

ANALYSIS OF NUTRITIONAL SUPPLEMENTS AND THEIR EFFICACY IN EXTRACTION SOCKET HEALING IN PATIENTS UNDERGOING ORTHODONTIC EXTRACTION OF MAXILLARY PREMOLAR – A SPLIT-MOUTH STUDY

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Introduction: Nutritional supplements have been known to play an effective role in wound healing. Lack of nutrition has been linked to a decline in wound tensile strength and increased infection rates. The present study aims to compare and evaluate the efficacy of nutritional supplements on the healing of the socket in patients undergoing bilateral maxillary first premolar extraction.

Methods: This prospective split-mouth trial includes twenty patients undergoing orthodontic treatment and requiring bilateral maxillary first premolars extraction. They were split into two groups: 'Group 14' received only analgesics, while 'Group 24' received analgesics and additional supplements of multivitamins and minerals. Both the groups underwent extractions at the gap of one month in which '14' was extracted prior to '24' and socket dimensions, Buccolingual width (B), Mesiodistal width (M), and Depth (D) were measured on the day of extraction, day seven and day twenty-one to assess healing.

Results: In this study, 20 patients were split into 'Group 14' (no supplements) and 'Group 24' (with supplements). The patients, 10 males and 10 females had an average age of 18.20 ± 3.23 years. 'Group 24' had a slight reduction in M width on day seven and a slight reduction in B width on day twenty-one when compared to 'Group 14'. However, no values were statistically significant.

Conclusions: The study shows that nutritional supplements led to slight socket healing improvement, but this wasn't statistically significant. It recommends nutrient-rich diets for healing, alongside balanced nutrition, oral hygiene, and advice post-operative instructions.

Keywords: extraction, nutritional supplements, diet, socket healing, wound size, split-mouth, oral hygiene.

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Conflicts of interest:

The authors declare no conflicts of interest

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ANALYSE DES COMPLÉMENTS NUTRITIONNELS ET LEUR EFFICACITÉ DANS LA CICATRISATION DES ALVÉOLES CHEZ LES PATIENTS SUBISSANT UNE EXTRACTION ORTHODONTIQUE DE PRÉMOLAIRE MAXILLAIRE - UNE ÉTUDE SPLIT-MOUTH

Introduction: Il est connu que les suppléments nutritionnels jouent un rôle efficace dans la cicatrisation des plaies. Le manque de nutrition a été associé à une diminution de la résistance à la traction des plaies et à une augmentation des taux d'infection. La présente étude vise à comparer et à évaluer l'efficacité des compléments nutritionnels sur la cicatrisation de l'alvéole chez les patients subissant une extraction bilatérale de la première prémolaire maxillaire.

Méthodes: Cet essai prospectif à bouche divisée inclut vingt patients subissant un traitement orthodontique et nécessitant une extraction bilatérale des premières prémolaires maxillaires. Ils ont été divisés en deux groupes : le « Groupe 14 » a reçu uniquement des analgésiques, tandis que le « Groupe 24 » a reçu des analgésiques et des suppléments de multivitamines et de minéraux. Les deux groupes ont subi des extractions à un intervalle d'un mois au cours duquel « 14 » a été extrait avant « 24 ». Les dimensions de l'alvéole, la largeur bucco-linguale (B), la largeur mésio-distale (M) et la profondeur (D) ont été mesurées le jour de l'extraction, et les jours 7 et 21, pour évaluer la guérison.

Résultats: Dans cette étude, 20 patients ont été répartis en « Groupe 14 » (sans suppléments) et « Groupe 24 » (avec suppléments). Les patients, 10 hommes et 10 femmes, avaient un âge moyen de $18,20 \pm 3,23$ ans. Le « Groupe 24 » présentait une légère réduction de la largeur M au septième jour et une légère réduction de la largeur B au vingt et unième jour par rapport au « Groupe 14 ». Cependant, aucune valeur n'était statistiquement significative.

Conclusions: L'étude montre que les suppléments nutritionnels ont entraîné une légère amélioration de la cicatrisation des alvéoles, mais cela n'était pas statistiquement significatif. Il recommande des régimes alimentaires riches en nutriments pour la guérison, ainsi qu'une alimentation équilibrée, une hygiène bucco-dentaire et des conseils postopératoires.

Mots clés: extraction, suppléments nutritionnels, régime alimentaire, cicatrisation de l'alvéole, taille de la plaie, split-mouth, hygiène bucco-dentaire.

Introduction

Exodontia is defined as the painless removal of a whole tooth or tooth root with minimal trauma to the investing tissues, so the wound heals uneventfully and no postoperative prosthetic problems are created [1]. It results in the depletion of deleterious bacteria as they contribute to depleting the entire oral cavity including gums and teeth. A deteriorated and fractured tooth can ruin your smile and aesthetics, which lead to additional problems if it is left treated. The most likely path to achieve ideal dental hygiene is by having your affected tooth extracted. Additional factors involve the following: crowding seen in any of the arches, supernumerary, over-retained deciduous tooth, malocclusions etc. Often orthodontic extraction of the teeth is done to create a space for further treatment. After the extraction of a tooth, the process of socket healing begins [2]. The average period of soft tissue healing following extraction is three weeks, and bony healing is approximately three to four months. The body's immune system, the cascade of coagulation components, and pathways of inflammation are all activated during an inflammatory response in order to remove cellular debris and prevent the spread of infection. For the purpose of haemostasis, a platelet plug formed from a fibrin-fibronectin matrix is created. This matrix prevents the loss of tissue fluid and acts as a scaffold for cellular infiltration. It has been assumed that platelets are essential for wound healing because they release growth factors that can be seen in the granules, promoting cell migration and proliferation.

The wound-healing process is thereby classified into three phases: - 'inflammation, proliferation and remodelling'. At each stage, there are interactions between cells and chemicals [3]. In addition, the phases overlap significantly. However, there are certain events

in each phase. Studies done by Casey G in 2003 supported that nutritional supplements promoted wound healing [4]proliferative, and maturation. The prolonged process of healing causes delayed recovery and high expenditures for many patients who are having surgical treatment or recovering from their trauma. Accelerated protein, glycogen, and fat breakdown are signs of rapid recovery from wounds. The following components provide descriptions of the primary micro and macro nutrients which substantially aid in wound healing. Nutritional supplements incorporated into your normal dietary intake seem to be more reasonable to restore nutrients and provide additional nutritional value to improve resistance and strength of the inflamed tissues and further enhance wound healing [5].

Nutritional intake in a regular diet endures a crucial part in the process of wound healing. However, its not so practical to look into every particular individual's nutritional intake in person, certain nutrients and proteins appear to be specifically essential in the future wound healing phases. Every stage of the wound healing procedure for wounds depends on proteins. When there is an injury, they serve as the primary building blocks for tissue growth, renewal, and repair. As claimed by many investigators, the body's 'defence and regeneration' mechanisms are directly linked to plasma vitamin levels. This vitamin has a very important role to play in repairing damaged tissues. The human body relies on at least 20 vitamin-like substances and 16 minerals and trace elements for normal health and physiological functions. Vitamin C is crucial for the production of connective tissue, especially collagen. It plays a significant role in collagen synthesis and promotes the proliferation of dermal fibroblasts, essential for wound healing. Fats serve as a source of energy and substrates

for the proliferation, maturation, and haemostasis of epidermal and dermal tissues [6]. They are also critical components of cell membranes and contribute to eicosanoid synthesis, promoting the inflammatory process. Immune system cells like lymphocytes, leukocytes, phagocytes, monocytes, and macrophages primarily consist of proteins and are essential for initiating a healthy inflammatory response during the healing process [7].

Zinc serves as a co-factor for numerous enzymatic reactions involved in RNA, DNA, and protein biosynthesis. Therefore, zinc is vital for all proliferating cells, and a low zinc status can hinder wound closure and reduce wound pressure while suppressing the inflammatory process.[8] Our study is a split-mouth trial designed to assess the efficacy of nutritional supplements in extraction socket healing

in patients undergoing orthodontic extraction of bilateral maxillary first premolars. The main rationale for conducting a split-mouth trial is to eliminate the bias pertaining to surgical site, patient's nutritional and dietary factors which plays a role in wound healing.

Materials and Method

The study was initiated after the approval of the Institutional Ethical Committee [IEC approval number: -DMIHER(DU)/IEC/2023/1069]. The present study is a prospective split-mouth trial, which included twenty patients undergoing orthodontic treatment, requiring extraction of the maxillary first premolar of both sides (14 and 24). For the patients who were referred to the Oral Surgery Department for extraction of '14 and 24', brief history had been obtained. Past medical and dental history will be taken into consideration. The participants were divided into two groups: 'Group 14' (without nutritional supplements) and 'Group 24' (with nutritional supplements). The sample size in total was 20.

Inclusion criteria were patients undergoing orthodontic treatment and requiring bilateral maxillary first premolar extraction. Patients are willing to give consent for the study. Exclusion criteria were malnourished and medically compromised patients, maxillary first premolars with dental caries or periapical pathology and history of restorations like root canal treated teeth, patients non-compliant with nutritional supplements, patients requiring surgical extraction or underwent traumatic extraction, and patients not willing for or missing follow-up. It includes a dental extraction armamentarium, nutritional supplement (multivitamins) graduated periodontal probe, and castroviejo Caliper.

Data Collection

All the extraction were carried out by single maxillofacial surgeon under local anaesthesia. The first maxillary premolar extraction of the right side (14) was done atraumatically. Post-extraction instructions were given and Analgesics (Ketorolac Tromethamine 10 mg) were prescribed as and when required after haemostasis, socket dimensions were recorded and the patients were followed up for seventh and twenty-first day for the same. A minimum of four weeks gap was kept between both procedures. Similarly, maxillary premolar extraction of the left side (24) extraction was done along with analgesic (Ketorolac Tromethamine 10 mg) a nutritional supplement, that is multivitamins (composition – “vitamin supplements: Niacinamide- 5 mg, Vitamin C- 5mg, Vitamin B1- 0.4 mg, Vitamin B2- 0.4 mg, Vitamin B6- 0.1mg, Vitamin A- 240 mcg, Folic acid- 800 mcg, Vitamin B12- 3.5mg, Minerals: Calcium- 150 mg, Iron- 2.5 mg, Zinc- 2 mg, Iodide- 14 mcg”) was prescribed 10 gm of which is to be mixed in cold water and taken twice daily for ten days.

In this study, the socket dimensions, i.e., Buccolingual width (B), Mesiodistal width (M) and Depth (D) of both the extraction sites were measured three times after immediate post-extraction, on day seventh and day twenty-first. The size of the extraction socket was measured with a Castroviejo Caliper (Figure 1) and the B and M dimensions were recorded, using the cementoenamel junction level of the neighbouring teeth as the reference level (rounded up to the nearest 0.5 mm) immediately after extraction, on the seventh and twenty-first day after the extraction. It determines the separation between two points on a plane. A graduated periodontal probe (Figure 2) was used to measure the D of the extraction socket at the centre of the buccal plate, at highest depth between the neighbouring teeth (rounded up to the nearest millimetre).



Figure 1. Castroviejo Caliper



Figure 2. Periodontal Probe

Results and Statistics

In this study, twenty patients were included, 10 were males and 10 females. The mean age of the patients was in the range of 18.20 ± 3.23 years. There were no complications observed during the socket healing phases. Statistical analysis was done by using descriptive and inferential statistics using Student's paired and unpaired t test and software used in the analysis was SPSS 27.0 version and $p < 0.05$ is considered as level of significance. There was significant reduction in Buccolingual (B), Mesiodistal width (D) and depth of the socket (D), on the day seven and day twenty-one when compared to immediate post-extraction socket width and depth, ($P = 0.0001$), depicted in table 1, table 2, table 3 and figure 1, figure 2, and figure 3. In the table, Significant is denoted as (S) and Non-Significant is denoted as (NS). All the values denoted are measured in millimetres.

Table 1: Comparison of B-L in two groups at day 7 and day 21 with immediate post extraction (Baseline) Student's paired t test

Group	Immediate Post Extraction (B-L)	Day 7 (B-L)	Day 21 (B-L)
Group 14	9.75 ± 1.01	6.30 ± 0.80	4.35 ± 0.93
Mean Difference	-	3.45 ± 1.14	5.40 ± 1.31
t-value	-	13.46	18.36
p-value	-	$P = 0.0001^*$	$P = 0.0001^*$
Group 24	9.50 ± 1.10	6.20 ± 1.05	3.25 ± 0.96
Mean Difference	-	3.30 ± 1.38	6.25 ± 1.48
t-value	-	10.69	18.85
p-value	-	$P = 0.0001^*$	$P = 0.0001^*$

* Significant at $p < 0.05$

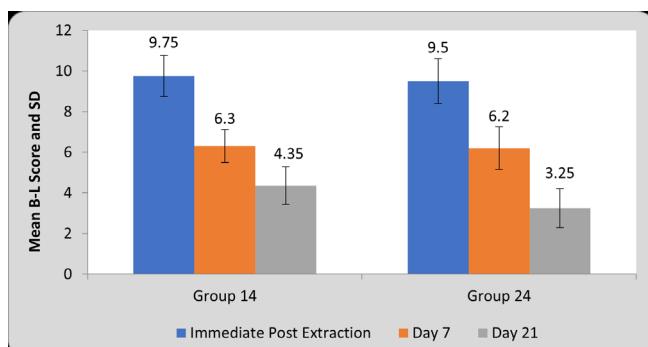


Figure 1. Comparison of B-L in two groups at day 7 and day 21 with immediate post extraction (Baseline)

Table 2: Comparison of M-D in two groups at day 7 and day 21 with immediate post extraction (Baseline), Student's paired t test.

Group	Immediate Post Extraction (M-D)	Day 7 (M-D)	Day 21 (M-D)
Group 14	5.35 ± 1.03	3.65 ± 0.87	1.95 ± 0.68
Mean Difference	-	1.70 ± 0.80	3.40 ± 0.82
t-value	-	9.48	18.52
p-value	-	$P = 0.0001^*$	$P = 0.0001^*$
Group 24	5.60 ± 1.09	3.15 ± 0.87	1.65 ± 0.67
Mean Difference	-	2.45 ± 0.88	3.95 ± 1.27
t-value	-	12.35	13.84
p-value	-	$P = 0.0001^*$	$P = 0.0001^*$

* Significant at $p < 0.05$

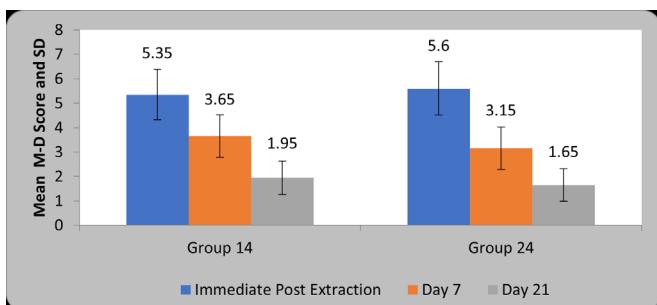


Figure 2. Comparison of M-D in two groups at day 7 and day 21 with immediate post extraction (Baseline)

Table 3: Comparison of Depth(mm) in two groups at day 7 and day 21 with immediate post extraction (Baseline), Student's paired t test.

Group	Immediate Post Extraction (D)	Day 7 (D)	Day 21 (D)
Group 14	9.70 ± 0.97	3.95 ± 0.82	2.10 ± 0.64
Mean Difference	-	5.75 ± 1.11	7.60 ± 1.14
t-value	-	23	29.74
p-value	-	$P = 0.0001^*$	$P = 0.0001^*$
Group 24	9.95 ± 1.05	4.10 ± 0.71	2.05 ± 0.68
Mean Difference	-	5.85 ± 0.93	7.90 ± 1.29
t-value	-	28.03	27.30
p-value	-	$P = 0.0001^*$	$P = 0.0001^*$

* Significant at $p < 0.05$

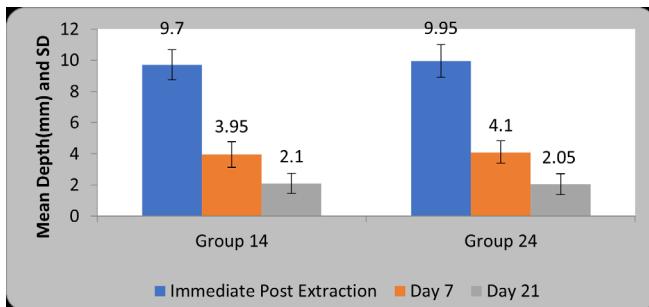


Figure 3. Comparison of Depth(mm) in two groups at day 7 and day 21 with immediate post extraction (Baseline)

Mean reduction in socket width on day seven and day twenty-one was calculated by reducing mean on day seven and on day twenty-one from socket width immediate post extraction. There was no significant reduction in Buccolingual (B) width, and depth of the socket on day seven and day twenty-one depicted in table 4, table 6 and graph 4 and graph 6. However, the mean reduction in Mesiodistal(D), on day seven was statistically significant, ($P=0.008$), depicted in table 4, table 5, table 6 and figure 4, figure 5 and figure 6. There was no significant difference on day 21, depicted in table 5 and figure 5.

Table 4: Comparison of mean difference in B-L in two groups at day 7 and day 21, (Student's unpaired t test).

Group	Day 7	Day 21
Group 14	3.45 ± 1.14	5.40 ± 1.31
Group 24	3.30 ± 1.38	6.25 ± 1.48
t-value	0.37	1.91
p-value	$p=0.71, \text{NS}$	$p=0.093, \text{NS}$

* Significant at $p < 0.05$

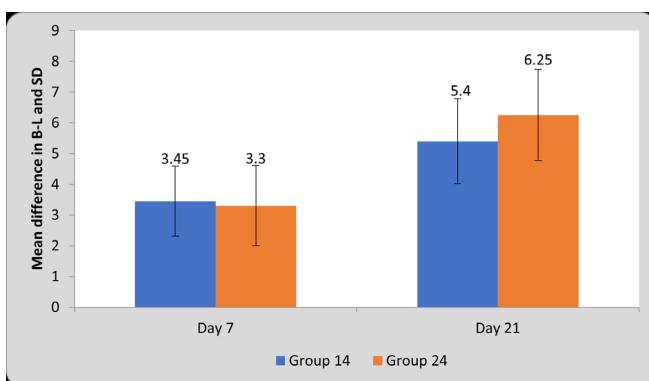


Figure 4. Comparison of mean difference in B-L in two groups at day 7 and day 21 (Student's unpaired t test)

Table 5: Comparison of mean difference in M-D in two groups at day 7 and day 21 (Student's unpaired t test)

Group	Day 7	Day 21
Group 14	1.70 ± 0.80	3.40 ± 0.82
Group 24	2.45 ± 0.88	3.95 ± 1.27
t-value	2.80	1.62
p-value	$p=0.008^*$	$p=0.11, \text{NS}$

* Significant at $p < 0.05$

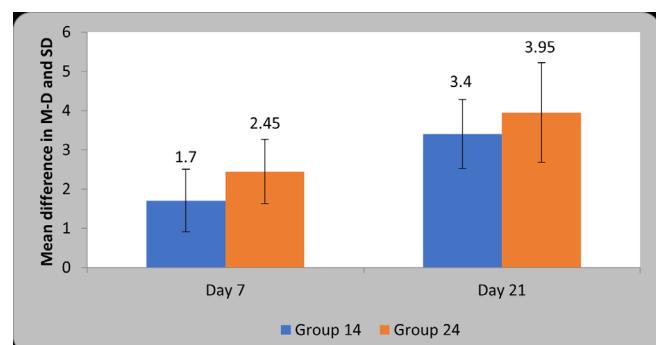


Figure 5. Comparison of mean difference in M-D in two groups at day 7 and day 21 (Student's unpaired t test)

Table 6: Comparison of mean difference in Depth(mm) in two groups on day 7 and day 21 (Student's unpaired t test)

Group	Day 7	Day 21
Group 14	5.75 ± 1.11	7.60 ± 1.14
Group 24	5.85 ± 0.93	7.90 ± 1.29
t-value	0.30	0.77
p-value	$p=0.76, \text{NS}$	$p=0.44, \text{NS}$

* Significant at $p < 0.05$

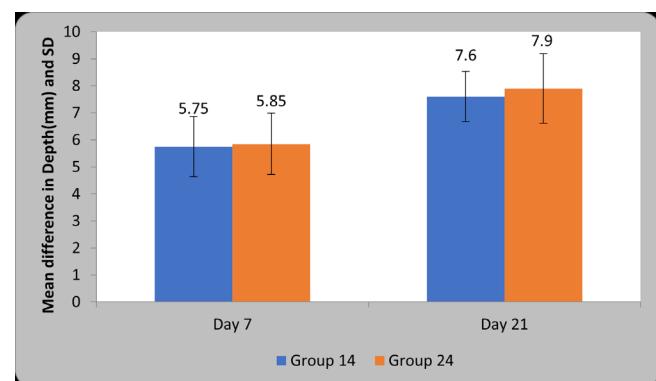


Figure 6. Comparison of mean difference in Depth(mm) in two groups on day 7 and day 21 (Student's unpaired t-test)

Discussion

The present study is a comparative split-mouth trial that is designed to assess the effect of nutritional supplements on socket healing. The rationale behind the split-mouth design and selection of bilateral maxillary first premolars was chosen to eliminate the confounding patient factors, (patient factors such as nutrition-rich diet, height, weight, immunity and overall growth and surgical site bias) while performing the procedure to analyse the proper understanding of the results and reach the objective of the study. The size of the extraction socket was measured with a Castroviejo Caliper and a graduated probe. In this study, the Buccolingual width (B), Mesiodistal width (M) and Socket depth (D) and its relation with the nutritional supplements and wound healing were evaluated to reach the objectives of the study. Atraumatic extraction is crucial for the success of orthodontic treatment. It has been suggested that protein supplements can help improve socket healing and recovery. The potential advantages and issues surrounding the use of nutritional supplements in socket healing during orthodontic extraction procedures will be discussed in the literature. 'Proteins are the basic building block for tissue growth, repair, and regeneration'. A complex healing process involving clot formation, inflammation, cell migration, and tissue remodelling occurs in the socket after tooth extraction [9]. Numerous cellular processes, such as fibroblast and osteoblast migration and proliferation, are involved in the healing of the socket. These procedures can be aided by the proteins in dietary supplements, which will result in faster socket closure and wound healing. There can be many complications after the procedure for example: - delayed

wound healing, dry socket, secondary infection etc that can be decreased with proteins for faster and more effective wound healing [10].

In this study, it was observed that there was a slight acceleration in the socket healing procedure in patients with nutritional supplements as compared to those without supplements. Also, Pisalsitsakul et al. in their article discussed that the significant percentage reduction of the mesiodistal extraction wound size on the 600 mg/d vitamin C side on day 7th ($P < 0.05$) was possibly due to fibroblast differentiation and the blood clot in an extraction wound is replaced by granulation tissue in one week and granulation tissue formation and collagen deposition occur from day 4–14 after injury. However, the mesiodistal dimension is supported by the interdental bone and intact adjacent teeth. Therefore, it was assumed that the mesiodistal change in the extraction wound size was possibly due to gingival tissue healing without the related effect of bone socket collapse. Although the analgesic mechanism of vitamin C is unclear, a previous study reported a correlation between vitamin C and pain control.

Li et al. found that 300 mg/d of vitamin C did not decrease postoperative pain in dental implant surgery; vitamin C supplementation enhances postoperative healing after dental implant surgery in patients with chronic periodontitis but does not lessen the pain felt after dental implant surgery. On day 7th for group B and day 14 post-surgery for groups A, B, and C, each of the experimental subgroups had considerably greater healing indices than the controls ($P < 0.05$) [11].

Ved M. Khosla et al. in their study found that the use of a vitamin B complex formulation reduced the duration of postoperative pain and enhanced healing in patients [12].

By comparing each extraction site with the percentage reduction of the extraction wound and using a split-mouth study design, we were able to control the specific variation between patients and divide a mouth into two or more experimental segments and randomly assign each segment to a different treatment, they are frequently used in dental clinical research [13] where a mouth is divided into two or more experimental segments that are randomly assigned to different treatments. It has the distinct advantage of removing a lot of inter-subject variability from the estimated treatment effect. Methods of statistical analyses for split-mouth design have been well developed. However, little work is available on sample size consideration at the design phase of a split-mouth trial, although many researchers pointed out that the split-mouth design can only be more efficient than a parallel-group design when within-subject correlation coefficient is substantial. In this paper, we propose to use the generalized estimating equation (GEE). A series of intricate biological processes are involved such as nutrition, oral hygiene, and post-operative care. in the healing of wounds since every tissue follows a nearly identical pattern to encourage healing with little scarring [14]. Therefore, an interdisciplinary approach involving orthodontists, oral surgeons, and nutritionists can provide comprehensive care to optimize socket healing outcomes [15].

Limitation

In this study, twenty sample size was used, so it couldn't give us a broader aspect to the study. Also, pain could have been considered as a parameter in the study to see the effect of nutritional supplements on post-operative pain management.

Conclusion

In this study, it was observed that the patients who were given nutritional supplements showed a slight acceleration in socket healing as compared to those without protein supplements, however, the results did not show statistical significance. To add on, patients can be counselled and given post-operative instructions to consume a nutrient-rich diet in their day-to-day life because of the slight benefits shown by them on socket healing. It is important to stress that a well-balanced diet should always be the main priority. Healthy eating, good oral hygiene, and adherence to the post-operative care instructions are a necessity for satisfactory socket healing and overall oral health of the patients.

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