Low-concentration Povidone-iodine and Normal Saline as Irrigant on Reducing Postoperative Complications after the Third-molar Surgery: A Comparative Study

Sruthy TV¹, Roshni A², Sachin Aslam³, Mathew Pynnummoottil Cherian⁴, Sooraj Soman⁵, Akhila K⁶

**Abstract**

Aim: This study was conducted to compare the efficacy of using 0.5 mg/mL povidone-iodine solution as an irrigant and coolant in reducing postoperative sequelae like swelling, trismus, and pain with the conventional normal saline irrigation during the surgical removal of the impacted lower third molar.

Materials and methods: The research was conducted out toward the MES Dental College in Perinthalmanna, Kerala, in the Department of Oral and Maxillofacial Surgery. After mandibular third-molar surgical removal, researchers studied 60 individuals, 30 of whom had normal saline irrigation (group I), and 30 of whom received 0.05% povidone-iodine irrigation (group II). The postoperative discomforts were measured on the second and seventh days after surgery, respectively. After that, the data were analyzed using SPSS. The data analysis considered p-values less than 0.05 to be significant.

Results: At the second postoperative visit, patients in the povidone-iodine group reported much less pain, swelling, and reduced mouth opening than those in the normal saline group. But on the seventh postoperative day, there was not much difference between either group.

Conclusion: Following the surgical removal of teeth, it was revealed that povidone-iodine solution (0.5 mg/mL) was more effective as irrigation and cooling aid than regular saline solution.

Clinical significance: Low-concentrated povidone-iodine is a better option in dentistry as irrigant.

Keywords: Postoperative sequelae, Povidone-iodine irrigation, Saline irrigation, Third-molar surgery.

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**Introduction**

Surgical removal of the impacted lower third molar is commonly performed to treat the pathosis caused by that tooth, which includes irreversible tooth decay, inflammation of the tooth’s supporting tissues and operculum, and cystic alterations in the dental sac. The literature contains numerous explanations offered by researchers for why third molars may become impacted. The progressive reduction in the size of human jaws due to evolution, less stimulation of jaw growth due to refined food consumption, and differential root-growth pattern are the most commonly accepted ones. Elective removal of third molars may be necessary if they obstruct prosthesis or prior to orthognathic surgery to avoid an unfavorable sagittal split. On the first assessment, patients were given treatment options based on the predicted difficulties of the procedure, the patient’s medical history, anxiety, and preference.

According to various studies, mesioangular (49.2%) is the most common impaction followed by vertical (24%), horizontal (20%), and distoangular (4.8%).¹ Mesioangular is a tooth with mesial tilt and angulation in the range of 11–79°. The last erupting molar begins its development in a horizontal angulation during normal development, and as the jaw grows, the angulation shifts from horizontal to mesioangular, then to vertical. The most common cause of a tooth getting impacted is a failure of rotation from the mesioangular to the vertical orientation. The pathologies associated with wisdom teeth depend on the spatial relationship between the second and third molar, it was dental caries (19.9%), periodontal pockets (15.2%), and root resorption (8.5%). When compared with other forms of impactions, Prasanna Kumar et al.² revealed that mesioangular inclination is highly associated with the development of caries (33.9%) and periodontal pocket formation (16.4%).

Swelling, pain, and trismus are all transitory side effects that might occur after an odontectomy because of the normal inflammatory reaction to tissue manipulation.¹ Inflammation is a response of mammalian tissue toward destructive agents. This reaction is characterized by redness, swelling, warmth, pain, and restricted movement of the afflicted area. When tissue damage occurs, a large number of inflammatory mediators are released at the site of the injury. Due to arterial dilation and endothelial gaps, these mediators encourage enhanced blood flow and the recruitment of defense cells to the site of damage. Tissue repair and function restoration occur as a result of these events. In other
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cases, excessive and unwanted inflammation ensues, leading to chronic pain and edema.

Pain is a multimodal sensory experience and a subjective condition that is inherently unpleasant and associated with hurting and discomfort. Scales for measuring pain can be single-dimensional or multidimensional. Since facial swelling comprises three dimensions of measurement, has an uneven, convex surface, and can appear both internally and externally, it is challenging to accurately quantify. While fair-skinned patients looked to have more swelling than fat ones, lean patients appeared to have more swelling than obese ones. Vernier calipers, modified face-bow devices, and photographic measures are recent measurement tools. Multiple needle pricks, severance of temporalis and medial pterygoid muscle, and low-grade infections are causes of jaw stiffness. When a muscle is injured, a pain reaction is triggered. “Muscle guarding” is a phenomenon that develops when muscle fibers are both uncomfortable and stretched. As a result of the discomfort, the muscles constrict, resulting in a reduction in range of motion.

Nowadays, operating surgeons have tried to implement various techniques to reduce these postoperative sequelae. Nonsteroidal anti-inflammatory drugs (NSAIDs), antibiotics, corticosteroids, and proteolytic enzymes (serratiopeptidase, chymotrypsin) are some of the medications that can be used in combination with various surgical closure techniques.

Shelanski and Shelaniki discovered povidone-iodine in 1956, and it is a powerful antiseptic. Polyvinylpyrrolidone and iodide form a complex with iodine via a hydrophobic link between two pyrroles. Although the majority of elemental iodine is complexed with polyvinylpyrrolidone and iodide, a little quantity of free iodine is constantly released, remains in dynamic equilibrium with the complex, and conducts iodine-specific chemical processes until the active iodine is depleted. As an antiseptic, povidone-iodine (polyvinylpyrrolidone iodine) has bactericidal effects on many distinct microorganisms. Studies on its hemostatic and anti-inflammatory activities have been successful in the past. Several studies have revealed that PVP-I inhibits human neutrophil-mediated TNF-α production and the proliferative enzyme β-galactosidase, bringing an end to the disease process.

When extracting an impacted lower molar tooth, dental experts utilize isotonic normal saline as an irrigant and coolant, and it is regarded as the best inert cleaner for chronic wounds. The isotonic character of this crystalloid fluid as compared with serum plasma is the primary justification for its use in humans.

The search for a reliable intervention, which can be used during the removal of partially or completely unerupted wisdom teeth, led us to choose the low-concentration povidone-iodine solution to improve patient satisfaction. The efficiency of low-concentration povidone-iodine and normal saline in minimizing postoperative difficulties after third-molar surgery is investigated in this study.

Materials and Methods

In total, 60 patients with a mesioangular impacted mandibular third molar who came to MES Dental College for surgical removal in the study period of January 2020 to September 2021 were included in this comparative research. The Institutional Ethical Committee approval number obtained was IEC/MES/43/2018.

Detailed case histories were gathered from each patient using the accompanying proforma after they had given their informed consent. There were two groups with 30 samples in each, and the sampling technique was simple random sampling. Assessment was done by the same principal investigator in both groups. All patients were asymptomatic. Facial measurements and interincisal distance were measured preoperatively in all patients. The sample size was calculated using this formula, and the required sample size was 17 ($p^1 = 0.633, q^2 = 0.367, p^2 = 0.166, q^2 = 0.834$).

$$n = \frac{(z_1^2 + z_2^2) \left(1 + \frac{1}{r}\right)}{z_1^2 q^2 + p^2 q^2/\Delta}$$

Inclusion Criteria

- Patients requiring removal of single lower mesioangular-impacted third molar.
- Age-group 18–40 years.

Exclusion Criteria

- Patients with systemic diseases.
- Pregnant and lactating women.
- Patients on long-term steroids.
- Patients with existing active infection.
- Patients under anticoagulant therapy.
- History of hypersensitivity to iodine.

Group I (Control Group)

The subjects were anesthetized with conventional intraoral mandibular nerve block (2% lignocaine with 1:80,000). During osteotomy and tooth sectioning, 0.9% saline was utilized in group I as an irrigant and coolant. After surgical exodontia, the socket was flushed with 30 mL of saline. Postoperative pain was measured using a Visual Analogue Scale ranging from 0 to 10, with 0 representing no pain and 10 reflecting the worst. Orotragus (Fig. 1) and mentotragus (Fig. 2) distances were used to measure facial swelling. The orotrugs and mentotragus distance is the measurement from tragus prominence of the external ear to the corner of the mouth and to the most inferior point of the symphysis in the midsagittal plane.

Fig. 1: Orotragus distance (measurement of facial swelling)
plane, respectively. Trismus was assessed by measuring interincisal distance. Assessments were made before the procedure and on the second day of postoperative care, in addition to the seventh day. Following the procedure, the patient was given the same antibiotics and analgesics in both groups.

**Group II (Povidone-iodine Group)**
During osteotomy and tooth sectioning, 0.05% povidone-iodine solution was used in group II. It was made by dissolving 10% of povidone-iodine (1 mL) in 20 mL of normal saline to get a concentration of 5%. About 1 mL of this solution was again diluted in 100 mL of normal saline. This is recognized as “Arakeri’s iodine solution”. After surgical exodontia, the socket was flushed with 30 mL of betadine solution. Postoperative pain was measured using a Visual Analogue Scale. Orotragus and mentotragus distances were used to measure facial swelling. Assessments were made before the procedure and on the second day of postoperative care, in addition to the seventh day.

**Statistics**
The data were coded and entered into an MS Excel spreadsheet before being analyzed with a Social Science Statistical Package (SPSS 20). Analyzes of the data were performed using descriptive statistics. The percentage has been used to express the proportions. Continuous variables are given a mean and a standard deviation. To investigate differences in parameters, t-tests and Mann–Whitney U testing were utilized.

**Results**
In the normal-saline group, there were 10 men and 20 women who made up 33.3% and 66.7%, respectively, of the sample. A total of 8 men (26.7% of the total) and 22 females (73.3%) were in the povidone-iodine group. Normal saline and povidone-iodine group had a mean age of 24.7 ± 5.2 and 24.8 ± 5.2, respectively, in the study.

**Comparison of the Pain at the Different Time Intervals**
Both study groups did not have any pain preoperatively. On the second postoperative day, pain was measured at 4.6 ± 1.3, and on the seventh postoperative day, it was measured at 0.9 ± 0.8. On the seventh postoperative day, the povidone-iodine group’s pain score was 0.9 ± 0.7, which is a marked decline from the 2.4 ± 1 score on the second postoperative day. Pain was drastically decreased in the povidone-iodine group on average (Table 1 and Fig. 3).

**Comparison of Orotragus and Mentotragus Distance at the Different Time Intervals**
Both at postoperative days two and seven, the average orotragus distance varied significantly between the treated groups with povidone-iodine or saline. The povidone-iodine group’s mean mentotragus distance was significantly less on the second postoperative day (Tables 2 and 3) (Figs 4 and 5).

**Comparison of Interincisal Distance at the Different Time Intervals**
At the second postoperative visit, the povidone-iodine group had a considerably greater mean maximum interincisal opening than the comparison group (Table 4 and Fig. 6).

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**Table 1: Comparison of the pain at the different time intervals**

<table>
<thead>
<tr>
<th></th>
<th>Normal saline group</th>
<th>Povidone-iodine group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>Mean ± SD</td>
<td>Median</td>
</tr>
<tr>
<td>Preop</td>
<td>0 ± 0</td>
<td>0.0</td>
</tr>
<tr>
<td>Day 2</td>
<td>4.6 ± 1.3</td>
<td>4.5</td>
</tr>
<tr>
<td>Day 7</td>
<td>0.9 ± 0.8</td>
<td>1.0</td>
</tr>
</tbody>
</table>

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**Table 2: Comparison of orotragus distance at the different time intervals**

<table>
<thead>
<tr>
<th>Orotagus distance</th>
<th>Normal saline group</th>
<th>Povidone-iodine group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Preop</td>
<td>107.3</td>
<td>1.6</td>
</tr>
<tr>
<td>2nd day</td>
<td>114.2</td>
<td>1.7</td>
</tr>
<tr>
<td>7th day</td>
<td>110.4</td>
<td>2.0</td>
</tr>
</tbody>
</table>

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**Fig. 2: Mentotragus distance (measurement of facial swelling)**
**Fig. 3: Comparison of pain at different time intervals**
The incomplete eruption of the mandibular third molar is one of the commonly encountered dental problems, which associates with various signs and symptoms. When the lower third molars do not fully erupt, it is mainly due to a lack of space between the second molar and the ascending ramus in the alveolar arch. For the greatest possible result, a detailed understanding of what may go wrong and how to avoid it before, during, and after extraction of an impacted mandibular third molar is essential.

The post-surgery phase is marked by mild-to-moderate discomfort. A number of functional and structural changes can be predicted following an extraction due to the loose connective tissue that holds blood and lymph vessels in the area of surgery.

Buccal osteotomy and tooth sectioning require adequate irrigation. It serves as a coolant, lubricant, and aids in the elimination of debris. Povidone-iodine's antiseptic qualities and its impact on reducing surgical site infection has been shown in several research. The release of serotonin, prostaglandins, leukotrienes, and other chemicals into the environment by human effector cells after damage was related to antiedematous efficacy.

Allograft sterilization and preservation studies have examined the toxic effects of PVP-I diluted to low concentrations, which have shown that these quantities enhanced osteogenic gene markers like alkaline phosphatase activity.

As an irrigant and cooling solution during surgical removal of impacted teeth, Arakeri and Brennan used PVP-I 0.5 mg/mL in a study published in 2011. According to the study’s authors, edema was greatly reduced.

### Table 3: Comparison of mentotragus distance at the different time intervals

<table>
<thead>
<tr>
<th></th>
<th>Normal saline group</th>
<th></th>
<th>Povidone-iodine group</th>
<th></th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mentotragus distance</td>
<td>Mean</td>
<td>SD</td>
<td>N</td>
<td>Mean</td>
<td>SD</td>
<td>N</td>
</tr>
<tr>
<td>Preop</td>
<td>144.3</td>
<td>2.4</td>
<td>30</td>
<td>144.6</td>
<td>3.4</td>
<td>30</td>
</tr>
<tr>
<td>2nd day</td>
<td>148.4</td>
<td>2.1</td>
<td>30</td>
<td>145.4</td>
<td>2.2</td>
<td>30</td>
</tr>
<tr>
<td>7th day</td>
<td>144.8</td>
<td>2.5</td>
<td>30</td>
<td>144.5</td>
<td>2.6</td>
<td>30</td>
</tr>
</tbody>
</table>

*Significant at 0.05 level
The hemostatic properties of povidone-iodine have been studied in the past with positive results. Because of the iodine’s corrosive characteristics and the povidone’s thickening and binding abilities, bleeding is halted when using these solutions.

In a previous study of 2014 that compared PVP-I irrigation to normal saline in impacted mandibular third-molar removal on postoperative day 2, the mean reported Visual Analogue Scale scores for the study and control groups were 4.70 and 4.90, respectively, with no significant difference between the two groups. On postoperative day 7, the degree of discomfort was not significant because the mean Visual Analogue Scale scores for the study and control groups were 3.17 and 3.4, respectively.

In this study, the findings show the difference, the mean value of pain experienced in the normal saline group was 4.6 ± 1.3 on the second postoperative day, and it was reduced to 0.9 ± 0.8 on the seventh postoperative day. During the second postoperative period, the mean pain value for the povidone-iodine group was 2.4 ± 1.1, and on the seventh postoperative day, it was 0.9 ± 0.7. During the second postoperative period, the povidone-iodine group showed a statistically significant reduction in pain (p < 0.01) when compared with the normal saline group.

In Arakeri and Brennan study, when compared with postoperative facial swelling on day 1 (p < 0.01, t = 2.83) and day 7 (p < 0.01, t = 7.63), a statistically significant difference (p < 0.01) was identified between the treatment and control groups, with higher measures in patients. Facial swelling assessment was not similar to our study. In another prospective study, a significant difference between two irrigants was observed at the first and second postoperative days (t = −0.55, p = 0.002 on day 2).

Both at postoperative days two (t = 10.02) and seven (t = 5), the average orotragus distance varied significantly between the treated groups with povidone-iodine or saline in this study. The povidone-iodine group’s mean mentotragus distance was significantly less on the second postoperative day (t = 5.52) (p < 0.01).

Yuce et al. undertook a randomized, controlled trial in 2020 to determine the therapeutic efficacy of various povidone-iodine concentrations for the management of postoperative discomforts. All three concentrations (0.5%, 1%, and 3%) of povidone-iodine provided significant reduction in mouth-opening restrictions. The mean interincisal distance (cm) was 3.14 ± 0.48, 3.5 ± 0.46, and 3.3 ± 0.44 on day two. In this study, mean interincisal distance (mm) was 33.3 ± 5.7 (in control group) and 35.7 ± 3.2 (in treatment group).

After the extraction of a mandibular third molar, a double-blind research comparing the postoperative results of 0.02% chlorhexidine chloride solution improves the bone/tooth cutting rates owing to its toxicity is directly proportional to its concentration at cellular level, the ideal concentration for wound irrigation is one percent. The adverse reactions of povidone-iodine such as staining and hypersensitive reactions are reported with higher concentrations. Prescribing betadine gargle in the postoperative period is a better option for fast recovery.

The primary drawback of the current study was the small sample size, which was due to logistical and financial constraints. It is advised to conduct additional clinical trials with high sample sizes in order to acquire more conclusive results and further reduce the unfavorable postoperative effects on patients. The need of prophylactic antibiotic/anti-inflammatory drugs during third-molar surgery might be reduced as a result of this concept. It is advised to investigate the impact of various concentrations of povidone solution on postoperative sequelae in further research using additional samples.

**Conclusion**

This study found that a low concentration of povidone-iodine was a cost-efficient, safe, and effective way to reduce postoperative problems following a third-molar surgical procedure. It is possible that the addition of an extra anion (iodine) to conventional sodium chloride solution improves the bone/tooth cutting rates owing to the “anionic chemo-mechanical effects,” which are also a benefit of povidone-iodine irrigation. This hypothesis is applicable to all surgical specialties.

**References**

2. Prasanna Kumar D, Sharma M, Vijaya Lakshmi G, et al. Pathologies associated with second mandibular molar due to various types of