



CODEN [USA]: IAJ PBB

ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

<http://doi.org/10.5281/zenodo.3492258>

Available online at: <http://www.iajps.com>

Research Article

**COMPARISON OF PATIENT-CENTERED OUTCOMES AFTER
ROUTINE IMPLANT PLACEMENT, TEETH EXTRACTION, AND
PERIODONTAL SURGICAL PROCEDURES**

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Article Received: August 2019

Accepted: September 2019

Published: October 2019

Abstract:

Objectives: To compare patient-centered outcome assessments (POAs) over a 2-week period after five categories of dento-alveolar surgical procedures.

Place of Study: Medina Teaching Hospital Faisalabad, Pakistan.

Methods: A total of 339 patients in need of dento-alveolar surgical procedures such as simple tooth extraction (SE), trans alveolar extraction (TE), straightforward implant placement (I), implant placement with guided bone regeneration (IGBR), and periodontal surgery (P) dental clinic were consecutively recruited. POAs in terms of bleeding, swelling, pain, and bruising were obtained using 10 cm visual analog scale (VAS) on each day of the first week and the 14th day post-surgery. Clinical examinations were recorded on the 7th day post operation.

Results: For the first 3 days of healing, area-under-the-curve (AUC) analyses showed that transalveolar extraction (TE) resulted in significantly higher overall bleeding and pain (AUC: Bleeding Mean = 5.6, Pain Mean = 7.5). However, implant placement with GBR (IGBR) resulted in significant higher level of swelling (AUC: Mean = 9.1) and bruising (Mean = 4.2) for the same period with also the highest use of painkillers. Healing outcomes of straightforward implant placement (I) were comparable to that of a simple extraction (SE). Two-week overall experience showed the symptoms quickly subsided for all groups. Prevalence for complications 1 week postoperatively was IGBR (20%), P (15.6%), I (12.7%), SE (4.8%), TE (1.5%), respectively.

Conclusions: The highest extent of swelling and bruising was observed in patients who got implant placement with GBR (IGBR), while healing events of straightforward implants were similar to these of simple extraction. The VAS scores for all POAs parameters were generally low and decreased to nearly zero over the study period following all five surgical procedures. Low prevalence of postsurgical complications was reported.

Keywords: Dento-alveolar, trans alveolar extraction, implant placement, periodontal surgery.

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Please cite this article in press Farheen Iqbal et al., *Comparison Of Patient-Centered Outcomes After Routine Implant Placement, Teeth Extraction, And Periodontal Surgical Procedures.*, Indo Am. J. P. Sci, 2019; 06(10).

INTRODUCTION:

Dento-alveolar surgical procedures such as tooth extraction, either straightforward or transalveolar, have been traditionally routine procedures in general dental practice. Lately, implant placement with or without guided bone regeneration (GBR) has been a rapidly increasing practice involving a large number of patients. The impact of these treatments evaluated from patients' perspective, also referred to as patient-centered outcomes assessments (POAs), has triggered the interest of many researchers and clinicians. For instance, "the feeling of pain," which is a common experience during the healing period has been frequently investigated (1). Patient's decision for a dental treatment often depends on the risk and benefit that arise from the outcome and could be strongly influenced by one's related knowledge. The patients may know little or nothing about the procedures and the subsequent healing events, yet they will be highly concerned with regard to the consequences of treatment. In that sense, allowing the patient to compare the impact of an unfamiliar procedure (e.g., implant surgery) to one the patient has already experienced (extraction) might be of significant value to patient's understanding and well-informed decision-making. Clear and evidence-based information on the expected level of pain or other uncomfortable experiences during the healing period could improve patients' understanding and acceptance of a treatment modality, which also facilitates better communication and establishment of trust between clinicians and patients (2). Such communication might help the patients formulate realistic expectations with regard to the treatment procedures, or at least avoid misperceptions, which can frequently lead to dissatisfaction and problems (3). According to the recommendations from the International Patient Decision Aid Standards Collaboration (IPDAS), presentation of quantitative information about treatment outcomes is an important prerequisite when evaluating the quality of communication (4). Empirical evidence suggests that presenting information in numbers and scales significantly improved the accuracy of treatment comprehension by the patients, as compared to only describing in words (5). Previously, a special questionnaire was developed to systematically evaluate patient centered outcome assessments (POAs) after implant surgery. Visual analog scale (VAS) scores on bleeding, swelling, pain, and bruising were recorded from day 1 to day 7 and the 14th day post-surgery. This tool was validated and further used in a large multicenter study, thus offering a profound insight on patient experiences of healing after placement of dental implants (6). One study assessed POAs of periodontal surgery, where

crown lengthening (CL) and open flap debridement (OFD) were compared with the implant installation (IMP). The author stated that the VAS scores of the four POAs parameters were generally low in three surgical procedures and tended to disappear over a week. The surgery duration rather than the surgery type seemed to influence the VAS score significantly (7). However, no studies have specifically discussed the patients' experiences during postsurgical healing period of implant surgery with guided bone regeneration (GBR), in particular when compared with common dento-alveolar procedures such as simple and transalveolar extractions. The aim of this study was to compare POAs and postsurgical complications using quantitative methods in five different types of oral surgery: simple single extraction (SE), transalveolar extraction (TE), straight forward implant placement (I), implant placement with GBR (IGBR), and periodontal surgery (P).

The subjective patient experiences assessed by the above tool (visual analog scale, VAS) during the early healing phase (1– 14 days) and their correlation with the duration of surgery, painkillers, patient demographics, and other confounders are investigated.

MATERIAL AND METHODS:

This prospective longitudinal study was conducted in two clinical centers. Patients enrolled were scheduled for surgical placement of one or more implants with or without guided bone regeneration (GBR), simple and transalveolar extraction as well as periodontal surgery (involving at least 3 teeth). Patients who were

- (i) Medically compromised (ASA classification III–V),
- (ii) Requiring antibiotic prophylaxis prior to dental treatment,
- (iii) Less than 21 years old,
- (iv) Heavy smokers or previous heavy smokers allergic to amoxicillin or penicillin antibiotics,
- (v) Pregnant and those who intend to conceive breast feed were excluded.

The subjects were informed about the purpose of the study together with the risks and benefits associated. Written informed consent was obtained for all patients before enrolment in the study. Ethics approval

This study was conducted in Medina Teaching Hospital Faisalabad. The observation period was 2 weeks, with baseline scores starting 1 day after the surgery (Day 1), and ending on the 14th day at the postsurgical review. All surgical procedures were

performed according to standard protocols in each center. Implant surgery and periodontal surgery were mainly conducted by supervised postgraduate residents of the respective implant dentistry, periodontology, or OMFS departments. IGBR group included single implants (n = 38, 54.3%) and multiple implants (n = 32, 45.7%) placed most frequently in the anterior maxilla. Teeth extractions especially in the TE group were performed by supervised residents or junior dental officers in OMFS department with at least 2 years of clinical experience. Ninety-five percent of the TE extractions concerned single or multiple extractions of wisdom teeth. Prescribing of postoperative antibiotics, antiseptic mouth rinse, and analgesics was decided by individual operators according to the respective clinical protocols of the department. The operators who performed the surgical procedure were the ones then to examine subjects clinically for postoperative complications on day 7 following. Questionnaires and variables Patients were asked to fill out 5 questions in a healing diary from day 1 to day 7 and then day 14. For each day, patients were asked whether or not they used painkillers (and type), followed by four questions representing their healing condition marked on a 10 cm long VAS scale for bleeding, swelling, pain, and bruising. Patients were instructed that 0 represented no bleeding, no swelling, no pain, and no bruising, while 10 represented very heavy bleeding, very heavy swelling, worst pain, and very severe bruising. Completed diaries were either mailed back to each center or directly returned to the dentist's in-charge.

Primary outcome variables were patient centered outcome assessments (POAs): VAS scores on bleeding, swelling, pain, and bruising. The secondary outcome variables were occurrence of postoperative complications such as flap dehiscence, suppuration, swelling, and spontaneous bleeding on Day 7.

STATISTICAL ANALYSIS:

The power analysis was performed for a one-way fixed effect analysis of variance with five levels. The

criterion for significance is set at $\alpha = 0.05$ (Type I error) and at $\beta = 0.20$ (Type II error). The analysis of variance is nondirectional (i.e., two-tailed) indicating that an effect in either direction will be interpreted. If a standardized effect of 2.5 VAS units (on the basis of 10 VAS units) is expected, the sample size is around 40 cases per group. Collected data from patients' scales and operators' clinical forms were entered into a database using SPSS version 21.

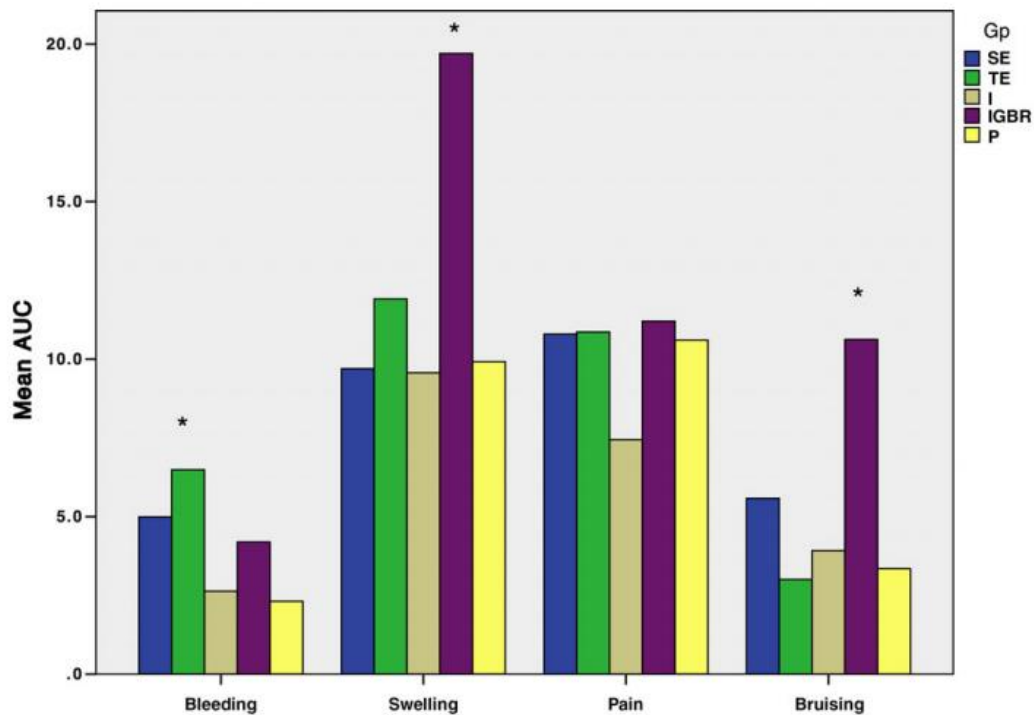
Nonparametric Kruskal–Wallis test and Wilcoxon–Mann–Whitney U-test were used to compare median data of five groups on each day. Both the immediate healing period (first 3 days) and the overall impact experienced over the study period (2 weeks) were assessed by area-under-the-curve (AUC) analyses (one-way ANOVA and Bonferroni test), where n = number of measurements, t = timing of measurement, and y = mean VAS score, Chi-square (or chi-square exact) tests were used to compare the percentage distribution of postsurgical complications and the usage of painkillers. Postoperative VAS for each POAs parameter, considering multiple confounders such as gender, age, surgical type, surgery duration, clinical center, use of painkillers, and post-surgery period, were analyzed using repeated-measures ANCOVA. All results were interpreted at a level of significance of 0.05.

RESULTS:

Distribution of the subjects:

Three hundred and thirty-nine healthy patients were consecutively recruited in two clinical centers. Among them, 42 cases were simple single extraction (SE); 132 cases were transalveolar extractions (TE), which were mainly surgeries of removing the third molar teeth; 63 were straight forward implant placements (I); 70 were implant placements with GBR (IGBR); and 32 were periodontal surgery (P). The subjects were distributed in gender (39.5% male), clinical site (51.3%), surgery duration use of antibiotic (51.4%), and use of painkillers (54.8%). The mean age of the subjects was 43.2 years (SD = 16.0).

Surgery Type (N)	Descriptive	Sub-groups		
SE (42)	Simple single extraction	NA		
TE (132)	Transalveolar extraction of wisdom teeth	Single 55 (42.6 %)	Multiple 74 (57.4 %)	
I (63)	Simple straight forward implant replacement (no GBR)	Single 50 (79.4)	Multiple 13 (20.6 %)	
IGBR (70)	Implant placement with Guided Bone regeneration	Single 38(54.6 %)	Multiple 32 (45.7%)	
P (32)	Periodontal surgery (3-8 teeth involved)	Regenerative 5 (15,6%)	CL lengthening 3 (9.4 %)	OFD 24 (75.0%)



PATIENT-CENTERED OUTCOMES:

The immediate (first 3 days) and 2-week overall postoperative experiences calculated by AUC were reported. Summing up the first 3 days after the operation, patients who received transalveolar extraction (TE) treatment had significant higher overall bleeding as well as pain scores compared with the other four groups (AUC: Bleeding Media = 5.6, $P < 0.001$; Pain Mean = 7.5, $P = 0.004$). Similarly, patients having implant placement with GBR (IGBR) reported significant higher level of swelling (AUC: Mean = 9.1, $P < 0.001$) and bruising (Media = 4.2, $P < 0.001$). Summing up the overall healing data, however, the differences are quickly leveling out. Patients who received transalveolar extraction (TE) treatment had significant higher overall bleeding scores compared with the other four groups (AUC:

Media = 6.5, $P < 0.001$), while patients having implant placement with GBR (IGBR) reported significant higher level of swelling (AUC: Mean = 19.7, $P < 0.001$) and bruising (AUC: Media = 10.6, $P < 0.001$). There was no significant difference in the overall pain scores among five groups ($P = 0.384$). Average mean of four POA parameters was significantly different ($P < 0.001$) with the highest AUC score of swelling 12.6 and pain 10.3. Median VAS scores of all four POAs parameters were generally low and decreased to zero relatively early in the study period. The phenomenon of bleeding disappeared on the third day after all five types of surgeries. Bleeding on the first and second day was significantly higher in TE group with the median 3 and 1, respectively. IGBR group showed the highest swelling score on every day, with the median

changed from 3 (day 1) to 0 (day 14). Similarly, the bruising scores of IGBR group were significantly higher than other surgeries from 1 (day 1) and 0 (day 14), even the data were relatively low compared with the other three POAs. The decreasing tendency in bleeding, swelling, pain, and bruising over the 2 weeks. The percentage of patients who took painkillers on each day. Generally speaking, all five groups displayed a quickly descending use in terms of taking painkillers. About 71.4% of patients who got the implant placement with GBR (IGBR) took painkillers on the first day post-surgery, 50% on day 2 and 35.7% on day 3, which was significantly higher than other four types of surgery. Repeated-measures ANCOVA to examine adjusted postoperative VAS Repeated-measures ANCOVA with a Greenhouse-Geisser correction were constructed involving all confounders: gender, age, clinical sites, surgery duration, surgery types, use of painkillers, use of antibiotics, and healing period post-surgery to measure daily change of the VAS scores on bleeding, swelling, pain, and bruising. Bleeding, swelling, and pain scores significantly decreased along with time ($P < 0.001$), while the bruising seemed decreased slightly without significant difference ($P = 0.26$). To be more precise, post hoc tests using the Bonferroni correction revealed that bleeding reduced obviously on the first 3 days; swelling scores usually declined from the second day, and pain scores dropped significantly from each day until the end of the study period. Postsurgical complications at the 7th day, clinical examination of the healing condition found that the prevalence for complications was SE (4.8%), TE (1.5%), I (12.7%), IGBR (20%), P (15.6%). Spontaneous bleeding and suppuration occurred rarely. IGBR group revealed the highest rate of flap dehiscence (11.4%, $P < 0.001$) and swelling (11.4%, $P = 0.004$). Duration of the surgery despite the small number of postsurgical complications, significant differences were found between shorter (60 min) surgeries.

DISCUSSION:

The study evaluated the patients' experience after different types of dento-alveolar surgery, including dental implant and GBR procedures. Although there appears to be only minor differences when examining the overall healing experiences of the first two postsurgical weeks, this study showed significant differences during the first 3 days. As the conditions of the first day are the most intensive, it is reasonable to expect that these will be the main determinant of patient's perceptions on the healing procedure and might need to be the main focus from the operator's perspective. It is an interesting finding that patients who underwent implants with GBR experienced

more swelling and bruising than wisdom teeth extractions, a procedure often considered as a major cause of swelling. This could not be objectively verified, as by the time of the postsurgical clinical examination, swelling had already subsided in all cases. As the majority of the GBR implants were placed in anterior maxilla, one can also wonder whether the patients are more likely to register swelling caused by procedures in the anterior rather than posterior, such as with wisdom teeth. Similarly, it is not surprising that patients who got transalveolar extractions (TE) experienced the most severe bleeding and pain compared with the other four surgeries. On the other side, it is noteworthy that patients used significantly more analgesics after IGBR procedures than after transalveolar extraction; despite that the pain registered was higher in the latter group. This indicates that the subjective registration of pain might not be the sole determinant for the voluntary use of analgesics by the patients and is an area worth further investigation. The healing patterns of patients who got straightforward implant surgery (I) did not show significant differences with simple extraction (SE). This might serve as an encouragement to patients who are afraid of implant surgery. On a daily basis, patients usually felt the strongest pain at 24 h after surgery. In recent study of implant surgery, the average pain score was highest on the first day with 2.4/10 (8). Similar to these results, our study found the median pain score 2/10 for the straightforward implant placement (I) and 2.7/10 for the implant placement with GBR (IGBR). A few studies reported numeric data of taking painkillers. A previous study, found 72% of patients who got the straightforward implant placement took painkillers on day 1 to day 3. The number dropped to 28% on day 4 and then 17% on day 6 (9). In another study, 63% of patients who got conventional implant treatment (compared with implant placement with flapless surgery) took painkillers on day 1, 27% on day 4, and 13% on day 6. We found similar percentage and dropping pattern in the usage of painkillers among the straightforward implant placement group (I) and implant placement with GBR (IGBR). Therefore, regardless of the use of painkillers, the results of this study is in agreement with a literature, who stated in 2011 those 3 days after surgery, most patients felt no postoperative pain (10). Moreover, from the outcomes in the repeated-measures ANCOVA testing, there is still a significant time effect on bleeding, swelling, and pain scores when adjusting other confounding variables including gender, age, and clinic center, use of painkillers, antibiotic prescriptions, surgery type, and surgery duration. Usually, the extent of bleeding and pain are highest on the first day and will decrease

significantly over time. Swelling seems to be severest on the second day, and then drops quickly in the first week post-surgery. To our knowledge, this is the first study to compare implant surgery and teeth extraction in terms of patient-centered outcomes during the healing period. In this study, 95% cases of TE group are removal of third molar teeth. According to a previous study, most young healthy adults may expect to experience some symptoms for 5 days or less after third molar surgery (11). Pain decreased steadily over the first 5 days from 5.1/10 to 3.1/10, while swelling, bleeding, and bruising scores were relatively minimal and limited to the first 2 days post-surgery. The outcomes in current study concur with Shugars et al. (1996). Not surprisingly, procedures below 60 min yielded significantly better healing outcomes and better reported patient experience. The threshold of 60 min, however, although present in other studies as well, remains a subjective mark, while it might be biased toward procedures of lesser complexity. Consequently, these results must be interpreted with caution. As this study enrolled all qualifying consecutive patient cases, the baseline characteristics of each group were not absolutely balanced. The number of cases, the duration of surgery, the clinic sites, and mean age were not evenly allocated between the two centers. Despite the efforts to calibrate researchers in the two centers, certain level of discrepancy of each individual surgeon was inevitable, such as minor differences operative and postoperative protocols. Moreover, the data did not include detailed information with regard to each procedure such as exact type and extent of periodontal surgery, submerged or transmucosal implant healing, or possible variations in postoperative care protocol (e.g., use of ice pack). When running the repeated ANOVA, the assumption of normality is violated. Nevertheless, one-way repeated ANOVA is fairly “robust” to deviations from normality; the results should be interpreted with caution. It is reasonable to assume that the sample size will account for the diversity of these factors; nevertheless, such diversity remains a limitation under which the results should be interpreted. Furthermore, assessment through VAS is known to be highly subjective. Again, the sample size, as well as the available data from previous studies which used the same protocol, might allow for a wider understanding of the results. This study only measured the levels of bleeding, swelling, pain, and bruising as these outcomes have been typically measured in previous studies and can be partly independently confirmed by the operator at clinical examination. Quality of life, however, is mainly perceived as the ability to perform daily activities such as eating, drinking, talking, and socializing

which are not addressed by this study, as this would require a different set of instruments, more open to the risks of subjective interpretation. Despite such shortcomings, these results provide valuable information with regard to the sequence of healing events from the patients’ perspective. The results from this study could be consequently used to produce evidence-based and patient-centered advice for patient candidates for implant surgery with or without GBR, offering for a comparison of the unknown with the known. In that sense, the healing experience for a straightforward implant placement is similar to a single extraction in terms of bleeding, swelling, pain, and bruising as well as the need for taking painkillers. However, more extent of swelling, pain, and bruising would be anticipated if implant placement involves guided bone regeneration (GBR), and this is the type of surgery where patients used painkillers the most. Future studies could offer a better insight into these procedures, by completely standardizing protocols and balancing the number of surgery types. Minimizing the operator variability for each procedure would also be important. Finally, parameters such as the anxiety level and final satisfaction from the treatment outcomes could be a valuable addition to the analysis.

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