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RESEARCH ARTICLE

# IMMEDIATE IMPLANT PLACEMENT IN SOCKET WITH PERIAPICAL LESIONS :A STUDY OF THE IMMEDIATE DENTAL IMPLANT PROCEDURE IN PATIENTS WITH PERIAPICAL LESIONS IN SANA'A, YEMEN

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## Abstract

**Background and Aims:** Immediate dental implant surgery involves inserting a dental implant into the socket of a recently extracted tooth at the time of extraction. This procedure has garnered significant attention in modern dentistry, particularly in cases of apical lesions. This study explores immediate implant placement in patients with periapical lesions, focusing on outcomes, success rates, and complications among Yemeni patients.
**Methods**: A clinical follow-up study involved patients who had a single tooth extracted from the incisors, canines, or premolars, divided into an experimental group (TG) and a control group (CG). Implants were immediately placed post-extraction, loaded after 3 months for the lower jaw and 4 months for the upper jaw in both groups. Ten patients with unrecoverable teeth and no periapical disorders made up the control group. Ten patients with periapical radiolucencies and pathology who showed no symptoms of discomfort, fistulas, or suppuration were included in the TG.
**Results**: The study involved 50% male and 50% female patients, primarily aged 40 to 48 years (55%), with a mean age of 37.1 years. A significant difference was found between the non-lesion group, which had 100% 'Free' sockets, and the periapical lesion group with 'periapical cyst/granuloma' sockets ($p$=0.000). The distribution of implant sites varied significantly ($p$=0.030), with the periapical lesion group concentrated in the maxillary left arch (70%) and the non-lesion group in the mandibular left arch (50%). Survival rates were 100% in the non-lesion group and 90.0% in the periapical lesion group. A significant reduction in mean bucco-lingual width was noted from baseline to the one-year follow-up ($p$=0.000*).
**Conclusion**: Within the limitations of the current study due to the small sample size, immediate implant placement in extraction cavities with asymptomatic apical periodontitis resulted in a high success rate with stability, no increase in the complication rate, and a similar type of favourable tissue fusion.
**Keywords:** Asymptomatic apical periodontitis, cone beam computed tomography, fresh socket implant, immediate implant placement, periapical lesions, Yemen.

## INTRODUCTION

A dental implant is placed into the socket of a recently removed tooth during immediate dental implant surgery. In contemporary dentistry, this treatment has received a lot of attention, especially when apical lesions are involved. These lesions pose special difficulties in implant dentistry because they are frequently linked to unsuccessful root canal therapy, oral trauma, or irreversible tooth loss. There are many benefits to immediate implant insertion, such as shorter treatment durations, alveolar bone preservation, and improved cosmetic results[1]. By reducing the amount of time between tooth removal and implant implantation, this method may preserve the alveolar ridge's morphological and physiological integrity[2]. The osseointegration of dental implants may be impacted by periapical lesions, which can cause problems like reduced bone quantity and quality[3]. Research on the impact of periapical infections on immediate implant insertion shows contradictory findings. According to certain study, inflammatory processes that impede bone

repair may result in increased failure rates when a periapical pathosis is present[4]. However, other research shows that if proper surgical procedures are followed, rapid installation can still be beneficial in these situations[5].

The results of instantaneous implants placed in infected locations have been investigated in a number of clinical studies. According to a noteworthy study by Carneiro *et al.*[6], patients with periapical lesions had a 2-year success rate of 92.5% for immediate implants, which is similar to success rates in non-infected sites. Peri-implantitis was only reported in a small percentage of cases linked to periapical lesions, according to a systematic review by Cosyn *et al.*[7], that assessed the impact of periapical lesions on the success of immediate implants placed in non-infected sites. This supports the idea that sites with periapical lesions can successfully receive immediate implants with careful case selection and surgical technique. Several studies have reported varying success rates for IIP in sites with PALs. These variations are likely attributable to differences in study design, patient selection criteria, surgical techniques, and definitions of success. Meta-analyses have attempted to synthesize these findings, but the results remain inconclusive due to the heterogeneity of the included studies[7,8]. Factors associated with increased risk of implant failure include the size and extent of the PAL, the presence of sinus tracts, the bacterial load, and the quality of the surrounding bone. The use of adjunctive therapies like antibiotics, antiseptics, and local regenerative materials may influence the outcome, although evidence regarding their effectiveness is not fully consistent[9,10]. The general lack of depend able clinical studies encompassing diverse population sand the requirement for more clinical studies to compare various methods, compare their outcomes, and evaluate their effectiveness, along with the need for long-term clinical studies[11,12].

When done carefully, immediate implant insertion in locations with periapical lesions is a difficult but doable option that can produce positive results. The understanding of immediate implantation in compromised sites is still being improved by ongoing research, which highlights the importance of customised treatment strategies and comprehensive preoperative evaluations[13]. In order to assess outcomes, success rates, and possible problems among Yemeni patients, this study is examined the available data about rapid implant placement in the presence of periapical lesions.

## SUBJECTS AND METHODS

**Study design**: A serial clinical follow-up study.

**Patient selection:** Patients were split into two groups an experimental group (TG) and a control group (CG) and had one tooth (upper or lower) extracted from their incisors, canines, or premolars. In both groups, implants were inserted right away following extraction and loaded three months later in the lower jaw and four months later in the upper jaw. Ten patients without any acute or chronic periapical lesions, unrecoverable teeth (root caries or root fractures), or periapical illness made comprised the control group. Ten patients with periapical radiolucencies and pathology who showed no symptoms of discomfort, fistulas, or suppuration were included in the TG.

**Patient selection criteria:** Being a Yemeni national residing in Sana'a, being between 18 and 48 years of age, having adjacent teeth, possessing four alveolar bone walls, having a bone beyond of at least 4 mm post-root apex, having periapical lesions on all bone walls less than 8 mm, having no local risk factors (such as a history of chronic periodontitis or bruxism), being in good health, and not having chronic systemic diseases. Exclusion criteria included: the presence of a split or perforation in the remaining bone walls, signs of acute infection around the alveolar bone at the surgical site, having diabetes, coagulation disorders, using steroid medications, or smoking heavily (more than 10 cigarettes per day).

**Surgical protocol:** Patients were given two grammes of amoxicillin and clavulanic acid an hour prior to surgery and two grammes twice a day for five days following the procedure. Local anaesthesia was used throughout the procedure. Twenty teeth were removed while maintaining the integrity of the dental socket, including premolars, canines, and incisors.To avoid lifting the gingival mucosal flap, a periodontal probe was used to assess the integrity of the fresh tooth socket walls. All granulation tissue was carefully removed from the periapical lesion area and irrigated with normal saline and iodine. The implant site was prepared using a standard drill, and the apical portion of the implant was positioned at least 4 mm from the root apex. The coronal border of the implant was located 1 mm below of buccal level of the bone crest. In both groups, 20 titanium implants were placed immediately after extraction. All implants were placed with an insertion torque of at least 30 N/cm. After implant placement, a partial-thickness flap was repositioned toward the coronally to initially close the wound, which was then sutured. A chlorhexidine mouthwash was prescribed twice daily for 10 days.

**Follow-up:** The following clinical criteria were assessed: pain, occlusion, and prosthesis mobility. Implant retention success criteria were considered to be: implant stability, absence of a radiolucent area around the implant, absence of signs of peri-implantitis or mucosal suppuration, and absence of pain. Follow-up examinations were performed at baseline and after 12 months. Periodontal pocket depth was measured using a periodontal probe.

**Radiographs:** In order to determine the presence of a radiolucent zone surrounding the root apex before to tooth extraction and one year following implant installation, CBCT exams were carried out both before and after tooth extractions. The most coronal, buccal, and palatal bone where the alveolar crest was located was used to measure the alveolar bone. The most coronally situated point of the alveolar bone on the buccal and palatal edges of the socket was thought to be the alveolar bone borders. One line was drawn from the palatal to the buccal side, 1 mm apical of the top of the alveolar crest, to measure the buccal-palatal

breadth. All measures were carried out by a separate, blinded radiologist who was not aware of the protocol.

**Statistical Analysis:**

The following tests were conducted as part of the study using the SPSS program, version No. 26. For every test, the threshold for statistical significance was established at $p<0.05$.

## RESULTS

Sex is the initial demographic variable reported in the survey, as illustrated in Table 1. The data indicates an equal distribution between genders, with 50.0% of patients (10) being male and 50.0% (10) being female. Age was analyzed as the second demographic variable in a survey, showing that patients aged 40 to 48 years comprised the largest group with 11 patients (55.0%). The second group, those under 40 years, included 9 patients (45.0%). The mean age of the patients was 37.1 years, with a standard deviation of 10.13 years. Marital status, the third demographic variable analyzed, shows that among patients, 70% (14 patients) are married, while 30% (6 patients) are single. The majority of patients exhibited the habit of chewing khat (9 patients, 90%), while smoking was noted in 1 patient (10%), classified as a light smoker (<10 cigarettes per day).

**Table 1: Distribution of patients on different parameters who underwent immediate implant placement in a tooth socket affected and non-effected by periapical lesions.**

| Parameters | Non-lesion group | Periapical lesion group | Total |
|---|---|---|---|
| | Frequency (%) | Frequency (%) | Frequency (%) |
| **Sex** | | | |
| Male | 6 (60) | 4 (40) | 10 (50) |
| Female | 4 (40) | 6 (60) | 10 (50) |
| Total | 10 (100) | 10 (100) | 20 (100) |
| **Age** | | | |
| Less than 40 years | 5 (50) | 4 (40) | 9 (45) |
| 40 to 48 years | 5 (50) | 6 (60) | 11 (55) |
| Total | 10 (100) | 10 (100) | 20 (100) |
| Age Mean±SD | 37.4±10.01 | 36.8±10.78 | 37.1±10.13 |
| **Marital Status** | | | |
| Single | 4 (40) | 2 (20) | 6 (30) |
| Married | 6 (60) | 8 (80) | 14 (70) |
| Total | 10 (100) | 10 (100) | 20 (100) |
| **Habit** | | | |
| Smoking | 1 (16.7) | 0 (0) | 1 (10) |
| Chewing khat | 5 (83.3) | 4 (100) | 9 (90) |
| Chewing Tobacco | 0 (0) | 0 (0) | 0 (0) |
| Others | 0 (0) | 0 (0) | 0 (0) |
| Total | 6 (100) | 4 (100) | 10 (100) |

Table 2 presents the frequency distribution of key patient risk factors for peri-implant disease and mechanical failure in the non-lesion and periapical lesion groups. An important finding is the total absence of bruxism, a known risk factor for implant failure, suggesting that the study's primary outcomes are unaffected by occlusal trauma. Additionally, the prevalence of significant biological risk factors was low and consistent across both groups. Both the Non-Lesion and periapical lesion groups showed a prior history of chronic periodontitis at 0%. Smoking was observed in only one patient (10%) in the non-lesion group, while none were reported in the periapical lesion group. Overall, the data suggests that patients in both groups were low-risk regarding known factors that can lead to long-term implant complications, such as smoking, periodontitis, and bruxism.

**Table 2: Distribution of patient risks assessment for patients.**

| Patient risk assessment | Non-lesion group | | Periapical lesion group | |
|---|---|---|---|---|
| | Yes (%) | No (%) | Yes (%) | No (%) |
| Smoking | 1 (10) | 9 (90) | 0 (0) | 10 (100) |
| Periodontal status | 0 (0) | 10 (100) | 0 (0) | 10 (100) |
| Occlusion state | 0 (0) | 10 (100) | 0 (0) | 10 (100) |

**Clinician and surgical protocol**

Table 3 analyzes the variables of the clinician's procedure and surgical protocol, validating the successful differentiation between two study groups based on pre-operative diagnosis. A significant difference was noted ($p$ value = 0.000*), with the non-lesion group comprising exclusively 'Free' sockets (100%) and the periapical lesion group consisting entirely of sockets identified as 'Periapical cyst / granuloma.' This confirms effective cohort separation regarding periapical pathology presence.

**Dental Arches**: A statistically significant difference was observed in the distribution of the implant sites ($p$ =0.030*).

**Table 3: Frequency distribution of the clinical and surgical protocol.**

| Clinician and surgical protocol | | Non-lesion group | Periapical lesion group | Chi-Square | *p* value |
|---|---|---|---|---|---|
| | | N (%) | N (%) | | |
| Number of teeth | 1 | 2 (20) | 3 (30) | 0.933 | 0.920 NS |
| | 2 | 1 (10) | 1 (10) | | |
| | 3 | 2 (20) | 1 (10) | | |
| | 4 | 3 (30) | 2 (20) | | |
| | 5 | 2 (20) | 3 (30) | | |
| | Total | 10 (100) | 10 (10) | | |
| Dental Arches | Maxillary Right | 1 (10) | 2 (20) | 7.778 | 0.030* |
| | Maxillary Left | 2 (20) | 7 (70) | | |
| | Mandibular Right | 2 (20) | 0 (0) | | |
| | Mandibular Left | 5 (50) | 1 (10) | | |
| | Total | 10 (100) | 10 (100) | | |
| Pre- op diagnosis (Preapical diagnosis for tooth extraction) | Free | 10 (100) | 0 (0) | 20.00 | 0.000* |
| | Chronic periapical periodontitis | 0 (0) | 0 (0) | | |
| | Acute periapical abscess | 0 (0) | 0 (0) | | |
| | Chronic periapical abscess | 0 (0) | 0 (0) | | |
| | Periapical cyst/granuloma | 0 (0) | 10 (100) | | |
| | Total | 10 (100) | 10 (100) | | |
| Bucco-lingual width (mm) Based on CBCT | ≤ 5 mm | 2 (20) | 1 (10) | 1.833 | 0.400 NS |
| | 5.1 – 6.5 mm | 3 (30) | 6 (60) | | |
| | > 6.5 mm | 5 (50) | 3 (30) | | |
| | Total | 10 (100) | 10 (100) | | |
| Implant dimension used Length | 8.0 | 0 (0) | 1 (10) | 1.624 | 0.654 NS |
| | 10 | 3 (30) | 2 (20) | | |
| | 12 | 6 (60) | 5 (50) | | |
| | 14 | 1 (10) | 2 (20) | | |
| | Total | 10 (100) | 10 (100) | | |
| Implant dimension used Diameter | 3.3 | 3 (30) | 2 (20) | 7.200 | 0.066 NS |
| | 3.7 | 3 (30) | 6 (60) | | |
| | 4.3 | 4 (40) | 0 (0) | | |
| | 4.8 | 0 (0) | 2 (20) | | |
| | Total | 10 (100) | 10 (100) | | |
| Primary stability | Yes | 10 (100) | 10 (100) | - | - |
| | No | 0 (0) | 0 (0) | | |
| | Total | 10 (100) | 10 (100) | | |
| Preoperative prophylactic antibiotic | Yes | 10 (100) | 10 (100) | - | - |
| | No | 0 (0) | 0 (0) | | |
| | Total | 10 (100) | 10 (100) | | |
| Post operative Systemic Antibiotic | Yes | 10 (100) | 10 (100) | - | - |
| | No | 0 (0) | 0 (0) | | |
| | Total | 10 (100) | 10 (100) | | |

Chi-Square Test, * $p < 0.05$, NS = Not significant.

The periapical lesion group showed a concentration in the maxillary left arch (70%), whereas the non-lesion group was more focused in the mandibular left arch (50%). This difference in distribution should be noted as a potential limitation in the Discussion section, although the clinical implication on implant outcome may be minor.

**Pre-operative bucco-lingual width**: The initial horizontal bone dimension showed no statistically significant difference between the two groups ($p$= 0.400 NS). This homogeneity in pre-operative ridge width is strength of the study, as it indicates that the presence of a periapical lesion had not caused a statistically greater horizontal bone defect prior to surgery, thereby setting a comparable baseline for assessing subsequent bone preservation.

**Implant Dimensions (length and diameter):** The distribution of implant lengths ($p$=0.654 NS) and diameters ($p$=0.066 NS) was statistically similar across both groups. This homogeneity is important to prevent confounding the results with differences in implant surface area or biomechanical stress distribution.

**Primary implant stability:** A prerequisite for immediate placement protocols was successfully achieved in 100% of all cases in both the Non-Lesion and periapical lesion groups. This finding is critical, as it confirms that all implants were placed under optimal mechanical conditions, allowing for a fair comparison of the biological response (Table 3).

**Preapical lesion:** Table 4 presents a descriptive analysis of the periapical lesion group (N=10), detailing lesion size and management during immediate implant placement. All lesions were ≤ 7 mm in size; 60% measured between 5.1-7 mm, and 40% were ≤5 mm. The absence of lesions ≥ 7 mm is favorable as smaller lesions correlate with a reduced bacterial load and a greater likelihood of successful biological containment. Apical clearance studies revealed that all cases had a space of ≥ 4 mm between the periapical lesion border and the final implant length, ensuring

sufficient apical bone reserve for optimal primary stability of the implants. Additionally, all cases maintained intact bony walls, which favors immediate implant success by reducing the need for guided bone regeneration (GBR) and promoting better long-term aesthetic and functional outcomes. **Post operative assessment (one year):**

Table 5 presents a comparative frequency analysis of the key categorical clinical and radiographic outcomes one year after immediate implant placement, utilizing the chi-square test to compare the non-lesion group and the periapical lesion group. The analysis of the critical success/failure binary variables reveals high survival and success rates, with no statistically significant differences observed between the two groups. The single failure in the periapical lesion group, while leading to a numerical difference, was not statistically significant as determined by the Chi-Square test ($p$=0.305 NS). This supports the conclusion that at the one-year mark, immediate placement in sockets with small chronic periapical lesions does not impose a statistically greater risk of failure or implant loss than in pristine sites (Table 4).

**Table 4: Frequency distribution – Preapical lesion.**

| Preapical lesion | | N (%) |
|---|---|---|
| Lesion size | ≤ 5 mm | 4 (40) |
| | 5.1 – 7 mm | 6 (60) |
| | 7.1 – 9 mm | 0 (0) |
| | ≥ 10 mm | 0 (0) |
| | Total | 10 (10) |
| Lesion management | Yes | 10 (10) |
| | No | 0 (0) |
| | Total | 10 (10) |
| Four bony intact | All intact | 10 (10) |
| | Enough intact | 0 (0) |
| | One or more un intact | 0 (0) |
| | Total | 10 (10) |
| Space between lesion and final length | ≤ 4 mm | 0 (0) |
| | ≥ 4mm | 10 (10) |
| | Total | 10 (10) |

**Comparison of mean bucco-lingual width (mm) based on CBCT between non-lesion and periapical lesion group:**

Table 6 presents a crucial quantitative analysis comparing the mean horizontal dimension (bucco-lingual width) of the alveolar ridge between the two study groups (non-lesion group and periapical lesion group) at two time points: pre-operatively (baseline) and post-operatively (one year). This comparison addresses the study's secondary outcome regarding horizontal bone preservation following immediate implant placement. The analysis using the paired samples t-test ($p$ value) revealed a highly significant reduction in the Bucco-lingual width within both groups from baseline to the one-year follow-up: non-lesion Group: $p$ value$^2$= 0.000* (highly significant).

**Table 5: Post operative assessment (one year) for patients.**

| Post operative assessment | | Non-lesion group | Periapical lesion group | Chi-square | *p* value |
|---|---|---|---|---|---|
| | | N (%) | N (%) | | |
| Clinical Mobility | Success | 10 (100) | 9 (90) | 1.053 | 0.305 NS |
| | Failure | 0 (0) | 1 (100) | | |
| | Total | 10 (100) | 10 (100) | | |
| Pain/Discomfort | No | 10 (100) | 10 (100) | - | - |
| | Yes | 0 (0) | 0 (0) | | |
| | Total | 10 (100) | 10 (100) | | |
| Soft Tissue Health | Good | 10 (100) | 10 (100) | - | - |
| | Bad | 0 (0) | 0 (0) | | |
| | Total | 10 (100) | 10 (100) | | |
| Probing Depth (PD) | 1.5 | 2 (20) | 3 (30) | 1.624 | 0.654 NS |
| | 2.0 | 6 (60) | 5 (50) | | |
| | 2.5 | 2 (20) | 1 (10) | | |
| | 3.5 | 0 (0) | 1 (10) | | |
| | Total | 10 (100) | 10 (100) | | |
| Radiographic Status Based on CBCT | Good (Success) | 10 (100) | 9 (90) | 1.053 | 0.305 NS |
| | Bad (Failure) | 0 (0) | 1 (10) | | |
| | Total | 10 (100) | 10 (100) | | |
| Bucco-lingual width (mm) Based on CBCT | ≤ 5 mm | 4 (40) | 6 (60) | 0.800 | 0.371 NS |
| | 5.1 – 6.5 mm | 6 (60) | 4 (40) | | |
| | > 6.5 mm | 0 (0) | 0 (0) | | |
| | Total | 10 (100) | 10 (100) | | |

Chi-Square Test, NS = Not significant.

Periapical lesion group: *p* value[2]=0.000* (highly significant). This finding confirms the universal phenomenon of horizontal alveolar ridge remodeling following tooth extraction and immediate implant placement. The results demonstrate that significant horizontal bone resorption occurred in both pristine (non-lesion) sockets and sockets with periapical lesions, a factor typically attributed to the loss of the periodontal ligament and subsequent resorption of the thin buccal bone plate.

**Table 6: Comparison of mean bucco-lingual width (mm) based on CBCT for patients.**

| Mean bucco-lingual width (mm) based on CBCT | Non-lesion group | | Periapical lesion group | | t test | *p* value[1] |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| Pre operative assessment | 6.13 | 0.99 | 6.14 | 0.62 | 0.027 | 0.979 NS |
| Post operative assessment | 5.16 | 0.94 | 4.98 | 0.82 | 0.456 | 0.654 NS |
| *p* value | 0.000* | | 0.000* | | | |

*p* value[1] Independent- Samples T test, *p* value[2] Paired Samples t test, * $p < 0.05$, NS = Not significant.

**The analysis using the Independent Samples t-test (*p* value[1]) showed the following**: The initial Bucco-lingual width was statistically non-significant (*p*= 0.400 NS) between the two groups. This confirms that the two groups started with comparable initial horizontal bone dimensions. The mean Bucco-lingual width remaining after one year was also statistically non-significant (*p*=0.654 NS) between the non-lesion group (7.40 mm) and the periapical lesion group (7.30 mm).

**Comparison of Mean Probing Depth (PD) between non-lesion and periapical lesion group**:

Table 7: presents the quantitative comparison of the mean peri-implant probing depth (PD) between the non-lesion group and the periapical lesion group after a one-year follow-up, utilizing the Independent Samples t-test. The mean PD values for both groups were exceptionally low and indicative of stable peri-implant soft tissue conditions. The independent samples t-test showed that the slight numerical difference in mean probing depth between the two groups was not statistically significant (*p*=0.821 NS).

The statistically non-significant difference in mean PD is a strong finding that supports the primary objective of the study. It demonstrates that the immediate placement of implants into small chronic periapical lesion sites did not negatively impact the long-term soft tissue health around the implant, resulting in outcomes statistically comparable to those achieved in pristine sockets. This suggests that the thorough debridement and management of the lesion was sufficient to ensure favorable soft tissue healing and stability (Table 7).

**Table 7: Comparison of Probing Depth (mm) with a periodontal probe for patients who underwent immediate implant placement in a dental cavity with a periapical lesion.**

| | Non-lesion group | | Periapical lesion group | | t test | *p* value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| Probing Depth (PD) | 2.00 | 0.33 | 2.05 | 0.60 | 0.231 | 0.821 NS |

*p* value Independent- Samples T test, NS = Not significant.

## DISCUSSION

Because Bacteroides species can persist in asymptomatic periradicular endodontic lesions and in periapical lesions, there is a risk of implant contamination during the initial healing period when implants are placed into the sockets of teeth with periapical lesions[14-17]. Retrograde peri-implantitis appears to have started because bacteria (or cyst/ granuloma) persisted in the bone after the extraction sockets were thoroughly and vigorously debrided, irrigated, and given enough time to heal[14]. In the current study, the analysis of the critical success/failure binary variables reveals high survival and success rates, with no statistically significant differences observed between the two groups. The overall implant survival rate was 100% in the non-lesion group and 90.0% in the periapical lesion group. The single failure in the periapical lesion group, while leading to a numerical difference, was not statistically significant as determined by the chi-square test (*p* =0.305 NS).

This supports the conclusion that at the one-year mark, immediate placement in sockets with small chronic periapical lesions does not impose a statistically greater risk of failure or implant loss than in pristine sites (Table 9). Numerous systematic reviews and meta-analyses that found no statistically significant difference in survival rates or marginal bone loss at one year between immediate implants placed in cavities with small chronic periapical lesions and those placed in unaffected (healthy) sites support this conclusion[18]. Numerous studies have shown that immediate implant placement in periapical diseased sites achieves success and survival rates comparable to those in uninfected sites when appropriate clinical procedures are followed (such as thorough cleaning and antibiotic treatment), which may account for the similar survival rates. There was no statistically significant difference between the rates of 98.1% and 98.2% in one retrospective investigation[19]. Similarly, meta-analyses showed no statistically significant differences in marginal bone or gingival level changes between the two groups after the initial healing period and at one-year follow-up in several studies. These studies have confirmed that success depends on strict adherence to protocols, including thorough cleaning of the extraction cavity to remove all granulation tissue and the use of antibiotics[20]. However, some studies suggest that while overall results are comparable, immediate placement in diseased sites may carry a higher risk of failure (up to

three times higher in some analyses) if the clinical situation is more complex (e.g., requiring concurrent sinus lift) or if adequate antiseptic measures are not taken[21].

The nature of endodontic infections, which are mixed infections dominated by anaerobic bacteria frequently restricted in the diseased root canal, explains the high success rate of fresh-socket implants implanted in both acute and chronic lesions[22-25]. The cultivated germs are usually eliminated after the affected tooth is extracted. The cultivated bacteria are eliminated by extracting the affected teeth with lesion degranulation and administering an appropriate antibiotic prophylaxis[22,26,27]. This may also lessen the inflammatory response and the bone-resorption process. Moreover, a granuloma is thought to be a sterile lesion, and after tooth extraction, bone regeneration may take place[22,28].

Our idea was maintained in our investigation; in situations where reactive soft tissue remained in the extraction sockets of teeth with asymptomatic apical periodontitis, rapid implant insertion revealed no biological impairment in the bone healing process. Cone beam sections showed satisfactory implant integration at the apical area in both groups, and the 12-months implant survival rate was 100%. Reactive soft tissue that remains after tooth extraction in asymptomatic apical periodontitis is an example of fibrovascular proliferation; it includes fibroblasts, mononuclear cells, and new tiny blood vessels in an oedematous extracellular matrix. It may organise in connective tissue during wound healing, persistent inflammation, and specific pathological conditions. It's interesting to note that granulation tissue fibroblasts from healing wounds and chronically inflamed periodontal lesions exhibited comparable in vitro behaviours[29]. Therefore, the chronically inflamed periodontal tissue that is usually removed during surgery might also contain stem cells for wound healing. The analysis using the paired samples t-test revealed a highly significant reduction in the Bucco-lingual width within both groups from baseline to the one-year follow-up: This comparison addresses the study's secondary outcome regarding horizontal bone preservation following immediate implant placement. Maintaining horizontal bone after immediate implant placement is critical for aesthetics and implant success, and is mainly achieved through alveolar ridge preservation (ARP) techniques such as cavity grafting (using bone substitutes and membranes) and specialist methods such as cavity shielding (a partial extraction treatment), all of which aim to reduce bone resorption after extraction, although some bone loss is expected, with combined treatments showing the best results[30].

In the current study, the quantitative comparison of the mean peri-implant probing depth (PD) between the Non-lesion group and the periapical lesion group after a one-year follow-up, utilizing the independent samples t-test. The mean PD values for both groups were exceptionally low and indicative of stable peri-implant soft tissue conditions. The independent samples t-test showed that the slight numerical difference in mean probing depth between the two groups was not statistically significant ($p$=0.821 NS). Our findings are consistent with research and meta-analyses that consistently found no statistically significant difference in mean periodontal pocket depth between immediate implants placed in cavities with periapical lesions following complete cleaning and those placed in healthy (uninfected) locations. For both groups, clinical results, such as periodontal pocket depth, are often favourable and suggestive of healthy gingival function[19,31].

In the current study, Table 9: presents the quantitative comparison of the mean peri-implant probing depth (PD) between the non-lesion group and the periapical lesion group after a one-year follow-up, utilizing the independent samples t-test. The mean PD values for both groups were exceptionally low and indicative of stable peri-implant soft tissue conditions. The independent samples t-test showed that the slight numerical difference in mean probing depth between the two groups was not statistically significant ($p$= 0.821 NS). The statistically non-significant difference in mean PD is a strong finding that supports the primary objective of the study. It demonstrates that the immediate placement of implants into small chronic periapical lesion sites did not negatively impact the long-term soft tissue health around the implant, resulting in outcomes statistically comparable to those achieved in pristine sockets. This suggests that the thorough debridement and management of the lesion was sufficient to ensure favorable soft tissue healing and stability. This result is similar to numerous systematic reviews and clinical trials which have found no statistically significant difference in mean periodontal pocket depth when comparing the two groups at different follow-up periods (e.g., 1, 2, 3 years). The reported mean periodontal pocket depth in both groups is typically low, often ranging between 2 and 3.5 mm, which is consistent with the definition of healthy peri-implant tissue. Moreover, the presence of a periapical lesion, provided the dental cavity is thoroughly cleaned during the procedure and prophylactic antibiotics are administered, does not appear to negatively affect long-term peri-implant soft tissue health, as measured by periodontal pocket depth. Additionally, studies have confirmed that other clinical parameters, such as marginal bone level, bleeding on palpation, and plaque indices, do not show any statistically significant differences between the two groups[32].

The results of the current study, as well as previous studies, indicate that immediate dental implant surgery is a predictable procedure even in the presence of periapical lesions, provided the correct surgical protocol is followed. The lack of variation in gingival pocket depth suggests that proper closure of the soft tissues around the implants, whether or not lesions are present, achieves a healthy biological presentation and similar stability over time. It is important to note that the absolute value of gingival pocket depth alone is not always a reliable indicator of the health or disease of the periapical area; rather, changes in gingival pocket depth over time, along with bleeding on examination and radiographic bone loss, are the main diagnostic indicators of periapical inflammatory disease[33].

**Limitations of the study**

Studying immediate dental implant procedures in patients with periapical lesions within a Yemeni sample faces several limitations, ranging from clinical study design issues to population-specific challenges and resource constraints. Furthermore, the research lacks standardized criteria, as the definitions of "success" and "complications" vary considerably across studies, making it difficult to compare results. The study also suffers from a small sample size, which may lead to unreliable survival rates and limit the power of statistical analysis. The study's follow-up period is limited to one year, which may not accurately reflect biological complications (such as periapical infection or bone loss) that often manifest after a longer period (e.g., 5 years or more).

## CONCLUSIONS

For both groups taken into consideration in the current clinical study, immediate implant placement into extraction sockets with asymptomatic apical periodontitis (periapical lesions) produced an equally favourable type of tissue integration of the implants and did not increase the rate of complications for those implants with primary stability. Unfortunately, little is known about the bone healing process around implants placed immediately; therefore more study is required to evaluate clinical and histological data on the significance of reactive soft tissue in asymptomatic apical periodontitis.

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## AUTHOR'S CONTRIBUTIONS

**Al Shami MM:** formal analysis, conceptualization, data organization, and clinical and laboratory examinations. **Al-Rahbi LM:** supervised the clinical work and approved the final version. **Al-Ashwal AA:** critical review. **Al-Shamahy HA:** critical review. Final manuscript was checked and approved by all authors.

## DATA AVAILABILITY

The associated author can provide the empirical data used to support the study's conclusions upon request.

## CONFLICT OF INTEREST

None to declare.

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