Int J Clin Exp Med 2018;11(11):12165-12172
www.ijcem.com /ISSN:1940-5901/IJCEM0078621

*Original Article*

# Clinical observation on the effect of minimally invasive flapless technique and implant prognosis in oral implants

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Received April 26, 2018; Accepted July 31, 2018; Epub November 15, 2018; Published November 30, 2018

**Abstract:** Objective: To explore the clinical effect of minimally invasive flapless technique and implant prognosis in oral implants. Methods: A total of 88 patients with oral implants placed from February 2016 to December 2017 in Dezhou People's Hospital were selected. The patients were randomly divided into two groups. The control group used conventional dental implant techniques, and the observation group used minimally invasive flapless technique. The intraoperative conditions and curative effect of the two groups were compared, including the satisfaction of patients, the success rate, the periodontal pocket depth, and dental plaque, as well as levels of inflammatory cytokines interleukin-1 (IL-1), c-reactive protein (CRP), and urinary deoxypyridinoline (UDPd). Results: The operating time, postoperative swelling time, postoperative antibiotic use time and postoperative hormone use time in the observation group were significantly shorter than those in the control group (all $P<0.05$). Postoperative visual analogue scale score in the observation group was significantly lower than that in the control group ($P<0.05$). The scores of chewing function, language function, retention function and aesthetic function of the observation group were significantly higher than those of the control group (all $P<0.05$). The success rate of both groups was 100% after surgery, without significant difference ($P>0.05$). The periodontal pocket depth and dental plaque index of the observation group were significantly lower than those of the control group (both $P<0.05$). There was no difference in CRP, IL-1 and UDPd levels between the two groups before and one week after the surgery (all $P>0.05$). After one month, the above indicators in the observation group were significantly lower than those in the control group, with significant differences (all $P<0.05$). Conclusion: The use of minimally invasive flapless technique in oral implants has good clinical therapeutic effect, can significantly shorten the operating time, reduce the pain degree of the patients, and reduce the chance of infection, providing a new treatment direction for clinical treatment.

**Keywords:** Minimally invasive flapless, oral implants, implant, satisfaction

## Introduction

Dental implants have always been a concern in dentistry, and dental implant techniques have also been developing rapidly. With the continuous development of medical techniques and continuous increase in medical investment, dental implants begin to enter the era of minimally invasive surgery. Minimally invasive implant technique has made great progress in clinical practice. More and more patients have begun to use minimally invasive implant technique for treatment [1-4]. The conventional treatment methods have the disadvantages of longer operating time, greater surgical trauma, and inconvenience to patients' lives and work [5, 6]. The above phenomena can be significantly improved via using minimally invasive implant technique, which will not have a major impact on gingival recession and bone resorption of the patients. Additionally, it does not require postoperative stitch removal, which greatly improves the prognosis of the patients [7, 8].

At present, there are few research reports on clinical effects of the minimally invasive flapless technique. Therefore, this study will further discuss the clinical application effect of the minimally invasive flapless technique based on the previous research.

## Materials and methods

### *General information*

A total of 88 patients with oral implants placed from February 2016 to December 2017 in

**Figure 1.** Operating methods. A. The control group used conventional dental implant techniques; B. The observation group used minimally invasive flapless technique. The difference between the control group and the observation group was that the control group needed to expose the periosteum, while the observation group only needed to guide the position. Therefore, the control group had a larger wound than the observation group.

Dezhou People's Hospital were selected as research objects and randomly divided into two groups. The observation group used the minimally invasive flapless technique. There were 45 patients, including 24 males and 21 females, with an average age of (34.9±3.23) years old. For the causes of tooth loss, there were 13 cases who lost teeth due to teeth defects, 8 cases due to trauma, 18 cases due to periodontal lesions, and 6 cases due to other conditions. The control group used the conventional implantation techniques. There were 43 patients, including 23 males and 20 females, with an average age of (35.6±3.16) years old. For the causes of tooth loss, there were 14 cases who lost teeth due to teeth defects, 7 cases due to trauma, 17 cases due to periodontal lesions, and 5 cases due to other conditions.

Inclusion criteria: Patients who met requirements for oral implants; patients whose heart, livers, and kidneys were not severely damaged; patients who were compliant and cooperate with the medical staff in the treatment.

Exclusion criteria: Patients with osteoporosis and periodontitis; patients with acute oral inflammation; patients who had recently taken anti-inflammatory agents; patients with diabetes.

This study was approved by the Ethics Committee of Dezhou People's Hospital. All patients were informed of the clinical protocol before the treatment and signed the informed consent form.

*Methods*

*Preoperative preparation:* Preoperative examinations were performed on all patients before surgery. First of all, the patient's oral cavity was examined. After it was detected that the patient had no other chronic periodontitis, a small steel ball was placed on the patient's missing teeth. The diameter of the steel ball was about 5 mm. The alveolar ridge height of the missing teeth, the bone density and width of the alveolar ridge were observed through X-rays and recorded. The conditions of the adjacent teeth and the occlusion of the oral cavity were also very important. Complete teeth cleaning and appropriate antibiotics were required within one week before surgery.

*Operating methods:* The two groups of patients rinsed their teeth with disinfectant before surgery, and then underwent the oral implant surgery. The observation group used the minimally invasive flapless technique. The anesthesia of primacaine (Produits Dentaires Pierre Rolland SAS, France) was performed on the missing teeth before the operation. After then, the implant surgery was started. Firstly, a guide template was used to fix the oral cavity, and a suitable annular mucotome was selected according to the size of the patient's oral cavity to remove part of the internal mucosa in the

**Table 1.** Comparison of general clinical data between two groups of patients

| | Observation group (n = 45) | Control group (n = 43) | $t/X^2$ | P |
|---|---|---|---|---|
| Gender | | | 0.02 | 0.43 |
| Male | 24 | 23 | | |
| Female | 21 | 20 | | |
| Age (year) | 34.9±3.23 | 35.6±3.16 | 0.43 | 0.54 |
| Cause of tooth loss | | | | |
| Teeth defects | 13 | 14 | 0.77 | 0.21 |
| Trauma | 8 | 7 | 0.43 | 0.42 |
| Periodontal lesions | 18 | 17 | 0.27 | 0.85 |
| Other | 6 | 5 | 0.29 | 0.69 |

oral cavity. The bone ridge surface was leveled. A round bur was used for the fixing. The process of reaming was mainly the recovery of the bone fragments. After the oral cavity was checked to be free of damaged teeth, the implant (BYBO DENTAL, titanium) was implanted into the defect site and sealed with a healing plug after implantation. No wound closure was required in the minimally invasive flapless technique, which shortened the operating time [9]. The operating time started from the piercing of the drill film into the fixed point, and ended at the implantation completion. The operation of the observation group is shown in **Figure 1A**.

The control group used the conventional dental implant techniques. After oral anesthesia, incisions were made at the implant site to expose the periosteum and implants (BYBO DENTAL, titanium) were implanted by a conventional implantation method. Then it was sealed with a healing plug and the wound was finally sutured [10]. The operation of the observation group is shown in **Figure 1B**. The operating time started from cutting the periodontal ligament to suturing the wound.

In order to reduce the infection, the two groups of patients were administrated with antibiotics appropriately after surgery. In the meanwhile, mouthwash could be used to clean the oral cavity within one week after the surgery to maintain the health of the oral cavity.

*Observed indicators*

*Main observed indicators:* Determination of C-reactive protein (CRP): Peripheral venous blood was taken from the patient under fasting conditions, centrifuged to collect peripheral blood serum, and measured by a fully automatic biochemical analyzer [11].

Determination of urinary deoxypyridinoline (UDPd)/serum creatinine (Scr): UDPd and Scr were measured by the chemiluminescent immunoassay. The urine was taken from the patient under fasting conditions and determined by a fully automatic chemiluminescent analyzer [12].

Determination of interleukin-1 (IL-1): Peripheral venous blood was taken from the patient under fasting conditions and centrifuged to collect the peripheral blood serum. IL-1 was measured by ELISA kit by means of the enzyme linked immunosorbent assay.

Operating time: The minimally invasive flapless technique surgery was performed from the piercing of the drill film into the fixed point to the implantation completion. The conventional technique surgery was performed from cutting the periodontal ligament to suturing the wound completely.

The patient's periodontal pocket depth and dental plaque index were recorded.

*Minor observed indicators:* Visual analogue scale (VAS): The pain degree of the patient after surgery was scored by the scale. A total of 10 scores were included in the scale. The higher the score, the more severe the pain of the patient after the surgery [13].

Determination of the success rate: It was successful if the patient had suffered no loosening of the implant after surgery, the gingival tissue was in a normal state, the gingival pocket was within 2.0 mm, the papilla fill index was 3, and the patient was satisfied with the tooth form after the implantation. And it was successful if X-rays on the oral cavity showed that there was no effect between the implant and the alveolar bone; it was basically successful if the patient had suffered slight loosening of the implant after surgery, congestion occurred in the gingival margin, the gingival pocket was within 2.0 mm, and the papilla fill index was at level 1 or 2, and the patient was satisfied with the tooth

**Table 2.** Comparison of surgery conditions between two groups ($\bar{x}$ ± sd)

| | Observation group | Control group | t | P |
|---|---|---|---|---|
| Operating time (min) | 22.56±2.43 | 31.23±3.12 | 2.12 | 0.02 |
| Postoperative swelling and pain time (min) | 20.05±2.09 | 70.54±6.98 | 0.97 | 0.04 |
| Postoperative antibiotic use time (h) | 25.90±2.34 | 98.60±9.54 | 1.21 | 0.01 |
| Postoperative hormone use time (h) | 26.75±2.75 | 92.47±9.32 | 1.54 | 0.03 |
| Postoperative VAS score | 2.20±0.20 | 4.20±0.43 | 0.87 | 0.02 |

Note: VAS, visual analogue scale.

**Table 3.** Comparison of satisfaction after treatment between two groups of patients (score; $\bar{x}$ ± sd)

| | Chewing function | Language function | Retention function | Aesthetic function |
|---|---|---|---|---|
| Observation group (n = 45) | 8.99±0.78 | 9.23±0.93 | 7.93±0.45 | 9.12±0.88 |
| Control group (n = 43) | 7.23±0.72 | 7.89±0.73 | 6.63±0.56 | 7.56±0.76 |
| t | 2.09 | 1.21 | 1.08 | 0.96 |
| P | 0.02 | 0.01 | 0.04 | 0.03 |

**Table 4.** Comparison of the success rate of implant between the two groups of patients

| | Case | Successful | Basically successful | Failure | Success rate (%) |
|---|---|---|---|---|---|
| Observation group (n = 45) | 45 | 45 | 0 | 0 | 100 |
| Control group (n = 43) | 43 | 40 | 3 | 0 | 100 |
| $\chi^2$ | | 1.48 | | | |
| P | | 0.06 | | | |

form after implantation, without impact on the beauty of the appearance of the patient; it was a failure if the patient had found the severe loosening of the implant after the implantation, there was no way to chew normally, congestion and swelling occurred in the gingival tissue, the gingival papilla was at level 4, and the implant falls off or got loose. Success rate = Number of patients (successful + basically successful)/ total number of patients * 100% [14].

Satisfaction evaluation: The satisfaction of patients was scored by the scale. Patients scored their own chewing, language, retention, and aesthetic functions. There were a total of 10 scores for each function, and 6 points or more were satisfactory.

*Statistical treatment*

SPSS 19.0 software was used for statistical analysis of the data. Measured data were expressed as mean ± standard deviation ($\bar{x}$ ± sd). The t-test was performed to compare the measured data in line with normal distribution between the two groups, expressed as t. The enumeration data were expressed as a percentage (rate), using the $X^2$ test and Fisher's exact probability method, expressed as chi-square. P<0.05 is considered statistically significant.

## Results

*Comparison of general clinical data between two groups of patients*

There was no statistic difference in gender and age between the two groups ($X^2$ = 0.02, P = 0.43; t = 0.43, P = 0.54), and there was no statistical difference in the causes of tooth loss ($X^2$ = 0.77, P = 0.21; $X^2$ = 0.43, P = 0.42; $X^2$ = 0.27, P = 0.85; $X^2$ = 0.29, P = 0.69), indicating that the two groups were comparable. See **Table 1**.

*Comparison of surgery conditions between two groups of patients*

The surgery conditions of the two groups of patients were analyzed. The operating time, postoperative swelling and pain time, postoperative antibiotic use time, and postoperative hormone use time in the observation group were all significantly shorter than those of the control group (t = 2.12, P = 0.02; t = 0.97, P = 0.04; t = 1.21, P = 0.01; t = 1.54, P = 0.03), with statistically significant differences; the

**Table 5.** Comparison of periodontal pocket index and dental plaque index between two groups of patients ($\bar{x} \pm sd$)

| | Periodontal pocket depth (mm) | Dental plaque index (score) |
|---|---|---|
| Observation group (n = 45) | 2.00±0.21 | 0.30±0.03 |
| Control group (n = 43) | 2.88±0.22 | 0.78±0.07 |
| t | 1.09 | 1.23 |
| P | 0.02 | 0.02 |

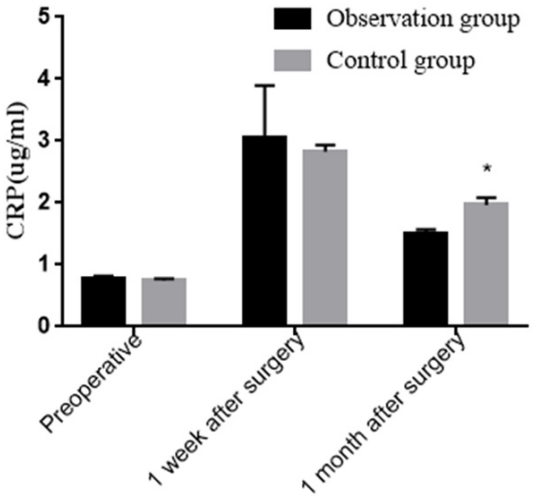


**Figure 2.** Comparison of CRP after surgery between two groups. One month after surgery, compared with observation group, *P<0.05. CRP, c-reactive protein.

postoperative VAS score in the observation group was significantly lower than that in the control group (t = 0.87, P = 0.02) and the difference was statistically significant. See **Table 2**.

*Comparison of satisfaction after treatment between two groups of patients*

The satisfaction after treatment was compared between the two groups of patients. The scores of the chewing function, language function, retention function and aesthetic function in the observation group were significantly higher than those in the control group (t = 2.09; P = 0.02; t = 1.21, P = 0.01; t = 1.08, P = 0.04; t = 0.96, P = 0.03), with statistically significant differences. See **Table 3**.

*Comparison of the success rate of implant between the two groups of patients*

There were 45 successful cases in the observation group, with a success rate of 100%. There were 40 successful cases in the control group, 3 basically successful cases and no failed case, with the success rate of 100%. The success rates of both groups were 100% after surgery, and there was no significant difference among the number of successful cases in the two groups ($X^2$ = 1.48, P = 0.06). See **Table 4**.

*Comparison of periodontal pocket depth and dental plaque index between two groups of patients*

The periodontal pocket depth and plaque index between the two groups were compared, and the results in the observation group were significantly lower than those in the control group (t = 1.09, P = 0.02; t = 1.23, P = 0.02). See **Table 5**.

*Comparison of levels of inflammatory cytokine before and after treatment in the two groups of patients*

The CRP in the observation group and the control group was respectively compared before and one week after the operation, which showed no significant difference between preoperative and postoperative CRP (t = 0.32, P = 0.21; t = 0.43, P = 0.10). The CRP in the observation group was significantly lower than that in the control group one month after the operation, which showed significant differences (t = 1.42, P = 0.01). See **Figure 2**. There was no significant difference in UDPd/Scr between the two groups before and one week after the operation (t = 0.62, P = 0.14; t = 0.47, P = 0.22), and UDPd/Scr in the observation was lower than that in the control group one month after operation. In the control group, with statistically significant differences (t = 0.98, P = 0.03). See **Figure 3**. There was no significant difference in IL-1 between the two groups before and one week after the operation (t = 0.59, P = 0.19; t = 0.22, P = 0.09). IL-1 in the control group was significantly higher than that in the observation group one month after the operation, with significant differences (t = 0.93, P = 0.03). See **Figure 4**.

## Discussion

The dental implant technique in dentistry is a widely applied surgery. Patients may suffer

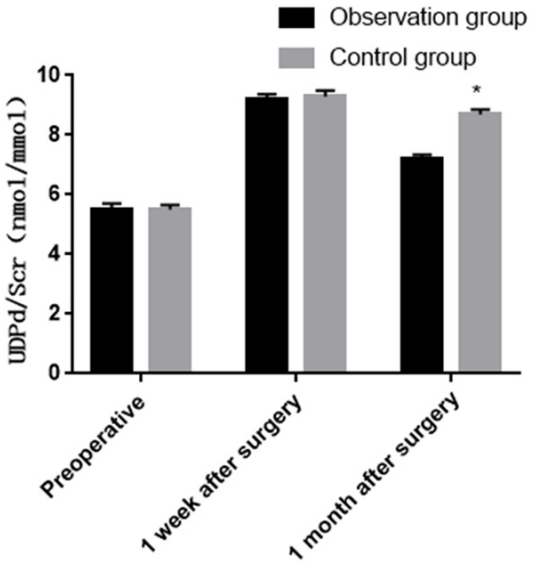


**Figure 3.** Comparison of UDPd/Scr after surgery between two groups. One month after surgery, compared with observation group, *P<0.05. UDPd, urine deoxypyridinoline; Scr, serum creatinine.

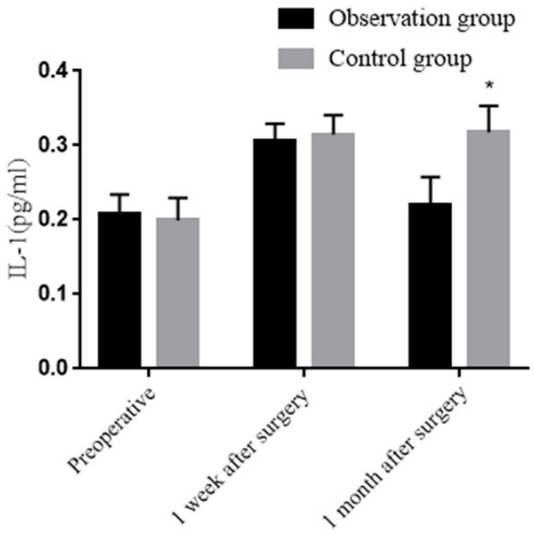


**Figure 4.** Comparison of IL-1 after surgery between two groups. One month after surgery, compared with observation group, *P<0.05. IL-1, interlukin-1.

from tooth defects due to periodontitis or trauma, which may seriously affect the patients' chewing function and aesthetics, and may cause psychological burden to the patients, in which case the dental implant technique surgery is particularly important [15, 16]. The dental implant technique surgery improves the chewing function and aesthetics of teeth by filling the missing teeth of patients [17]. In this surgery, a variety of instruments and equipment will be used. For the conventional implant technique, the missing teeth are exposed first, then implants are implanted, and finally the wound is sutured. The traditional flapless dental implant technique is also simple in operation with better repair effect, so it is also widely used in clinical practice [18]. However, the conventional dental implant technique requires the incision and stripping of the gingiva and periodontal ligament of the patients, resulting in greater trauma. The wound sutured later will be more likely causing inflammation after surgery due to infection. In addition, intraoperative incisions will bring patients a greater sense of pain, leading to redness and swelling of the gums, and the time for taking antibiotics and hormone drugs will also be extended correspondingly after operation.

At present, the new minimally invasive flapless technique in clinical practice can significantly improve the above situation. This technique produces incisions by perforation, which has less damage to the gums. In the surgery, the round bur is used for locating. No suture is required after the surgery, which can significantly shorten the operating time, reduce the harm to the patient, and produce less pain after the surgery. In addition, the surgery does not require suturing, which maintains the aesthetics of the oral cavity. The bone bass and blood vessels at the site of implant placement will not be affected during surgery and the recovery time will be significantly shortened. The patients' requirement for the aesthetics during implant surgery can also be satisfied, without major impact on the aesthetics of the teeth.

In this study, it was found that in the observation group, the antibiotics and hormone use time were significantly lower than those in the control group. The minimally invasive flapless technique did not require suturing the wound, which significantly shortened the operating time. The small wounds were not susceptible to infection, and the risk of gum swelling and pain was reduced, thus shortening the time for taking antibiotics and hormones. In addition, the patients undergoing the minimally invasive flapless technique surgery had a lower pain degree due to the small wounds. It was found in this study that the satisfaction of the patients in the observation group was significantly higher than

that of the control group. The results of this study are similar to those of previous studies. Some researchers have found in their studies that the satisfaction of the patients in the minimally invasive flapless technique surgery is significantly higher than that of the control group, and the operating time and hormone use time of the observation group are both shorter than the control group [19].

In this study, there was no difference between the success rate of the observation group and the control group, indicating that both implant surgeries can implant the implants successfully. However, all the patients in the observation group were judged to have a successful surgery, while the control group had three patients who were basically successful, indicating that the operation result of the minimally invasive flapless implant surgery was slightly better than the control group and the damage to the gums would be reduced as much as possible. The conventional flap implant technique requires exposing the periodontal ligament. During the surgery, it may cause the membrane cells to enter the implants, which may lead to poor osseointegration of dental implants, loosening or even failure. In this experiment, the periodontal pocket index and dental plaque index of the observation group were significantly lower than those of the control group. This result can also verify the above statement. In addition, the periodontal pocket index after minimally invasive flapless implant technique surgery was found to be significantly lower in the previous clinical studies, and the healing condition was better than that of the conventional implant technique group [20].

Clinically, CRP, UDPd/Scr, and IL-1 are all related inflammatory cytokines for the prognosis of oral implants. CRP is an indicator commonly used to indicate the infection in the body, UDPd/Scr is used for bone resorption in oral implants, and IL-1 is a factor commonly used to indicate the inflammation. Previous study has shown that these indicators are associated with poor oral implant osseointegration during oral implant surgery. These indicators will increase when poor osseointegration aggravates [21]. In this study, there was no significant difference in CRP, IL-1 and UDPd levels between the two groups before and one week after the surgery. After one month, the above indicators in the observation group were significantly lower than those in the control group, with statistic differences. This data is consistent with the reported findings, indicating that the occurrence of poor osseointegration after the minimally invasive flapless technique surgery is less, and the prognosis is significantly better than that of the control group [22].

However, this study did not provide the therapeutic effects of the two implant techniques from the immune function-related biochemical indicators. Further research is needed in this aspect to explore the mechanism of the minimally invasive flapless technique.

In summary, the clinical effect of minimally invasive flapless implant technique in oral implant surgery is better, the surgery conditions are significantly improved, and the prognosis is better than that of the conventional implant techniques. It has high clinical application value, but the deficiencies include the failure to study the therapeutic effects of the two implant techniques from the immune function-related biochemical indicators. Further research is needed in this aspect.

## Acknowledgements

This paper was supported by Medical Science and Technology Development Program in Shandong Province (No. 2017WS671).

## Disclosure of conflict of interest

None.

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