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Comparison of the Effectiveness of the Methanolic Extract of Green Tea and Chlorhexidine Gel on Pain after Impacted Wisdom Tooth Extraction

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Abstract

Background: One of the main complications of wisdom tooth surgery is postoperative pain. Thus, various methods have been used to reduce postoperative dental pain. This study aimed to compare the effectiveness of the methanolic extract of green tea and chlorhexidine gel on pain after impacted wisdom tooth extraction.

Methods: The participants in this double-blind clinical trial study were 72 patients aged 18 to 40 years who had impacted wisdom teeth in the mandible requiring surgery. To reduce postoperative dental pain, 5% green tea extract and 0.2% chlorhexidine gel were used for one week after surgery. The collected data were analyzed using mean, standard deviation, frequency, and repeated measures ANOVA at a confidence level of 0.95.

Results: The intensity of postoperative pain was at the highest level in both green tea and chlorhexidine gel groups on the first day and the pain intensity gradually decreased until the seventh day. The pain score reported by the patients using green tea was slightly lower than the pain score for the patients using chlorhexidine gel. However, there was no statistically significant intergroup difference in terms of the mean pain score (P = 0.21). There was a statistically significant difference between the groups that used green tea and chlorhexidine in terms of the number of analgesics used after surgery (P = 0.04). The mean number of analgesics used by the participants in the chlorhexidine group was higher.

Conclusion: Green tea extract can be recommended as an effective compound in reducing the severity of pain after impacted wisdom tooth extraction.

Keywords: Impacted tooth, Green tea, Chlorhexidine, Pain, Surgery

Background

Oral health is part of general health and oral problems such as impacted teeth, periodontal problems and tooth decay affect various aspects of quality of life. The high prevalence of tooth impaction, as well as the unforeseen complications associated with surgery, highlights the need to find an effective solution to reduce these complications (1,2). The prevalence of impacted wisdom teeth was reported to be 52.26% in the mandible and 27.7% in the maxilla (3). On the other hand, the non-removal of impacted wisdom teeth leads to problems such as dull head and face pain, cysts, benign and malignant tumors, and inflammation of the tissues adjacent to the teeth (4). As a general rule, all impacted teeth should be extracted, unless their extraction is contraindicated. Extraction of the impacted mandibular third molars is one of the common dental surgeries, but it is associated with inflammatory reactions that cause pain, swelling, and trismus (lockjaw) (5). This pain and inflammation is a physiological response of the body to injury. The inflammatory process is necessary for the postoperative recovery process, but excessive inflammation often causes swelling, pain, and trismus in the patient (6). So far, various methods have been proposed to control and minimize these side effects, such as the use of hot and cold compresses, the use of various drains and drugs. However, the effectiveness of these methods has always been questioned.

Postoperative complications resulting from surgery include edema, trismus, and pain, which cause morbidity and affect patients' quality of life, and many people stay away from dentistry because of unpleasant experiences (1,7). Postoperative pain control with analgesics is considered as the basis of treatment. However, due to the known side effects of salicylate and opioid compounds, the adverse effects of nonsteroidal anti-inflammatory drugs such as ulcers and gastric bleeding, and complications of corticosteroids such as inhibition of tissue macrophage function and inhibition of antibody production, many attempts have been made to reduce the use of drugs by finding newer analgesics (8-11).

In recent years, the use of medicinal plants instead of chemical drugs has increased due to fewer side effects and a variety of effective compounds, and most people prefer to use herbal substances to reduce the possible side effects of chemical drugs (12).

Tea can be considered one of the most important medicinal plants in the world. Tea is made from the leaves of the Camellia Sinensis plant and is divided into several categories based on the type of processing. Green tea is made by drying and steaming fresh leaves and does not undergo any fermentation or oxidation process. Studies have reported that green tea extract has antibacterial and antiviral activity, and is also effective in improving neurological and cardiovascular diseases, and diabetes. The antioxidant and anti-cancer properties of polyphenols in this plant have been proven (13,14).

Tea contains approximately 400 bioactive compounds, one-third of which are polyphenols. Polyphenols belong to a large group of substances called catechins, and the presence of this compound in tea can explain the benefits and potential effects of tea on oral health. Due to the presence of these compounds, green tea has unique anti-inflammatory, antibacterial, and anti-decay properties, and reduces gingivitis (14,15). The anti-inflammatory and anti-bacterial properties of green tea reduce postoperative dental pain, decrease the need for painkillers, and are without side effects, while non-steroidal painkillers and antibiotics have side effects. Catechins in tea also reduce the activity of oral bacteria, which in turn reduces postoperative dental pain (16). Commercial antiplatelet agents are mainly antibacterial compounds, but they can disrupt the oral bacterial flora and lead to the induction and growth of opportunistic pathogens, including Candida albicans. There is evidence for the indirect antibacterial effect of tea by increasing the secretion of salivary protective compounds such as immunoglobulins, lysozyme, lactoferrin, histatins, and mucin (17, 18).

Chlorhexidine was first developed more than 40 years ago and has been used extensively in medicine and particularly in dentistry as a standard substance to control chemical plaque and decay. However, its side effects such as changes in taste, bad flavor, discoloration of teeth, tongue, and gums, and stomach upsets have prevented its widespread use (19- 21).

A study by Halabi showed that the alveolar osteitis after tooth extraction was less frequent in chlorhexidine than placebo (22). Shahakbari et al. examined the effect of green tea mouthwash compared to chlorhexidine in patients with acute pericoronitis and introduced this compound as an effective substance for controlling pain and trismus in acute pericoronitis. (23). Other studies showed that chlorhexidine significantly reduced the number of oral bacteria and infections compared to green tea, fluoride, and probiotics (24, 25).

As mentioned earlier, various methods have been proposed to control and minimize the effects of impacted wisdom tooth extraction. However, the effectiveness of these methods has always been questioned. Furthermore, given the prevalence of traditional medicine in the world and the public acceptance of herbal compounds instead of chemical drugs, the present study aims to compare the effect of methanolic extract of green tea and chlorhexidine mouthwash on reducing pain after impacted wisdom tooth extraction.

Methods

The protocol for this double-blind clinical trial study was approved with the code of ethics IR.KMU.REC.1397.240 by the Ethics Committee of Kerman University of Medical Sciences. Following a similar study by Soltani et al. and using the data related to mean bleeding time in the green tea group and control group (5.87±1.76 vs. 10.09±3.61) (25), G-Power software, independent samples t-test, and assuming $\alpha = 0.05$, $\beta = 0.95$, and the effect size = 1.48, the minimum sample size was estimated as 26 persons. However, to obtain more reliable results, 72 persons were selected as the participants in the research sample. The patients aged 18 to 40 years who had an impacted wisdom tooth in the mandible and required surgery were evaluated in this study. The participants were selected using convenience sampling from among the patients who visited the surgical ward of the School of Dentistry. The inclusion criteria were having moderate difficulty level of impacted teeth according to the Pederson index (17) surgery of empactes mandibular third molar SIM score, having no allergy to green tea, not taking any medication in the past month, not taking herbal supplements, having no bleeding disorders or systemic diseases, having no acute or uncontrolled surgical infection, and not taking any analgesics, corticosteroids, or antibiotics in the past two weeks. The exclusion criteria were smoking, pregnancy, or breastfeeding, and having a lesion in the surgical site on panoramic radiography (16, 26). Before conducting the study, the objectives and significance of the research project were explained to the patients. They were also told that their information would be kept confidential. Then, the informed consent was obtained from the patients.

To prepare 5% green tea extract, fresh Camellia Sinesis leaves were first dried in a pharmacology laboratory at 40 °C for 45 minutes and ground in an electric grinder. Afterward, 100 g of the powder was mixed with 500 cc of water. After 48 hours, the mixture was filtered and the precipitates were removed. The remaining solution was kept at room temperature and green tea extract was extracted after 4 hours. Then, a methanolic gel base was added to the solution to form a gel (27). Thus, 0.2% chlorhexidine gel was obtained by adding a polyphenol gel-based to 0.2% chlorhexidine mouthwash to find a form similar to tea extract.

All wisdom tooth surgeries were performed by an oral and maxillofacial specialist using a similar procedure. Iodopovidone was rubbed around the mouth and the lower alveolar and long buccal nerve blocks were anesthetized using 2% lidocaine with epinephrine 1.80000. The patient's demographic information such as age, sex, duration of surgery, and degree of surgical difficulty was recorded in a form. The patients who required multiple anesthesias or had more surgical difficulty than others were excluded from the study. Using a random number table, the patients were divided into two groups of 36 persons with equal numbers of men and women. Both substances were poured into opaque containers so that their contents were not clear. The containers were coded and the physician did not know the prescribed substances. A statistician analyzed the data based on the mentioned codes and did not know the type of material. After surgery, the patients were instructed to use one of the two compounds twice a day for a week. Thus, they applied 2 cc of the gel to the surgical site using a cotton swab. A visual analogue scale (VAS) was used to record the pain intensity. A zero number on the scale means no pain and 100 means unbearable pain. The patients were instructed to show their pain on this 100

mm scale for seven consecutive days after surgery at a specific time before taking any analgesics. During this period, in case of severe pain, patients were allowed to use only acetaminophen 325-mg tablets and they were not permitted to take any other pain medication. They were also required to record the number of pills taken per day (16).

The collected data were analyzed by SPSS software (version 24). The normality of the quantitative variables was checked by the Shapiro-Wilk test. The chi-square test was used to compare the frequency of gender between the two treatment methods. The independent samples t-test was run to compare the two groups in terms of age, duration of surgery, and postoperative pain. Furthermore, the Mann-Whitney U test was used to compare the mean number of analgesia used after surgery between the two groups. Since the data did not follow a normal distribution pattern, the Spearman correlation test was also run to investigate the relation of the mean pain score with the patients' age and time of surgery in the two groups. All statistical analyses were performed at the significance level of 0.05 (P = 0.05).

Results

The participants in this study were 72 patients with a mean age of 26±3 years. The mean duration of surgery was 58±17 minutes. There was no statistically significant difference in terms of gender, age, and duration of surgery between the two groups (p> 0.05). (Tables 1 and 2).

Table 1. A comparison of the two groups in terms of gender

Groups	Males	Females	Total	P-value
Green tea	15	20	35	0.23
Chlorhexidine	21	16	37	

Table 2. A comparison of the two groups in terms of age and surgery duration

Variable	Groups				P-value
	Green tea		Chlorhexidine		
	Mean	SD	Mean	SD	
Age	25.49	2.769	26.16	3.210	0.34
Surgery duration	54.29	13.457	61.76	19.265	0.06

The results showed that after impacted wisdom tooth extraction and applying both methanolic extracts of green tea and chlorhexidine gel, the pain intensity was at the highest level on the first day and gradually decreased until the seventh day. The patients who used green tea methanolic extract reported slightly lower pain scores every seven days after surgery compared to the patients who used chlorhexidine gel. However, there was no statistically significant difference in the mean pain score between the two drugs and both groups reported a decrease in their pain scores (Table 3 and Figure 1).

Table 3. A comparison of the mean pain scores after taking the two drugs

Measurement day	Green tea		Chlorhexidine		P-value
	Mean	SD	Mean	SD	
1	3.3	1.4	3.5	1.0	0.68
2	2.8	1.3	3.2	1.1	0.11
3	2.3	1.2	2.7	1.0	0.14
4	1.9	1.1	2.0	1.0	0.65
5	1.6	1.2	1.7	1.2	0.71
6	0.8	0.9	1.2	1.0	0.07
7	0.6	0.7	0.9	1.0	0.11

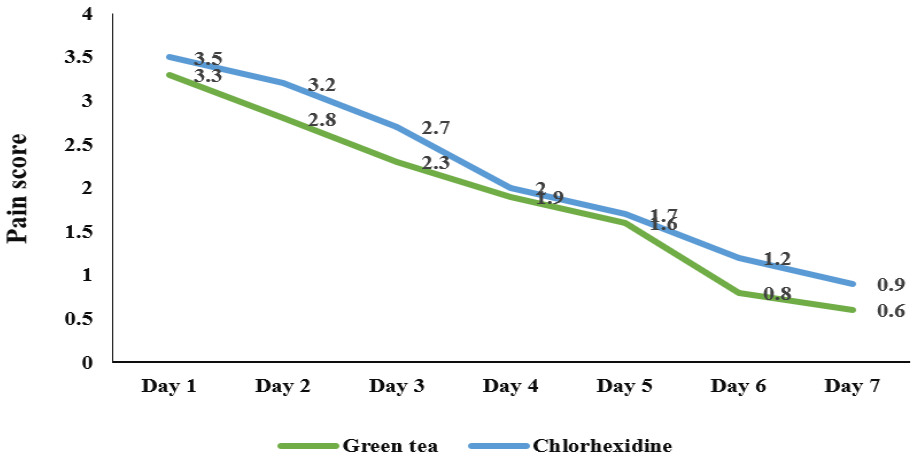

Figure 1. A comparison of the mean pain scores after taking green tea and chlorhexidine

As shown in Table 4, there were no significant differences between the male and female patients in terms of their postoperative pain scores (p>0.05).

Table 4. A comparison of the pain scores between the male and female patients

Measurement day	Males		Females		P-value
	Mean	SD	Mean	SD	
1	3.36	1.199	3.44	1.206	0.798
2	3.00	1.171	3.06	1.218	0.774
3	2.61	1.178	2.47	1.055	0.504
4	1.94	1.013	2.00	1.146	0.860
5	1.69	1.009	1.56	1.403	0.501
6	1.14	0.867	0.94	1.068	0.227
7	0.72	0.701	0.75	0.996	0.728

There was no statistically significant relation between the mean pain score and age on any day in both groups. However, there was a positive significant relation between the mean pain score and the duration of surgery, and the pain has increased as the surgery time increased (p> 0.05). (Table 5 and Figure 2).

Table 5. The correlation between the mean pain score and the duration of surgery

Measurement day	Statistics	Green tea		Chlorhexidine	
		Surgery duration	Age	Surgery duration	Age
1st	Correlation	0.628	0.055	0.591	-0.046
	P-value	<0.001	0.753	<0.001	0.788
2nd	Correlation	0.778	0.115	0.687	0.075
	P-value	<0.001	0.510	<0.001	0.660
3rd	Correlation	0.690	0.238	0.684	0.037
	P-value	<0.001	0.169	<0.001	0.829
4th	Correlation	0.641	0.049	0.666	0.033
	P-value	<0.001	0.778	<0.001	0.848
5th	Correlation	0.589	0.142	0.758	0.097
	P-value	<0.001	0.417	<0.001	0.569
5th	Correlation	0.506	0.187	0.753	0.059
	P-value	0.002	0.282	<0.001	0.729
7th	Correlation	0.336	0.195	0.790	0.177
	P-value	0.049	0.262	<0.001	0.295

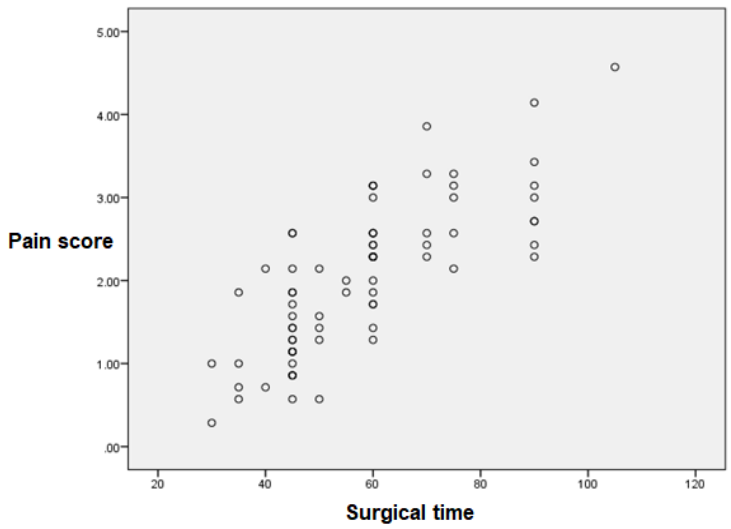

Figure 2. The correlation between the mean pain score and the duration of surgery

There was a statistically significant difference between the two groups using green tea and chlorhexidine in terms of the number of analgesics taken after surgery on the first to the third day, and the patients in the group that took chlorhexidine used a greater number of analgesics. However, from the fourth to the seventh day, there was no significant intergroup difference (Table 6).

Table 6. A comparison of the number of analgesics taken by the two groups

Measurement day	Green tea		Chlorhexidine		P-value
	Mean	SD	Mean	SD	
1	3.3	1.2	4.0	0.5	0.003
2	2.9	1.4	3.8	0.9	0.001
3	2.5	1.6	3.4	1.3	0.003
4	2.0	1.6	2.4	1.7	0.207
5	1.1	1.3	1.5	1.8	0.416
6	0.6	1.1	0.7	1.5	0.793
7	0.3	0.9	0.3	1.0	0.603

Discussion

Impacted teeth are one of the most common reasons for people to see dentists and oral and maxillofacial surgeons. Impacted teeth can cause many problems for a person for various reasons, so in most cases, their extraction is recommended. One of the main complications of wisdom tooth surgery is postoperative pain. Various methods have been used so far to reduce pain after impacted wisdom tooth extraction, but the effectiveness of these methods has always been questioned. The use of painkillers is associated with some side effects. Thus, various methods have been proposed to reduce the need to use painkillers and analgesics (8- 11). Moreover, traditional medicine has currently become a widespread practice in the world and herbal compounds are used widely instead of chemical drugs.

The results of the present study suggested that the intensity of postoperative dental pain after consuming both green tea methanolic extract and chlorhexidine gel was at the highest level on the first day but gradually decreased until the seventh day. The patients who used green tea methanolic extract reported slightly lower pain scores all seven days after surgery compared to the patients who used chlorhexidine gel. However, there was no statistically significant difference in the mean pain score between the two drugs. In general, green tea methanolic extract was more effective in reducing pain after impacted wisdom tooth extraction compared to chlorhexidine gel. There was a statistically significant difference between the two groups using green tea and chlorhexidine in terms of the number of analgesics taken after surgery, and the patients in the group that took chlorhexidine used a greater number of analgesics until the seventh day.

Tea is made from the leaves of the Camellia Sinensis plant and is divided into several categories based on the type of processing. Green tea is made by drying and steaming fresh leaves and does not undergo any fermentation or oxidation process. Studies have shown that green tea extract has antibacterial and antiviral activity, and is also effective in improving neurological and cardiovascular diseases and diabetes. Polyphenols in this plant have also antioxidant and anti-cancer properties (8). The aromatic compounds of green tea have anti-inflammatory properties at the postoperative inflammation site. The results of the present study indicated that green tea extract reduces postoperative pain after its application in the surgical area. This pain relief effect can be attributed to the anti-inflammatory and anti-bacterial properties of green tea catechins at the surgical site. Furthermore, laboratory studies have reported the effectiveness of green tea against bacteria in periodontal disease and caries (16). Similarly, Awadalla et al. confirmed the effectiveness of green tea as an antibacterial and anti-cariogenic agent (28). Eshghpour et al. assessed the application of green tea mouthwash and demonstrated its effectiveness in reducing postoperative dental pain. Thus, the authors considered green tea as a good choice for controlling postoperative pain and stated that the amount of analgesia taken when using green tea was significantly reduced (17). In another study, green tea mouthwash was introduced as an effective substance for

controlling pain and trismus in acute pericoronitis (29).

Soltani et al. examined the effect of green tea extract on the prevention of gingival bleeding after posterior mandibular teeth extraction and the results showed that green tea extract significantly reduced cavity bleeding caused by tooth extraction and also reduced ichor leakage (26).

Prabakar found that chlorhexidine could significantly reduce the number of oral bacteria and reduce infection compared to green tea, fluoride, and probiotics (24). Another study showed that chlorhexidine, compared to green tea, reduced a greater number of bacteria (25). Moreover, Reflan observed a decrease in the number of Enterococcus faecalis with the consumption of green tea, but it was less effective than chlorhexidine (30). Another animal study examined the extent of surgical site infection when using chlorhexidine, green tea, and povidone-iodine and the greatest reduction in infection was observed with chlorhexidine, and green tea did not have a significant effect on bacteria (31). A study of microbial changes after third molar extraction showed a greater rate of bacterial reduction when consuming chlorhexidine compared to a combination of green tea and Calendula officinalis (32). However, the data in the present study indicated that chlorhexidine gel was effective in reducing patients' pain after impacted wisdom tooth extraction, but was less effective than the green tea extract. A similar study by Haraji and Rakhshan examined the effect of 0.2% chlorhexidine gel on pain prevention in patients undergoing mandibular third molar surgery. The results showed that 0.2% chlorhexidine gel reduced pain in patients by only 31% compared to controls (33). Another study examined pain intensity after gingival surgery and found pain intensity after using mixed green tea and aloe vera mouthwash was significantly lower compared to placebo. (34). However, rinsing the surgical site with green tea does not have the side effects of antibiotics such as bacterial resistance and complications caused by chlorhexidine including changes in taste and discoloration of the mouth. Moreover, green tea is commonly found in Eastern countries and is cheaper and more accessible (16, 19, 21).

Several studies have also shown that chlorhexidine alone is not very effective in relieving surgical complications (35). There are currently few studies comparing the effect of chlorhexidine gel and green tea on pain after mandibular third molar extraction. Babar et al. reported the positive effect of chlorhexidine gel in preventing dry cavities and subsequent pain relief (36), which was partly similar to the results of the present study.

The effect of chlorhexidine gel in reducing pain after the impacted wisdom tooth extraction is probably due to the antiseptic and antibacterial properties of this substance. Since chlorhexidine has a strong cationic charge, it adheres strongly to negatively charged components on the bacterial membrane, causing the membrane to rupture and precipitate cytoplasmic compounds, eventually killing the bacterium, which reduces inflammation of the oral mucosa following a decrease in bacterial activity (19,21).

The results of a meta-analysis showed that the use of chlorhexidine, in any formulation and concentration or diet, was effective in preventing alveolar osteitis in patients undergoing tertiary molar extraction and that chlorhexidine gel was relatively more effective than mouthwash (37, 38). Recent studies have recommended the use of chlorhexidine in combination with other substances such as platelet-rich fibrin (PRF) and analgesics (39-41).

The findings of the present study confirmed a statistically significant relationship between the mean pain score and the time of surgery in the patients in the two groups who used green tea and chlorhexidine so that the pain increased with increasing the surgery time. Bello et al. found that pain, swelling, and trismus increased with increasing wisdom tooth surgery time, possibly due to the release of more inflammatory agents in some cases where the surgery time has been longer, leading to more severe postoperative pain (42).

The data of the present study indicated that the mean pain score of the participants on any of the postoperative days was not statistically significant between males and females. However, de Santana Santos et al. observed

more pain in women than men only in the first 4 and 12 hours after surgery, but 24 and 48 hours after surgery, pain intensity in women was not significantly different from men (43). These differences may be associated with latent variables in males and females, such as hormonal, psychological, or genetic differences.

The results of the present study showed no statistically significant relation between the mean pain score and age in the two groups of patients using green tea and chlorhexidine on any day after surgery. Furthermore, Bui et al. did not find any significant relation between age and surgical complications (44). However, Blondeau reported the complications of wisdom tooth surgery more frequently in women than men (45). Overall, the statistical differences reported in different studies can be attributed to the surgeon's experience, dental condition, dental sockets, the extent to which the patient followed the instructions, and individual and cultural differences.

Conclusion

Overall, the results of the present study indicated that the daily application of green tea can be useful to reduce pain after impacted wisdom tooth extraction. In addition, green tea can reduce the need for analgesics and prevent side effects following the use of non-steroidal anti-inflammatory drugs and chlorhexidine mouthwash.

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Conflict of interest

The authors reported no conflict of interest.

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