Clinical Application of a Supportive Drinking Device for Patients After Lumbar Spine Surgery

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Abstract: Objective: To investigate the clinical application of a self-designed auxiliary drinking device in patients after lumbar spine surgery. Methods: Patients undergoing lumbar spine surgery in our department from May 2023 to May 2024 were selected. They were divided into an observation group and a control group using a random number table, with 30 patients in each group. The experimental group used the novel auxiliary drinking device, while the control group used traditional manual drinking methods. Detailed records and analysis were conducted on indicators such as water intake, drinking frequency, drinking duration, patient satisfaction, and incidence of adverse reactions in both groups. Results: In terms of water intake, the average daily water intake of patients in the experimental group was 2000 milliliters, while in the control group it was 1500 milliliters; in terms of drinking frequency, the average daily number of times patients in the experimental group drank water was 8 times, compared to 5 times in the control group. Regarding drinking duration, patients in the experimental group had an average drinking time of 2 minutes per session, while the control group had 5 minutes. The results of the patient satisfaction survey also showed that 80% of patients in the experimental group expressed a high level of satisfaction with the device, while only 50% of patients in the control group were satisfied with the traditional manual drinking method. In terms of the incidence of adverse reactions, the experimental group had an incidence rate of 10%, while the control group had 20%. Conclusion: Comparative experimental analysis reveals that the novel auxiliary drinking device has significant advantages in increasing water intake, drinking frequency, and drinking efficiency in patients after lumbar spine surgery. It can also effectively enhance patient satisfaction and reduce the incidence of adverse reactions. These results indicate that the novel auxiliary drinking device holds great promise and potential value in clinical applications.

Keywords: Auxiliary Drinking Device; Patients After Lumbar Spine Surgery; Clinical Application

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1 Introduction

Post-lumbar surgery patients often face drinking problems that are typically addressed manually by caregivers or with traditional drinking devices. However, existing solutions have several limitations. Manual assistance by caregivers not only increases their workload but can also cause patient discomfort or aspiration if not done properly [1]. Traditional drinking devices, such as ordinary cups, straws, and spray bottles, while somewhat helpful, have relatively simple designs and functions and cannot meet the special needs of patients after lumbar spine surgery. Ordinary cups require patients to have a certain level of independent mobility, but patients after lumbar spine sur-

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gery often have limited mobility and find it difficult to use them on their own. Straws can reduce the need for patient movement, but due to limitations in straw length and angle, it is challenging for patients in bed to find a suitable angle for drinking, which can easily lead to issues like slow water flow or aspiration. Spray bottles are primarily used for local moisture and cannot meet the patients' regular drinking needs. Additionally, existing drinking devices lack portability and adaptability. Ordinary cups and straws have poor portability, making them inconvenient for patients to carry and use. While spray bottles are portable, their limited capacity does not satisfy the patients' continuous drinking needs [2]. Traditional drinking devices also have poor adaptability and cannot be adjusted according to the individual needs of patients, making it difficult to meet personalized requirements. Furthermore, there are issues with cleaning and disinfecting traditional drinking devices. Ordinary cups and straws need to be cleaned frequently to prevent bacterial growth, but caregivers often struggle to ensure the cleanliness of these devices, which increases the risk of infection. Spray bottles, due to their complex structure, are even more challenging to clean, making them prone to bacterial residue [3]. In summary, existing solutions have significant limitations in terms of ease of use, portability, adaptability, and cleaning and disinfection, and they cannot effectively address the drinking problems of patients after lumbar spine surgery. These limitations highlight the urgent need for an innovative auxiliary drinking device to fill the gap and better meet patient needs. For this reason, I have developed an auxiliary drinking device (National Utility Model Patent No.: ZL202320367191.X) for clinical use in post-lumbar surgery patients, which has shown promising results. Patients after lumbar spine surgery face numerous challenges in drinking, often relying on manual assistance from caregivers or traditional drinking devices. However, these existing solutions have clear limitations. This innovation has the potential to fill this gap, greatly meeting the actual needs of patients and improving their quality of life [4]. The new auxiliary drinking device is designed with the special circumstances of post-lumbar surgery patients in mind, such as providing a more convenient operation method, accommodating different drinking angles and postures, and featuring easy cleaning and disinfection. These improvements will significantly reduce the workload of caregivers, lower the risk of aspiration and infection, and offer patients a more convenient and safe drinking experience [5]. In future clinical practice, this innovative device is expected to become part of the standard care process, providing support to more post-lumbar surgery patients in need and enhancing their quality of life and rehabilitation outcomes.

2 Materials and Methods

This study selected inpatients who underwent lumbar spine surgery in our department, with an age range of 18 to 75 years, and no gender restrictions. In the observation group, there were 17 males and 13 females, with an average age of (54.00±7.62) years (ranging from 43 to 68 years); 15 cases of lumbar disc herniation, 5 cases of lumbar spondylolisthesis, 7 cases of lumbar spinal stenosis, and 3 cases of lumbar fracture. In the control group, there were 16 males and 14 females, with an average age of (54.43±6.29) years (ranging from 44 to 67 years); 13 cases of lumbar disc herniation, 6 cases of lumbar spondylolisthesis, 7 cases of lumbar spinal stenosis, and 4 cases of lumbar fracture. The comparison of basic data between the two groups showed no statistically significant differences ($P>0.05$). All subjects signed informed consent before the surgery and received detailed explanations from medical staff.

Inclusion criteria: No severe cardiovascular or cerebrovascular diseases or mental disorders, and no drinking difficulties [6].

Exclusion criteria: Allergies to plastic materials, complications after surgery that prevent participation in the trial, or severe infections after surgery.

Experimental Design: In this study, subjects were randomly divided into an experimental group and a control group in a 1:1 ratio. The experimental group used the new auxiliary drinking device for drinking, with records of the drinking volume and user experience. This new device is designed to be convenient and easy to operate, aiming to improve the comfort and efficiency of drinking. Control Group (Traditional Drinking Method): Subjects will continue to use the traditional drinking method, with records of drinking volume and user experience similarly documented. The traditional drinking method will serve as the baseline for comparing the effectiveness of the new auxiliary drinking device [7]. Group allocation will be achieved using a computer-generated random number table to ensure the randomness and scientific validity of the grouping process. Before grouping, the research team will ensure that all subjects meet the inclusion criteria and exclude those who meet any of the exclusion criteria. Subjects will continue to use the traditional drinking

method, with relevant data recorded and feedback provided. Data on drinking volume, user feedback, and any possible side effects will be collected [8]. The research team will compare the data between the experimental and control groups to assess the effectiveness and feasibility of the new auxiliary drinking device in enhancing the drinking experience. This study aims to comprehensively evaluate the practical application effects of the new auxiliary drinking device in the target population, providing scientific evidence and data support for future clinical applications. The randomized controlled trial design will effectively reduce systemic biases, ensuring the scientific and objective nature of the research results.

3 Auxiliary Drinking Device

Considering the bedridden posture and limited mobility of patients, we have specifically designed a series of user-friendly features for this new auxiliary drinking device. Firstly, the device adopts an adjustable length hose to connect the water source and drinking spout [9]. This design aims to ensure that it not only meets the daily water intake needs of patients but also avoids affecting the user experience due to the hose being too long or too short. The flexibility and adjustability of the hose allow patients to adjust it to the most suitable length according to their individual needs. Additionally, For the drinking spout, we innovatively designed it with an adjustable angle feature. The angle of the spout can be adjusted by simple rotation, allowing it to adapt cleverly to different drinking postures of patients. Whether lying on their back or side, patients can find the most comfortable angle for drinking, greatly enhancing their user experience [10]. For the water source, we use a movable water bottle design with a capacity of 1.5 liters. This capacity design aims to eliminate the need for patients to frequently change the water source while ensuring they have an adequate amount of water to drink. The portability of the water bottle allows patients to easily access water in various scenarios. To better secure the device, we have specially designed an adjustable bracket system. The bracket's base is equipped with anti-slip rubber pads, which not only enhance stability but also effectively prevent the device from sliding or tipping over during use, ensuring the safety of patients. For the device's power source, we have adopted a rechargeable lithium battery. This battery can operate continuously for approximately 72 hours after being fully charged, and it only takes about 3 hours to recharge.

This design not only ensures long-term use of the device but also significantly reduces the inconvenience patients might experience due to power issues [11]. Finally, for the device's control, we have equipped it with a user-friendly remote control [12]. The remote communicates wirelessly with the device's main unit, ensuring that patients can effectively operate the device within a certain range. This design not only enhances convenience but also allows patients to easily control the device according to their needs [13]. In summary, this new auxiliary drinking device takes into full account the practical needs and user experience of patients at every design stage, aiming to provide a more convenient and comfortable drinking solution for bedridden patients.

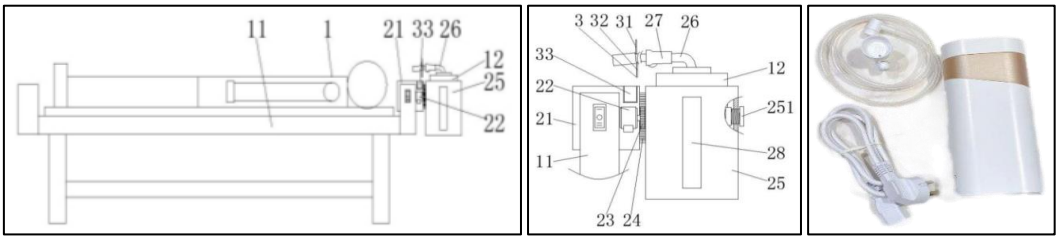

Figure 1 21, Drinking Component; 11, Bed Frame; 12, Cup; 2, Adjustment Component; 21, Frame Body; 22, Motor; 23, Gear One; 24, Gear Two; 25, Casing; 251, Set Screw; 26, Pipe Body; 27, Flow Restrictor; 28, Observation Window; 3, Fixing Component; 31, Fixing Strap One; 32, Fixing Strap Two; 33, Groove Body.

4 Nursing Methods

To comprehensively evaluate the effectiveness and feasibility of the new auxiliary drinking device, detailed experimental operations and data recording were conducted during the trial. Patients in the experimental group began using the new device immediately after surgery. Medical staff first provided operational guidance to ensure that patients could master the usage method proficiently. During the use of the auxiliary drinking device by the patients, medical staff continuously observed and recorded the fol-

lowing: Drinking Volume Record: Daily recording of the total drinking volume of patients in the experimental group. Drinking Frequency and Time: Recording the number of times patients drink each day and the specific times of drinking [14]. Additionally, medical staff will inquire about the patients' subjective experiences, including the convenience and comfort of drinking, as well as any discomfort or operational difficulties. This information will help assess the actual effectiveness of the device and patient acceptance.

Patients in the control group continued to use conventional drinking cups or straws. Similarly, medical staff recorded the following data: Drinking Volume Record: Daily recording of the total drinking volume of patients in the control group. Drinking Frequency and Time: Record the number of times patients drink each day and the specific times of drinking. Patients in the control group will also be asked about their subjective experiences with drinking, including any issues or discomfort encountered. All data on drinking volume, frequency, timing, and patient subjective experiences will be carefully recorded and collected. This data will be used to compare differences between the experimental group and the control group, evaluating the actual effectiveness and feasibility of the new auxiliary drinking device in improving the drinking experience. Daily data recording will be completed by specifically responsible nursing staff to ensure data accuracy and reliability. This data will provide important support and evidence for the analysis and conclusion of the research results [15]. Through the above detailed operations and data recording, we hope to comprehensively evaluate the practical application effect of the new auxiliary drinking device among bedridden patients, providing scientific evidence and data support for future clinical implementation.

5 Evaluation Indicators and Data Collection

Data Collection and Analysis Methods: To thoroughly evaluate the effectiveness of the new auxiliary drinking device, this study employs two data collection methods: questionnaire surveys and observational records, supplemented by statistical analysis for data processing. Before starting the use of the auxiliary drinking device, we first collect patients' basic information through a questionnaire survey. This information includes, but is not limited to, patients' age, gender, specific type of surgery performed, and the stage of postoperative recovery. The collection of this basic information helps us to more accurately understand the personal background of each patient, providing a strong foundation and support for further data analysis. The questionnaire survey also includes patients' subjective evaluation of the difficulty level of drinking water, which is an important component of evaluating the effectiveness of the new auxiliary drinking device [16]. Additionally, we inquire about changes in water intake before and after using the auxiliary drinking device, drinking frequency, and evaluations of comfort and convenience during device use. This information will assist us in understanding patients' actual usage experiences and acceptance of the new auxiliary drinking device. Data Analysis Methods: This study primarily employs the following data analysis methods: (1) Descriptive Statistics: Conduct descriptive statistical analysis on the data collected from the questionnaire surveys, calculating statistics such as means and standard deviations for indicators like water intake and drinking frequency. (2) Test: When the sample size is small, a t-test is used to compare data differences before and after using the auxiliary drinking device. (3) Analysis of Variance (ANOVA): Used to compare measurement data at different time points, evaluating the impact of the new auxiliary drinking device on indicators such as water intake and drinking frequency. (4) Qualitative Analysis: For observational data, qualitative analysis methods are employed. This involves summarizing and synthesizing patient feedback and actual observations of device usage to analyze common issues and feedback during device use. Through these detailed data collection and analysis methods, we will be able to comprehensively assess the specific impact of the new auxiliary drinking device on patients' convenience and comfort in drinking water, providing scientific evidence and decision support for related medical practices.

6 Statistical Analysis

Data analysis was conducted using SPSS 23.0 software, including descriptive statistics and hypothesis testing. For categorical data, percentages were used. For quantitative data, the results are presented as mean ± standard deviation ($x \pm s$). Between-group comparisons were performed using independent samples t-tests to compare the experimental group and the control group. The significance level was set at $P < 0.05$ to determine whether the statistical

differences were significant. Specific analysis content:

Descriptive statistical analysis: Calculate the mean and standard deviation of indicators such as water intake and drinking frequency, as well as the percentages of categorical data. Hypothesis testing: Use independent t-tests to compare data differences before and after using the auxiliary drinking device, and evaluate whether the impact of the new device on water intake and frequency is significant. Significance level: Set the P-value less than 0.05 as the significance level to determine whether the results are statistically significant.

7 Results

In this study, 60 patients who underwent lumbar spine surgery were selected and divided into two groups: 30 patients in the experimental group and 30 patients in the control group. The experimental group used the new auxiliary drinking device, while the control group used the traditional manual drinking method. During the study, detailed records and analyses were conducted on indicators such as water intake, drinking frequency, drinking times, patient satisfaction, and the incidence of adverse reactions in both groups. The average daily water intake of patients in the experimental group was significantly higher than that in the control group, indicating that the new auxiliary drinking device has a significant effect on increasing patients' water intake. Specifically, the average daily water intake in the experimental group was 2000 milliliters, compared to 1500 milliliters in the control group [17].

Table 1 Comparison of Water Intake, Drinking Frequency, and Drinking Time Between the Two Groups of Patients

Group	Sample Size	Average Daily Water Intake (milliliters)	Average Daily Number of Water Intakes	Time of Each Water Intake
Control Group	30	1500	8	5
Experimental Group	30	2000	5	2

Table 2 Comparison of Postoperative Hospitalization Time and Satisfaction in Lumbar Spine Patients

Group	Hospitalization Time ($\bar{x} \pm s$)	Satisfaction Status			
		Very Satisfied	Satisfied	Unsatisfied	Satisfaction Rate (%)
Experimental Group (30 samples)	9.32±5.46d	28	1	1	96.67
"Control Group (30 samples)"	13.67±6.32d	25	0	5	83.33

This significant difference may be attributed to the ease of use of the new device, which effectively reduces the inconvenience and discomfort patients may encounter during drinking, thereby enhancing their willingness and ability to drink independently. This finding not only highlights the potential advantages of the new auxiliary drinking device in clinical practice but also suggests that its application could be particularly important for maintaining fluid balance and promoting recovery in patient populations that require prolonged bed rest or have limited mobility. The simplicity of operation allows patients to obtain the necessary water more easily without relying too much on the help of nursing staff, thereby improving overall nursing efficiency and patient comfort [13]. In addition, the new auxiliary drinking device also significantly increased the drinking frequency and reduced the time required for each drinking session in the experimental group. The average daily drinking frequency in the experimental group was 8 times, compared to 5 times in the control group; the average time required for each drinking session was 2 minutes and 5 minutes, respectively. These results further support the positive impact of the device on enhancing drinking efficiency, addressing the issue of reduced drinking frequency due to limited mobility, which is particularly important for patients requiring frequent bedside care. The design and application of the new auxiliary drinking device not only significantly increased patients' water intake and frequency but also improved drinking efficiency, thereby providing substantial practical value for clinical practice. Future research could further explore the device's applicability and long-term effects across different patient populations, as well as its sustained impact in daily care, thus offering more refined and personalized support for medical care. In terms of drinking frequency, the experimental group had an average of 8 drinking sessions per day, while the control group had 5. The portability and ease of use of the new auxiliary drinking device made it easier for patients to drink anytime and anywhere, effectively reducing the issue of decreased drinking frequency due to limited mobility. This is particularly beneficial for bedridden patients, as the device helps avoid discomfort caused by frequent movement. This finding further highlights the positive impact of the new auxiliary drinking device on improving

patients' drinking behaviors. The simplicity of operation allows patients to more independently meet their daily drinking needs without relying heavily on nursing staff, thereby enhancing their autonomy and quality of life. Moreover, the increased drinking frequency may help maintain fluid balance, which is particularly important for patients in recovery or those who are bedridden for extended periods. By reducing the difficulty and time cost associated with drinking, the new device not only improved patients' drinking habits but also enhanced overall nursing efficiency and patient comfort. The device's performance in increasing drinking frequency aligns with its effect on improving daily water intake, jointly revealing its potential advantages in clinical practice. Future research could further explore its effectiveness in different medical conditions and stages of treatment, as well as the long-term impact of sustained use on patients' health, thereby providing more comprehensive support and guidance for medical care.

In terms of drinking time, the experimental group required significantly less time per drinking session compared to the control group. Specifically, the average time for each drinking session in the experimental group was 2 minutes, whereas in the control group it was 5 minutes. This finding indicates that the new auxiliary drinking device significantly improves drinking efficiency, effectively reducing the fatigue and time cost that patients might experience during drinking. The ease of operation allows patients to complete each drinking session more quickly and effortlessly, which not only enhances patient comfort but may also improve their attitude and acceptance towards drinking behavior. Especially for patients who are bedridden or have limited mobility, reducing the time required for each drinking session can effectively alleviate discomfort and fatigue associated with maintaining the same posture for extended periods, thereby enhancing their quality of life and treatment outcomes. In summary, the new auxiliary drinking device not only excels in increasing daily water intake and drinking frequency but also demonstrates significant advantages in optimizing the time required for each drinking session. These results further support the potential application of the device in clinical practice. Future research could explore its long-term effects and applicability across different patient populations to more comprehensively assess its value and practical impact in medical care [18].

Patient satisfaction survey results indicate that the experimental group had significantly higher satisfaction with the new auxiliary drinking device compared to the control group. Specifically, 96.67% of patients in the experimental group reported being satisfied with the device's usability, while only 83.33% of patients in the control group were satisfied with the traditional manual drinking method. This suggests that the new device's design is ergonomically sound, easy to operate, and effectively reduces discomfort during drinking, thereby significantly enhancing the overall user experience. This finding further reinforces the positive role and potential advantages of the new auxiliary drinking device in clinical practice. The ease of use not only increased patients' drinking volume and frequency but also directly influenced their satisfaction and comfort, providing a more user-friendly and effective care solution for bedridden or mobility-impaired patients. Future research could further explore the relationship between patient satisfaction and treatment outcomes, as well as the practical application of the device in various clinical settings. These efforts will help to more comprehensively assess the long-term impact of the new auxiliary drinking device on improving the quality of medical care and patient quality of life, providing more reliable evidence and guidance for clinical decision-making. In terms of adverse reaction rates, the experimental group had an adverse reaction rate of 10%, compared to 20% in the control group. Specifically, adverse reactions mainly included coughing due to improper posture and dehydration symptoms due to insufficient water intake. This finding suggests that the lower adverse reaction rate in the experimental group may be attributed to the new auxiliary drinking device's assistance in helping patients better control their water intake and drinking posture, thereby effectively reducing related risks. The design of the new device incorporates ergonomic principles, allowing patients to more easily select a suitable drinking posture and avoid coughing caused by improper positioning. Additionally, by increasing daily water intake and frequency, the device helps to prevent dehydration symptoms, which is particularly significant for patients who are bedridden or have limited mobility. In summary, the new auxiliary drinking device not only excels in enhancing drinking efficiency and increasing patient comfort but also demonstrates a significant advantage in reducing the incidence of adverse reactions. These results further support its potential for clinical application. Future research could further explore its long-term effects in various disease states and treatment stages to comprehensively assess its practical value and safety in medical care.

8 Discussion

The design of the new device incorporates ergonomic principles, allowing patients to more easily select a suitable drinking posture and avoid coughing caused by improper positioning. Additionally, by increasing daily water intake and frequency, the device helps to prevent dehydration symptoms, which is particularly significant for patients who are bedridden or have limited mobility. In summary, the new auxiliary drinking device not only excels in enhancing drinking efficiency and increasing patient comfort but also demonstrates a significant advantage in reducing the incidence of adverse reactions. These results further support its potential for clinical application. Future research could further explore its long-term effects in various disease states and treatment stages to comprehensively assess its practical value and safety in medical care, The new device's user-friendly design, such as adjustable tube length and angles, further enhances patient autonomy and ease of use. These features not only improve patient comfort and quality of life but also help reduce the workload of medical staff, thereby enhancing overall nursing efficiency. Future research could further explore the device's application effects in various postoperative recovery stages and its suitability for different types of patients, to comprehensively assess its practical value and long-term effects in clinical practice. For caregivers, the use of this device also reduces their workload, allowing them to focus more on other nursing tasks. Additionally, by enhancing patients' self-care abilities, the device effectively alleviates the psychological pressure on caregivers, contributing to improved overall care quality. From the patient's perspective, the use of the auxiliary drinking device has significantly improved postoperative quality of life. Patient feedback indicates that the device's ease of use and comfort are widely recognized, and patient satisfaction during the postoperative recovery period has notably increased. This positive feedback not only boosts patients' confidence in their recovery but also earns the hospital a good reputation. The application of the auxiliary drinking device for patients after lumbar spine surgery has not only significantly improved their postoperative experience but also brought numerous conveniences to clinical care work, promoting the efficient use of medical resources. The introduction of this device allows patients to easily drink while in bed without needing additional caregiver assistance, thus reducing the need for frequent repositioning and helping to lower the risk of postoperative complications, such as increased pain or wound tearing. Sure! Here's the translation of the text into English:

The user-friendly features of the device design, such as adjustable pipe length and angles, further enhance patient autonomy and ease of use. This not only improves patient comfort and quality of life but also reduces the workload of healthcare professionals, thereby increasing nursing efficiency and service quality. In future clinical practice, this device is expected to become a standard configuration, providing consistent, high-quality care for more patients requiring postoperative rehabilitation. Further research could explore its applicability and long-term effects in different stages of postoperative rehabilitation and for other types of surgeries, in order to further validate its practical value in improving medical care standards and overall patient health management.

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