



# Postoperative online follow-up improves the quality of life of patients who undergo extraction of impacted mandibular third molars: a randomized controlled trial

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## Abstract

**Objective** To evaluate the effect of online follow-up on the quality of life of patients who undergo extraction of impacted mandibular third molars.

**Materials and methods** This study enrolled patients with impacted mandibular third molars who were treated at the Department of Oral and Maxillofacial Surgery of the Stomatological Hospital at Southern Medical University and divided them into test and control groups. The test group received an online follow-up on the first, third, and fifth days after tooth extraction, while the control group was not followed up with. Patients in both groups were reexamined on the postoperative seventh day, completing the postoperative symptom severity (PoSSe) scale to comprehensively and quantitatively evaluate their quality of life after tooth extraction. A visual analogue scale (VAS) was used to evaluate the degree of approval for an online follow-up after tooth extraction by 20 senior doctors ( $\geq 40$  years old) and 20 young doctors ( $<40$  years old).

**Results** The PoSSe scale scores of the remaining options in the test group were significantly lower than those in the control group. The VAS score of senior doctors for online follow-up was significantly lower than that of young doctors.

**Conclusions** A postoperative online follow-up effectively improved the quality of life of patients who underwent extraction of impacted mandibular third molars. Compared with senior doctors, young doctors were more likely to approve an online follow-up after tooth extraction.

**Clinical relevance** Online medical care can be considered as an auxiliary tool to improve the effect of oral treatment.

**Keywords** Online follow-up · Quality of life · PoSSe · Impacted mandibular third molars

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## Introduction

An impacted mandibular third molar is a commonly encountered condition in the Department of Oral and Maxillofacial Surgery, and it is mainly treated by surgical extraction [1–3]. Because the operation often necessitates cutting the gum and removing the bone, tooth extraction often affects the patients' eating, speaking, and feeling, causing pain, swelling, and bleeding, which seriously affects their quality of life [4].

To date, all aspects of the improvement related to impacted mandibular third molar extraction have mainly been focused on the steps during the diagnosis and treatment [5–17]. However, reports on the postoperative follow-up care of patients after returning home are rare and limited to telephone follow-up [18–20]. Traditional postoperative follow-up via telephone has proven to be effective [20], and it has effects such as reducing the cost of consultation compared with conventional on-site follow-up [19]. However, in clinical practice, we have also found that telephone follow-up greatly increases the time consumption of doctors and nurses, as they have to repeat the same instructions or guidelines, and patients often reject the calls, as they think that these unknown incoming calls are harassing calls.

The increase in online medical care facilitates patients' access to medical services and also enables doctors to manage their cases more efficiently and follow up with their registered patients quickly and accurately to obtain important clinical data [21, 22]. This study used the Good Doctor Online mobile app as an example, through which the doctors followed up with the registered patients after tooth extraction. As a questionnaire with good reliability and validity, the PoSSe scale was used to evaluate the quality of life of patients after operation [23].

The primary aim of the present study was to evaluate the effectiveness of postoperative online follow-up on patients' quality of life following impacted mandibular third molar removal. A further objective was to investigate the application value of online medical care in the field of oral therapy.

## Materials and methods

### Study design

The study was a prospective, randomized, double-blind clinical trial. No changes to trial design were made during the study. The report of the methodology used in the study conforms with the CONSORT Statement [24].

### Participants

Patients with impacted mandibular third molars treated at the Department of Oral and Maxillofacial Surgery of the

Stomatological Hospital at Southern Medical University from June 2019 to December 2019 were enrolled in the study. All patients were informed about the procedure and signed a consent form. The basic information of patients was collected, and a cone beam CT (CBCT) was taken before operation. Two observers who were not involved in the follow-up of research subjects evaluated the CBCT independently to make a judgment on the position of the third molar, Pell and Gregory classification, Winter classification, and the alveolar nerve canal [25]. Two training sessions were organized prior to the final observations for calibration of the observers.

### Inclusion criteria

The included subjects were healthy patients aged 18–45 years with an indication of extraction of impacted mandibular third molars. All of them received the first extraction operation; they had no history of systematic disease such as high blood pressure, diabetes, or heart disease; and they had good medical compliance and were able to return on time.

### Exclusion criteria

The excluded patients had contraindications of tooth extraction, local or systemic infection within 4 weeks before tooth extraction, smoking, poor oral hygiene, severe periodontitis, being pregnant or lactating, or having basic diseases or severely damaged organ function.

### Rejection criteria

Patients with poor compliance, patients without follow-up, and patients whose operation time was too long (> 45 min) were excluded from our analysis.

### Sample size calculation

A priori power analysis was carried out during the planning stage of the study in order to determine the appropriate sample size that would allow performance of robust statistics on the PoSSe scale and VAS. To detect a difference between the two groups with a two-sided 5% significance level and a power of 80%, a sample size of 60 patients and 40 doctors per group was necessary.

### Randomization

A randomization table was created electronically in blocks of 2 patients. The treatment assignment was performed by a person not involved in any part of the clinical treatment using sealed envelopes. Each participant had an equal chance of being assigned to one of the two groups, but they did not know this. The treatment assignment was disclosed to the surgeon

immediately after tooth extraction. The PoSSe scale assessments were performed by an assessor not involved in any other part of the trial.

### Surgical procedures

Surgery was performed under local anesthesia with articaine 4% and epinephrine 1:100,000 (Bieland, France). All patients were operated on by the same surgeon with more than 10 years of experience. According to the surgical difficulties and by strictly following the standard operating procedure, incision, flapping, bone removal, and tooth splitting were performed as needed. After removal of the tooth, the surgical field was meticulously rinsed with sterile 0.9% saline and sutured. After placing a cotton ball over the wound, all patients were given postoperative instructions by the surgeon (i.e., biting over the cotton ball for half an hour, intermittently applying ice on the affected cheek for 6 h after surgery, not brushing teeth on the day of the operation, and consuming only liquids for a few days). The following medication was prescribed: an antibiotic (amoxicillin 750 mg p.o. three times a day for 3 days; patients with a history of allergy to penicillin were prescribed clindamycin 300 mg p.o. four times a day for 3 days), a NSAID (ibuprofen 600 mg p.o. at least 12 h apart when necessary), and a mouthrinse (0.12% chlorhexidine mouthwash twice a day for 7 days).

### Postsurgical management

Patients in the test group were asked to download the Good Doctor Online mobile app on their mobile phones and register their personal information. The surgeon used the Good Doctor Online mobile app to group and actively follow up with the patients on the first, third, and fifth days after surgery to monitor their postoperative response, reemphasize the postoperative instructions, and answer the patients' questions. Patients in the control group did not receive a postoperative online follow-up. Patients in both groups were followed up with in the hospital for suture removal and completion of the PoSSe scale 7 days after the surgery. The PoSSe scale was used as a measure to effectively evaluate the quality of life of the patients, including their eating, talking, feeling, appearance, pain scale, nausea, and other daily life activities.

We recorded the approval of an online follow-up after tooth extraction by 20 senior doctors ( $\geq 40$  years old) and 20 young doctors ( $< 40$  years old). A VAS was used for the analysis, in which a score of 0 represented lack of approval and a score of 10 represented high approval. None of the 40 doctors participated in the clinical trial, and they did not know the results of the clinical trial.

This study tested the null hypothesis that there were no differences in the clinical outcomes of patients without online follow-up vs. those with online follow-up, against the

alternative hypothesis of a difference. All measurements were taken by independent blinded assessors.

### Statistical analysis

The SPSS 20.0 software (IBM SPSS, Inc., Chicago, IL) was used for statistical analysis in this study. Normally distributed data were presented in the form of mean  $\pm$  standard deviation. The test level  $\alpha$  was set at 0.05. Two-sided  $P < 0.05$  was considered to indicate a statistically significant difference. Baseline data of the test and control groups were compared using the chi-square ( $\chi^2$ ) test and independent sample  $t$  test to measure the comparability between the two groups. Kappa values were also calculated for inter- and intra-observer agreement. A  $\kappa$  value of  $< 0.40$  was considered to be poor, 0.40–0.59 fair, 0.60–0.74 good, and 0.75–1.00 excellent agreement. Levene's test was used to compare the PoSSe scale and VAS scores between the two groups.

### Results

In this study, 145 patients were enrolled, and 12 patients were excluded. The remaining 133 patients were randomly divided into the test group (68 cases) and control group (65 cases). Thirteen patients did not come to the on-site follow-up, and 122 patients were finally analyzed, including 62 in the test group and 60 in the control group (Fig. 1).

There was no significant difference in age, operation time, sex, Pell and Gregory classification, Winter classification, relationship with inferior alveolar nerve canal, osteotomy,

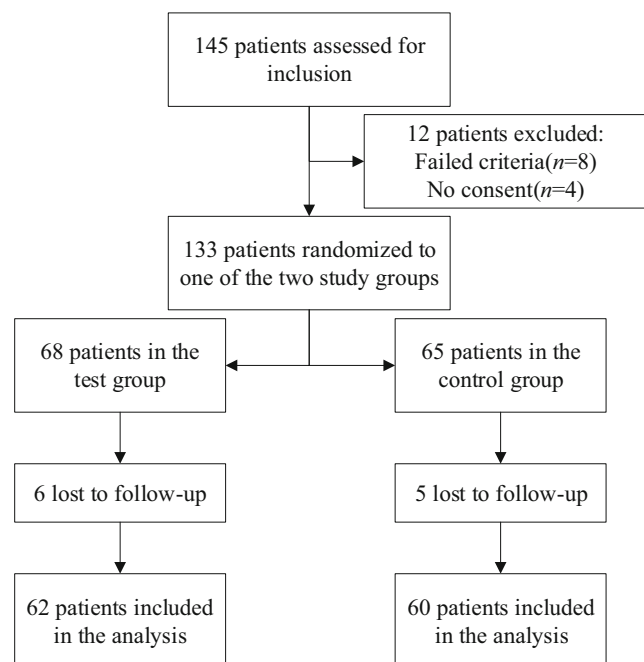


Fig. 1 CONSORT flow chart of the participants in the trial

crown cutting, or root splitting between the two groups ( $P > 0.05$ ). Thus, the two groups were comparable (Table 1). Interobserver agreement was excellent for baseline, showing a  $\kappa$  value of 0.93 for the classification of the third molar. Owing to this excellent interobserver agreement, the results obtained from observers were used for further analysis.

All patients successfully underwent tooth extraction. In the test group, in addition to our active follow-ups, 18 patients still actively asked questions through the app. There was 1 case of postoperative hemorrhage and 1 case of postoperative swelling that failed to improve on their own under the online guidance of the doctor and needed to be followed up with in the hospital. The remaining cases were provided nursing advice and did not need to come to the hospital, which minimized the burden of patient visits. In the control group, 9 patients returned to the hospital for follow-up treatment, including 2 cases of postoperative hemorrhage, 3 cases of discomfort due to swelling, and 4 cases of foreign body sensation in the wound. Among these 9 patients, only 1 case of postoperative hemorrhage required postoperative wound re-suturing after examination by the doctor, and the remaining cases were provided explanation and

given comforting treatment. Thirty-two patients in the control group said they had questions during the whole healing process, but because they could not get the doctor's response in time, they could only query the Internet or ask friends who had had their teeth pulled out. In the on-site follow-up 7 days after surgery, the scores of the other PoSSe scale items were significantly lower in the test group than in the control group (Table 2). Higher scores on the PoSSe scale represent more severe symptoms and worse quality of life of patients.

The VAS scores of young doctors and senior doctors for the approval of an online follow-up after tooth extraction were  $8.05 \pm 1.46$  and  $4.45 \pm 2.21$ , respectively, indicating that the young doctors' approval of a postoperative online follow-up was significantly higher than that of senior doctors ( $F = 36.78$ ,  $P = 0.000$ ).

## Discussion

Extraction of impacted mandibular third molars often causes various complications and discomfort to the patients, affecting their quality of life after surgery [26]. Currently, the research

**Table 1** Comparison of baseline values between the test group and the control group

Variable		Test group	Control group	$t/\chi^2$	$P$ value
Age		$25.6 \pm 1.5$	$25.1 \pm 2.6$	3.078*	0.097
Gender	Male	22	24	0.265#	0.607
	Female	40	36		
Position	Right	32	32	0.036#	0.849
	Left	30	28		
Pell–Gregory classification	Class I	13	15	0.792#	0.673
	Class II	39	33		
	Class III	10	12		
	Level A	21	22		
Winter classification	Level B	27	22	0.634#	0.728
	Level C	14	16		
	Vertical	13	10		
	Horizontal	15	17		
	Mesioangular	18	17		
Inferior alveolar nerve canal	Distoangular	8	9	1.883#	0.930
	Buccoangular	5	4		
	Linguangular	2	3		
	Inverted	1	0		
Operative time (min)	Contact	39	42	0.688#	0.407
	No contact	23	18		
Osteotomy	Yes	10.73 $\pm$ 2.09	10.33 $\pm$ 1.85	0.027*	0.872
	No	23	28		
Crown cutting	Yes	39	32	1.148#	0.284
	No	28	29		
Root separation	Yes	34	31	0.123#	0.726
	No	28	29		
Root separation	Yes	13	10	0.369#	0.544
	No	49	50		

\*  $t$  test

#  $\chi^2$  test

**Table 2** Statistical analysis of differences in the PoSSe between the test group and the control group

	Variable	Test group	Control group	<i>F</i>	<i>P</i> value
PoSSe	Eating	2.62 ± 2.14	6.12 ± 3.93	5.966	0.026
	Speech	2.62 ± 1.75	6.12 ± 3.47	7.947	0.012
	Sensation	1.37 ± 1.09	3.00 ± 2.16	6.938	0.017
	Appearance	1.65 ± 1.31	3.66 ± 2.38	5.367	0.033
	Pain	2.37 ± 1.58	5.32 ± 3.33	6.242	0.023
	Sickness	1.57 ± 1.09	3.19 ± 1.88	5.384	0.033
	Interference	1.07 ± 0.78	1.92 ± 1.42	5.211	0.036
	Total	13.43 ± 4.81	29.82 ± 14.15	11.935	0.003
Postoperative abnormality visits ( <i>n</i> )	Bleeding	1	2	–	–
	Swelling	1	3	–	–
	Sense of foreign body	0	4	–	–
Postoperative questions ( <i>n</i> )		18	32	–	–

on the improvement of this situation has mainly focused on the improvement of tooth extraction techniques [5, 6], suture methods [7, 8], flapping methods [9, 10], choice of implants in the extraction sockets [11, 12], irrigation of extraction sockets [13, 14], and postoperative care methods [15–17]. This study changed the postoperative care mode of the telephone, which was commonly used in the past, to the innovative mode of a mobile app. This method enabled us to easily register and group the patients. The patients were followed up with via the group messaging function, and we provided targeted answers to questions raised by the patients. For common questions, we set up common answers regarding the treatment of mild wound bleeding, dietary precautions, and medication timing so as to quickly reply to the patients. The mobile app can also transmit pictures, such as of patients' mouth opening, facial swelling, and wound healing, to doctors, which is more effective than simple text communication.

With the development of Internet and the arrival of the 5G era, online medicine has developed solid technical support. In December 2019, a highly contagious pneumonia caused by a novel coronavirus was found in China [27, 28]. Hospitals are high-risk places, so the Chinese government encouraged the public to minimize going out and deal with common diseases through Internet hospitals. Thus, online medical care has a very important value.

This study found that 9 patients in the control group returned to the hospital for reexamination due to discomfort, and only 1 of them had obvious bleeding from the wound that needed to be re-sutured. The remaining 8 patients developed various postoperative reactions, leading to dental fear, which was well resolved through explanation and providing nursing advice, without the need for clinical treatment. Therefore, we believe that if the 9 patients had also received timely postoperative online consultation, some of them may not have needed to specifically return to the hospital.

The prevalence of dental fear is very high among outpatients [29, 30], especially before and after extraction [31].

Serious dental anxiety affects the doctor–patient relationship and the progress of the oral treatment plan [32]. Anxious patients are hypothesized to overestimate the amount of pain involved [33]. Fear of pain was found to be the most significant predictor of dental fear in both males and females [34]. Pain is a kind of subjective feeling. Psychological intervention can reduce the degree of pain and improve the comfort of patients through the extraction of impacted third molars [35]. Although there is a close relationship between pain and injury, the intensity of the two is not exactly the same; some pain is not necessarily caused by injury, and some injuries will not produce pain. The quality and quantity of pain perception are closely related to the cognition of pain [36]. Severe pain usually occurs in patients after extraction of impacted third molars. In order to effectively relieve the postoperative pain, it is necessary to intervene. In this study, the test group was followed up with a mobile app after operation to answer questions in time and give suggestions to relieve dental fear.

Based on the above analysis, it was not difficult to understand why the PoSSe scale scores in the test group were significantly lower than those in the control group. Through the postoperative online follow-up, we improved the quality of life of patients after extraction of impacted mandibular third molars.

Interestingly, we found that young doctors had a higher degree of approval for an online follow-up after tooth extraction using a mobile app, possibly because the young doctors grew up accompanied by the development of mobile Internet, making them more open to adopting an online follow-up than the senior doctors.

Of course, with the development of online medical care, many corresponding problems still need to be overcome, such as the coverage of medical insurance and the management of medical disputes, which require further consideration. Online medical care is still preliminary in the dental field, and there is no relevant evidence yet about the enhancing effects of these tools in the oral surgery field. There are also some limitations



to our study, such as the objectivity of the evaluation method. We will make up for these defects in further studies.

## Conclusions

Postoperative online follow-up effectively improves the quality of life of patients who undergo extraction of impacted mandibular third molars. Young doctors are more likely to approve the online follow-up after tooth extraction than senior doctors. However, we should seriously address many issues encountered in the development of online medical care.

**Authors' contributions** Xianghui Zheng performed the conception and design of study/review/case series and approved the manuscript and is one of the guarantors of the manuscript. Jianjiang Zhao and Zhiping Wang approved the manuscript and are one of the guarantors of the manuscript. Bo Jia performed the acquisition of data: laboratory or clinical/literature search. Zhaoqiang Zhang performed the acquisition of data: laboratory or clinical/literature search. Jinyuan Guo performed the analysis and interpretation of data collected. Zhaohui Duan performed drafting of article and/or critical revision. Xi Lin approved the manuscript and is one of the guarantors of the manuscript.

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## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** This study was registered in the Chinese Clinical Trial Registration Center (registration number: ChiCTR2000031032) and approved by the ethics committee of the Stomatological Hospital of Southern Medical University (approval number: [2019]40). All procedures performed in studies involving human participants were in accordance with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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