"Hand as Foot Teaching Method" Application in Upper Cervical Anatomy and Common Diseases

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Abstract

Background

"Hand as Foot teaching method" has been applied to the clinical teaching of various orthopaedic subspecialties and achieved good results, but it has not been carried out in the specialized teaching of spine surgery, especially the upper cervical spine. The orthopedics teaching team of the Second Affiliated Hospital of Harbin Medical University applied this teaching method to the clinical teaching of atlantoaxial anatomical relationships and common atlantoaxial diseases.

Methods

The "Hand as Foot Teaching Method" was used to teach key and difficult points for master students of osteology in the Second Affiliated Hospital of Harbin Medical University, supplemented by PPT + anatomical specimens to assist the teaching process.

Results

"Hand as Foot Teaching Method" can concretize the complex anatomical structure of upper cervical vertebra, thus deepening students' understanding and memory of difficult points, enhancing teacher-student interaction and activating the teaching atmosphere.

Conclusion

"Hand as Foot Teaching Method" can be applied to the clinical teaching of atlantoaxial knowledge. Compared with the simple application of PPT + model teaching, this teaching method is more helpful for students to grasp difficulties quickly and in three dimensions, significantly improve the teaching quality, and can even be applied to preoperative doctor-patient communication. It has application and promotion value in clinical teaching of spinal surgery.

Introduction

In recent years, with the development of artificial intelligence and other technologies, digital teaching technologies such as virtual reality(VR) and augmented reality(MR) have been applied to clinical teaching of orthopedics [1, 2], which not only bring immersive and interactive experience to teachers and students, but also prove to improve the quality of teaching. However, in China, especially in northeast China, due to the shortage of medical teaching resources and funds, there are still many problems in orthopedics teaching, especially in clinical teaching of spinal surgery, including (1) complicated spinal anatomy and adjacent relationship, which makes it difficult to display relevant teaching contents in three-dimensional space; (2) The teaching method is traditional and monotonous, and the teaching quality is general; (3) The model teaching AIDS are expensive, inconvenient to carry and easy to lose, and inconvenient to disassemble; Anatomical specimens are vulnerable, etc. "Hand as Foot Teaching Method" has been applied to many diseases in the teaching of spine surgery, including lumbar spondylolisthesis [3], lumbar

disc herniation[4], etc., by simulating the lower limbs and even the related structures of spine by changing the upper limb posture. It has advantages of simplicity, image, stereo and economy, and has remarkable teaching effects. At present, the "Hand as Foot Teaching method" has not been applied in the clinical teaching of the upper cervical vertebra (the main structure is atlas and axis). We tried to apply this teaching method to the clinical teaching of the anatomical relationship of atlas and common diseases of atlas and axis, and achieved good teaching effects.

Application of "Hand as Foot teaching method" in the teaching of upper cervical spine

The present study was approved by the ethics committee of the Second Affiliated Hospital, Harbin Medical University and was conducted in accordance with the Declaration of Helsinki. All the students and teachers agreed to participate in the study and written informed consent was obtained from all participants.

The orthopedics teaching group of the Second Affiliated Hospital of Harbin Medical University used "Hand as Foot Teaching Method" combined with PPT + anatomical specimens to conduct auxiliary teaching of upper cervical vertebra course. The teaching object was master of osteology students. In the teaching process, students and teachers are required to conduct the simulation demonstration of "Hand as Foot Teaching Method" together. According to the characteristics of the first cervical vertebra course, we divided the knowledge points into sections: atlas, axis and atlantoaxial joint complex anatomy knowledge; Normal rotation relationship of atlantoaxial complex, Gehweiler classification of atlas fracture, Anderson and D'Alonzo classification of axial odontoid fracture, Atlantoaxial rotatory subluxation The mechanism and characteristics of Fielding typing, clinical manifestations and treatment principles of the disease.

Simulation demonstration of atlantoaxial anatomy and atlantoaxial joint complex anatomical knowledge

The atlas was annular, without vertebral body, spinous process and articular process, and consisted of anterior arch, posterior arch and lateral mass. The anterior arch was short, and there was a dental fovea in the middle of the posterior, which was related to the axial odontoid. The posterior arch is long, with transverse vertebral arteries crossing the vertebral arteries, lateral masses connecting the anterior and posterior arches, above the occipital condylar related segments, below the axial joint surface joint; The axis (C2), the vertebral body extends upward the odontoid process (dens), and the atlas dentate concave dental fovea forms the atlas dentate joint.

In teaching, teachers completed the simulation demonstration of anatomical structure through different combinations of hands: both hands were horizontally closed in the shape of "C", indicating flexion of fingers (indicating transverse foramen), and the other four fingers were interlinked in the shape of "O" to represent atlas (Fig. 1A); The thumbs of both hands are erect and overlapping (representing the odontoid process), and the remaining four fingers are opposite to each other to represent the axis (Fig. 1B); In the

simulation of atlantoaxial joint complex, the left thumb and index finger were in the horizontal plane, and the other three fingers were in the same coronal plane with the index finger to represent the atlas. The right thumb is erect, the remaining four fingers are bent to the center of the palm to indicate the axis, and the hands are combined to indicate the atlantoaxial joint complex (Fig. 2). In the teaching process, teachers and students quickly simulated the anatomical structure of atlas, axis and atlantoaxial joint complex through "Hand as Foot Teaching method", and combined with PPT+ anatomical specimens, students could quickly grasp the key points of relevant anatomical knowledge and spatial structure relations.

Simulation of atlantoaxial rotation relationship

Atlantoaxial rotation is essential to cervical rotation and relies on the atlantoaxial joint complex, which includes the atlantoodontoid joint and the atlantoaxial facet joint. Under physiological conditions, the atlas rotates alone when the neck rotates $< 23^\circ$; At $24-65^\circ$, both atlas and axis rotated, but the Angle of atlas rotation was larger. $> 65^\circ$, atlas and axis rotate synchronously[5]. In teaching, teacher and students simulated the atlantoaxial joint complex in the way of Figure 2, and this rotation relationship could be vividly simulated by rotation of left and right hands (Fig. 3).

Simulation of Gehweiler typing of atlas fractures

Atlas fracture accounts for 2%-13% of cervical spine injuries; Gehweiler classified atlas fractures into 5 types[6], Type I: anterior arch fracture; Type II: posterior arch fracture; Type III: Simultaneous anterior and posterior arch fractures (Jefferson fractures); Type IV: atlas lateral mass fracture; Type V: Transverse process fracture of atlas (Fig. 4); In teaching, based on the simulation demonstration in Figure 1A, Gehweile classification I-III and IV and V can be vividly simulated by changing the combination of hands (Fig. 5).

Although the classification of atlas fracture is easy to understand, it has been found from previous teaching experience that Students' understanding and memory of this knowledge only rely on instantaneous memory, which is easy to forget. However, "Hand as Foot Teaching Method" can dynamically simulate the characteristics of fracture, which is convenient for students to memorize key knowledge in the long term.

Simulation demonstration of Anderson and D'Alonzo typing of Fractures of the axial odontoid fractures

Anderson and D 'Alonzo classify odontoid fractures into three types[7], Type I : fracture at the tip of odontoid; Type II: fracture at the bottom of the odontoid process; Type III : The fracture extends from the base of the odontoid process to the axial body (Fig. 6A).

In teaching, the axis is simulated as figure 1B, with the thumb representing the odontoid process. The second phalanx of the thumb represents the tip of the odontoid process, and the middle part of the first

phalanx is the neck. The proximal end of the first phalanx represents the base of the odontoid process; The thumb root of both hands represents the axial vertebral body (Fig. 6B). In this part of teaching, we found that since the shape and structure of thumb are very similar to the odontoid process, students can quickly and accurately understand and master the classification of odontoid fracture, achieving satisfactory teaching effects. In addition, we noticed that students applied this simulation demonstration to clinical doctor-patient communication before surgery and achieved satisfactory communication effect, which suggested that "Hand as Foot Teaching Method" also has promotion value in doctor-patient communication.

Simulation demonstration of atlantoaxial rotatory subluxation

Atlantoaxial rotatory subluxation is the key and difficult point in the teaching of upper cervical spine. Due to the complex anatomical structure and multiple pathological types, it has always been a headache for spinal surgery students. Fielding classified rotatory subluxation of the atlas into four types[8], Type I: atlantoaxial rotation and fixation, without anterior atlantoaxial displacement, with the gap between anterior arch of atlantoaxial odontoid less than 3mm, and without fracture of transverse ligament of atlas. The axial odontoid is still the rotation axis, and the atlantoaxial rotation is fixed within the normal rotation range.; Type II: atlantoaxial rotation fixation, 3~5mm anterior atlas displacement, accompanied by transverse atlas ligament rupture. One side mass was not damaged. As the axis of rotation, the lateral mass on the other side moved forward, and the atlantoaxial rotation exceeded the normal rotation range.; Type III: atlantoaxial rotation and fixation, the atlas moved forward more than 5mm, the transverse atlas ligament and other auxiliary ligaments were broken. Both sides of the lateral mass moved forward, one side shifted more than the other. Rare, with a higher risk of nerve damage; Type IV: atlantoaxial rotational fixation, posterior atlas displacement, associated with odontoid hypoplasia (Fig. 7).

In teaching, atlantoaxial joint complex was simulated in Figure 2, where the black dotted line represented the displacement distance of atlas, and the lateral mass displacement of atlas could be simulated by thumb and finger movements (Fig. 8). This demonstration method presents the complex Atlantoaxial rotatory subluxation pathological conditions dynamically and vividly in front of teachers and students, simplifying the complex teaching content, not only achieving the teaching purpose, but more importantly, increasing the interaction and communication between teachers and students, so as to activate the teaching atmosphere.

Discussion

Advantages and disadvantages of "Hand as Foot Teaching Method" in upper cervical vertebra teaching

The clinical teaching of spine surgery has always been a difficult point in orthopedics teaching, and the effect and quality of traditional teaching methods are not satisfactory. We used the "Hand as Foot

Teaching Method" for reference and applied it to the teaching practice of upper cervical spine for the first time, with satisfactory results. The teaching mode of "Hand as Foot Teaching Method" +PPT+ anatomical specimens has brought vigor and vitality to the clinical teaching of spinal surgery. At the same time, we note that this method has many outstanding advantages, such as (1) low teaching cost: the traditional teaching mold is expensive, the department allocation is limited, and easy to damage; Digital teaching equipment such as VR or MR technology is more expensive and difficult to popularize; "Hand as Foot Teaching Method" requires no additional input in teaching costs. It can simulate the anatomical structure of upper cervical spine and common fracture and dislocation and complete teaching tasks only by relying on the images of hands. (2) Simple operation and easy to learn; VR or MR technology-assisted teaching has the advantages of immersion and three-dimensional sense, but it depends on equipment and site, and the modeling process of teaching materials is complicated. However, "Hand as Foot Teaching method" is not limited by equipment and site, and can complete the teaching content anytime and anywhere, which effectively improves the teaching quality. (3) Strong real-time interaction: In the teaching process, both teachers and students can participate in the teaching content. It is found that in the application of "Hand as Foot Teaching method", students can also make Hand movements that are different from teachers, and these postures can well simulate the upper cervical spine. It is helpful to deepen the understanding of knowledge and improve the teaching methods, strengthen the interaction and activate the classroom atmosphere. (4) Visualization and three-dimensional: Through the change and combination of hands posture, upper cervical anatomy can intuitively reach three-dimensional space from two-dimensional plane, and the simulation of atlas and axial vertebra is highly similar, which is undoubtedly conducive to students to quickly grasp the teaching content, and more conducive to their real-time review of the knowledge learned.

"Hand as Foot Teaching Method" is expected to improve the quality of doctor-patient communication

The purpose of research on clinical teaching methods is not to help teachers complete teaching tasks, but to explore how to effectively enable students to master complex teaching content, so that students can apply what they learn and grow up to be qualified physicians. Good doctor-patient communication, especially preoperative communication, is an important part of clinical work. Due to the imbalance of professional knowledge information between doctors and patients, it is more difficult for patients to understand the anatomy of upper cervical spine and other related knowledge. The previous communication methods are mostly based on patients' imaging data and anatomical model, but the communication effect is not satisfactory. The combination of "Hand as Foot Teaching Method" brings new ideas for preoperative doctor-patient communication. We observed that by using this method, patients and their families can have a good understanding of the disease and the doctor's diagnosis and treatment plan, making the doctor-patient relationship more harmonious, which needs to be further studied and has clinical promotion value.

The "Hand as Foot Teaching Method" provides new ideas for clinical teaching in the context of novel coronavirus pneumonia(COVID-19) normalization

At present, in China, although COVID-19 has been effectively controlled across the country, there is often a counter-attack and the epidemic has become normal. In order to avoid gathering and contact and effectively reduce the spread of the virus, online teaching has become a new trend. However, we found that online teaching students are more likely to feel boring, and online teaching only relies on PPT for teaching, which greatly reduces the teaching effect. In addition, the teaching model and advanced digital teaching equipment (VR glasses, etc.) have no effect, which makes the teaching effect not satisfactory. "Hand as Foot Teaching Method" has the advantages of real-time interaction and free from site restrictions, so students can follow teachers to complete the simulation demonstration of upper cervical vertebra teaching content through "Hand", which fully attracts students' attention while innovating teaching methods and improves teaching quality and teaching satisfaction.

Concluding Remarks

We used the "Hand as Foot Teaching Method" for reference and applied it to the teaching practice of upper cervical vertebra for the first time, with satisfactory results. This teaching method can effectively bring the complex anatomical knowledge remaining in the two-dimensional plane into the three-dimensional space, thus improving the teaching quality. At the same time, teachers and students simulated the knowledge they learned by changing their hands posture, which obviously strengthened the interaction and activated the classroom atmosphere. More importantly, we noticed that through this teaching method, students can review the knowledge they have learned through gesture language anytime and anywhere, so as to achieve a firm memory, and this method is applied to the clinical preoperative doctor-patient communication, which is exactly the purpose of our clinical teaching. In addition, this method brings new ideas for online teaching in the context of the COVID-19 pandemic. Finally, we hope that "Hand as Foot Teaching Method" can be more systematic and standardized, and be better promoted and applied in clinical teaching of spine surgery and even other disciplines.

Abbreviations

PPT

Powerpoint presentations

Declarations

Ethics approval and consent to participate

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Consent for publication

All medical students and authors involved in the experiments have given their consent for this manuscript to be published.

Availability of data and materials

Not applicable.

Competing interests

The authors claim that they have no competing interests.

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Authors' contributions

All the authors (HJH, LX,HHW,ZW,XYL,PPW,XQL) were involved and contributed significantly to the concept and design, data analysis and drafting and approval of the manuscript.

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Figures

Figure 1

Model building(A.Simulation demonstration of atlas;B.Simulation demonstration of axis)

Figure 2

Simulation demonstration of Atlantoaxial complex(A.Superior aspect;B.Norma lateralis)

Figure 3

Simulation demonstration of atlantoaxial complex rotational relation

Figure 4

Gehweiler type The red dotted line represents the fracture line

Figure 5

Simulation demonstration of Gehweiler type V The red dotted line represents the fracture line

Figure 6

Simulation demonstration of Anderson and D'Alonzo type I, II, and III fractures. The red dotted line represents the fracture line.

Figure 7

Fielding type (The red arrow represents the shift of lateral mass)

Figure 8

Simulation demonstration of Fielding type (The red arrow represents the shift of lateral mass)