponding legal and regulatory system to specifically regulate their use. There is also some domestic legislation on surgical robots, such as the access mechanism for surgical robots stipulated in the Measures for the Administration of Medical Devices. The establishment of these studies and systems has provided strong support for guiding the future direction of surgical robots as well as regulating related behaviors.

It should be noted that these views and studies are still in the preliminary stage, and there are still many controversies and discussions about the legal status and responsibility attribution of surgical robots in the medical field. With the continuous development and application of AI, the relevant laws and systems need to be improved and adapted to new contexts to ensure the safe and legal use of medical robots and to protect the rights and interests of patients. This requires the joint efforts of all parties, including the cooperation of scholars, legal institutions, industry organizations and regulatory authorities, to promote the construction and standardization of the relevant legal system.

4. SUMMARY

In Given China's large population size and lack of medical resources, advances in surgical robotics provide an effective solution to alleviate this pressure. As a new diagnostic and therapeutic tool, surgical robots are capable of realizing minimally invasive operations on the human body. Surgical robots are a masterpiece of perfect integration of artificial intelligence technology and biomedical technology, providing patients with high-precision and high-efficiency treatment programs. The autonomous decision-making ability and "algorithmic black box" of surgical robots have brought many challenges to the application of traditional medical damage liability and product liability. In determining the subject of liability, there is a narrow scope of the subject of liability, the status of the legal subject of the surgical robot is not clear, and it is difficult to prove the causal relationship and other problems. Therefore defining the tort liability of surgical robots has become an urgent problem to be solved. Considering the current level of development of surgical robot technology and the characteristics of infringement in the medical process, combined with the existing research at home

and abroad, this paper aims to analyze the current subject of tort liability for personal injury caused by surgical robots, and to explore how to identify and resolve the subject of tort liability in the context of surgical robots. For the identification of the subject of tort liability of surgical robots, it is still in the preliminary research stage, and needs to further improve the relevant system.

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