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Prevalence of Skeletal and Dental Anchorage Usage During Orthodontic Space Closure

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Abstract: Anchorage control plays a vital role in the effective management of orthodontic treatment for obtaining both structural and facial esthetics. Anchorage can be augmented by various methods. Anchorage support can be derived from the teeth or bone and is called dental anchorage or skeletal anchorage respectively. The aim of the present study was to assess the prevalence of use of skeletal anchorage and dental anchorage during space closure in all extraction cases and also to study the association between the type of anchorage used and the nature of treatment results required for the patient. This was a retrospective cross-sectional study conducted in the Department of Orthodontics, Saveetha Dental College and Hospitals, Chennai. 320 records of patients who underwent orthodontic treatment with extraction were extracted and divided into two groups based on the type of intraoral anchorage used - dental anchorage and skeletal anchorage. The samples were also divided based on the type of treatment results required for the patients, that is, pure dentoalveolar change and dentoalveolar change along with skeletal change. 28.75% patients were treated using skeletal anchorage and 71.25% patients were treated using dental anchorage. 72.19% of the selected sample required pure dentoalveolar changes whereas 27.81% of the sample required both skeletal and dentoalveolar changes. P- value of less than 0.001 was obtained as result of chi-square test indicating that there was a significant association between the type of anticipated results and the type of anchorage used. The use of conventional dental anchorage for space closure is more prevalent than skeletal anchorage. Skeletal anchorage was commonly used for patients who required both skeletal and dentoalveolar changes.

Keywords: Anchorage; conventional anchorage; dental anchorage; temporary anchorage devices; skeletal anchorage, innovative

INTRODUCTION

Anchorage control plays a vital role in the effective management of orthodontic treatment for obtaining both structural and facial esthetics. Anchorage is defined as the resistance to unwanted tooth movement(Proffit and Fields, 2000) as the desired reaction of posterior teeth to space closure mechanics. Depending on the requirement it can be classified as minimum, moderate or maximum anchorage(NANDA and R, 1997; Proffit and Fields, 2000).

Anchorage loss is the reciprocal reaction to the anchor unit that can hinder the success of orthodontic treatment by complicating anteroposterior correction. Anchorage can be augmented by various methods. Anchorage support can be derived from the teeth or bone and is called dental anchorage or skeletal anchorage respectively. Traditional methods of dental anchorage include multiple teeth at anchorage segment, transpalatal arch, lingual stabilizing arch and intra-oral elastics. Nance holding arch derives support from both dental and skeletal units. Skeletal anchorage was traditionally obtained by the use of extra-oral traction from headgears.(Renfroe, 1956; Rajcich and Sadowsky, 1997) However, all these methods have their own disadvantages - complicated design, need for exceptional patient compliance, elaborate wire bending and so on.

In recent years, mini-screws and mini-implants have gained enormous popularity in the orthodontic community and are being considered as absolute sources of orthodontic anchorage (Costa, Raffainl and Melsen, 1998; Lee, 2001; Park *et al.*, 2001). Their advantages over the conventional method of anchorage reinforcement are easy placement and removal, immediate loading and placement at various anatomic locations including the alveolar bone between the roots of teeth. These screws have made en masse anterior retraction, en masse distalization, and intrusion of teeth possible with minimal adverse effects.(Jain, Kumar and Manjula, 2014; Sivamurthy and Sundari, 2016; Felicita, 2017b; Vikram *et al.*, 2017) Several studies have been done to explore the use of biomedical agents in anchorage control and are still under various levels of clinical trials.(Krishnan, Pandian and Kumar S, 2015)

Bidental proclination is one of the most common malocclusion seen in various ethnic groups (Farrow, Zarrinnia and Azizi, 1993). It is characterized by increased proclination of the anterior teeth with resultant protrusion of the lips and convexity of the face. The treatment for bidental protrusion often involves extraction of the four first premolars, followed by anterior teeth retraction under maximum anchorage. And it is also important to control the vertical movement of molars to provide an ideal facial profile. The vertical movement of the molar will depend on the vertical skeletal growth pattern of the patient.(Rubika, Felicita and Sivambiga, 2015) Thus anchorage plays an important role in treatment of bidental alveolar protrusion.

Our department is passionate about research we have published numerous high quality articles in this domain over the past years ((Kavitha *et al.*, 2014) , (Praveen *et al.*, 2001),(Devi and Gnanavel, 2014), (Putchala *et al.*, 2013), (Vijayakumar *et al.*, 2010), (Lekha *et al.*, 2014a, 2014b) (Danda, 2010) (Danda, 2010) (Parthasarathy *et al.*, 2016) (Gopalakannan, Senthilvelan and Ranganathan, 2012), (Rajendran *et al.*, 2019), (Govindaraju, Neelakantan and Gutmann, 2017), (P. Neelakantan *et al.*, 2015), (PradeepKumar *et al.*, 2016), (Sajan *et al.*, 2011), (Lekha *et al.*, 2014a), (Neelakantan, Grotra and Sharma, 2013), (Patil *et al.*, 2017), (Jeevanandan and Govindaraju, 2018), (Abdul Wahab *et al.*, 2017), (Eapen, Baig and Avinash, 2017), (Menon *et al.*, 2018), (Wahab *et al.*, 2018), (Vishnu Prasad *et al.*, 2018), (Uthrakumar *et al.*, 2010), (Ashok, Ajith and Sivanesan, 2017), (Prasanna Neelakantan *et al.*, 2015). The aim of the present study was to assess the prevalence of use of skeletal anchorage and dental anchorage during space closure in all extraction cases and also to study the association between the type of anchorage used and the nature of treatment results required for the patient.

MATERIALS AND METHODS

This was a retrospective cross-sectional study conducted in the Department of Orthodontics, Saveetha Dental College and Hospitals, Chennai. Records of patients who underwent orthodontic treatment with extraction were collected from the data of orthodontic patients from June 2019 to March 2020.

The samples were selected based on the following selection criteria:

- Orthodontic patients treated with extraction
- Patients for whom intra-oral anchorage reinforcement method was used
- Patients treated by non-extraction treatment protocols and for whom extra-oral anchorage was used were eliminated from the study.

320 patient records were selected based on the inclusion criteria. The samples were divided into two groups based on the type of intra-oral anchorage used, namely, Group 1 - skeletal anchorage and group 2 - dental anchorage. The samples were also divided based on the type of treatment results required for the patients, that is, pure dentoalveolar change and dentoalveolar change along with skeletal change. The later type of grouping was done based on assessment of pre-treatment extraoral and intraoral photographs and lateral cephalograms of the selected subjects. Steiner's analysis, McNamara's analysis, Rakosi Jarabak analysis, Tweed's analysis and Cephalometrics for Orthognathic Surgery Analysis by Burstone were done to group the sample into the latter category.

SPSS software version 20.0 for Windows was used for statistical analysis. Frequency distribution for each group was done separately for type of anchorage used and the type of treatment results required for the patient. Chi-square analysis was done to assess the association among type of treatment results and the type of anchorage used in orthodontic patients with extraction treatment protocol.

RESULTS AND DISCUSSION

320 patients who were treated with extraction and intra-oral anchorage were identified. Out of the 320 patients, 92 of them were treated using skeletal anchorage and 228 patients were treated using dental anchorage. The number of patients who required pure dentoalveolar change was 231 and those who required both dentoalveolar and skeletal change was 89.

Figure 1 represents the percentage of patients treated using skeletal and dental anchorage. 28.75% patients were treated using skeletal anchorage and 71.25% patients were treated using dental anchorage. Figure 2 represents the percentage of orthodontic patients with extraction treatment protocols who require pure dentoalveolar changes and those who require a combination of dentoalveolar and skeletal changes. 72.19% of the selected sample required pure dentoalveolar changes whereas 27.81% of the sample required both skeletal and dentoalveolar changes. P- value of less than 0.001 was obtained as result of chi-square test indicating that there was a significant association between the type of anticipated results and the type of anchorage used (Figure 3). Skeletal anchorage was most commonly used to obtain both skeletal and dentoalveolar changes.

In the centre, a total of 321 patients had undergone orthodontic treatment with extraction. Out of this one patient was eliminated from the study because extraoral traction was used for anchorage control. Skeletal anchorage devices were also used in non-extraction treatment protocol for en-masse distalization of entire maxillary/mandibular dentition and intrusion of a tooth or a group of teeth. These cases were not included as it was beyond the scope of the study.

In the centre, 28.75% of orthodontic patients treated with extraction used skeletal anchorage whereas 71.25% of patients were treated using dental anchorage. The various types of dental anchorage used were transpalatal arch, lingual stabilizing arch, Nance button, Class II elastics and including second molars for posterior anchorage. Nance palatal holding arch was included under dental anchorage even though the acrylic button is thought to derive support from the horizontal slope of the anterior palate. Most of the patients who required maximum anchorage were also treated with dental anchorage.

Mini-implants and bone screws such as infrazygomatic crest screws and buccal shelf screws were used while mini-plates were not used. This might be because of the surgical procedure involved during placement as well as removal of mini-plates. Tooth movement achieved using these skeletal anchorage devices are en masse retraction of anterior teeth, intrusion and retraction of anterior teeth, protraction of posterior teeth (in a few cases).

Fouda et al(Fouda *et al.*, 2010) reported a mean anchorage loss of 1.4mm (+/- 0.418) on right side and 1.42mm (+/- 0.437) on left side in Nance holding arch group whereas no anchorage loss in implant group.In both the groups there was no evidence of molar rotation. Thiruvenkatachari et alt(Thiruvenkatachari *et al.*, 2006) reported an anchorage loss of 1.6mm in the maxilla and 1.7mm in the mandible on the conventional molar anchorage side and no anchorage loss on the implant side during canine retraction. A mean anchorage loss of 2.48mm (+/- 0.71) was noted in transpalatal arch group by Sharma et al (Sharma, Sharma and Khanna, 2012). Zablocki et al(Zablocki *et al.*, 2008) reported that transpalatal arch did not provide a significant effect on either the anteroposterior or the vertical position of the maxillary first molars during extraction treatment. From the results of these studies we can infer that skeletal anchorage is more effective in anchorage control compared to all other types of dental anchorage.

Due to the better efficiency of skeletal anchorage devices in controlling tooth movement, a drastic drift from dental anchorage devices to skeletal anchorage devices will be seen in the near future. Even though there are many studies done by our team on skeletal anchorage devices(Jain, Kumar and Manjula, 2014; Sivamurthy and Sundari, 2016; Felicita, 2017b; Vikram *et al.*, 2017) and also on other aspects of orthodontics(Ramesh Kumar *et al.*, 2011; Felicita, Chandrasekar and Shanthasundari, 2012; Dinesh *et al.*, 2013; Kamisetty *et al.*, 2015; Rubika, Felicita and Sivambiga, 2015; Viswanath *et al.*, 2015; Felicita, 2017a, 2018; Samantha *et al.*, 2017; Pandian, Krishnan and Kumar, 2018), future studies evaluating the patient and clinician comfort with different types of anchorage control devices are recommended.

CONCLUSION

Within the limits of the study, it can be concluded that even though the conventional dental anchorage for space closure is more prevalent than the skeletal anchorage, the latter was commonly used for patients who required both skeletal and dentoalveolar changes.

Author Contributions

All authors have contributed equally towards the study.

Conflict of Interest

No conflict on interest.

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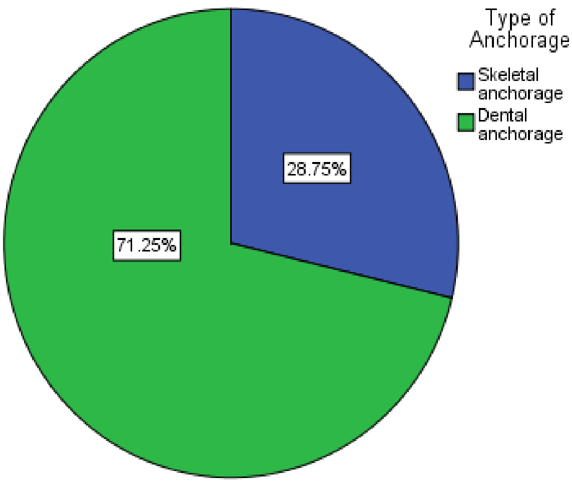

Fig.1: The pie chart represents the percentage of orthodontic patients with extraction treatment protocols who were treated using skeletal anchorage and dental anchorage. Blue (28.75%) represents skeletal anchorage and green (71.25%) represents dental anchorage.

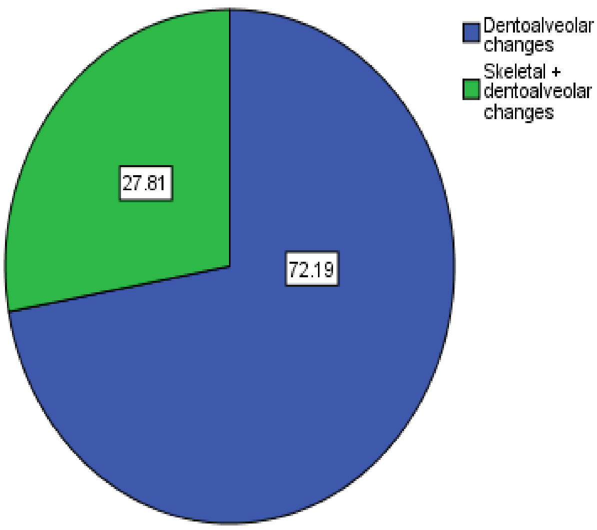

Fig.2: The pie chart represents the percentage of orthodontic patients with extraction treatment protocols who require pure dentoalveolar changes and those who require a combination of dentoalveolar and skeletal changes. 72.19% of the selected sample required pure dentoalveolar changes which are represented by blue color whereas 27.81% of the sample required both skeletal and dentoalveolar changes that are represented by green color.

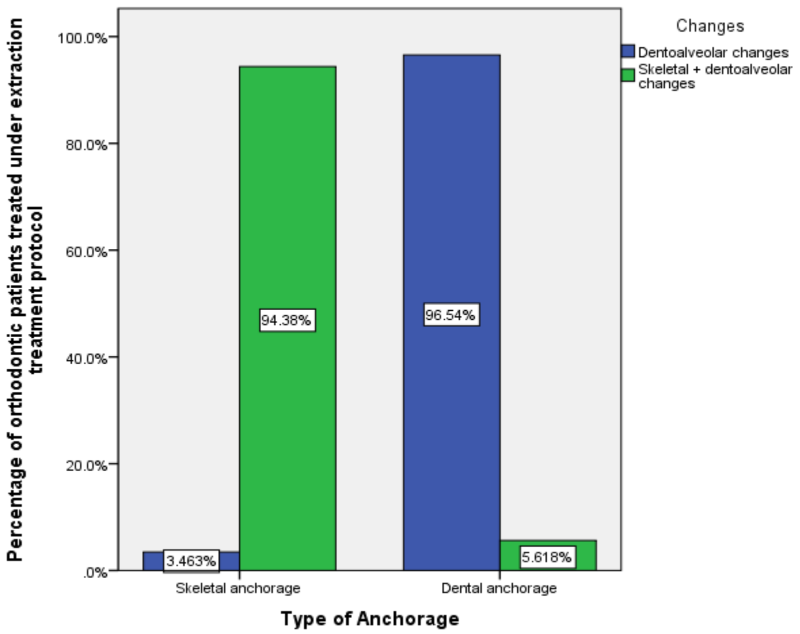

Fig.3: The bar graph depicts the association between the type of treatment results required and the type of anchorage being used. X -axis represents the type of anchorage and y-axis represents the percentage of orthodontic patients treated under extraction treatment protocol. The bar graph is clustered based on the type of treatment results required, namely, pure dentoalveolar changes (blue) and both dentoalveolar and skeletal changes (green). There was a significant association between the two variable and skeletal anchorage was most commonly used for patients who required both skeletal and dentoalveolar changes. (Pearson's chi square test; p value < 0.001)