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The Effect of Different Factors on the Prevention of Periodontal Pocket Formation on the Distal Surface of the Second Molar after Impacted Wisdom Tooth Removal Surgery: A Literature Review

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Submitted: 2021-02-23; **Accepted:** 2021-03-15; **Published Online:** 2021-04-07; **DOI:** *10.22037/rrr.v5i1.37908*

Introduction: The formation of localized periodontal pockets on the distal surface of adjacent molars is known as one of the asymptomatic lesions associated with impacted wisdom teeth. In this study, the effect of different factors on the prevention of periodontal pocket formation on the distal surface of the second molar following impacted wisdom tooth removal surgery was investigated. **Materials and Methods:** The present study was a review of the related literature published over the last 10 years. The main tool recruited for this purpose was a researcher-made checklist, developed based on the main objectives of the study. Accordingly, wisdom tooth occlusion, suture technique, flap type, and periodontal envelope, extracted from the articles, were recorded in the relevant checklist. The extracted information was finally imported into the SPSS (ver. 20) software package and analyzed, using descriptive and analytical statistics. **Results**: In total, 22 articles, reflecting on the effect of different factors on the prevention of periodontal pocket formation on the distal surface of the second molar following impacted wisdom tooth removal surgery, and meeting the inclusion criteria in this study were retrieved and then reviewed. Based on the preliminary analyses, 15 articles (68.18%) had mentioned periodontal pocket formation after impacted tooth surgery. As well, nine studies had referred to attachment loss in patients. In this review using surveys among patients undergoing surgery, had not demonstrated a significant relationship between periodontal pocket formation and attachment loss. Moreover, eight articles (36.36%) examined flap type employed during the surgery. **Conclusion:** It was concluded that impacted wisdom tooth removal surgery had been thus far introduced directly in many studies as a factor affecting the reduction of periodontal complications, including periodontal pocket formation in adjacent teeth.

Keywords: Molar; Third; Periodontal Pocket; Surgical Flaps; Sutures; Tooth; Impacted

Introduction

Up to now, impacted tooth removal surgery has been discussed among the alternatives in dentistry, as a common procedure practiced in dental offices. Although there is the possibility of impaction for every permanent tooth, the third mandibular molars can be the most affected ones (1). A tooth is called "impacted" once two-thirds of its root has been formed, but has not yet reached the occlusal level. Related studies have shown that 17% of over 10-year-old patients have one impacted tooth, and various factors, including tooth bud malposition, extra teeth, no space in the dental arch, cysts, tooth root decay, and some oral habits can contribute to this condition (2). The bulk of impacted teeth is the third mandibular and maxillary molars (3, 4). The occurrence of this impaction is also more probable in the mandible than in the maxilla. The third molar usually grows at the ages of 18-24, but it sometimes cannot grow or will be impacted (5). If not extracted, this tooth can cause many problems, including caries, adjacent tooth decay, periodontal and orthodontic problems, cysts, pericoronitis, tumors, recurrent pain, interference with orthognathic surgery, and other jaw surgeries for individuals. In most cases, the influence of impaction on the health of adjacent molars and their periodontal tissues leads surgeons to remove the impacted wisdom tooth, which has complications and symptoms, differing from minor to major, including periodontal pocket formation on the distal surface of the second molar. Such side effects also occur by different factors, such as suture selection and technique (6).

In this respect, it is expected that attachment loss followed by pocket formation on the distal surface of these teeth along with the occurrence of periodontitis will occur (7). In addition, the extraction of the impacted mandibular molar is often accompanied by soft and bone tissue removal. Other than these complications including edema, pain, and periodic trismus, there is the possibility of periodontal side effects following this surgical procedure. As stated in the related literature, periodontal pocket formation, clinical attachment loss, and loss of the second molar alveolar bone are possible (8, 9). Periodontal diseases take place in approximately 75% of the adult population, according to the amount of prevention and the type of treatment recruited for this complication (10-12). Plaque control and periodontal pocket prevention are thus introduced as the main part of all treatments and prevention methods in the face of periodontal diseases. Studies have further shown that periodontal pocket formation on the distal surface of the second molar often results in severe periodontitis. Deep pockets on the distal surface of the molars are common in these patients, but the probing depth is often normal in the rest of the mouth. Such pockets even expand to the apical side and cause serious issues (9, 13). Nowadays, flap surgery is the first resort for treating and repairing periodontal pockets. Envelope, triangle, and rectangular flaps are also among the most common techniques used in mouth surgery (7). Flaps are commonly applied by surgeons when gingival and tooth-supporting tissues are damaged, and periodontitis occurs in the form of inflammation, red bleeding gums, and localized periodontal pockets (4, 14, 15). Therefore, it seems that the surgical procedure, especially the flap design adopted in impacted tooth removal surgeries, is of utmost importance. However, research has revealed that the flap design is not highly related to periodontal health after the surgery, but different results have been reported about this connection in long-term and short-term health issues. Among various types of flaps, Szmyd flap can have the best effects on periodontal and bone factors, by retaining the tissue strip on the buccal surface of the second molar, compared with regular triangle ones. (4, 5, 13-16). The main purpose of this study is to investigate the effects of different factors on the prevention of periodontal pocket formation on the distal surface of the second molar following impacted wisdom tooth removal surgery.

Materials and Methods

The Current study is a literature review study and only requires the full text of articles in the field under study, so the full text of all existing studies in the field was included in the study. The present study was done over 10 years and its purpose is to research the effectiveness of preventing the formation of periodontal pockets at the distal of the second molar after impacted wisdom tooth surgery. Published articles in domestic, foreign, and verifiable databases such as Irandoc, Magiran, Ovid, Scopus, Google Scholar, Medline, Embase, Cochrane, Cochrane Library, ISI Web of Science, PubMed, MD Consult, Science Direct, CINAHL databases were used to find the conducted studies. The inclusion criteria were as follow: Studies conducted in the last 10 years (2011-2021) which are in English and their full text is available and registered in the Clinical Trial Registration Center. After the articles related to the study subject were collected, their required information including the place of the research, the name of the first author, and the year that the article was written was extracted in related forms. In the end, the final analysis and interpretation were completed within the results section.

Results

Information exciting in the articles was registered in the first part of the checklist and finally, an important variable of the study including the type of impaction of the wisdom tooth, stitching technique, type of flap, and periodontal pocket that were extracted from each article, was registered in related checklists (Table 1).

Table 1. Characteristics of studies included in the review

	Author name and Year of publication	Number Of Examined samples	Main purpose	Type of impacti on	Angulation of impacted tooth	Flap type	Attachme nt loss	The pocket's average depth
1	Mokhtari (2019)(7)	30	Maxillary second molar teeth problems examination Ater third molar teeth extraction	Soft tissue	NR*	Envelope	+	3.02±0.75

2	Shahoon (2010)(17)	100	Association between mandibular second molar periodontal pocket and the type, and depth of the wisdom teeth	Soft tissue	NR	NR	-	3.00±0.80
3	Arjmand Monfared (2020)(18)	264	Examination the condition of the impacted mandibular third molar and its effect on the nearby second molar in panoramic radiography	NR	Mesioangular	NR	-	(+)NR
4	Syed KB (2017)(19)	979	Prevalence of distal caries in mandibular second molar owing to impacted third molar	NR	Mesioangular	NR	-	NR
5	Ghaeminia (2016)(20)	416	Surgical removal against retention for the treatment of asymptomatic impacted mandibular third molar	NR	NR	NR	-	NR
6	Ardakani (2017)(21)	174	Morphometric assessment of external root resorption of second molar teeth adjacent to the impacted third molars in CBCT imaging	NR	Horizontal, mesioangular	NR	+	NR
7	Hamid Reza Fallahi (2019)(22)	50	Relationship between the type of impaction of mandibular third molars and the caries of distal surface of mandibular second molars	Hard tissue	Impacted mesioangular (34%) and impacted distangular and horizontal (34%) Impacted diagonal (18%)	NR	-	NR
8	Khzam (2016)(23)	1	Treating Advanced Periodontal disease after the Surgical Removal of Impacted third molar with a Multi-Ingredient Recipe	NR	Mesioangular	Mucoperi osteal	-	3
9	Alberto De Biase (2020)(24)	1	Using dentin autologous graft for Prevention of periodontal pocket formation after mandibular third molar removal	Soft tissue, and hard tissue	NR	NR	+	4mm 3mm

10	Zhang Y(2020) (25)	Review	Effects of impacted mandibular third molar removal on periodontal tissue of the adjacent teeth	NR	NR	NR	-	NR
11	Corinaldesi (2011)(26)	11	Treatment of intrabony defects following impacted mandibular third molar removal with membranes	Soft tissue , and hard tissue	NR	NR	+	5.2 ± 3.9 5.5 ± 3.4
12	Aniko-Włodarczyk (2021)(27)	120	The effect of surgical removal of an impacted mandibular third molar on the periodontal status of the second molar	NR	63.67°	Mucoperi osteal	-	3.67±1.39
13	Pham (2019)(28)	38	Periodontal status of the second molar after impacted mandibular third molar extraction	Soft tissue	vertical	NR	+	2.83±0.82
14	Aljuboori (2015)(29)	1	Third molar socket grafting after surgery for prevention of periodontal pocket formation	Soft tissue	NR	Rotational buccal flap	+	3
15	Hari Petsos (2016)(30)	78	Surgical removal of wisdom teeth and periodontal condition of adjacent second molars	Soft tissue, and hard tissue	NR	Mucoperi osteal	+	2.57± 0.5
16	Yi Tian (2021)(31)	26	Removal of nonimpacted third molars on the periodontal condition of their adjacent teeth	Soft tissue	NR	NR	-	2.48 ± 0.23
17	Passarelli (2019)(32)	89	Impact of third molar surgical extraction on the periodontal condition of adjacent second molar	Soft tissue	NR	NR	+	3± 1

18	Fereidooni (2016)(33)	42	Periodontal criterion mandibular second molar after adjacent impacted third molar surgery	Soft tissue	Mesioangular	Triangular flap	+	3.09 ± 0.39
19	Luzuriaga Chávez (2020) (34)	277	Periodontal condition of the second molar near to the mandibular third molar	NR	Mesioangular	NR	-	(%69) > mm 3 (%31) mm3-1
20	Marques (2017)(35)	203	Impacted lower third molars and distal caries in the mandibular second molar. Is prophylactic removal of lower third molars justified?	NR	Horizontal	NR	-	NR
21	M.E. Nunn (2013)(36)	416	Retained Asymptomatic Third Molars and Risk for Second Molar Pathology	Soft tissue, and hard tissue	NR	NR	-	> 4
22	Korkmaz (2015)(37)	56	Does Laterally Rotated Flap Design Influence the Short-Term Periodontal Status of Second Molars and Postoperative Discomfort After Partially Impacted Third Molar Surgery?	NR	Mesiofacial line angle	Rotational flap	-	0.45±1.90 0.51±2.74

*NR: Not reported/ + : Does have/ - : Doesn't have

In the end, after the primary study of the articles on the following bases, there were 591875 articles found overall, based on the keywords and primary search (Table 2). After the primary examination of the mentioned articles, 316 articles entered the study after the entrance and exit elements related to the study subject were examined. Finally, 22 articles with totally matched titles and purposes to the present study were completely studied (Figure 1).

Table 2. Results from databases for primary search of articles based on the key-words

Number	Results of primary search
17600	Total articles
16543	Scopus
518688	Magiran
4628	Irandoc
26404	PubMed
2221	ISI Web of Science
2021	Cochrane Library
1023	CINAHL databases
2158	Science Direct

Under-study years:

Based on the results of the present article, the majority of the articles are related to the years 2016-2019. (Figure 2)

Volume of under-study sample:

The results of examining articles showed that the average under-study sample size is 159.61 samples. The lowest sample size is in case report studies and the highest sample size is 979 and 416 samples.

Depth of periodontal pocket:

According to the results concluded from the articles, the average depth of the periodontal pocket was reported at 3.017 millimeters in 11 studies that included the periodontal pocket in the distal of the second molar after impacted wisdom tooth surgery.

Determination of the frequency of periodontal pocket in distal of the second molar after impacted wisdom tooth surgery:

According to the results of under-study articles, a periodontal pocket was formed in 56.52% of the patients after the impacted wisdom tooth surgery was done. (Table 3)

Table 3. Frequency and relative frequency of periodontal pocket formation in under-study articles

Frequency(٪)	Periodontal pocket
(68.18%)15	+
(31.82)7	-

Frequency of periodontal pocket in distal of the second molar after impacted wisdom tooth surgery based on the existence of attachment loss:

The results of this studies showed that there is no relation between periodontal pocket formation and attachment loss in patients. (Table 4)

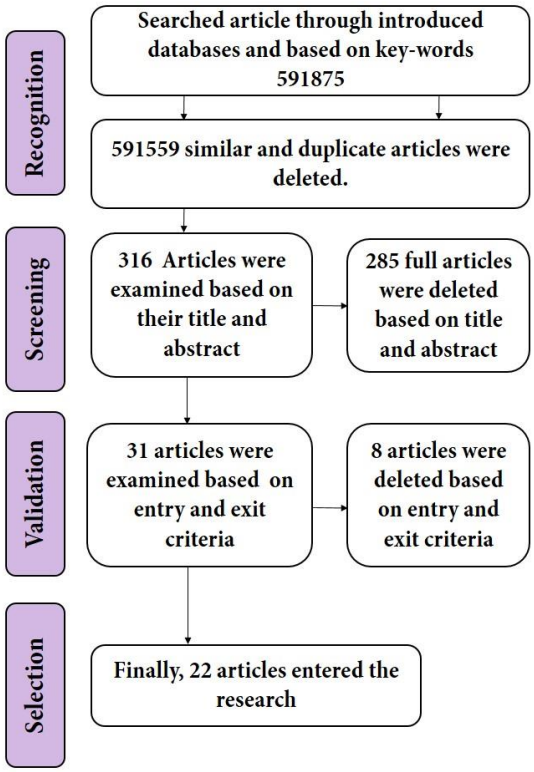

Figure 1. Flow diagram demonstrating search strategy and selection process

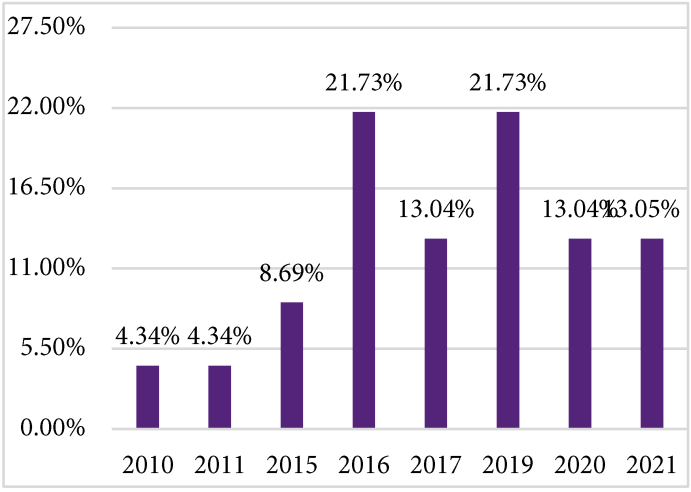

Figure 2. Relative frequency of separation of years of articles reviewed

Table 4. Frequency and relative frequency of periodontal pocket formation based on the existence of attachment loss.

Non-attachment loss frequency Author ,(%)		Attachment loss frequency (٪) Author ,		Periodontal pocket
(31.82)7	Shahoon 2010 Arjmand Monfared 2019 Khzam 2016 Luzuriaga Chávez 2020 M.E. Nunn 2013 Korkmaz 2015	(36.36)8	Mokhtari 2019 Alberto De 2020 Corinaldesi 2011 Pham 2019 Aljuboori 2015 Hari Petsos 2016 Passarelli 2019 Fereidooni 2016	+
(27.27)6	Bokhari 2017 Ghaeminia 2016 Fallahi 2019 Zhang Y 2020 Yi Tian 2021 Marques 2017	(4.54)1	Ardakani 2017	-

+: Does have/ - : Doesn't have

Determination of the frequency of periodontal pocket in distal of the second molar after impacted wisdom tooth surgery based on the type of flap:

The results of periodontal pocket formation based on the type of flap in the reviewed articles are shown in Table 5.

Table 5. Frequency and relative frequency of periodontal pocket formation based on the type on Flap

The flaps that are not assessed in this paper		Mucoperiostal	Rotational		Rectangular	Triangular		Sulcular		Periodontal pocket
(31.82)7	Shahoon 2010 Arjmand Monfared 2019 Alberto De Biase 2020 Corinaldesi 2011 Pham 2019 Yi Tian 2021 Passarelli 2019 Luzuriaga Chávez 2020 Nunn 2013	(18.18)4	Khzam 2016 Aniko-Włodarczyk 2021 Hari Petsos 2016 Passarelli 2019	(9.09)2	Aljuboori 2015 Korkmaz 2015	0	(4.54)1	Fereidooni 2016	(4.54)1	Mokhtari 2019	+
(36.36)8	Bokhari 2017 Ghaeminia 2016 Ardakani 2017 Fallahi 2019 Zhang Y 2020 Marques 2017	0		0	0	0		0		-

+: Does have/ - : Doesn't have

The results of periodontal pocket formation based on the kind of impaction of the wisdom tooth in the reviewed articles are shown in Table 6. The impacted wisdom teeth removal is associated with periodontal pocket formation.

Table 6. Frequency and relative frequency of periodontal pocket formation based on the kind of impaction.

Were not assessed in this article		Hard tissue		Soft tissue		Periodontal pocket
(19.23)5	Khzam 2016 Arjmand Monfared 2019 Luzuriaga Chávez 2020 Marques 2017 Korkmaz 2015	4(15.38)	Alberto De Biase 2020 Corinaldesi 2011 Hari Petsos 2016 M.E. Nunn 2013	(42.3)11	Mokhtari 2019 Alberto De Biase 2020 Corinaldesi 201 Shahoon 2010 Pham 2019 Aljuboori 2015 Hari Petsos 2016 Yi Tian 2021 Passarelli 2019 Fereidooni 2016 M.E. Nunn 2013	+
(19.23)5	Bokhari 2017 Ghaeminia 2016 Ardakani 2017 Zhang Y 2020 Aniko-Włodarczyk 2021	1(3.85)	Fallahi 2019	0		-

+: Does have/ - : Doesn't have

Some parameters, including gender- and age-related indices, mesioangular variants, accurate clinical examination of second molar pre-and post-operatively, type of impaction, assessment of depth, design of flap, tools for suture drawing, type of stitches, examination of impaction angle, third molar depth, have a prominent role in decreasing the occurrence of periodontal defects in the second molar, such as periodontal pockets. Beneficial outcomes can be observed for early impacted wisdom teeth removal in young patients. One of the leading causes of periodontal pocket development is the wisdom tooth impaction angle. Therefore, admirable preoperative examinations, appropriate choice of flap operation, traction instruments, and type of suture can minimize the incidence rate of periodontal defect of the second molar after removal of impacted wisdom tooth. The use of mesioangular surgery to extract the mandibular third molars can result in a reduction in the depth of the probe on the distal surface of the second molars and an improvement in the periodontal status. The periodontal condition of the second molars can be affected by the flap design applied in the surgery of the impacted third molar, thereby leading to minimizing postoperative challenges. Great care should be taken with the indications for third molar operation for patients with preoperative periodontal problems due to the clinical risk of worsening pocket depth and loss of adhesion on the distal surface of the second molar after the third molar operation.

Discussion

Impacted tooth removal surgery is one of the most common procedures in dental centers. The emergency of tooth removal depends on various factors, including the destructive effect of impaction on the periodontium due to plaque accumulation and chronic inflammation(38). Moreover, extracting impacted mandibular molars is often accompanied by the removal of soft and bone tissues, which can be associated with different side effects, such as periodontal pocket formation and adjacent tooth trismus (39). Luzuriaga Chávez *et al.,* (34) had reported that the existence of the mandibular third molar could significantly affect the periodontal condition of the second molar, and consequently lead to the periodontal pocket formation, bone resorption, and even caries in their distal region. Moreover, Nunn *et al.,* (36) concluded that the existence of the third molar tooth with

impacted soft tissue could increase the risk of periodontal damage to the second molar up to 4.88 times. Having the third impacted molar tooth that was bulging or bony could further augment the risks of periodontal damage to the second molar up to 1.74 times. Zhang *et al.,* (25) had similarly reported that the surgeries on the third mandibular molars could generally cause periodontal pocket formation, attachment loss, bone loss, and the second molar loosening. Fallahi *et al.,* (22) had also reported that the impaction angle (viz. mesioangular and horizontal) and class Ⅱ could be significantly correlated with decay and periodontal side effects in patients with impacted third mandibular. Many studies explored the causes of periodontal complications on the second adjacent molar following the removal of an impacted tooth. In this regard, Bokhari *et al.,* (19) demonstrated that the mesioangular impaction angle, the male gender, and 21-28 age groups were among the most important factors affecting distal decay, and the subsequent periodontal complications in the second molar in patients with decay expansion in the second mandibular molar, due to the impaction of the third molar. As highlighted in the related literature, the impaction angle of the wisdom tooth was among the factors affecting the occurrence of periodontal pockets in patients. The risk of the second molar periodontal defects after impacted wisdom tooth removal could be minimized through appropriate evaluations before this surgery, the proper selection of flap surgery, traction tools, and suture type, as endorsed in the study by Magda Aniko-Włodarczyk *et al.,* (27). In this study, clinical evaluation of the second molar before and after surgery has been proven effective for relieving the periodontal side effects, such as periodontal pocket formation. In addition, Arjmand Monfared *et al.,* (24) had shown that the impaction angle and depth of the third molars needed to be considered when deciding whether or not to remove the teeth and prevent further complications. According to Fereidooni *et al.,* (33) extracting the third mandibular molars via mesioangular surgery could reduce the probing depth on the distal surface of the second molar, and improve periodontal conditions. Yavuz Tolga Korkmaz *et al.,* (37), had further reported that the flap design used in impacted third molar surgery could significantly influence the primary periodontal health of the second molar, and consequently minimize postoperative discomfort. Moreover, in the study by Shahoon *et al.,* (17), there was a statistically significant difference in the relationship between the depth of the periodontal pocket and the type and depth of wisdom tooth impaction. Based on the study findings, surgeons needed to pay more attention to diagnosing the symptoms of periodontal pockets on the distal surface of the second mandibular molar when examining the clinical condition of adjacent impacted wisdom teeth. This is because the type and depth of impaction could determine the prevention of various surgical complications. Ana Inocêncio Faria *et al.,* (40), reported that in patients with healthy periodontal tissues before their third molar surgery, the pocket depth and attachment loss in the distal second molar could remain unchanged once the third molar was removed. However, the indication for the third molar surgery should be carefully considered for those having periodontal problems before the surgery, as these individuals had a clinical risk of worsening pocket depth and attachment loss on the distal surface of the second molar following the third molar surgery. Impacted wisdom tooth removal surgery was one of the most common oral surgeries to prevent or solve problems, but like all procedures, it could face several complications (41). Mokhtari *et al.,* (7), had also reported that the maxillary third molar surgery does not harm periodontal tissue and the health of this tooth had not been endangered by this surgical procedure. Furthermore, Yi Tian *et al.,* (31) had confirmed that the removal of the impacted third molars had a direct effect on reducing the periodontal complications of adjacent teeth, including the periodontal pocket. Thuy Anh Vu Pham *et al.,* (28), had concluded that the periodontal position of the second molar and the adjacent septum had significantly improved after the impacted molar surgery. In this sense, Hari Petso *et al.,* (30) had reported that young patients, having early removal of impacted wisdom teeth in the mandible, could bring beneficial results. Additionally, Mohammed Jasim *et al.,* (29) found a bone formation on the distal surface of the second molar as well as an absence of a periodontal pocket in a patient undergoing the surgical removal of the mandibular third molar. Adjacent second molar periodontitis was one of the cases that needed to be considered with wisdom tooth surgery and performed by a dentist with sufficient skill. Therefore, various parameters could be effective in improving the results and reducing the complications in adjacent molar teeth.

Conclusion

Impacted wisdom tooth removal surgery has been directly introduced in many studies as a factor affecting periodontal pockets in adjacent teeth. In the studies in which the removal of impacted wisdom teeth has been shown to affect the occurrence of periodontal pockets, gender parameters, age, mesioangular type, accurate clinical evaluation of second molar before and

after surgery, impaction type and depth evaluation, appropriate flap design, suture drawing tools and type of stitches, and careful examination of impaction angle and depth of the third molar, have been mentioned as the effective factors in reducing the risk of periodontal defects of the second molar, including periodontal pockets.

Conflict of Interest: 'None declared'.

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Please cite this paper as: Mohammadi S, Rouzmeh N, Razmara D, Razmara F. The Effect of Different Factors on the Prevention of Periodontal Pocket Formation on the Distal Surface of the Second Molar after Impacted Wisdom Tooth Removal Surgery: A Literature Review. Regen Reconstr Restor. 2021;6 (1): e10. Doi: 10.22037/rrr.v5i1.37908.