

Investigation of the Relationship Between Primary and Secondary Wound Healing After Surgical Extraction of Maxillary Third Molar Teeth with Different Impaction Degrees and Postoperative Complications

Farklı Gömülülük Derecelerine Sahip Maksiller Üçüncü Molar Dişlerin Cerrahi Ekstraksiyonu Sonrası Primer ve Sekonder Yara İyileşmesi ile Postoperatif Komplikasyonlar Arasındaki İlişkinin Araştırılması

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ABSTRACT Objective: The purpose of this prospective, randomized, split-mouth clinical trial was to evaluate the effects of sutureless healing after surgical removal of impacted maxillary third molars. **Material and Methods:** Sixty patients, aged between 18-40, with symmetrical positioned bilateral impacted maxillary third molars, were included. According to Pell and Gregory's classification of depths, patients were divided into 3 groups, each containing 20 patients. After surgeries, one side was primarily sutured; the other side was left unsutured for secondary healing. Operation times and postoperative complications including pain, oedema, alveolar osteitis, infection and excessive bleeding were examined for each side. **Results:** Operative time was higher in all sutured wounds. Pain was higher in Class-B sutured wounds during the 6th, 12th hours compared to Class-B unsutured wounds; however, no significant difference was observed between sutured and unsutured wounds in Class-A and Class-C. Postoperative oedema, alveolar osteitis, bleeding and infection values presented no significant difference between sutured and unsutured wounds in all impaction groups. All wounds healed at 1-week follow-ups. **Conclusion:** We are of the opinion that regardless of impaction degree; unsutured secondary healing for intraoral wounds may be a safe technique for upper impacted third molar surgery. Due to the fact that operative time is shortened, it might increase patient satisfaction.

Keywords: Impacted tooth; third molar; maxilla; wound healing; postoperative complications

ÖZET Amaç: Bu prospektif, randomize, bölünmüş-ağız klinik çalışmanın amacı, maksiller gömülü üçüncü molar diş cerrahisi sonrası sutureless iyileşmenin etkilerini değerlendirmektir. **Gereç ve Yöntemler:** 18-40 yaş arası, çift taraflı simetrik pozisyonlu maksiller gömülü üçüncü molar dişlere sahip 60 hasta çalışmaya dahil edildi. Pell ve Gregory'nin gömülülük sınıflamasına göre, hastalar 20 kişilik 3 gruba ayrıldı. Ameliyatlardan sonra rastgele bir taraf birincil iyileşme sağlamak amacıyla dikildi; diğer taraf ikincil iyileşme sağlamak amacıyla dikişsiz olarak bırakıldı. İki ameliyat sahası için ayrı olacak şekilde, ameliyat süreleri ve ağrı, ödem, alveoler osteit, enfeksiyon ve aşırı kanama gibi ameliyat sonrası komplikasyonlar değerlendirildi. **Bulgular:** Tüm sutured yaralarda ameliyat süresi daha fazlaydı. Altıncı ve 12. saatlerde Pell ve Gregory B Sınıfı sutured yaralarda ağrı, sutured yaralara göre daha yüksekti; bununla birlikte, Pell ve Gregory A-Sınıfı ve C-Sınıfında sutured ve sutured yaralar arasında anlamlı bir fark gözlenmedi. Postoperatif ödem, alveolit, kanama ve enfeksiyon değerleri, tüm gömülülük gruplarında sutured ve sutured yaralar arasında anlamlı bir farklılık göstermedi. Tüm yaralar 1 haftalık takiplerde iyileşme gösterdi. **Sonuç:** Gömülülük derecesi ne olursa olsun; maksiller gömülü üçüncü molar dişler için sekonder iyileşme, güvenli bir teknik olabilir. Ameliyat süresinin kısalması nedeniyle hasta memnuniyetini artırabilir.

Anahtar Kelimeler: Gömülü diş; üçüncü azı dişi; maksilla; yara iyileşmesi; postoperatif komplikasyonlar

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Today, although still being controversial, the general tendency is towards the prophylactic extraction of impacted third molars if no specific contraindication is present and thus impacted third molar surgery is considered as a routine operation in oral and maxillofacial surgery.¹ Postoperative complications observed after surgery may lead to discomfort and cause an impairment in patients' quality of life. These complications are influenced by operative time, surgical complexity, amount of bone mass removed, patients' ability to provide oral hygiene, and surgeon experience, as well as age, gender, medical history, presence of pericoronitis and smoking history of the patient.^{2,3}

In relation to the inflammatory response created with surgery, patients may encounter negative experiences such as pain and oedema and for this reason methods in order to decrease these complications have been the focus of many studies.⁴ Some of these methods consist of medical treatments such as analgesic, corticosteroids and anti-inflammatory medications, physical therapy, various incision types, low-level laser therapy and secondary wound healing techniques.

Secondary wound healing takes place when the wound edges are not approximated and the wound needs to heal from the floor of the extraction socket (i.e. routine dental extraction sockets). This technique is reported to decrease postoperative pain and oedema by allowing the inflammatory infiltrate to drain from the wound.⁴

The widely used secondary wound healing techniques for impacted molar surgery have attracted more attention compared to other techniques, because they have been thought to cause fewer side effects, and have most closely been linked to the decrease of postoperative pain and oedema.^{4,6} In different studies, secondary wound healing has been implemented using different techniques, for example creating a window with mucosa excision after primary closure (window technique), drain usage, partial closure with single suture (single suture technique) and sutureless technique.⁷

Many studies researching the effect of secondary wound healing after impacted mandibular third molar surgery are present in literature, although very few exist concerning the use of these techniques for impacted maxillary third molar surgery. For this reason,

the present study investigates secondary wound healing via sutureless approach for impacted maxillary third molar surgery.

MATERIAL AND METHODS

Approval from the Ankara University Faculty of Dentistry Ethics Committee of Clinical Research was obtained (Date: 23.11.2013 No:36290600/55) and the study has been carried out in accordance with the Declaration of Helsinki. All patients gave verbal and written consents to be included in the split-mouth study. Sixty patients who administered between 2014-2015, among referrals for impacted maxillary third molar surgery, were included in the study. All patients were consulted with prophylactic or orthodontic extraction indications and had bilateral, impacted maxillary third molars with symmetric impaction depths. Patients with history of pericoronitis, systemic diseases or smoking, women who were pregnant, breastfeeding or using oral contraceptives were not included in the study. Patients were radiologically examined with panoramic radiography, and were divided into 3 groups according to Pell-Gregory classification of depths; Class-A (n=20 patients), Class-B (n=20 patients) and Class-C (n=20 patients) (Figure 1).

The total patient group consisted of 19 males (31.7%) and 41 females (68.3%); Class-A 8 males (40%), 12 females (60%), Class-B 6 males (30%), 14 females (70%), Class-C 5 males (25%), 15 females (75%). Mean age of all patients was 20.25±3.462 years (Class-A 20.40±1.759, Class-B 20.50±2.395, Class-C 19.85±5.304).

Extractions for both maxillary impacted third molars were practiced during the same sessions, and by the same oral surgeon with 5-year experience in oral and maxillofacial surgery practice. During extractions, each tooth was randomly assigned to primary wound healing (PWH) or secondary wound healing (SWH) groups using the Microsoft Excel Program. Routine triangular flap design was used in Class-B and Class-C patients and a single horizontal incision behind the second molar was used in Class-A for a less traumatic surgery (Figure 2a and Figure 2b). The least possible bone tissue was removed with a round burr in Class-B and Class-C patients. No

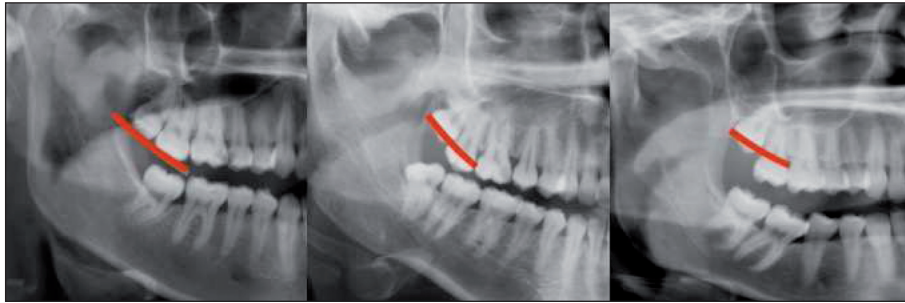


FIGURE 1: Impaction classifications of impacted maxillary third molars according to Pell and Gregory.

bone tissue was removed in Class-A patients. Teeth were removed from their sockets using elevators; no fragmentation of teeth was required in any of the groups. Sockets were irrigated with 20 ml, 0.9% sodium chloride solution after extractions. In PWH, flap was sutured conventionally with 3.0 silk sutures (Figure 3). In SWH flap was repositioned and left unsutured for secondary healing (Figure 4). Patients were asked to bite on humid gauze for half an hour and then checked

for haemorrhage before discharge. No excessive bleeding was observed in any group of patients during discharge. Routine medical regimen of 500mg amoxicillin 2 times a day, and mouthwash 3 times a day was prescribed. Paracetamol, an agent effective for mild-medium pain, with no anti-inflammatory effect, (not effecting oedema formation) was prescribed for pain control. All patients came to their follow-ups, no patients were excluded from the study.

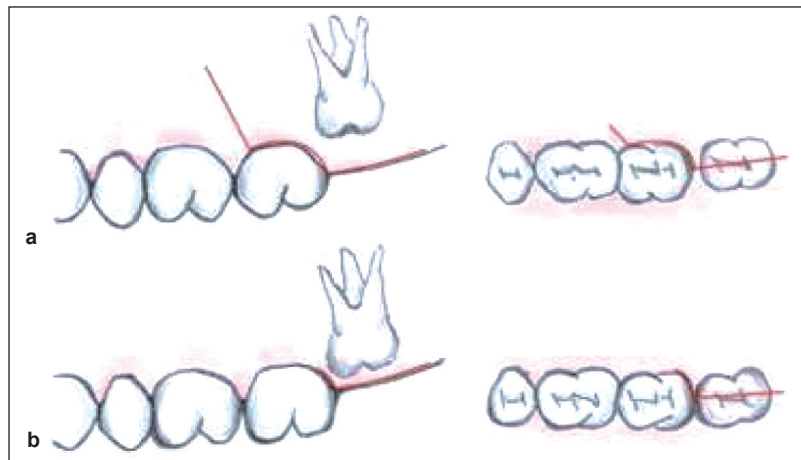


FIGURE 2: Incision designs. a) Incision design for Class A impaction degree, sagittal and occlusal view. b) Incision design for Class B and C impaction degree, sagittal and occlusal view.



FIGURE 3: View of primary closure.

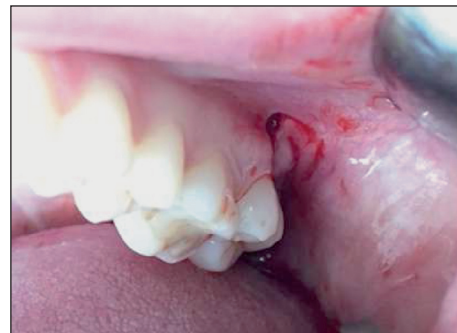


FIGURE 4: View of secondary closure.

Operative times starting from the first incision, to the final suture in the PWH, and to the flap repositioning in the SWH was recorded. The surgeon made oedema measurements, preoperatively and on the 1st, 2nd and 7th days postoperatively with the craniometrical point measurements method.⁴ With this method, distances from the outer canthus of the eye to the gonium, from the tragus to the corner of the mouth and from the tragus to the soft tissue pogonion were measured using a flexible ruler. Mean value of the three measurements was recorded as oedema value. Pain was recorded by the patients, separately for both sides, on 6th and 12th hours and on day 1, 2 and 3 using a 10 cm Visual Analogue Scale (VAS). On postoperative 1st, 2nd and 7th days, patients were examined for alveolar osteitis, bleeding and infection. Data was recorded as 'present' or 'not present' separately for both sides. Alveolar osteitis was marked 'present' when the patient administered 2-5 days after surgery with pain and a necrotic socket free of supuration. Infection was marked 'present' with inflamed, reddish presentation of the wound with suppuration, with or without pain. Patients were asked to track bleeding that necessitated the need of using additional gauze during the first 24 hours or late bleeding after 24 hours.

Statistical analyses: Data analysis was performed with IBM SPSS Statistics 22 program and with frequency distribution for categorical variables and descriptive statistics for quantitative variables (mean \pm SD, median). The normality of quantitative variables was controlled before starting analysis with the Kolmogorov-Smirnov normality test. Parametric tests were used for variables, which provided normality assumption in the test results; non-parametric tests were used for the variables, which did not provide normality assumption in the test results. Wilcoxon test was used to determine the differences between two dependent groups; repeated measures test and Friedman Test were used to determine the difference between more than two dependent groups. Kruskal-Wallis test was used to determine the difference between more than two independent groups. Because chi-square test did not provide assumptions, Freeman-Halton Fisher's exact chi-square test was used to determine the relationship between two independent categorical variables.

RESULTS

Mean operative time for Class-A was 1:11 and 0:49 minutes, for Class-B was 3:23 and 2:07 minutes and for Class-C was 6:30 and 4:24 minutes, respectively for PWH and SWH. Operative times were significantly longer in PWH in all impaction depth groups ($p < 0.05$).

Postoperative pain scores are presented in Table 1. In Class-A and Class-B patients, no statistically significant difference was found between PWH and SWH during controls ($p > 0.05$). In Class-B, no statistically significant difference was found between PWH and SWH on the 24th, 48th and 72nd hours ($p > 0.05$) while pain scores in the PWH on the 6th and 12th hours were significantly higher than the SWH ($p < 0.05$).

Postoperative oedema values are presented in Table 2. No statistically significant difference was found between PWH and SWH in all impaction depth groups during controls ($p > 0.05$).

While no alveolar osteitis, bleeding and infection complication was observed in Class-A and Class-B groups, 4 patients (20%) in Class-C had postoperative complications. Observed complication was continuing bleeding arising from the wound (3 in SWH, 1 in PWH). All four bleeding complications occurred immediately after surgery and were managed easily with the use of additional gauze for 30 more minutes. No late bleeding complications were noted by the patients. Postoperative complication rate was found to be higher in Class-C group but no statistically significant difference was found between PWH and SWH groups ($p > 0.05$).

DISCUSSION

Studies presenting the effects of secondary wound healing on impacted mandibular third molars can be commonly encountered in literature, although there exist very little literature concerning impacted maxillary third molars. The present study therefore aimed to investigate the effect of secondary wound healing on impacted maxillary third molar surgery.

There have been opposing ideas in literature concerning primary and secondary wound healing after impacted third molar surgery. It can be observed that while some researchers favour for primary healing,

TABLE 1: Evaluation of pain in two closure groups.

Group	Pain	n	Median	Min-Max	Z	p
A	Primary Closure (6 th hr)	20	1.00	0-6	-1.562	0.118
	Secondary Closure (6 th hr)	20	0.00	0-3		
	Primary Closure (12 th hr)	20	1.00	0-4	-1.476	0.140
	Secondary Closure (12 th hr)	20	0.00	0-3		
	Primary Closure (24 th hr)	20	0.00	0-6	-0.816	0.414
	Secondary Closure (24 th hr)	20	0.00	0-2		
	Primary Closure (48 th hr)	20	0.00	0-2	-1.000	0.317
	Secondary Closure (48 th hr)	20	0.00	0-2		
	Primary Closure (72 nd hr)	20	0.00	0-4	-1.000	0.317
	Secondary Closure (72 nd hr)	20	0.00	0-2		
B	Primary Closure (6 th hr)	20	2.50	0-7	-3.358	0.001**
	Secondary Closure (6 th hr)	20	2.00	0-5		
	Primary Closure (12 th hr)	20	3.00	0-7	-2.449	0.014*
	Secondary Closure (12 th hr)	20	2.50	0-7		
	Primary Closure (24 th hr)	20	2.00	0-6	-1.721	0.085
	Secondary Closure (24 th hr)	20	2.00	0-4		
	Primary Closure (48 th hr)	20	1.00	0-4	-1.857	0.063
	Secondary Closure (48 th hr)	20	1.00	0-2		
	Primary Closure (72 nd hr)	20	0.00	0-6	-1.000	0.317
	Secondary Closure (72 nd hr)	20	0.00	0-2		
C	Primary Closure 6 th hr)	20	5.00	0-8	-0.471	0.638
	Secondary Closure (6 th hr)	20	5.00	0-7		
	Primary Closure (12 th hr)	20	5.00	0-8	0.277	0.782
	Secondary Closure (12 th hr)	20	5.00	0-7		
	Primary Closure (24 th hr)	20	4.00	0-7	-0.061	0.951
	Secondary Closure (24 th hr)	20	4.00	0-8		
	Primary Closure (48 th hr)	20	2.00	0-6	-1.809	0.070
	Secondary Closure (48 th hr)	20	2.00	0-5		
	Primary Closure (72 nd hr)	20	0.00	0-6	-1.289	0.197
	Secondary Closure (72 nd hr)	20	0.00	0-5		

∗: p<0.05 ∗∗p: 0.01 ∗∗∗: p<0.001.

some favour for secondary healing.⁸ Primary wound healing could be preferred because of the thought that it lowers postoperative infection rate and secondary healing could be preferred because it lets the inflammatory exudate to drain away from the wound and allows less tissue manipulation during surgery leading to decreased operation time. One method might not have supremacy to the other.^{9,10}

In literature, different techniques have been described for obtaining secondary wound healing. Some studies have used drains after mandibular impacted third molar surgery and concluded that drain usage helps to control postoperative discomfort in the form of

swelling but has no effect on pain.¹¹⁻¹³ These studies also reported that the presence of the drain itself could be an irritating factor causing pain and that the use of drains cause 4 minutes extra operation time. The presence of a drain in the oral cavity can also allow food accumulation, leading to infection. The window technique, which is another method of obtaining secondary healing, creates a window with mucosa excision after primary closure, and has been commonly used for investigating secondary healing.^{2,14,15} Studies investigating the window technique similarly concluded that pain and oedema was significantly lower in the window technique groups. When the results of these studies are

TABLE 2: Evaluation of oedema in the two closure groups.

Group	Edema	n	Median	Min-Max	Z	p
A	Primary Closure (Preop)	20	12.50	11-22	0.000	1.000
	Secondary Closure (Preop)	20	12.50	11-22		
	Primary Closure (1 st day)	20	13.00	11-22	-1.732	0.083
	Secondary Closure (1 st day)	20	12.50	11-22		
	Primary Closure (2 nd day)	20	13.00	11-22	-1.732	0.083
	Secondary Closure (2 nd day)	20	12.50	11-22		
	Primary Closure (7 th day)	20	12.50	11-22	0.000	1.000
	Secondary Closure (7 th day)	20	12.50	11-22		
B	Primary Closure (Preop)	20	12.50	11-22	-2.236	0.025*
	Secondary Closure (Preop)	20	13.00	11-22		
	Primary Closure (1 st day)	20	13.00	11-22	0.000	1.000
	Secondary Closure (1 st day)	20	13.00	11-22		
	Primary Closure (2 nd day)	20	13.00	11-22	-0.378	0.705
	Secondary Closure (2 nd day)	20	13.00	11-22		
	Primary Closure (7 th day)	20	12.50	11-22	-2.236	0.025*
	Secondary Closure (7 th day)	20	13.00	11-22		
C	Primary Closure (Preop)	20	13.00	11-27	-2.121	0.034*
	Secondary Closure (Preop)	20	12.50	11-27		
	Primary Closure (1 st day)	20	14.00	11-28	0.000	1.000
	Secondary Closure (1 st day)	20	13.50	11-30		
	Primary Closure (2 nd day)	20	14.00	11-28	-0.540	0.589
	Secondary Closure (2 nd day)	20	13.00	11-28		
	Primary Closure (7 th day)	20	13.00	11-27	-2.121	0.034*
	Secondary Closure (7 th day)	20	12.50	11-27		

*, p<0.05 **p: 0.01 ***: p<0.001.

evaluated, authors favoured the window technique for impacted mandibular third molar surgery.^{2,5,6,8,14,15} Nevertheless, for the present study, the opinion of excising healthy tissue was speculated as unaccustomed and could deviate from surgical principals. For these causes, open wound healing was the preferred technique in the present study. A study investigating single-suture closure technique (suture on the distal aspect of the second molar) on mandibular impacted third molars and found a statistically significant difference concerning pain, swelling and trismus during the initial days following surgery.⁷ Associating their results with literature, they recommended the single-suture technique for impacted lower third molar surgery. Studies investigating the use of sutureless technique on mandibular impacted third molars, also concluded that pain and oedema was significantly lower in the sutureless groups.^{4,16}

In order to control postoperative pain, oedema and trismus, medical regimens such as corticosteroids

have also been used. Ordulu et al. extracted mandibular impacted third molars and compared single dose intravenous 1.5 mg/kg metilprednisolone after conventional suturing with drain usage.¹⁷ Pain, oedema and trismus were higher in the drain group but was only statistically significant in the 5th and 7th days. Authors indicated that postoperative bleeding lasted longer in the drain group but were of the opinion that drain usage could be preferred since used medications can have unwanted side effects, not to mention patient's fear of intravenous injections.

While studies investigating secondary wound healing, presented their results for postoperative pain, oedema and trismus, postoperative infection and alveolar osteitis rates were not mentioned. Pasqualini et al. reported a 33% wound dehiscence at the distal aspect of the mandibular second molar in the conventional suturing group.⁵ They reported that this condition was not declared in other studies but could alter postoperative

complication data. In addition to the other studies, Hashemi et al. evaluated postoperative infection and alveolar osteitis rates after secondary wound healing, and reported no complications.¹⁶ Although the study was done on impacted mandibular third molars, the conclusion supported the results of the present study.

Wound closure is known to be slower in secondary wound healing due to delayed epithelial closure and a higher rate of granulation tissue formation and occurs in the presence of many interruptions, including the oral flora with its high bacterial and viral content, and usually proceeds under disturbance of oral function.¹⁸ Even in these conditions, the results of the present study suggested that secondary wound healing may be used for maxillary impacted third molar surgeries.

CONCLUSION

The results of the present study suggest that; sutureless secondary wound healing technique could be used for maxillary impacted third molar surgery with different impaction depths. This method could shorten operative time without increasing postoperative

complication rates such as oedema, alveolar osteitis, bleeding and infection and may in accordingly increase patient satisfaction.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

This study is entirely author's own work and no other author contribution.

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