The Effects of Intraoperative Povidone Iodine and Normal Saline Irrigations on Postoperative Inflammatory Sequelae and Bleeding in Mandibular Third Molar Disimpactions: a Comparative Study

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ABSTRACT

Aim: Mandibular third molar disimpactions (M3-Disimpactions) are often associated with postoperative sequelae of pain, swelling, trismus, and dysphagia which disturb patients' daily activities postoperatively. Poor bone drilling efficiency and irrigation of the surgical site during M3-Disimpactions may worsen the postoperative morbidity and delay wound healing due to the persistence of debris and devitalized bone fragments in the surgical site. Therefore, it is necessary to improve cutting efficiency and remove M3-Disimpaction site debris and devitalized tissues via copious irrigation and lavage to prevent the worsening of the postoperative inflammatory sequelae. The study aimed to compare the effects of Povidone iodine solution (PI) and normal saline (NS) irrigants on postoperative pain, swelling, trismus, and immediate postoperative bleeding (IPB) in M3-Disimpactionsn at the Aminu Kano Teaching Hospital, Kano, Nigeria (AKTH).

Methods: The study was a randomized controlled study conducted among M3-Disimpaction patients who presented to the Oral surgery clinic of AKTH between May to November 2018. A sample size of 76 was calculated and convenience sampling was used to recruit subjects who were randomly assigned into a study group (SG) and a control group (CG). Each group comprised 38 subjects. The disimpaction irrigants were PI (0.5mg/ml solution) and NS in the SG and CG respectively. Immediate postoperative bleeding (IPB) was assessed for all disimpactions. Pain was assessed on postoperative days 1, 2, and 7 (POD1, POD2, and POD7) while swelling and trismus were measured on POD2 and POD7. Statistical comparisons of outcome measures were done within and across groups with significance level set at $p \leq 0.05$.

Results: All recruited 38 subjects of each comparative group in the study completed the study. Each group had a similar M:F ratio of 1:1.3. Within-group analyses revealed that both PI and NS had significant effects on control of postoperative pain (PI: *p=0.0001*, NS: *p=0.0001*), swelling (PI: *p=0.0001*, NS: *p=0.0001*) and trismus (PI: *p=0.0001*, NS: *p=0.001*). Intergroup comparisons of outcome measures taken on POD1, POD2 and POD7 showed there were no significant differences in the means of postoperative pain scores (POD1: *p=0.414*, POD2: *p=0.079*, POD7: *p=0.213),* swelling measures (POD2: *p=0.127*, POD7: *p=0.333)* and Trismus values (POD2: *p=0.599*, POD7: *p=0.566*) of both groups. The mean IPB of both

groups was significantly different (*p=0.0001*), with lower mean bleeding outcomes in the PI group.

Conclusion: Providone Iodine (PI) and Normal Saline (NS) irrigations have similar significant effects on post-operative pain, swelling, and trismus in M3-Disimpactions. However, PI has better haemostatic activity than NS. Clinicians should consider PI irrigation in M3-Disimpactions to reduce peri-operative bleeding.

INTRODUCTION

M3-Disimpactions, a commonly performed surgery in Dental clinics, is often associated with postoperative pain, swelling, trismus and dysphagia.[1] These may disturb patients' daily activities in the postoperative recovery period.[2] Bone drilling in M3-Disimpaction causes production of debris and production of devitalized tissues within the surgical site that delays wound healing thereby worsening the postoperative morbidity and patient discomfort.[3–6] Hence, the removal of M3-Disimpaction site debris and devitalized tissues via copious irrigation and lavage of the site is crucial to prevent the worsening of the postoperative sequelae. In M3-Disimpactions, irrigation prevents thermal injury to tissues, enhances lubrication between bur and bone to ease drilling of the bone, facilitates clearance of debris from surgical field, and improves surgical site visibility.[5,7] Irrigating solutions (irrigants) create an optimal environment for wound healing. The ideal irrigant should (I) be non-toxic to cells involved in wound healing, (II) be bactericidal against all relevant microorganisms, (III) be stable in body fluids, (IV) inhibit excessive host response, (V) not induce toxic host reaction, and (VI) be non-haemolytic.[4,8] There is no known ideal irrigant. Though PI has been suggested to possess some properties of an ideal irrigant, NS has been the traditional irrigant for M3-Disimpactions due to its ready accessibility, compatibility with body tissues and its postoperative effects as an antiseptic and in reducing postoperative complications.[9,10]

PI is an antiseptic commonly applied on intact skin and mucosa for preoperative surgical site preparation and on open wounds.[11] Intraoperatively, it is used as an irrigant or lavaging agent to reduce surgical site infections.[12] In oral surgery, it is used for irrigating alveolar sockets following extractions.[11] PI solutions for use as mouthwashes/gargles are formulated at a concentration of 1% (w/v) containing 0.1mg/ml of available elemental iodine which interacts with cellular myeloperoxidase to form free radical iodine that kills microbes.[13] Besides its antibacterial action, in new wounds, the iodine in PI can suppress inflammatory responses by scavenging oxygen and inhibiting initial neutrophil chemotaxis and secretion of pro-inflammatory cytokines — Tumour Necrosis Factor-Alpha (TNF-) and Nitric Oxide.[14] PI also has a hemostatic effect and can reduce bleeding following tooth extractions when used to irrigate the extraction socket postoperatively.[11] Irrigants that are electrolytes containing anions (surface active agents) have been known to interact with bone surface and cause changes in its surface chemistry that result in enhanced lubrication and bone cutting rates.[7,15] Therefore, iodine as an anion within the PI irrigant may boost the cutting rate (CR) via a chemo-mechanical effect.[7]

The synergism of iodine's chemo-mechanical effect on bone drilling, its haemostatic effect, and its ability to inhibit the initial acute inflammatory response in wounds may result in reduced surgical trauma, bleeding, and inflammatory response with consequent reduction of postoperative sequelae. Arakeri et al[16] and Hashemi et al[17] utilized 0.5mg/ml PI as irrigant in M3-Disimpactions and reported good outcomes in controlling postoperative sequelae. The need to continuously seek means of improving postoperative comfort of M3-Disimpaction patients prompted this study which aims to compare the effects of PI (0.5mg/ml concentration) and NS irrigants on postoperative pain, swelling, and trismus and IPB in M3-Disimpactions at AKTH. The complications rate associated with these irrigants' use was also compared.

MATERIALS AND METHODS

The study was a randomized controlled study conducted at the Oral surgery clinic of AKTH. The study protocol was approved by the ethics committee of AKTH

(NHREC/21/08/2008/AKTH/EC/2082). The study population comprised patients who presented to the clinic from May to November 2018 for M3-Disimpactions. The sample size was scientifically calculated with the formula for comparative research studies with quantitative outcomes using a two-tailed statistical analysis with an assumed standard deviation of mean visual analogue scale (VAS) scores gotten from a previous study[17] A sample size of 76 subjects was derived after adjusting for 10% attrition of the subjects and to obtain equal comparative groups. Prior to subjects' recruitment, a randomization plan was developed using a computer-generated randomization Table of numbers 1 to 76 to aid random assignment of the subjects into 2 equal groups: a PI study group (SG) and a NS control group (CG). The subjects were recruited using convenience sampling. Patients aged 18-45 years who provided informed consent to participate in the study were those included in the sample. The exclusion criteria were patients on anticoagulant therapy and prescription non-steroidal anti-inflammatory drugs (NSAIDs) like aspirin, and histories of bleeding dyscrasias, thyroid disease, renal disease, hypersensitivity to iodine and iodine containing compounds, and patients with active trismus. Data concerning clinicoradiologic factors known to influence M3-Disimpaction time were collected (appendix 1). The surgical difficulty score for each Mandibular third molar (M3) was determined using the Pederson's index (Appendix 1) and patients with values of 7 and above were also excluded from the study as their M3-Disimpactions may require sedative adjuncts or general anaesthesia.

All subjects were given serial numbers in order of recruitment and assigned into the SG or CG based on the randomization Table plan. Each group comprised 38 subjects. In the SG, the irrigant used for disimpactions was 0.5mg/ml PI solution formulated from commercial 10% PI (Jawa Wosan™) by the AKTH pharmaceutical compounding unit using sterile distilled de-ionized water as the diluent. One millilitre (ml) of 10% PI (Jawa Wosan™) was diluted in 19ml of sterile distilled de-ionized water to obtain a 0.5% concentration of PI. Ten millilitres of this solution was further diluted in 990ml sterile distilled de-ionized water to get a concentration of 0.5 mg/ml for the study group. The CG had NS (Dana™) as its surgical irrigant. All disimpactions were performed by the same surgeon under local anaesthesia. Three-sided mucoperiosteal flaps were raised to access the surgical sites using crevicular incisions with mesial and distal relieving incisions. The crevicular incisions extended posteriorly from the mesiobuccal cusp area of the second molar to the mid-distal region of the M3's crown. Mesial relieving incisions were extended downwards from the anterior edge of the crevicular incision obliquely through the attached gingiva only while the distal relieving incisions extended from the back of the M3 riding up laterally towards the external oblique ridge.

The water bottle of the chair containing the irrigant to be dispensed through its waterline was filled with the assigned irrigant for each subject preoperatively. Distobuccal guttering was done with No. 8 round and 703 fissure burs on a straight surgical handpiece (operating at 20,000-40,000 revolutions/minute). The handpiece had an automated irrigating system connected to the waterline of the dental chair that simultaneously released the irrigant into the surgical site during bone drilling. After bone guttering and tooth delivery, sharp bony edges were smoothened with a bone file, followed by lavage of surgical site with the assigned irrigant to eliminate bone and tooth debris under the flap. To standardize the lavage phase, 200ml of irrigant was calibrated for delivery within 100 seconds from the irrigator tip of the dental chair before flap closure. Mucoperiosteal flap reapproximation was achieved with 3/0 Vicryl (neocryl™) simple interrupted sutures placed posterior to the second molar, and at the mesial and distal relieving incisions. The total operating time (TOT) for each disimpaction was measured with a stopwatch as the time between commencement of incision to raise the mucoperiosteal flap and completion of the last suture to reapproximate it. Postoperatively, prophylactic antibiotics including Amoxicillin (Amoxil™) 500mg 8-hourly and Metronidazole (flagyl™) 400mg 8-hourly for five days each were prescribed with Diclofenac Potassium (Cataflam™) 50mg 12-hourly for three days as analgesic for all

subjects. Omeprazole 20mg, 12-hourly for three days was added to medications of known non-active peptic ulcer disease patients.

The IPB was measured using a gravimetric method according to a protocol by Karsl et al.[18] Immediately after flap closure, saliva in the mouth was evacuated with an aspirator tip. Absorbent pads were placed in the upper buccal sulci and on the floor of the mouth bilaterally on the parotid, submandibular, and sublingual ducts' orifices. Immediately, preoperatively weighed gauze swabs were folded and pressed gently over the surgical site applying pressure for 20 minutes to achieve haemostasis. The weights of the gauze swabs were then measured using an electronic device (ScoutPro SPU202 Ohaus Corporation, Pine Brook, New Jersey USA). Weight differences (in milligrams) before and after tamponading with gauze swabs were interpreted as the IPB outcome (IPBO) in 20 minutes. Where bleeding did not cease after 20 minutes, extra gauze swabs were applied to achieve hemostasis before patients were discharged from the clinic. An Oral surgeon who was blinded to (and hence not aware of) the subjects' group (i.e. SG or CG) evaluated the subjects, collected and recorded data concerning pain, swelling, trismus, and complications on predesigned forms during reviews on POD1, POD2 and POD7. All subjects were further reviewed at 4 weeks and 2 months postoperatively. A 10cm visual analogue scale (VAS) was used to assess pain on POD1, POD2 and POD7. Subjects were given a VAS showing 0 to 10 and were requested to mark a vertical line across the VAS to reflect the amount of pain that was being experienced on the assessment days. Prior to marking, subjects were informed that 0 on the VAS represented 'no pain at all' and 10 indicated 'worst pain imaginable.

Facial swellings were measured using a flexible measuring tape in the closed mouth position (in millimeters) and recorded. Fixed points on the face were used as references to measure swelling. These points were: A-the most posterior point on the tragus, B-the lateral canthus of the eye, C-the most lateral point on the corner of the mouth, D-the soft tissue pogonion, which is the most prominent point at the midline on the chin, E-the most inferior point on the angle of the mandible. From these reference points, three lines were derived as: AC-line joining A to C, AD-line joining A to D, BE-line joining B to E. Preoperative baseline measurement was taken just before surgery and similar measurements were done on POD2 and POD7. The linear measurements AC, AD, and BE were measured with a flexible measuring tape. Each measurement was done 3 times and an average of the 3 measurements was utilized. The difference in swelling was calculated as the difference between the sum of averages of the preoperative and postoperative values, i.e. postoperative (AC + AD + BE) minus preoperative (AC + AD + BE). Concerning trismus, all subjects in the SG and CG had measurement (in millimeters) of maximum inter-incisal opening (MIO) using an electronic digital vernier caliper preoperatively on the morning of surgery and postoperatively on POD2 and POD7. MIO was measured as the distance between the incisal tip of the intact crown of the upper right and lower right central incisors**.** All measurements were recorded, and the value of trismus was taken as preoperative value of MIO minus postoperative value of MIO on POD2 and POD7.

Data analyses

Data analyses were performed using Statistical Package for Social Sciences (SPSS) version 24.0 SPSS Inc. Chicago, IL, USA. Quantitative data were summarized using mean and standard deviation while qualitative data were presented as frequencies and percentages.

One way analysis of variance (ANOVA) and student t-tests were respectively used to perform within-group and intergroup comparisons of pain, swelling, trismus and bleeding outcomes as necessary between the PI and NS groups. Chi's square test for independence was used to test association between extra gauze utilization and type of irrigant used. A confidence interval of 95% was used in this study and the level of significance was set at a $p \leq 0.05$.

RESULTS

Seventy-six subjects were recruited and randomized into the SG and CG. The male to

female ratio was 1: 1.4. The mean age (SD) of the study population was 29.3 (5.4) years. Students (28.9%) and Civil servants (28.9%) were the modal occupational groups. Forty-eight (63.2%) subjects gained tertiary education and no subject was uneducated. Table I shows the socio-demographic characteristics of the study population.

Table 1: Socio-demographic characteristics of the study sample

Variables		Povidone iodine		Normal saline		Total (76)	
		Frequency (N)	Percent (%)	Frequency (N)	Percent (%)	Frequency (N)	Percent (%)
Gender	Male	16	42.1	16	42.1	32	42.1
	Female	22	57.9	22	57.9	44	57.9
Age (years)	18-25	11	28.9	11	28.9	22	28.9
	26-35	16	42.1	21	55.3	37	48.7
	36-45	11	28.9	6	15.8	17	22.4
Marital status	Single	15	39.5	15	39.5	30	39.5
	Married	23	60.5	23	60.5	46	60.5
Occupation	Student	13	34.2	9	23.7	22	28.9
	Civil servants	9	23.7	13	34.2	22	28.9
	Dependant	10	26.3	7	18.4	17	22.4
	Professional	0	0	1	34.2	1	1.3
	Trader	4	10.5	8	21.1	12	15.8
	Artisan	2	5.3	0	0	2	2.6
Educational level	Tertiary	21	55.3	27	71.1	48	63.2
	Secondary	10	26.3	9	23.7	19	25.0
	Primary	7	18.4	1	2.6	8	10.5
	Islam/Arabic	0	0	1	2.6	1	1.3

Table 2 presents clinico-radiologic variables and operative time determinants analyses. Besides root curvature, the groups were statistically similar in terms of the variables ($p>0.05$). The mean TOT (±SD) in the SG and CG were 30.26 (±15.274) minutes and 31.00 (±15.026) minutes respectively and there was no significant difference ($p=0.833$) between these times.

Table 2: Clinico-radiographic and operative determinants of the PI and NS groups

Variables		Povidone iodine (N=38)		Normal saline (N=38)		P-value
		Frequency	%	Frequency	%	
*Impacted third molar side	Right	27	71.1	28	73.7	0.799
	Left	11	28.9	10	26.3	
*Position to external oblique ridge	Anterior	26	68.4	26	68.4	0.939
	Mid	4	10.5	5	13.2	
	Posterior	8	21.1	7	18.4	
*Angulation	Mesioangular	24	63.2	19	50.0	0.216
	Horizontal	10	26.3	12	31.6	
	Vertical	4	10.5	7	18.4	
*Relative depth	Class A	36	94.7	35	92.1	0.646
	Class B	2	5.3	3	7.9	
*Relation with ramus	Class 1	10	26.3	10	26.3	0.534
	Class 2	18	47.4	14	36.8	
	Class 3	10	26.3	14	36.8	
*Surgical difficulty grade	Easy	20	52.6	14	36.8	0.169
	Moderate	18	47.4	24	63.2	
*Number of roots	Fused roots	4	10.5	5	13.2	0.077
	Two roots	28	73.7	33	86.8	
	≥ 3 roots	6	15.8	0	0.0	
*Curvature of roots	Straight roots	6	15.8	16	42.1	0.002
	Favourable	3	7.9	7	18.4	
	Unfavourable	29	76.3	15	39.5	
*Bulbosity of roots	Not bulbous	14	36.8	17	44.7	0.487
	Bulbous	24	63.2	21	55.3	
*Root contact relationship with IDC	No contact	12	31.6	15	39.5	0.296
	<2mm	7	18.4	9	23.7	
	Contact	19	50.0	14	36.8	
*Contact with second molar	No contact	2	5.3	4	10.5	0.203
	Crown only	25	65.8	27	71.1	
	Crown and root	9	23.7	6	15.8	
	Root only	2	5.3	1	2.6	
*Root-periodontal space interface	Clear space	14	36.8	17	44.7	0.256
	Some clear space	19	50.0	20	52.6	
	sclerosed	5	13.2	1	2.6	
*Depth from point of elevation	0-3mm	28	73.7	29	76.3	0.901
	4-6mm	10	26.3	7	18.4	
Surgical time (mins)	Means(SD)	30.26(15.274)†		31.00 (15.026)†		0.833

*Individual variable
IDC- Inferior dental canal.
†Mean surgical time measured in minutes for PI and NS groups; SD- Standard deviation.
Independent sample t-test used to analyse surgical time.
Mann Whitney U test used to analyse categorical variables

In Table 3, One-way analysis of variance (ANOVA) was conducted to compare mean VAS (pain), facial measurement and trismus values of POD1, POD2, and POD7 within the SG and CG are presented. There were significant differences between the mean VAS scores (PI: p=0.0001, NS: p=0.0001), swelling measures (PI: p=0.0001, NS: p=0.0001) and trismus values (PI: p=0.0001, NS: p=0.001) of POD1, POD2, and POD7 when compared within the groups.

Table 3: Within-group analysis of outcome measures using ANOVA in the povidone iodine (N=38) and normal saline (N=38) groups

Group	Outcome measures	Day 1 Mean± SD	Day 2 Mean± SD	Day 7 Mean± SD	F	P	Effect size
Povidone iodine	VAS	.50±2.34	5.71±2.11	1.80±1.73	67.93	0.0001*	0.791
	Facial swelling	38.06±1.73	39.66±1.91	38.47±1.64	123.37	0.0001*	0.873
	Trismus	48.24±5.53	31.91±10.42	37.11±10.61	58.57	0.0001*	0.765
Normal saline	VAS	7.90±1.88	4.80±2.32	1.37±1.22	238.58	0.0001*	0.930
	Facial swelling	38.74±1.91	40.95±3.16	39.25±1.85	35.62	0.0001*	0.664
	Trismus	47.02±5.22	30.04±9.72	37.11±11.04	56.90	0.001*	0.765

*The differences in mean values were statistically significant at p≤0.05

Table 4 presents comparisons of postoperative pain scores, facial swelling measures and trismus values across the SG and CG. There were no significant differences in pain scores of the two groups on POD1 (*p=0.414),* POD2 (*p=0.079)* and POD7 (*p=0.213).* Though the means of facial swelling measures were lower for the SG on POD2 and POD7, the differences observed in means of swelling measures between the 2 groups were not statistically significant on POD2 (t=-1.541; *p=0.127*; 95%CI=-1.370-0.570) and POD7 (t=-0.974; *p=0.333*; 95%CI=-0.295-0.101). As regards trismus, the mean changes were smaller in the SG on POD2 but higher on POD7 in comparison to those of the CG. Like pain and swelling mean comparisons between the groups, there was no significant differences in mean trismus values when compared across the groups on POD2 (t=-0.527; *p=0.599*; 95%CI=-5.359-3.116) and POD7 (t=-0.577; *p=0.566*; 95%CI=-2.994-5.434)

Table 4: Student t-test comparison of means between povidone iodine and normal saline groups

Variables	Day	Group PI Mean±SD N=38	Group NS Mean±SD N=38	T-test	p-value	95%CI	
						Lower	Upper
Pain (VAS)	Day 1	7.50 ±2.34	7.90±1.88	-0.821	0.414	1.370	0.570
	Day 2	5.71 ± 2.32	4.80± 2.11	1.779	0.079	-1.088	1.924
	Day 7	1.80 ± 1.73	1.37±1.22	1.258	0.213	-0.252	1.918
Facial swelling differences	Day 2 (d_2-d_0)	1.60±0.62	2.21±2.36	-1.541	0.127	-1.399	0.179
	Day 7 (d_7-d_0)	0.41±0.42	0.51±0.45	-0.974	0.333	-0.295	0.101
Trismus	Day 2 (d_2-d_0)	16.33 ± 9.18	17.45±9.36	-0.527	0.599	-5.359	3.116
	Day 7 (d_7-d_0)	11.13 ± 8.59	9.91 ± 9.81	-0.577	0.566	-2.994	5.434

(d_2-d_0) = day 2 postoperative measurement – preoperative measurement. (d_7-d_0) = day 7 postoperative measurement – preoperative measurement.

Immediate postoperative bleeding outcome (IPBO) was lower in the povidone iodine SG (mean gauze weight=2,848.68±861.28mg) compared to the normal saline CG (mean gauze weight=3,962.63±920.24mg) and comparison of the IPBO means of the groups showed there was a statistically significant difference between them. ($t = 5.448$; p=0.0001; 95% CI=706.50-1521.35)

Table 5 shows analysis of the subjects in the PI and NS groups based on need of extra gauze for immediate postoperative haemostasis. In the PI group, only 3 subjects required extra gauze to achieve haemostasis compared to 11 subjects who needed extra gauze to achieve haemostasis in the NS group. There was a significant association (p=0.038) between number of extra gauzes used for haemostasis and the type of irrigant used.

Table 5: X2 test of association between subject groups and need/no need for extra gauze to achieve hemostasis

	Group PI N=38	Group NS N=38	Chi-square test	
			continuity correction value	p-value
need extra gauze	3	11	4.290	0.038*
no need extra gauze	35	27		
Total	38	38		

***Statistically significant at $p \leq 0.05$ level. Pearson's chi-square X^2 test phi coefficient = -0.272**

Overall, a complication rate of 7.6% was observed in the present study. The frequency of subjects with complications were equal (i.e. n=8) for both the SG and CG. All complications in both groups resolved within 2 months postoperatively. Table 6 shows the frequency distribution of observed complications in the PI and NS groups.

Table 6: Complications in the study population

Complications	Povidone iodine (n)	Normal saline (n)	Total frequency	Percent %
Dysphagia	3	1	4	5.3
Sensorineural deficit	2	3	5	6.6
Prolonged pain	1	1	2	2.6
Earache	1	2	3	3.9
Wound dehiscence	1	0	1	1.3
Post-operative haemorrhage	0	1	1	1.3
Total	8	8		

DISCUSSION

Pain, swelling, and trismus are frequently experienced by patients following M3-Disimpactions. There has been a prevalence of the use of NSAIDs with or without steroids[19-23] and antibiotics[24,25] in the management of these sequelae through the inhibition of mediators in their inflammatory pathways. In the present study, diluted PI irrigant at a concentration of 0.5mg/ml was compared to NS to determine their effectiveness in reducing these inflammatory responses and aiding hemostasis in M3-Disimpactions. Operation time has become the most reliable predictor of M3-Disimpaction difficulty,[26,27] which greatly affects postoperative inflammatory sequelae.[28] There was no statistically

significant difference between TOTs of both groups despite the observed statistical difference in the M3 root curvatures of the groups (Table 2). Therefore, objectively, the PI and NS groups were similar in terms of their M3-Disimpaction times which might have affected the outcome of the study. Measures were taken to standardize all disimpactions to limit variability that may impact on study outcomes.

The use of gauze pressure swabs is a standard method of achieving hemostasis in extraction sockets and quantity of blood soaked by the swabs is a good indicator of how quick hemostasis was achieved.[29] A limitation of this method for measurement of immediate postoperative bleeding outcome within the oral cavity in this study is its subjectivity due to saliva contamination, and, therefore, the soaked gauzed is not entirely filled with blood despite attempts to reduce the saliva contamination by aspiration and use of absorbent pads at salivary duct orifices. In the present study, the mean weights of gauze used were lower for the PI group compared to the NS group and the difference was statistically significant *(p=0.0001).* This finding is like those of Kumar[11] et al and Soodan et al[30] who both investigated the hemostyptic activity of povidone iodine and reported that post-extraction bleeding was significantly controlled in the PI group compared to NS group.

The effects of postoperative medications cannot be overlooked in postoperative control of pain, however, since these medications and the M3-Disimpactions were standardized for all the subjects coupled with similar clinicoradiologic parameters of both groups, the effects of PI and NS irrigants may then be compared. Intragroup analysis of both groups to determine their effectiveness at reducing pain from day 1 through day 7 showed the results to be statistically significant ($p<0.05$). Both irrigants were, therefore, effective at reducing pain. Though NS showed a higher effect size in the control of pain compared to PI (Table 3), PI appeared to have an initial comparatively better control of pain as shown by lower postoperative day 1 VAS scores (Table 3), possibly due to a short-lived modulatory effect of povidone iodine on pain by temporarily inhibiting inflammatory mediators' release and cellular chemotaxis at the surgical site in the immediate postoperative period.[31,32] Onward, the accumulation of inflammatory cells and release of inflammatory mediators such as bradykinin increases cyclo-oxygenase availability and stimulate local prostaglandin-2 production within the wound, leading to increased pain.[19] This may account for the increased VAS score in the SG compared to the CG on days 2 and 7, thus nullifying the initial effect of povidone iodine.

The mean VAS score differences between POD1, POD2 and POD7 in this study aligns with findings of Gallagher et al[33] and Todd et al[34]. Intergroup analysis between the PI and NS groups (Table 4) in this study showed no significant difference in the mean VAS scores of the groups. This is similar to the findings of Hashemi et al[17] who conducted a similar study. Within-group analyses (Table 3) showed that the effects of PI and NS were statistically significant in controlling facial swelling between postoperative days 2 and 7. Thus, PI and NS were both effective at reducing the post-surgical facial swelling in their respective groups. On consideration of the effect sizes (Table 3), it appears PI had more effect in controlling the swelling when compared to NS. This may be related to the better hemostyptic activity of PI that may have caused less postoperative bleeding into tissue planes. Also, the initial inhibition of inflammatory processes by PI might have caused reduced exudate production in the immediate postoperative period and hence less swelling compared to NS. However, in the intergroup analyses comparing the mean facial swelling measurements of the two groups on days 2 and 7 (Table 4), there was no statistically significant difference in mean facial swelling measures of the PI and NS groups on days 2 and 7. These findings do not align with those of Arakeri et al[16] and Hashemi et al[17] who found statistically significant differences between PI and NS groups on days 2 and 7. In both studies,[16,17] NS was the diluent used to obtain 0.5mg/ml PI, hence the synergistic effects of PI and NS may have caused the pronounced differences between their results and that of this study which utilized distilled deionized water diluent to obtain similar PI concentration.

In the present study, within-the-group analyses to determine the effectiveness of each irrigant at reducing trismus showed both solutions had significant similar effects in controlling trismus on days 2 and 7 as their effect sizes on trismus were the same (Table

3). Also, intergroup analyses comparing mean inter-incisal openings of the SG and CG revealed that there were no significant differences in their mean values on postoperative day 2 *(p=0.0599)* and day 7 *(p=0.0566).* This contrasts the findings of Hashemi et al[17] in which significant differences in inter-incisal opening between the SG and CG were reported. The different diluents used in both studies for PI may have caused the contrasting results. The overall complication rate in this study falls within the range of 2.6% to 30.9% reported for M3-Disimpactions[27]. The frequency of complications observed for both the SG and CG were equal (Table 6). This may imply that 0.5mg/ml PI is comparable to NS as regards prevention of complications.

In conclusion, 0.5mg/ml PI and NS irrigants are both effective in the control of postoperative pain, swelling and trismus and there is no significant difference in their effects on these sequelae. The M3 complication rates are similar with use of either PI or NS irrigant. 0.5mg/ml PI irrigant is however more effective than NS irrigant in controlling M3-Disimpaction's IPB. It is therefore recommended that clinicians should consider using 0.5mg/ml PI as irrigant to reduce peri-operative bleeding in M3-Disimpactions especially those expected to be difficult or prolonged.

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Appendix 1- Surgical difficulty grading and definition of preoperative variables

a. Pederson's index of surgical difficulty[35]

Criterion	Variable	Obtainable score	Subject's score
Angulation	Mesioangular	1	
	Horizontal	2	
	Vertical	3	
	Distoangular	4	
Relative depth	Class A	1	
	Class B	2	
	Class C	3	
Relation with ramus and available space	Class 1	1	
	Class 2	2	
	Class 3	3	
Total score obtainable		**10**	

Difficulty grade	**Total**
Easy	3–4
Moderate	5–6
Difficult	7–10
Subject's Difficulty score and grade:	

b. Other preoperative variables[36]

Number of roots	1: Fused root 2: Two roots 3: Three or more roots
Curvature of roots- the long axis of the root in relationship to the root of the second molar	1: incomplete roots 2: straight roots 3: Favourable roots when roots are curved in the direction and towards path of elevation 4: when roots are either curved in opposite direction or against path of elevation.
Bulbousity of roots	1: not bulbous when the dimension of the mesiodistal width of the third molar at its cervix > the dimension of the widest part along the roots of the impacted third molar. 2: bulbous when the dimension of the mesiodistal width of the third molar at its cervix < the dimension of the widest part along the roots of the impacted third molar.
Third molar root and inferior dental canal relationship	1: no contact when the root at its closest point is more than 2 mm from the canal 2: approximation: when the closest point is < 2 mm from canal but there is no contact 3: contact when there is any relationship between root and canal (e.g. contact, impinging, overlap)
Contact with second molar	1: no contact 2: contact with crown only 3: contact with crown and root 4: contact with root only 5: overlap
Root-periodontal space interface	1: clear when the periodontal space is clear all around the tooth 2: some clear when the periodontal space around the tooth is clear in some places 3: sclerosed when the periodontal space is not clear all-round the tooth.
Depth from point of elevation: a horizontal line will be drawn distally from the distal amelocemental junction of the second molar, then a line perpendicular to the horizontal line will be drawn downwards from it to reach the point of elevation of the third molar. The length of the perpendicular line drawn represents the depth of the third molar from its point of elevation (i.e. where force is applied to elevate the tooth from its socket). The application point of the elevator for the mesioangular and horizontal impactions will be the mesial amelocemental junction of the third molar while those of the vertical and distoangular impactions will be at the root bifurcation.	1: 0 – 3 mm 2: 4 – 6 mm 3: > 6 mm