

# EVALUATION OF SITE PREDILECTION FOR SOCKET PRESERVATION

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## ABSTRACT

Changes in alveolar ridge in terms of volume, height and morphological features tend to be clinically significant and may result in difficulty for the placement of a conventional bridge or an implant-supported crown. Bone deformities or resorption from tooth removal can be prevented by a procedure called socket preservation. Studies have discussed the rationale of performing socket preservation as a therapeutic procedure following tooth extraction which includes the procedure done during or after the removal of tooth in order to reduce the risk of external ridge resorption and increase the formation of bone with the socket. This study aims to evaluate the site predilection for socket preservation in maxillary and mandibular anterior teeth following extraction. It is a retrospective study conducted by reviewing 86,000 patient case records of the Saveetha Dental College and Hospital, Chennai, India. A total of 25 consecutive case records of patients for a period of October 2019 to March 2020 with signed informed consent were selected from the Departments of Prosthodontics and Implantology based on the inclusion criteria of patients who have undergone socket preservation procedure indicated for implant placement. Information such as patient's name, patient's identification number (PID), age, gender and area of socket preservation were retrieved from the patients' case records. Datas were entered in Excel and analyzed using SPSS software version 23.0. Descriptive analysis was done for the assessment of age, gender and area of socket preservation. Chi-square test was used to evaluate the association of socket preservation with age and gender. Significant level test was set at less than or equal to 0.05 ( $p \leq 0.05$ ). In this study, higher prevalence of socket preservation was seen in the upper anterior region (60%) than the other sites. Most cases of socket preservation were seen in males (80%) as compared to females (20%). Socket preservation was done mainly in individuals within the 21-30 years age group. Within the limits of the study, socket preservation is done mainly in individuals within the 21-30 years age group with higher predilection in males compared to females. Most of the socket preservation procedures are done in the upper anterior region, followed by upper posterior, both upper anterior and posterior and lower posterior. However, there is no significant association between the area of socket preservation with age and gender.

**KEYWORDS:** Alveolar ridge, Bone resorption, Extraction, Socket healing, Trauma

## INTRODUCTION

Osseous deformities of the alveolar ridge such as reduced height and width of the residual ridge commonly occur following tooth extraction and subsequent healing of the socket which can be associated with factors such as caries, trauma and extensive periodontal diseases (Jyothi *et al.*, 2017; Vijayalakshmi and Ganapathy, 2016). Changes in alveolar ridge in terms of volume, height and morphological features tend to be clinically significant and may result in difficulty for the placement of a conventional bridge or an implant-supported crown (Duraisamy *et al.*, 2019; Ranganathan, Ganapathy and Jain, 2017). If bone resorption persists over a period of time to a point where it becomes clinically significant, it may affect the placement of an implant which becomes extremely difficult (Irinakis, 2006). Various factors may be

associated with alveolar bone loss such as periodontitis, trauma and aggressive extraction technique (Marcus *et al.*, 1996; Meall and Rosenfeld, 1996).

Following tooth extraction, alveolar ridge undergoes resorption which reduces the bone volume and changes the bone architecture, which complicates the placement of implant (Schropp *et al.*, 2003; Nevins *et al.*, 2006). Some studies have reported on the success of immediate implant placement following extraction, while others mentioned that implants do not adequately preserve the alveolar ridge (Chen, Wilson and Hämmerle, 2004; Araújo *et al.*, 2005, Botticelli, Berglundh and Lindhe, 2004). It can be attributed to the early disappearance of the thin bundle bone following the loss of blood supply from the periodontal ligament space palatally and damage to the blood supply buccally due to flap elevation during extraction procedure (Braut *et al.*, 2011; Araújo, Wennström and Lindhe, 2006). Socket healing following extraction consists of internal changes and external or dimensional changes. Internal changes such as formation of granulation tissues after tooth extraction resulting in the formation of a blood clot often lead to formation of bone within the socket, while external or dimensional changes result in the loss of alveolar ridge height and width (Schropp *et al.*, 2003).

Bone resorption involving the external buccal and lingual walls of the socket results in the dimensional changes of the ridge (Johnson, 1969). Previous studies have reported on the difference in the rate of resorption between maxillary and mandibular ridges, in which the mandible undergoes four times more changes in its dimension as compared to maxilla (Atwood and Coy, 1971; Ariga *et al.*, 2018). According to a study by Schropp *et al.*, most changes occur within the first 12 months following extraction with 50% (5-7mm) reduction in both horizontal and vertical directions and approximately two-thirds of this reduction takes place in the first 3 months which may be due to the loss of blood supply, periodontal ligament fibers and bundle bone (Schropp *et al.*, 2003).

Bone defects following tooth extraction may affect the success of the restorative procedure which can be in the form of dental implants, bridges or dentures and eventually limits the choice of treatment (Kannan and Venugopalan, 2018). Extraction of the teeth also leads to shrinkage of the gums and surrounding bone, leading to collapse of the lips and cheeks with unpleasant defects (Irinakis, 2006; Ashok *et al.*, 2014). Bone deformities from tooth removal can be prevented by a procedure called socket preservation (Dimova, 2013). Socket preservation helps to restore an individual's smile appearance in addition to the success of implant placement (Ashok and Suvitha, 2016; Venugopalan *et al.*, 2014). Various studies have discussed the rationale of performing socket preservation as a therapeutic procedure following tooth extraction which includes the procedure done during or after the removal of tooth in order to reduce the risk of external ridge resorption and increase the formation of bone with the socket (Araújo *et al.*, 2005). Previous reports suggested that ridge preservation procedure should be considered in cases where implant placement is planned more than 6 to 8 weeks following tooth extraction (Ajay *et al.*, 2017). Socket preservation techniques can be done based on the principles of guided bone regeneration (GBR), minimally traumatic tooth extraction and tissue grafting with or without the use of barrier membranes (Kokovic and Todorovic, 2011).

Sufficient alveolar bone volume and bone architecture are considered to be the important features for the ideal prosthetic reconstruction following implant placement which satisfies both the functional and esthetic criteria. Complications such as buccal dehiscence may occur following implant placement if it is done in the presence of thin crestal ridge following extraction (Irinakis, 2006; Subasree, Murthykumar and Dhanraj, 2016). Improper healing of the socket may affect the design of an implant-supported or a conventional restoration and result in improper placement of an implant (Lekovic *et al.*, 1998; Ganapathy *et al.*, 2016). Post-extraction preservation of the alveolar ridge reduces the risk of residual ridge resorption which allows for proper placement of an implant that satisfies the esthetic and functional standard. The success of implant placement highly depends on the presence of adequate volume of healthy bone at the recipient site during the placement of implant as it requires the presence of sufficient host bone into which

the implant can be adequately integrated in its proper position in three dimensions (Sheikh Z, Dh D, Nader Hamdan BD, 2018; Selvan and Ganapathy, 2016; Ganapathy, Kannan and Venugopalan, 2017). This study was done to evaluate the site predilection for socket preservation following tooth extraction for the placement of implants.

## **MATERIALS AND METHODS**

A retrospective study was conducted by reviewing 86,000 patient case records of the Saveetha Dental College and Hospital, Chennai, India. In the study, 25 consecutive case records of patients for a period of October 2019 to March 2020 with signed informed consent were retrieved from the Departments of Prosthodontics and Implantology based on the inclusion criteria of patients who have undergone socket preservation procedure indicated for implant placement. All the case records of completely edentulous patients were excluded on subjecting to selection criteria. A total of two examiners were involved in this study. An effort had been made to confirm that the sorted case records contained information of socket preservation. Prior permission use of the case records analysis was obtained from the institutional review board. Information such as patient's name, patient's identification number (PID), age, gender and area of socket preservation were collected from the patients' case records. Age of the patients were categorized for statistical convenience as 11-20, 21-30, 31-40, 41-50, 51-60, 61-70 and 71-80 years. Data was entered in Excel and analyzed using SPSS software version 23.0. Descriptive analysis was done to assess the frequency distribution of different age groups, gender and area of socket preservation. Chi-square test was used to evaluate the association of socket preservation with age and gender. Significant level test was set at less than or equal to 0.05 ( $p \leq 0.05$ ).

## **RESULTS AND DISCUSSION**

Our present study indicates that higher predilection for socket preservation is seen in males (80%) compared to females (20%) [Figure 1] but there are no statistically significant differences between genders ( $p > 0.05$ ). [Figure 4] Beck et al., also mentioned that there is no statistically significant difference between males and females but their study shows higher cases of socket preservation done in females compared to males (Beck and Mealey, 2010). Another study also mentioned a greater amount of reduction in mandibular residual ridges in females compared to males which increases their need for socket preservation procedure (Imirzalioglu, Yuzugullu and Gulsahi, 2012). Most studies mentioned hormonal influence as the main factor responsible for the difference in the rate of bone resorption between males and females. It has been suggested in a previous study that menopause in women significantly increases the rate of bone resorption over bone formation due to the low levels of estrogen which increases bone loss in the later stages of life. Estrogen may inhibit osteoclast formation and activity by increasing the production of osteoprotegerin (OPG) or transforming growth factor  $\beta$  (TGF- $\beta$ ) (Demontiero, Vidal and Duque, 2012; Basha, Ganapathy and Venugopalan, 2018).

Most of the cases of socket preservation in our studies were done in patients aged 21-30 years (52%), followed by 31-40 years age group (12%) and 51-60 years age group (12%). The other age groups of 11-20 years, 41-50 years and 61-70 years contributed to about 8% of the total results for socket preservation procedure. [Figure 2] It is seen no statistically significant association is present between age and area of socket preservation ( $p > 0.05$ ). [Figure 5] A report by Imirzalioglu et al., states that individuals over the age of 50 shows greater residual ridge resorption compared to those below 49 years of age which increases their need for socket preservation following extraction (Imirzalioglu, Yuzugullu and Gulsahi, 2012). Bone remodelling is a continual self-regeneration process which involves the removal of old bone, followed by its replacement with new bone in specific areas of bone called bone metabolic units (BMU) (Riggs, Khosla and Melton, 2002). Bone formation by osteoblasts and bone resorption by osteoclasts occur simultaneously in a delicate balance in order to maintain bone mass and prevent the risk of bone deformity within each BMU. However, this balance tends to shift in a negative direction as the age

increases which leads to more bone resorption and less bone formation (Demontiero, Vidal and Duque, 2012).

In this study, we observed that socket preservation has a higher predilection in the upper anterior region (60%), followed by upper posterior (28%), both upper anterior and upper posterior (8%) and lower posterior (4%). [Figure 3] This finding differs from a previous study that mentioned a higher rate of ridge resorption in the mandible than the maxilla which increases the requirement for socket preservation in the mandible (Tallgren, 1957). Atwood et al., mentioned that there are differences in the rate of resorption between maxillary and mandibular arches, with the changes being four times more prominent in the mandible as compared to the maxilla (Atwood and Coy, 1971). A previous study reported that a wider extraction socket requires longer time for bridging the defect bone as compared to a smaller extraction socket, which explains the longer period of healing at molar sites compared to single rooted sites (Schropp *et al.*, 2003).

## LIMITATIONS

In this study, we focus on the site predilection for socket preservation. However, the study was limited to certain post extraction treatment options that are available in Saveetha Dental College and Hospital. Delayed socket preservation procedure following extraction due to factors such as acute infection may contribute to the limitations of this study.

## FUTURE SCOPE

Further advancement in diagnosis and newer preventative measures are believed to be helpful in reducing risk of alveolar ridge resorption which may affect the placement of implants. Future studies should include clinical examination of these associations to help in better understanding of the condition. Some studies suggested that future advances in stem cell technology may help in the placement of tooth buds in sockets to regrow teeth or placement of cellular scaffold in the socket to maintain the bone.

## CONCLUSION

Within the limits of the study, socket preservation is done mainly in individuals within the 21-30 years age group with higher predilection in males compared to females. Most of the socket preservation procedures are done in the upper anterior region, followed by upper posterior, both upper anterior and posterior and lower posterior. However, there is no significant association between the area of socket preservation with age and gender.

## AUTHOR CONTRIBUTIONS

First author (Nur Liyana Hannah Binti Izham Akmal) performed the original draft preparation, statistical analysis, interpretation, manuscript writing and editing. Second author (Dr. Revathi Duraisamy) contributed to topic selection, methodology, data design, analysis, interpretation and critical revision of the manuscript.

## CONFLICTS OF INTEREST

The authors report no conflict of interest.

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**TABLES AND GRAPHS**

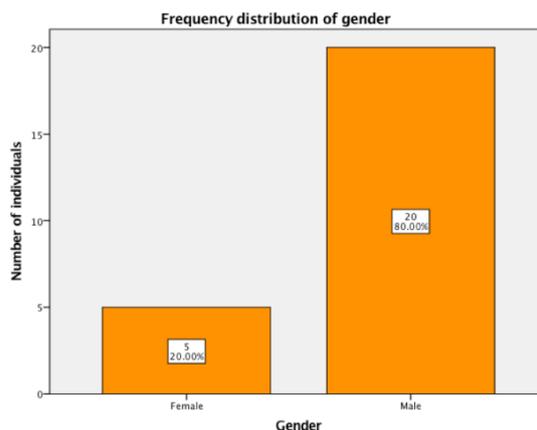


Figure 1: Bar graph showing the frequency distribution of genders. X axis represents the gender. Y axis represents the number of individuals of each gender. Orange denotes the females and males involved in this study. Most of the patients in this study were males (80.00%) as compared to females (20.00%).

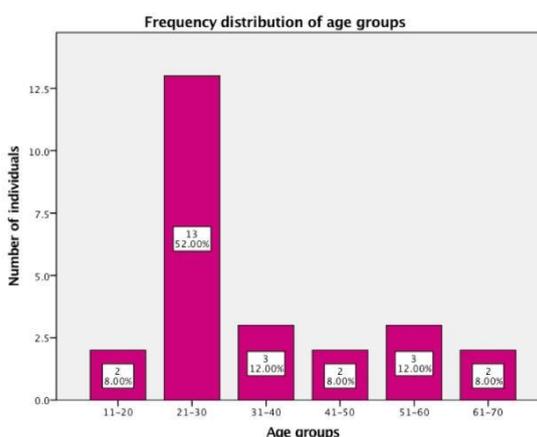


Figure 2: Bar graph showing the frequency distribution of different age groups. X axis represents the age groups. Y axis represents the number of individuals in each age group. Pink denotes all the age groups involved in this study. Most of the individuals in this study were within the 21-30 years age group (52.00%), followed by 31-40 years (12.00%), 51-60 years (12.00%), 11-20 years (8.00%), 41-50 years (8.00%) and 61-70 years (8.00%).

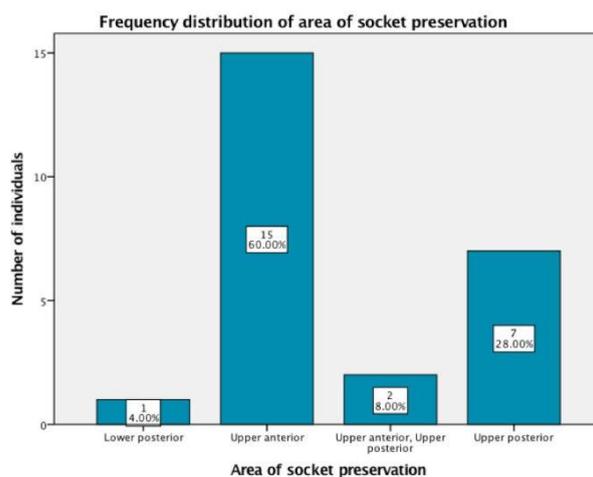


Figure 3: Bar graph showing the frequency distribution of area of socket preservation. X axis represents the area of socket preservation. Y axis represents the number of individuals. Blue denotes different areas of socket preservation involved in this study. Most of the cases, socket preservation were done in the upper anterior (60.00%), followed by upper posterior (28.00%), upper anterior and posterior (8.00%) and lower posterior (4.00%).

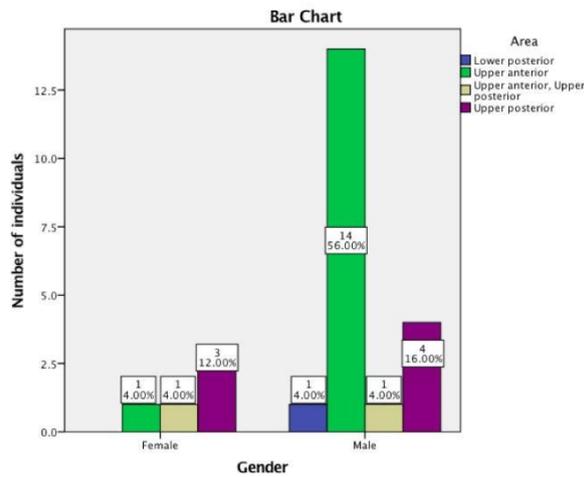


Figure 4: Bar graph showing the association between Gender and area of socket preservation. X axis represents the gender. Y axis represents the area of socket preservation of different gender. Blue denotes lower posterior (Male - 4.00%). Green denotes upper anterior (Female - 4.00%; Male - 56.00%). Yellow denotes upper anterior and posterior (Female - 4.00%; Male - 4.00%). Purple denotes upper posterior (Female - 12.00%; Male - 16.00%). Most of the socket preservation was done in the upper anterior as seen mainly in males (56.00%) and females (4.00%). However, this is statistically not significant. (Pearson Chi-Square value - 5.327; p value - 0.149;  $p > 0.05$  - Not significant)

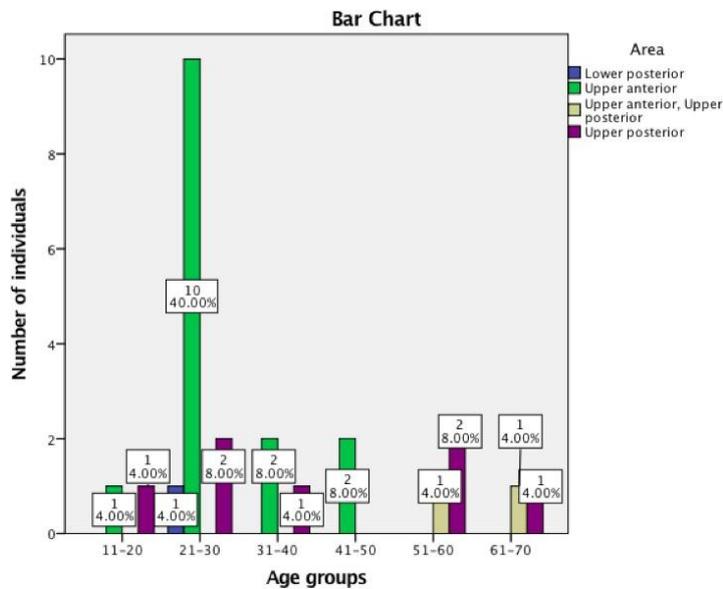


Figure 5: Bar graph showing the association between age groups and area of socket preservation. X axis represents the different age groups. Y axis represents the area of socket preservation of different age groups. Blue denotes lower posterior (21 to 30 years - 4.00%). Green denotes upper anterior (11 to 20 years - 4.00%; 21 to 30 years - 40.00%; 31 to 40 years - 8.00%; 41 to 50 years - 8.00%). Yellow denotes upper anterior and posterior (51 to 60 years - 4.00%; 61 to 70 years - 4.00%). Purple denotes upper posterior (11 to 20 years - 4.00%; 21 to 30 years - 8.00%; 31-40 years - 4.00%; 51 to 60 years - 8.00%; 61 to 70 years - 4.00%). Most of the socket preservation was done in the upper anterior as seen mainly in 21-30 years (40.00%), 21-40 years (8.00%) and 41-50 years (8.00%). However, this is statistically not significant. (Pearson Chi-Square value - 17.172; p value - 0.309;  $p > 0.05$  - Not significant)