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The effects of primary and secondary wound closure following surgical extraction of lower third molars on post-operative morbidity: A prospective randomized clinical trial

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The aim of this study was to compare the effects of primary and secondary wound closure on post-operative pain, swelling, and acute alveolar ostietis (AO) after surgical extraction of partially impacted lower third molars. A prospective randomized parallel clinical trial was conducted on 60 patients. Exclusion criteria included pericoronal infection and uncontrolled systemic diseases. Pain was estimated preoperatively. Facial measurements (FM) were obtained using a measuring tape for three lines between five defined points on the face. A single extraction with envelope flap was performed. Two types of wound closures were adopted, primary in Group 1 (G1) and secondary in Group 2 (G2). Pain, FM, and AO were evaluated on days 3 and 7. In both groups, FM and pain significantly increased on day 3, and then decreased on day 7. The amount of increase in FM, pain, and empty socket was higher in G1 than in G2. Tenderness and halitosis were more prevalent in G2 than in G1 on day 3. Five cases of AO were found in G1 (16.7%) and 4 cases in G2 (13.3%). No significant differences were found between the two groups regarding these variables. When the envelope flap is used, secondary wound closure has insignificant advantages over primary closure with respect to swelling, pain, and AO.

Key words: Primary closure, secondary, third molar, extraction.

INTRODUCTION

Surgical extraction of the lower third molar is the most common surgical procedure in oral and maxillofacial surgery (Yuasa and Sugiura, 2004). Morbidity following this procedure includes tissue reaction and complications. Post-operative tissue reactions involve pain, swelling, trismus, and dysphagia (Garcia Garcia et al., 1997). The occurrence of postoperative pain and edema is related to many factors, mainly the inflammatory process, which is the immediate and early response to injury (Danda et al., 2010). A critical function

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of this response is to deliver leucocytes to the site of injury, where they help clear the invading bacteria and degrade the necrotic tissue resulting from damage (Maria et al., 2012).

Complications may occur following extraction, including bleeding, alveolar osteitis, nerve injury, infection, delayed healing, and periodontal pocketing (Chiapasco et al., 1993; Halpern and Dodson, 2007). Alveolar osteitis (AO) or "dry socket" is defined as "postoperative pain inside and around the extraction site, between the first and third day after extraction, accompanied by a partial or total disintegrated blood clot within the alveolar socket with or without halitosis" (Blum, 2002).

The frequency of complications associated with the removal of impacted third molars is influenced by the surgical technique, experience of the surgeon, and the procedure's duration (Danda et al., 2010; Sisk et al., 1986). Other factors include age of the patient, administration of preoperative or postoperative medications, patients' compliance with postoperative instructions, oral hygiene, and the existence of a previous periodontal or periapical pathology (Erdogan et al., 2011).

Wound closure techniques following surgical extraction include total and partial closure. In total closure, the muco-periosteum is hermetically sealed so the wound heals by primary intension. In partial closure, a window exists and allows the wound to heal by secondary intention (Pasqualini et al., 2005), which starts from the base and borders and moves to the upper part by deposition of new tissue (Carrasco-Labra et al., 2012). The socket remains in communication with the oral cavity to facilitate drainage of inflammatory products (Danda et al., 2010; Bello et al., 2011).

This study used envelope flap for surgical extraction of partially impacted lower third molars and aimed to compare the effect of primary and secondary wound closure on post-operative pain, swelling, and AO. Furthermore, it compared these reactions and complications with previous similar studies that used another type of flap.

MATERIALS AND METHODS

A prospective randomized parallel clinical trial was conducted in the College's dental hospital from February 2014 through January 2015. The study involved 60 male and female patients who had partially impacted lower third molars. Exclusion criteria include infection around the crown, bone pathology, uncontrolled systemic diseases, pregnancy or lactation, contraindications of epinephrine, and allergy to chlorohexidine (CHX), lidocaine, or ibuprofen. Fully impacted third molars and any extractions with operation time lasting more than 30 min were also excluded.

Sample size was estimated depending on a power calculation by Minitab release 14 statistical software for windows. At level of significance, $\alpha = 0.05$ with estimated standard deviation 1, maximum difference ≈ 1 and power 0.96, the sample size in each group should be at least 30.

The study followed the World Medical Association Declaration of Helsinki and was registered in the College's research center, with a registration number of FRP/2014/94. The aims and procedures of the study were explained to the patients before they signed an informed consent.

All required information was documented in the questionnaire regarding name, age, gender, mobile number, file number, and medical condition. The third molars were recorded and classified according to Pell and Gregory classifications.

On the first day directly before the operation (day 1), the patients were asked to estimate the intensity of pain by selecting the score on VAS (0, 1, 2, ..., 10) (Figure 1). A score of 0 represented no pain and 10 represented extremely severe pain. Facial measurements were obtained using a measuring tape while the patient was sitting upright and the mandible was in the physiologic rest position. Five points on the face were used: most posterior point at midline on tragus (A), lateral canthus of eye (B), most lateral point on corner of mouth (C), soft tissue pogonium, which is the most prominent point at midline on chin (D), and most inferior point on the angle of the mandible (E) (Figure 2). The author performed all the clinical assessments, however, the measurements for these three lines, (A to C), (B to E), and (A to D), were recorded three times, then the average was taken. Halitosis was reported if bad breath odor was smelled by the author.

The patients were divided randomly into two parallel groups by asking them to choose 1 of 60 playing cards. These cards, which had images of different shapes, had been mixed. The first shape included 30 cards and represented the first study group, while the second shape included 30 cards and represented the second study group.

Surgical procedure

Preoperatively, the patients rinsed with 0.12% chlorohexidine mouth wash. Local anesthesia was achieved by inferior alveolar nerve block and buccal infiltration of 2% lidocaine with 1:80,000 epinephrine. A single surgical extraction was performed by the author on every patient per visit. A standard surgical technique was followed in all cases: reflection of envelope flap by sulcular incision extending from the mesial papilla of the second molar to disto-buccal aspect of retro-molar area (Figure 3), bone osteotomy, and crown sectioning by bur and low-speed surgical hand piece under copious irrigation of normal saline. After extraction, bony margins of the sockets were smoothed, and the socket was irrigated with normal saline. The procedure duration was recorded using a stopwatch.

The wounds were sutured by 4-0 polyglycolic acid (PGA RESORBA, RESORBA Medical GmbH, Nurnberg, Germany); however, two different types of closure were performed. Group 1 (G1, Primary closure): the postoperative wound was totally closed by three interrupted sutures; the first suture distal to the second molar, the second suture across the distal incision, and the third suture across the socket. Group 2 (G2, Secondary closure): the postoperative wound was sutured by two interrupted sutures; the first suture distal to the second molar and the second suture across the distal incision (Figure 4). With this type of closure, the wound was left open to heal by secondary intention without removal of a wedge of the mucosa.

Post-operative medications included Ibuprofen (Brufen, Hamol Limited, Nottingham, England) 600 mg p.o. every 8 h for 3 days and 0.12% chlorohexidine mouthwash (Peridex, Oral Rinse, 3M, ESPE, USA) every 12 h for 7 days. No antibiotics were prescribed for the patients in either group.

Evaluations

On the third day post-operatively (day 3), the facial swelling was evaluated by measuring the same three lines of day 1 (A to C), (B to E), and (A – D). The measurements were performed three times

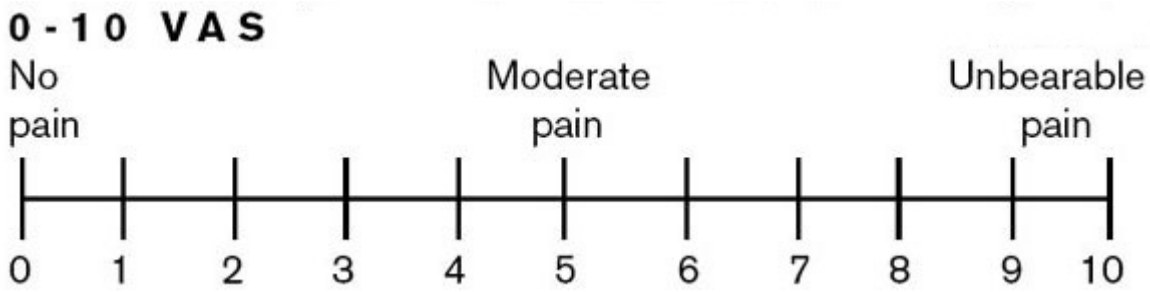

Figure 1. Visual analogue scale.

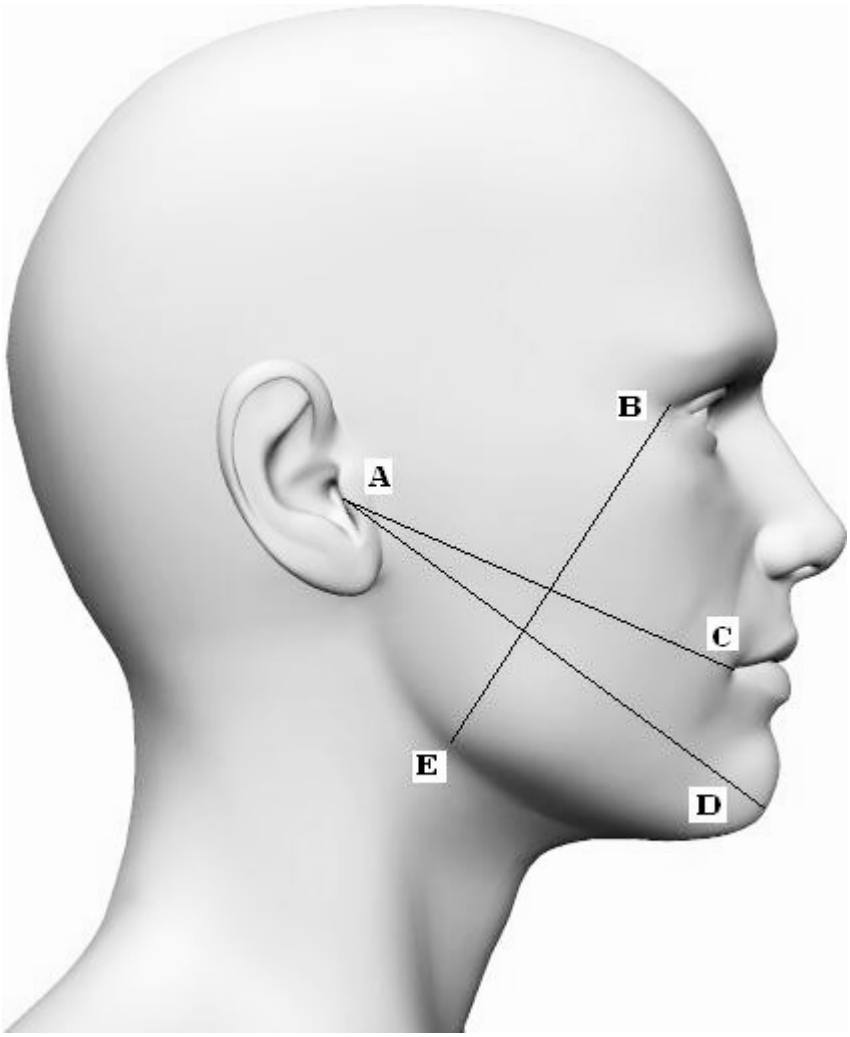

Figure 2. Three lines indicating distances for measurement of facial swelling.

and the average was taken. Halitosis was recorded. The extraction socket was examined for empty socket, food debris, and tenderness in probing. Pain assessment was carried out using the visual scale (VAS).

On the seventh day post-operatively (day 7), the same evaluations as on the third day were repeated. AO was diagnosed if the patient presented between the 2nd and 4th days with pain, tenderness in probing of socket, empty socket, and food debris with or without halitosis. After irrigation with normal saline, the sutures were removed. For patients who required bilateral extraction, a gap of at least 15 days was allowed between the two procedures to allow for total recovery from the first procedure.

The measurements of the facial three lines on day 1 were collected to find the total facial measurement (FM1). Then the total

Figure 3. Envelope flap.

Figure 4. Secondary wound closure.

facial measurement in day 3 (FM2) and day 7 (FM3) were calculated in the same way. The percentages of increase in total facial measurements (PFM) between days 1 and 3 were calculated and compared between the two groups. PFM from day 1 to day 3 = (FM2 - FM1) / FM1 × 100. The data of the study was analyzed using SPSS software version 20 for windows.

RESULTS

Sixty patients completed this study, 38 males (63.3%) and 22 females (36.7%). G1 included 18 males and 12 females, while G2 included 20 males and 10 females. The patients were divided into two groups, with both including 30 patients. The mean age of all patients was 25.5 years. The mean age of G1 and G2 was 25.3 and 25.7 years, respectively. The operation times ranged from 22 to 30 min and the mean was 25.9 min. The mean operation time of G1 and G2 was 25.4 and 26.4 min, respectively, and the difference was not significant (P = 0.140). The data regarding pain, and the total facial measurements were analyzed using one-way repeated measures test; the means are available as shown in Table 1.

In both groups, the means of the total facial measurements significantly increased on day 3 (P = 0.000), then decreased on day 7, but were still significantly greater than on day 1. P values for G1 and G2 were P = 0.003 and P = 0.002, respectively. The percentage of increase in total facial measurement from days 1 to 3 was greater in G1 than in G2; however, there was no significant difference (P = 0.902) according to an independent samples t test.

The means of pain in both groups significantly increased on day 3 (P = 0.000), then decreased on day 7. The mean of pain was greater in G1 than in G2 on day3, but without a significant difference (P = 0.543) according to an independent samples t test.

The occurrence of tenderness, empty socket with food debris, and halitosis is available as shown in Table 2. The analysis of these variables was done using Chi-squared tests. On day 3, tenderness was greater in G2 than in G1, but without a significant difference (P = 0.771), while on day 7 the percentage was the same. Empty socket and food debris were greater in G1 than in G2 on day 3 and day 7, but there were no significant differences at P = 0.748 and P = 0.472, respectively. Halitosis on days 3

Table 1. Changings of the variables in postoperative review days.

Variable	Group 1 (Primary closure)			Group 2 (Secondary closure)		
	Day 1	Day 3	Day 7	Day 1	Day 3	Day 7
Mean pain	1.25	5.25	1.05	0.85	3.85	1.95
Standard deviation	1.71	2.15	1.28	2.25	2.62	2.21
Mean (FM)	35.38	37.08	36	36.22	37.68	37.03
Standard deviation	1.88	2.12	1.94	1.86	1.77	1.60

FM: Total facial measurement by collection of the measurements of the three lines; (A–C), (B–E), and (A–D).

Table 2. Frequency of signs and symptoms of AO in postoperative review days.

Variable	Group 1 (Primary closure)		Group 2 (Secondary closure)	
	Day 3	Day 7	Day 3	Day 7
Tenderness (%)	7 (23.3)	2 (6.7)	9 (30)	2 (6.7)
Empty socket and debris (%)	7 (23.3)	6 (20)	5 (16.7)	3 (10)
Halitosis (%)	7 (23.3)	5 (16.7)	9 (30)	9 (30)

%: Percentage of the signs and symptoms within the group.

and 7 was greater in G2 than in G1, without significant differences at P = 0.771 and P = 0.360, respectively.

Five cases of AO were found in G1 (16.7%) and 4 cases in G2 (13.3%). There was no significant difference at P = 1.000 according to Chi-squared tests.

DISCUSSION

Minimizing postoperative pain and swelling is a major concern for patients and clinicians as well. Postoperative pain increases with increased surgical difficulty, such as tooth sectioning and bone reduction (Lago-Méndez et al., 2007). On the other hand, operation time significantly affects postoperative swelling, trismus, and pain (de Santana-Santos et al., 2013). To avoid the variability in postoperative morbidity, the author performed similar surgical procedures for all patients: envelope flap, bone reduction, crown sectioning, and tooth delivery. Moreover, fully impacted third molars were excluded as procedure may require more bone removal and thus affect the operation time, which ranged from 22 to 30 min in this study without significant difference between the two groups.

Several studies have evaluated facial swelling after surgical extraction of lower third molars by depending on the visual scale (Danda et al., 2010; Maria et al., 2012; Pasqualini et al., 2005; Khande et al., 2011; Chaudhary et al., 2012), which correlates the patient's estimation of the presence of swelling, difficulty in mastication, and mouth opening. The present study evaluated swelling by measuring three lines on the face with a flexible tape as in the study of Bello et al. (2011). This type of evaluation is objective and avoids the patient's estimation of swelling, which can be affected by other factors like pain and discomfort. Additional methods that have been proposed to measure facial edema include postoperative computerized tomography (CT), magnetic resonance imaging (MRI), and ultrasound evaluations (Erdogan et al., 2011).

The idea in this study was the use of the envelope flap in such comparison between the two types of wound healing following surgical extraction of an impacted lower third molar. Other studies have used the standard ward's incision to reflect the three-sided mucoperiosteal flap (trapezoid) that included a mesial releasing incision (Danda et al., 2010; Maria et al., 2012; Pasqualini et al., 2005; Bello et al., 2011; Khande et al., 2011; Chaudhary et al., 2012; Chukwuneke et al., 2008). The envelope flap provides the operator with a sufficient amount of visualization, minimizes soft tissue trauma, and limits the compromising blood supply to mucosa and periosteum as well. Furthermore, postoperative swelling is significantly less with the envelope flap than flaps with a mesial releasing incision (Erdogan et al., 2011; Kirk et al., 2007) because a releasing incision blocks the route of lymphatic vessels and impairs local lymph transport (Szolnoky et al., 2007).

Secondary wound closure after surgical removal of a lower third molar has been achieved in different ways. Some investigators have preferred to create a window by removing a 5 to 6 mm wedge of mucosa distal to the second molar (Danda et al., 2010; Maria et al., 2012; Pasqualini et al., 2005; Khande et al., 2011; Chaudhary et al., 2012; Dubois et al., 1982). Insertion of a tube drain in the buccal fold is another technique (Chukwuneke et al., 2008; Rakprasitkul and Pairuchvej, 1997; Sağlam, 2003). Conversely, this study used a simple technique as the wounds were left open by placing only two sutures-distal to the second molar and across the distal incision.

A similar technique was used by Bello et al. (2011), who were not comfortable with the ethical consideration of excising mucosa distal to the second molar to obtain partial closure.

The type of flap and wound closure are modifiable factors that have been investigated in the literature to reduce postoperative morbidity; however, controversy still exists. Thoma (1969), Howe (1971) and Killey and Kay (1975) were in favor of closed wound healing due to fewer complications and postoperative infections. In contrast, a significant increase in facial swelling has been reported in other studies associated with a primary versus secondary closure technique (Danda et al., 2010; Maria et al., 2012; Pasqualini et al., 2005; Bello et al., 2011; Khande et al., 2011; Chaudhary et al., 2012; Dubois et al., 1982; Holland and Hindle, 1984; Refo'a et al., 2011). In this study, primary closures had greater swelling than secondary closures, but without a significant difference. However, both types of closures were associated with significant swelling on day 3 postoperatively, which decreased on day 7. Postoperative facial swelling can be attributed to the accumulation of inflammatory exudate within facial tissues, hematoma collection, or both (Holland and Hindle, 1984; Alkan et al., 2004). Partial wound closure permits drainage and thus appears to minimize immediate postoperative edema and contribute to reduced patient discomfort (Dubois et al., 1982).

Carrasco-Labra et al. concluded that important differences in outcomes may not exist between secondary and primary wound closures after they performed a meta-analysis on 14 studies that compared the two types of closure.

In this study, the recorded cases of alveolar ostietis were greater in number with primary closures (16.7%) than secondary closures (13.3%), but there were no significant difference. In the same way, Danda et al. (2010) reported more cases of alveolar osteitis with primary closure (4.3%) than secondary closure (3.2%). In contrast, Bello et al. (2011) found more cases of AO with secondary closure (7.3%) than primary closure (4.9%), but without a significant difference.

Most studies that estimated the morbidity after third molar surgery have recorded more significant pain with primary closure than secondary closure in the following days (Danda et al., 2010; Maria et al., 2012; Pasqualini et al., 2005; Khande et al., 2011; Chaudhary et al., 2012; Dubois et al., 1982; Holland and Hindle, 1984; Refo'a et al., 2011). This result is consistent with this study as the primary closure group experienced more pain than the other group, but no significance was found. In contrast, Bello et al. (2011) reported more pain in the partial closure group than the total closure, with no statistically significant difference.

The incidence of tenderness, empty socket, food debris, and halitosis was reported in this study without significant differences between the two groups.

Tenderness and halitosis were more frequent in the secondary closure group, which can be explained by exposure of the socket walls to food and bacteria in the postoperative days. Breakdown of food results in a malodor that can freely leak into the oral cavity through the open wound. On the other hand, an empty socket and debris were reported more frequently with primary closure, because this type of wound is not self-cleansing as compared to secondary closure (Yuasa and Sugiura, 2004; Halpern and Dodson, 2007; Dubois et al., 1982). Furthermore, this type of wound acts like a one-way valve that allows food debris to accumulate in the socket by hindering removal and thus increases the possibility of further infection (Pasqualini et al., 2005; Figueiredo et al., 2007).

In conclusion, when the envelope flap is used for surgical extraction of partially impacted lower third molars, the secondary wound closure technique has insignificant advantages over primary closure with respect to swelling, pain, and acute alveolar osteitis.

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Conflicts of interest

The author declares no potential conflicts of interest with respect to the authorship and publication of this article.There were no external funding sources for this study.

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