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ARTICLE

Wisdom Tooth Extraction Training for Dental Students: Step-by-Step or All-in-One?

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Abstract

Aims/Background For inexperienced dental students, impacted wisdom tooth extraction is a complex procedure involving a series of intricate steps. This study compared the effectiveness of step-by-step and all-in-one teaching methods for dental students learning impacted wisdom tooth extraction, by evaluating their practical abilities, understanding, and learning satisfaction.

Methods Fifty dental students were randomly assigned to either a step-by-step teaching group (Group S) or an all-in-one teaching group (Group A) for impacted wisdom tooth extraction training. Their skills were assessed using the Assessment of Competency in Exodontia Skills (ACES) scoring system, and their theoretical knowledge was tested in a test. The students also completed a questionnaire to gauge their satisfaction regarding the teaching method received.

Results The students in Group S demonstrated superior performance in clinical procedures compared to Group A, evidenced by the significantly higher ACES scores ($p < 0.05$). There was no significant difference in theoretical exam scores between the two groups ($p > 0.05$). The students in Group S reported higher general satisfaction ($p < 0.05$), suggesting a preference for the step-by-step approach. The results also showed that satisfaction toward hands-on practice and teaching sessions significantly contributed to general satisfaction, while satisfaction with mastery of clinical skills did not.

Conclusion The step-by-step teaching method was more effective in improving students' clinical skills and augmenting their satisfaction during impacted wisdom tooth extraction training. Our findings support the use of incremental learning approaches in dental education to enhance both clinical competencies and students' learning experiences.

Key words: oral surgery education; dental student; tooth extraction training; teaching method; step-by-step; all-in-one

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Introduction

The oral surgery internship is a crucial component of dental training. It integrates theoretical knowledge with practical skills, particularly in the extraction of impacted teeth (Feng et al, 2021). Impacted wisdom teeth can cause pain, swelling, and infection, potentially damaging nearby teeth and bone (Ghaeminia et al, 2020). Therefore, the removal of wisdom teeth is generally recommended to alleviate pain,

improve oral health, and restore normal function (Normando, 2015; Steel et al, 2022; Zou et al, 2023). However, extracting impacted wisdom teeth is a complex procedure requiring a deep understanding of anatomy and effective pain management for patients, while inflicting minimal damage to surrounding tissues. Comprehensive training in tooth extractions and other surgical procedures can significantly improve students' clinical abilities.

Bridging the gap between theoretical knowledge and practical skills in tooth extraction stands as a challenge facing contemporary dental education. Without properly addressing the gap, the quality of clinical training for undergraduate students could be impacted. The effectiveness of teaching methods in dentistry is a topic of ongoing research and discussion (Sekhon et al, 2022). The traditional Chinese method for impacted wisdom tooth extraction, known as the "all-in-one" approach, starts with theoretical instructions, followed by hands-on practice in a clinical setting. Students are expected to complete all extraction steps independently, with instructor assistance available if needed. Through practice, students develop tooth extraction proficiency in the procedure. However, the effectiveness of the all-in-one teaching method has been less than ideal. For multi-step surgical procedures, such as the extraction of impacted teeth, inadequate performance in one step often hampers subsequent steps. Therefore, students can only attain the competency in handling more complex cases after having practiced on numerous simple cases, a learning process that results in an extended cycle and entails considerable challenges for instructors. In recent years, the step-by-step teaching method, an innovative teaching approach, has been introduced in realm of dental education. Nevertheless, its application in dental surgery teaching remains unexplored. Thus, this study aims to assess the effectiveness of a step-by-step teaching method in training undergraduate medical interns to extract impacted teeth. In contrast to the all-in-one approach, which expects students to grasp and execute the complete extraction procedure at the outset, the step-by-step method fosters a more incremental learning experience (Liu et al, 2019). This method involves instructors meticulously explaining and demonstrating each distinct step of the extraction process. Students then are given the opportunity to practice in accordance with these individual steps under the instructor's close guidance. Initially, students may focus solely on mastering a single step before gradually progressing to independently complete the entire procedure. Throughout this process, instructors remain readily available to provide support and address any difficulties that may arise.

To evaluate students' abilities in oral surgery, educators typically employ a combination of hands-on and written assessments. The Assessment of Competency in Exodontia Skills (ACES) rating scale is a common tool used in controlled settings to gauge students' practical skills and ensure consistent evaluation of clinical performance (Janjua et al, 2019). Alongside practical assessments, theoretical exams remain crucial in dental education, testing students' understanding of core oral surgery concepts and principles (Abd Alraheam et al, 2022). In addition, students' satisfaction and engagement are crucial for creating an optimal learning environment, as they significantly impact educational outcomes (Alqarni, 2021; Kantek and Kazanci, 2012). This study compared the effectiveness of step-by-step and

all-in-one teaching methods for training students to extract impacted wisdom teeth. We evaluated dental students' performance using the ACES clinical skills assessment and written exams, as well as their satisfaction toward the teaching approach. Importantly, we sought to understand how different teaching methods influence student learning and satisfaction. By identifying the strengths and weaknesses of each approach, dental educators can refine their teaching strategies to improve the educational experience and develop the clinical competence of future oral surgeons.

Methods

Study Design and Participants

To evaluate the effectiveness of different teaching methods in impacted wisdom tooth extraction training, a randomized controlled trial was conducted. The study involved 50 undergraduate dental interns from the newly established Department of General Dentistry II at Stomatology Hospital of Guangzhou Medical University. This department, launched in 2023, provides a comprehensive internship experience encompassing various disciplines like oral and maxillofacial surgery, endodontics, and periodontics. These interns were fourth-year undergraduates of Guangzhou Medical University majoring in dentistry with no previous experience in tooth extraction.

Participants were randomly assigned to either a step-by-step teaching group (Group S) or an all-in-one teaching group (Group A) using a computer-generated randomization sequence. They were all given a practical assessment before the start of the internship and passed the test. The study adhered to the Declaration of Helsinki and was approved by the Ethics Committee of Stomatology Hospital of Guangzhou Medical University (LCYJ2024008). Verbal and written consent were obtained from the participants before the study began.

Teaching Interventions

The study compared two teaching methods. Group S received step-by-step instructions, with each session focusing on a distinct step of tooth extraction. In contrast, Group A learned the entire procedure at once before moving on to hands-on practice. Both groups had equal access to resources, received instructions for the same length of time, and were taught by experienced dental surgery instructors.

For Group S, the procedure was broken down into four one-week modules to ensure a thorough understanding of each step:

- Week 1: Local anesthesia techniques
- Week 2: Flap design and tissue handling
- Week 3: Tooth sectioning and elevation
- Week 4: Suturing techniques

The idea of breaking down the tooth extraction process into four distinct stages and providing proper stage-specific instructions in sequential manner over 4 weeks epitomizes an educational approach rooted in the Cognitive Apprenticeship (Butler et al, 2019; Konishi et al, 2020; Lyons et al, 2017). This staged approach allows students to focus on mastering specific skills each week before moving on to the next,

allowing for a gradual buildup of expertise. The effectiveness of this teaching technique lies in its ability to simplify complex skills into manageable parts and offer plenty of practice opportunities, making it suitable for learners of all backgrounds and skill levels.

During week 1, the students focused on learning local anesthesia techniques for mandibular tooth extraction. Effective pain control during extraction is crucial and relies on proper local anesthesia. The lessons planned for this week covered essential steps like topical anesthetic application, anatomical considerations for block injections, aspiration during injection, and ensuring adequate onset time. Students also practiced relevant skills such as assembling an anesthetic syringe, positioning for inferior alveolar nerve blocks, and recognizing signs of anesthesia.

Week 2 focused on flap design and tissue handling techniques. A well-designed flap, typically triangular or envelope-shaped, is crucial for providing visibility and access to the bone and tooth roots. Emphasis was also placed on proper tissue handling skills, including using periosteal elevators, tissue retraction, and achieving primary closure to minimize trauma. As in the previous week, students received feedback from instructors regarding their hands-on practice to enhance their skills.

Tooth sectioning and elevation is the main topic in week 3. Students learned how to use high-speed dental handpieces to section teeth into smaller pieces with burs, minimizing damage to adjacent structures. Sectioning facilitates extraction, particularly for multi-rooted teeth. They also practiced using elevators to apply gentle rotational forces and mobilize tooth roots. This week culminated in students completing extractions, integrating the sequential skills developed over the previous three weeks.

In week 4, the students focused on learning various suturing techniques for tooth extraction. Sutures help minimize bleeding and promote wound healing after tooth removal.

The students in the all-in-one group watched a video demonstrating the entire tooth extraction process before practicing the complete procedure from week one. Conversely, the students in the step-by-step group received video instruction focused on individual stages of the extraction process. This allowed them to gradually build their skills toward performing complete extractions.

Clinical Skill Examination

The validated ACES scoring system (**Supplementary Material 1**) practicing was employed to evaluate students' clinical skills following the intervention. The rating scales comprise 28 items in five subscales to assess tooth extraction proficiency: pre-op patient assessment, local anesthesia, extraction technique, cross-infection control, and post-op management and care. Each item was rated using a five-point Likert scale (range: 1 = Poor, 2 = Unsatisfactory, 3 = Satisfactory, 4 = Good, 5 = Excellent) (Janjua et al, 2019). The internal consistency was satisfactory (Cronbach's alpha coefficient was 0.857).

Clinical Theory Examination

Both groups took a standardized written exam to assess their theoretical knowledge. The exam was developed based on the standards of the Chinese Medical Practitioner Examination and reviewed by a panel of experts to ensure its content validity.

Student Satisfaction Survey

The Internship Satisfaction Questionnaire, designed specifically for Chinese dental students (English translation available in **Supplementary Material 2**), utilizes a 10-question, 5-point Likert scale format (ranging from 1 = Very dissatisfied, to 5 = Very satisfied) to assess satisfaction across four key dimensions: general satisfaction (questions 1–2), hands-on practice satisfaction (questions 3–5), teaching session satisfaction (questions 6–8), and mastery of clinical skills satisfaction (questions 9–10). To ensure clarity, accuracy, and comprehensiveness, the questionnaire had been comprehensively reviewed in a pilot study consisting of 20 students, and refined by two experienced educators based on students' feedback. All students gave their informed consent to voluntarily participate in this survey after having been briefed on the study's goals and procedures. Their identity was kept anonymous through the survey.

Statistical Analysis

SPSS 27.0 (IBM Corp., Armonk, NY, USA) was used to compute descriptive statistics (count, percentage, mean ± standard deviation) and comprehensively analyze the collected data by using chi-square tests, independent samples *t*-tests, reliability and validity assessments, Pearson's correlation analysis, and linear regression. Chi-square tests, independent samples *t*-tests were conducted to compare ACES scores and exam scores between the groups. We also used independent samples *t*-tests to compare the four dimensions of the satisfaction scale within each group. Linear regression was employed to examine the relationships between the other three dimensions related to general satisfaction. All data analyzed with *t*-tests, Pearson's correlation analysis and linear regression had been tested for normality using the Shapiro-Wilk normality test prior to actual statistical tests. A *p*-value of less than 0.05 was regarded as statistically significant for all analyses.

Results

Baseline Characteristics

Fifty students were randomly assigned to either Group S or Group A. These two groups presented a well-balanced distribution in terms of gender, with Group S consisting of 12 males and 13 females, and Group A comprising 15 males and 10 females. Chi-square analysis confirmed no significant difference in gender between the groups ($\chi^2 = 0.725$, $p > 0.05$). The average age of students in Group S and Group A was 23.72 ± 0.89 and 23.56 ± 0.82, respectively, with no significant difference ($t = 0.661$, $p > 0.05$). The Grade Point Average (GPA) for Group S and Group A was 3.26 ± 0.50 and 3.27 ± 0.47, respectively, presenting no signif-

icant difference between the two groups—an indication that both groups possess a comparable level of initial competence.

Clinical Skill Performance

To evaluate the effectiveness of the tested teaching methods, an independent samples *t*-test was performed to compare ACES scores between the two groups. Students in Group S achieved significantly higher scores (87.56 ± 4.51) compared to Group A (84.56 ± 5.32) ($t = 2.15$, $p < 0.05$) (Fig. 1). This suggests the step-by-step approach led to superior clinical skills. Moreover, we observed significant differences in ACES scores between female and male students in Group S ($t = 2.47$, $p < 0.05$) but not in Group A ($t = 0.575$, $p > 0.05$). The male students in Group S achieved higher ACES scores than those in Group A ($t = 2.50$, $p < 0.05$). Meanwhile, there was no significant difference in ACES scores between female students in the two groups ($t = 0.891$, $p > 0.05$) (Fig. 2).

Clinical Theory Exam Scores

A comparative analysis of clinical theory examination scores was conducted between the two groups. These exams assessed students' understanding of the core principles and decision-making frameworks related to tooth extraction. Students in Group S achieved a mean score of 73.28 on the clinical theory examination (SD = 6.83), whereas students in Group A obtained a mean score of 71.72 (SD = 10.02) (Fig. 1). An independent samples *t*-test revealed no significant difference between the groups ($t = 0.643$, $p > 0.05$), suggesting that both instructional methodologies were equally effective in conveying theoretical knowledge relevant to oral surgery. Likewise, in terms of Clinical Theory Exam scores, no obvious difference existed between the female and male students in both groups (Group S: $t = 0.657$, $p > 0.05$; Group A: $t = 0.968$, $p > 0.05$). For either female ($t = 0.015$, $p > 0.05$) or male ($t = 0.647$, $p > 0.05$) students, no significant difference was observed across Groups S and A (Fig. 3).

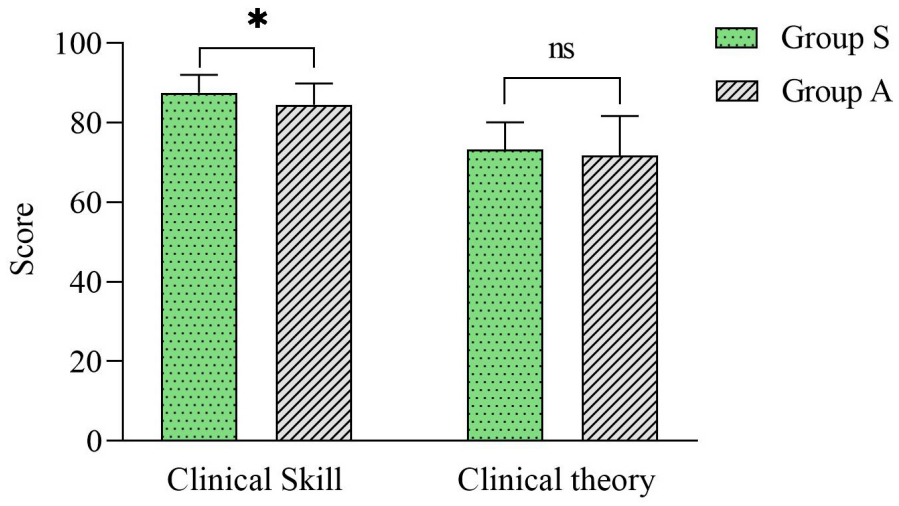

Fig. 1. Comparison of clinical skills and clinical theory exam scores between Group S and Group A (n = 25). Data are expressed as mean ± SD. Notes: *$p < 0.05$; ns denotes $p > 0.05$.

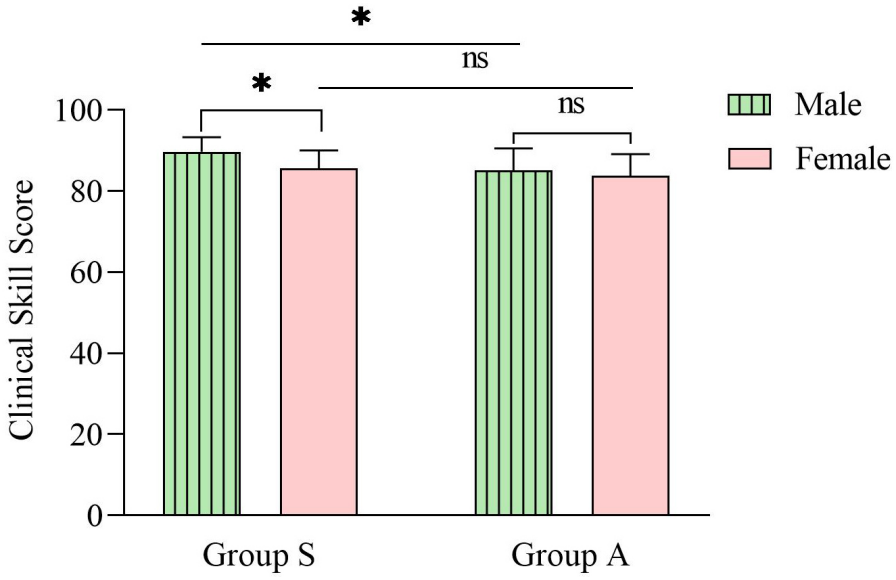

Fig. 2. Comparison of clinical skill exam scores between males and females in Group S (males: n = 12; females: n = 13) and Group A (males: n = 15; females: n = 10). Data are expressed as mean ± SD. Notes: *$p < 0.05$; ns denotes $p > 0.05$.

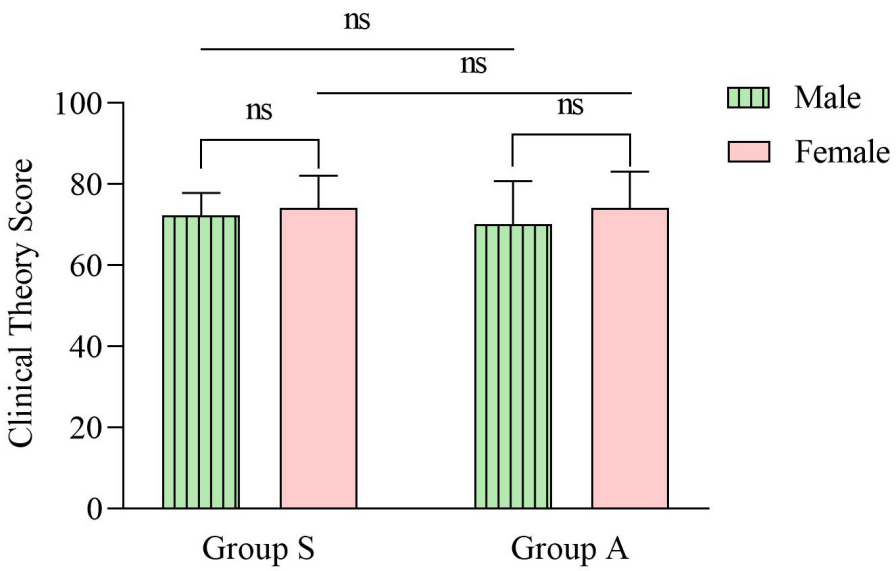

Fig. 3. Comparison of clinical theory exam scores between males and females in Group S (males: n = 12; females: n = 13) and Group A (males: n = 15; females: n = 10). Data are expressed as mean ± SD. Notes: ns denotes $p > 0.05$.

Students' Satisfaction with Teaching Method

To ensure the accuracy of our findings, we assessed the questionnaire's reliability and validity. The Cronbach's alpha coefficient was 0.891, exceeding the recommended threshold of 0.7, indicating high internal consistency (reliability). Validity testing was conducted using the Kaiser-Meyer-Olkin (KMO) and Bartlett's tests. All question commonalities (shared variance) exceeded 0.4, the KMO value was

0.815 (greater than 0.6), and the cumulative explained variance after rotation was 81.01% (well above 50%). These results suggest the data possesses good structural validity, meaning it is suitable for extracting meaningful information.

The distribution of responses across the 5-point Likert scale for each question is shown in Figs. 4,5. Group S exhibited higher average scores on all questionnaire items, indicating greater overall satisfaction. We used independent samples *t*-tests to compare the data of the four questionnaire dimensions separately (Table 1). The results showed significant differences between the groups in general satisfaction ($t = 2.547$, $p < 0.05$), hands-on practice satisfaction ($t = 2.362$, $p < 0.05$), and teaching session satisfaction ($t = 2.973$, $p < 0.05$), with Group S scoring higher in all three categories. However, no significant difference was found in mastery of clinical skill satisfaction ($t = 1.522$, $p > 0.05$). These findings suggest that students were generally more satisfied with the step-by-step approach to learning tooth extraction, particularly regarding the instructional delivery and hands-on practice aspects.

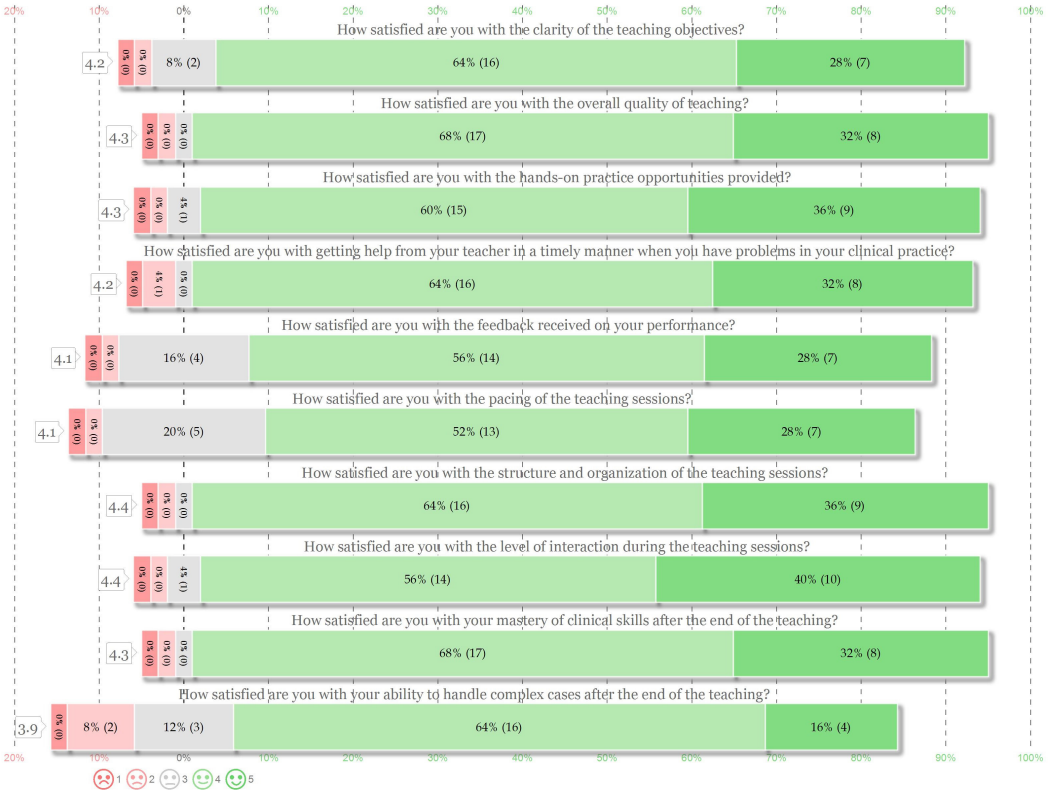

Fig. 4. Percentage of responses for each category measured on a 5-point Likert scale for Group S (n = 25). Note: Likert scale: 1 = Very dissatisfied; 2 = Dissatisfied; 3 = Neutral; 4 = Satisfied; 5 = Very satisfied.

Correlation analysis of all questionnaire data was conducted to examine the relationships between general satisfaction, hands-on practice satisfaction, teaching session satisfaction, and mastery of clinical skill satisfaction. The Pearson's correlation coefficients between general satisfaction and the other three dimensions were 0.635, 0.609, and 0.445, respectively, which are all statistically significant ($p < 0.05$) (Table 2). These results indicate that general satisfaction has a positive

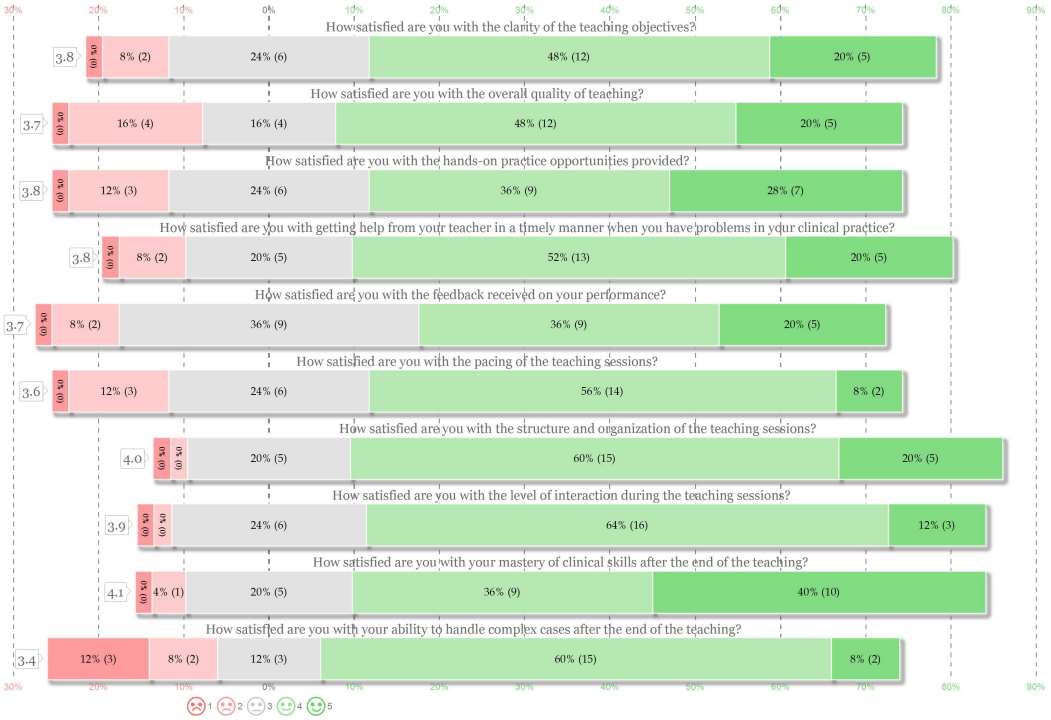

Fig. 5. Percentage of responses for each category measured on a 5-point Likert scale for Group A (n = 25). Note: Likert scale: 1 = Very dissatisfied; 2 = Dissatisfied; 3 = Neutral; 4 = Satisfied; 5 = Very satisfied.

Table 1. Comparison of satisfaction in the four dimensions of Group S and Group A.

	Groups (mean ± SD)		*t*	*p*
	S (*n* = 25)	A (*n* = 25)		
General satisfaction	4.26 ± 0.44	3.76 ± 0.88	2.547	0.015*
Hands-on practice satisfaction	4.23 ± 0.53	3.77 ± 0.80	2.362	0.023*
Teaching session satisfaction	4.27 ± 0.51	3.83 ± 0.54	2.973	0.005**
Mastery of clinical skill satisfaction	4.10 ± 0.54	3.78 ± 0.90	1.522	0.136

Note: *$p < 0.05$; **$p < 0.01$.

correlation with the other three dimensions, showing the strongest association with hands-on practice satisfaction. A linear regression analysis was conducted to examine how hands-on practice satisfaction, teaching session satisfaction, and mastery of clinical skill satisfaction influence general satisfaction (Table 3). These three variables were entered as independent variables, and general satisfaction was treated as the dependent variable. The model accounted for 47.6% of the variance in general satisfaction (adjusted $R^2 = 0.441$). Tests to assess multicollinearity (variance inflation factor (VIF) values <5) and autocorrelation (Durbin-Watson (D-W) value close to 2) confirmed that the model assumptions were met, indicating a good fit for the model. The analysis revealed significant positive relationships between general satisfaction and both hands-on practice satisfaction (regression coefficient = 0.407, $t = 2.703$, $p < 0.01$) and teaching session satisfaction (regression coefficient =

0.419, $t = 2.223$, $p < 0.05$). Interestingly, mastery of clinical skills satisfaction did not significantly impact general satisfaction (regression coefficient = 0.063, $p > 0.05$).

Table 2. Pearson's correlation analysis for the four dimensions.

	General satisfaction	Hands-on practice satisfaction	Teaching session satisfaction	Mastery of clinical skill satisfaction
General satisfaction	1			
Hands-on practice satisfaction	0.635**	1		
Teaching session satisfaction	0.609**	0.641**	1	
Mastery of clinical skill satisfaction	0.445**	0.534**	0.527**	1

Note: **$p < 0.01$.

Discussion

This study compared the effectiveness of step-by-step and all-in-one teaching methods for impacted wisdom tooth extraction training among dental students. Our findings suggest that the step-by-step approach is potentially more beneficial for improving students' clinical skills, as evidenced by the higher ACES scores in Group S. This result was consistent with previous research findings (Liu et al, 2019; Lukas et al, 2019; Yuan et al, 2020). However, those studies focused on teaching dental filling and dental crown preparation, whereas this study was the first to apply a step-by-step approach to teaching complex surgery of impacted wisdom tooth extraction. Our finding highlights the importance of incorporating a structured and incremental approach to teaching complex surgical skills, which can have implications for the design of oral surgery education curricula. Students receiving step-by-step instruction demonstrated greater enthusiasm and a clearer understanding of learning objectives. Despite an initial focus on fundamental skills, they became more acquainted with tackling more complex tasks as their proficiency increased. This fostered a sense of confidence and self-belief in their abilities. This enhanced self-efficacy is crucial, as it shapes students' perceptions of their capabilities and can ultimately influence their academic motivation and future career aspirations (Al-Dajani, 2015). The conventional all-in-one teaching methods require students to master simple cases before handling complex ones. Some students are vulnerable to setbacks during this process, which might undermine their confidence and hinder their progress. Thus, in this study, students were arranged to learn and operate tooth extraction of a complex case, but one step at a time, under the guidance of teachers. With sufficient mastery of a particular skill, they would advance to learn the next step or skill in an incremental way, which significantly boosted their confidence. This step-by-step teaching method required a more reasonable curriculum, necessitating an overhaul of the previous teacher- or student-centred teaching mode into an approach featuring efficient teacher-student interaction, thus warranting higher demands on teachers.

Table 3. Linear regression analysis for the four dimensions.

	Unstandardized coefficients		Standardized coefficients	*t*	*p*	Collinearity diagnostics
	B	Std. error	*Beta*			VIF
Constant	0.442	0.586	-	0.754	0.455	-
Hands-on practice satisfaction	0.407	0.150	0.394	2.703	0.010**	1.866
Teaching session satisfaction	0.419	0.188	0.323	2.223	0.031*	1.847
Mastery of clinical skills satisfaction	0.063	0.128	0.064	0.488	0.628	1.524
R^2			0.476			
Adj R^2			0.441			
D-W			2.047			

Notes: General satisfaction was entered as the dependent variable in this model. *$p < 0.05$; **$p < 0.01$.
Abbreviation: VIF, variance inflation factor; D-W, Durbin-Watson.

Interestingly, our study did not detect a significant difference in clinical theory exam scores between the two student groups. This finding suggests that the instructional method might have less influence on the retention of theoretical knowledge than on the content and difficulty level of the learning materials themselves. Prior research has indicated that dental students' grasp of theoretical knowledge might be more dependent on individual study habits and existing knowledge foundation than the specific instructional style employed in the classroom (Husmann et al, 2016). Further investigation is warranted to disentangle the role of the instructors and their interaction with the students' self-directed learning in the context of theory teaching. Our study also observed slight gender-based variations. While statistically insignificant, the average clinical skill scores for males were slightly higher than those for females, while the reverse was true for the clinical theory exam scores. In addition, males in Group S demonstrated significantly higher clinical skills scores. This could potentially be linked to differences in gender-specific learning interests; however, further research is necessary to confirm this hypothesis.

The questionnaire results revealed that a large majority of students favored the step-by-step teaching method, perceiving it as fostering greater learning interest and motivation due to its interactive and real-time feedback nature. A comparative analysis of students' satisfaction across four dimensions (general satisfaction, hands-on practice satisfaction, teaching session satisfaction, and mastery of clinical skill satisfaction) demonstrated significantly higher satisfaction for the first three categories in the step-by-step teaching context. This may be attributed to the method's nature that provides superior hands-on experiences and facilitates more effective teacher-student interaction. Notably, no significant difference in satisfaction levels was observed regarding mastery of clinical skills. This could be explained by the influence of psychological factors and confidence levels on students' self-assessment of skill mastery. These findings collectively highlight the importance of prioritizing clear demonstrations and effective communication during skills-based internship training. Furthermore, the correlation analysis revealed that hands-on practice satisfaction and teaching session satisfaction positively impact general satisfaction, whereas mastery of clinical skill satisfaction does not exert a significant influence. This suggests that factors influencing general satisfaction are primarily associated with the learning experience itself rather than the outcome of skill acquisition. This underscores the need to prioritize the quality of clinical teaching during internships. Dental students' satisfaction is an important indicator because it affects not only their academic performance but also their professional development and well-being. Satisfied learners are more likely to delve deeper into the learning material, seek further learning opportunities, and ultimately achieve higher levels of medical excellence. Students may prefer a step-by-step approach to learning because it reduces the cognitive load and allows students to build confidence as they master each step before moving on to the next. This method of achieving large goals through small steps not only improves the efficiency of learning but also augments the enjoyment of learning.

While an integrated approach may better reflect the fast-paced realities of clinical practice, the step-by-step method offers distinct educational advantages. By providing a supportive framework for skill development, the step-by-step approach allows students to build and solidify their clinical competencies in a gradual yet effective manner. This method not only fosters deeper learning but also enhances student enjoyment and satisfaction with the learning process.

Several limitations to this study warrant consideration. First, the subjective nature of students' satisfaction surveys is a source of response bias. Additionally, while ACES scores are a reliable tool for skill assessment, they may not capture all aspects of clinical competence. Future research should investigate the long-term retention of knowledge and skills acquired through these teaching methods, as well as their applicability in diverse surgical disciplines. Furthermore, the sample size and study duration may have limited the generalizability of the findings and the ability to assess long-term effects, respectively. To address these limitations, future studies should aim to expand the sample size, extend the follow-up period, and explore the applicability of these methods across different educational settings and cultural contexts.

Conclusion

Overall, this study suggests that the step-by-step approach to teaching tooth extraction is more effective in promoting students' clinical operational skills and heightening their satisfaction within the context of oral surgery education. While certain advantages of the all-in-one approach should not be overlooked, particularly in imparting theoretical knowledge, educators should prioritize integrating the step-by-step method into their curricula to optimize both learning outcomes and students' experiences.

Key Points

- The study compares the efficiency of step-by-step and all-in-one teaching approaches to tooth extraction training for dental students.
- The step-by-step approach resulted in higher clinical skill performance, as indicated by higher ACES scores.
- There was no significant difference in clinical theory exam scores between the two groups separately trained in step-by-step mode and all-in-one mode.
- Students generally expressed higher satisfaction with the step-by-step approach.
- Hands-on practice satisfaction and teaching session satisfaction had a significant positive impact on overall satisfaction, while mastery of clinical skill satisfaction did not.
- Learning the segmented tooth extraction process is beneficial for students to master procedural accuracy and memorize the relevant skills.

Availability of Data and Materials

All data included in this study are available upon request by contact with the corresponding authors.

Author Contributions

XY conceived and designed research; XY and TY performed experiments; XY and LH analyzed data; ZB and KO interpreted the results of experiments; XY drafted the manuscript; KO and LH edited and revised the manuscript. All authors significantly contributed to the critical editorial revisions of the manuscript. All authors have reviewed and approved the final version of the manuscript. All authors have actively participated in the research and have consented to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

The study adhered to the Declaration of Helsinki and was approved by the Ethics Committee of Stomatology Hospital of Guangzhou Medical University (LC YJ2024008). Verbal and written consent were obtained from the participants before the study began.

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Conflict of Interest

The authors declare no conflict of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://www.magonlinelibrary.com/doi/suppl/10.12968/hmed.2024.0249.

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