



Comparison of the Effectiveness and Outcome of Infrazygomatic Crest Implants with Temporary Anchorage Devices

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ABSTRACT:

Background and Aim: Orthodontic treatment with fixed appliances requires stable molar anchorage. Mini-implants can be an efficient alternative to conventional molar anchorage, particularly in maximum anchor-age settings. The aim of this study is to compare infrazygomatic crest mini-implants with inter-radicular mini-implants for en masse anterior retraction of teeth in orthodontic patients who underwent therapeutic extraction of maxillary 1st premolar.

Material and Methods: Present prospective randomized control trial done in the department of Orthodontics and Dentofacial Orthopaedics, Tertiary Care Dental College of India. A total of 44 patients were included in the study. Standard orthodontic records were taken which included case history, extra-oral and intra-oral photographs, lateral cephalogram and panoramic radiographs. A diagnosis was made and a detailed treatment plan was formulated. The patients included in the study were randomly divided into 2 groups. Both the patients had an intervention, the study group G1 included patients for whom infrazygomatic crest mini-implant were placed. The second study group G2 included patients for whom inter-radicular mini-implant was placed. Patients were recalled every month to assess the space closure and for engaging new e-chain. Any complications that rose were duly addressed to. The patient was followed up to the point of space closure.

Results: The changes in SNA in this group were statistically significant and the post treatment values were 87.29 ± 6.11 with a p value of 0.003. The retraction of the maxillary incisors have an effect of the A point of the maxilla and the upper lip. The pretreatment values of position of U1 to NA, L1 to NB are 8.80 ± 3.07 mm and 8.01 ± 2.54 mm respectively. Both the values were significantly reduced. The changes of SNA post retraction in this group was not statistically significant and was with a mean value of 94.30 ± 10.14 . The angulation of the maxillary incisor was significantly reduced and this was observed from the following measurements.

Conclusion: There are no significant changes in the type of retraction brought about by infrazygomatic crest mini-implant and inter-radicular mini-implant. Infrazygomatic crest and inter-radicular mini-implants can both be used as temporary anchorage devices and prevent the mesial migration of the molar unit.



Introduction

Malocclusion is a common problem in dental practice. Bimaxillary protrusion and class II division 1 malocclusion often demand complete retraction of the anterior segment for aesthetic correction and to bring about significant change in the profile. The first premolars are most commonly extracted when there is a need to correct the anterior protrusion, the orthodontic treatment by this therapeutic extraction greatly improves the profile of the patient and it remains satisfactory during treatment. Class II division 1 cases with maxillary 21 OF 150 implications are often treated by means of maxillary first premolar extraction on the malocclusion side. With the advent of mini-implants, it has become one of the most effective anchorage resources used to address anchorage loss.^{1,2}

Anchorage has been defined as resistance to undesired tooth movement. Many of our patients have proclined upper anterior teeth with an increased overjet, so these should be retroclined and retracted.

In response to this good tooth movement, the upper posterior molars migrate mesially, which is unfavorable. As a result, anchorage has frequently used headgear, palatal arches, or temporary anchorage devices in the maxilla to prevent this unwanted mesial movement of the upper molar teeth. Our paper focuses at the En Masse distalization of the entire maxillary dentition, rather of only preventing upper molar teeth from sliding mesially as a result of upper incisor retractions. This is a novel development for our specialty, because this type of En Masse movement of the entire dentition was previously only achievable by orthognathic surgery.^{3,4}

Orthodontic treatment with fixed appliances requires stable molar anchorage. Skeletal anchorage using mini-implants has been described as an adjuvant to orthodontic therapy that is less reliant on patient compliance. In split mouth experiments comparing conventional anchorage with mini-implants, retraction can be performed with no loss of anchorage on the implant side, but a slight loss of anchorage on the non-implant side. Mini-implants can be an efficient alternative to conventional molar anchorage, particularly in maximum anchor-age settings. Not only have these screws proven effective for anchorage in extraction situations, but they have also been used in circumstances when it is desirable to distalize the entire arch.^{5,6}

Finite element analysis is being used in orthodontics because to its ability to provide extensive and precise information about stress and load application. Finite element method (FEM) research can help us comprehend the different aspects that cannot be clinically assessed.⁷

Infrazygomatic crest mini-implants are often constructed of stainless steel or titanium and put in the region of infrazygomatic crest distal to the first permanent molar. They are mostly utilized for mass distalization and orthodontic treatment of malocclusions without surgery or extractions. Conventional mechanics often lead to inefficient and slow distal movement of anterior teeth. Whereas mini-screws allow the practitioner to translate the entire anterior quadrant. This reduces the treatment duration, eliminates any loss of anchorage, and reduces patient discomfort. Mini-screws have been employed in non-extraction patients and maintained throughout the treatment to offer anchorage for the retraction of the entire dentition. The aim of this study is to compare infrazygomatic crest mini-implants with inter-radicular mini-implants for en masse anterior retraction of teeth in orthodontic patients who underwent therapeutic extraction of maxillary 1st premolar.

Materials and Methods

Present prospective randomized control trial done in the department of Orthodontics and Dentofacial Orthopaedics, Tertiary Care Dental College of India. The study was conducted on patients who had a bimaxillary proclination or Class II malocclusion reporting to the Department. Sample included patients for whom the upper first premolar was extracted and for whom maximum anchorage was needed for retraction and space closure. The study was approved by the Ethical committee of the institute.

The sample size was based on the statistical evaluation of the previous study with power of 90%. A total of 44 patients were included in the study. A qualified orthodontist was given the details about the inclusion and exclusion criteria for the study, which screened and selected the patients reported to the Department of Orthodontics for orthodontic treatment. All the pre-treatment records were taken for the selected patients. The patients were briefly informed about their



involvement in the study. The patient or a parent or guardian signed an informed consent form.

Inclusion Criteria

Patients with permanent dentition and of the age group minimum of 16 years and maximum of age 35 years. Patient who require fixed orthodontic treatment, Patient with maximum anchorage requirement in the maxilla, Patients with Class II malocclusion for whom upper 1st premolars was extracted as a method for camouflage, Patients with bimaxillary protrusion and class I molar for whom maximum anchorage was required and 1st premolars were extracted in the maxilla, Cooperative patients who were willing to participate in the study.

Exclusion Criteria:

Patients with mixed dentition and below 16 years for whom adequate bone density would not have been established. Patient with missing teeth or abnormal tooth morphology, Patient with previous history of orthodontic treatment. Patient with systemic problem and bone pathologies

In this study standard orthodontic records were taken which included case history, extra-oral and intra-oral photographs, lateral cephalogram and panoramic radiographs. A diagnosis was made and a detailed treatment plan was formulated.

A parallel randomized clinical trial was planned, the patients included in the study were randomly divided into 2 groups. Both the patients had an intervention, the study group G1 included patients for whom infrazygomatic crest mini-implant were placed. The second study group G2 included patients for whom inter-radicular mini-implant was placed. The mini-implants were used for en masse anterior retraction. All the patients in the both the groups were treated with preadjusted edgewise appliance system using MBT prescription.

All the patients after leveling and aligning in both groups G1 and G2, 0.019*0.025-in stainless steel arch wires with power arm of height 7-8mm placed distal to the lateral incisors in the upper arch. To allow the wire to be passive, the 19*25 SS wire was left in place for 6 weeks prior to the start of retraction. The lateral cephalogram of the patient was taken prior to the start of retraction without arch wire in natural head position.

In group G1, infrazygomatic crest bone screws were placed distal to the 1st maxillary molar at 12-13 mm above the CEJ at an angulation of approximately 50-70°

from the level of the occlusal plane. The orientation for insertion began at 90° taken as being perpendicular to the buccalbone and a reduction 20-40° to achieve the desired angulation. In group G2, inter-radicular mini-implant were placed between the tooth roots of 2nd premolar and 1st molar at 7 mm above the CEJ at an angulation of 30-40° to the long axis of the posterior teeth.

For en masse anterior retraction the force was measured to 300 gms per side in Group 1 where IZC bone screw was placed and 250 gms per side in Group 2 where inter-radicular mini-implant was placed. All the mini-implants placed in both the groups were self drilling. For the evaluation post placement, in group 1 postero-anterior cephalogram was taken to assess the angulation and height of placement and if the bone screw intruded the maxillary sinus. In group 2, postplacement intra-oral periapical radiograph was taken to evaluate the inter-radicular mini-implants placed. Immediate post placement torque values were recorded. Force was delivered using an elastomeric chain from the implant head to the power arm. The amount of force was measured using a dontrix gauge.

Patients were recalled every month to access the space closure and for engaging new e-chain. Any complications that raised were duly addressed to. The patient was followed up to the point of space closure. After completion of space closure, the mini-implant was removed, upon removal the removal torque was recorded as an indicator of stability. A lateral cephalogram was repeated at the stage without archwires.

Landmarks, cephalometric planes, linear and angular parameters used in this studies are as follows:

U1-FH, U6-PTV and Nasolabial angle measurements were taken from the ricketts analysis. IMPA was used to see the axial angulation of the lower incisor and this value was taken based on the Frankfurt mandibular incisor angle. Burstone analysis was used to check the linear measurements of the upper and lower incisors, upper and lower molars to the palatal plane and mandibular plane and also the angular measurements. This would give us a picture of the dental heights in the incisor and in the molar level. The soft tissue changes such as a facial convexity, superior and inferior sulcus depth and changes in the lip posture were noted by taking measurements from Holdaway's analysis.



Superimposition was done with the cephalogram taken at T1 and at T2. The T1 cephalogram was traced with black color and T2 cephalogram was traced with red. Superimposition was done with the Sella-nasion line at sella. The superimpositions indicated that there was no movement of the molar teeth, positive soft tissue change was observed in all the treated subjects, with profile soft tissue values improving. Lip seal was established in most cases and the interlabial gap was reduced post treatment.

All the statistical analyses were performed using SPSS software package. The mean and standard deviation for each cephalometric variable were determined.

Results

The paired T test was done in order to compare the treatment changes of between T1 and T2 in the group treated by infrazygomatic crest mini-implant aided en masse anterior retraction. The angular measurements were done to assess the changes in the inclination of the upper and the lower incisors. The changes in SNA in this group were statistically significant and the post treatment values were 87.29 ± 6.11 with a p value of 0.003. The retraction of the maxillary incisors have an effect of the A point of the maxilla and the upper lip. The U1 to Frankfurt plane angle also showed a significant decrease in the angle of inclination as well as the decrease of interincisal angle is also reduced post retraction, both with a p value of 0.000. The changes of the lower incisor angle post retraction also showed a reduction with the mean value of 103.22 ± 8.23 and a p value of 0.004.

The pretreatment values of position of U1 to NA, L1 to NB are 8.80 ± 3.07 mm and 8.01 ± 2.54 mm respectively. Both the values were significantly reduced with a p value of 0.000 for both. Post retraction a significant decrease in the overjet was observed with a mean of 5.05 ± 0.72 mm (p value = 0.004).

Retraction using an infrazygomatic crest didn't cause any significant increase or decrease in the overbite. U6 to PTV values remained unchanged indicating that there was no loss of anchorage or mesial movement of the molar.

The nasolabial angle becomes more obtuse after retraction with a mean of 105.54 ± 15.60 but was not statistically significant. The retrusion of the lower lip in relation to the SL line was statistically significant with a

p value of 0.001. The interlabial gap after retraction also reduced to 3.47 ± 4.5 which was statistically significant. None of the other soft tissue changes after retraction was of statistical significance.

The paired T test was done in order to compare the treatment changes of between T1 and T2 in the group treated by interradicular mini-implant aided en masse anterior retraction. The changes of SNA post retraction in this group was not statistically significant and was with a mean value of 94.30 ± 10.14 . The angulation of the maxillary incisor was significantly reduced and this was observed from the following measurements.

The upper incisor to the Frankfurt horizontal plane was reduced to a mean of 115.28 ± 9.01 mm. The other values of the incisors that were significantly reduced post en masse anterior retraction were the angulation formed between upper incisor to the NA and to the PP. The change in the inclination of the lower incisor was also statistically significant.

Of all the linear measurements evaluated pre and post none of the values were statistically significant. We had only one parameter that showed significant value was U1 to Palatal plane, that significantly decreased with a mean value of 38.78 ± 9.12 and a p value of 0.006. There was no change or movement of the molar suggesting there was no loss in anchorage.

Changes in the lower lip and decrease in the values of the lower lip to the line, as well the decrease in the interlabial gap for teeth at rest to acceptable gap with a mean of 9.50 ± 8.60 . As well the lower lip to e line value and lower lip with respect to changes in it being retruded were statistically significant. None of the other soft tissue changes we assessed are statistically significant.

Comparison of treatment changes of en masse anterior retraction using infrazygomatic mini-implant and radicular inter-radicular mini-implant between T2 and T1. The SNA values were different post completion of retraction in both the groups. There are significant changes in SNA. The mean value of treatment changed in the infrazygomatic group 2.25 ± 0.25 degree whereas in the interradicular group it was -2.0 ± 3.15 ; with a statistical difference among the two groups. The SNB value treatment changes were also different in both the groups we compared; the mean treatment change value in G1 is 0.42 ± 2.14 and for G2 is -0.60 ± 0.47 with a statistically significant difference between the two



groups. There was no mesial movement of the molar noted in both the groups. There was a statistical significant difference also in the treatment change of interlabial gap.

Discussion

One of the perceived complications of the retraction of upper anterior teeth using sliding mechanics is the extrusion of the upper anterior teeth during the retraction process. This would be a particular risk for patients presenting with a high smile line or vertical maxillary excess. The true retraction will take place when the force passes through the centre of resistance of the anterior teeth. When mini-screws are placed between the second premolar and the first molar there is increase in rotation of anterior teeth and the vertical movement is reduced. For en masse distalization infrazygomatic crest mini-implants are mostly indicated however it has been proposed that inter-radicular implants can be used for the same effect.^{8,9}

There are various studies both in-vitro and in FEM models where mini-implants have been widely researched in order to evaluate the results on retraction of anterior teeth and for en masse anterior retraction. This study is the first of its kind to evaluate and compare the infrazygomatic crest mini-implants and the interradicular mini-implants and to gain an understanding of the bone stress patterns.¹⁰

The results of our study showed in the group 1 were en masse anterior retraction using infrazygomatic crest mini-implant (G1) significant treatment changes were observed in relation to the Angular changes in SNA, U1 to FH, interincisal angle, IMPA, U1 to NA, U1 to PP, L1 to MP; in relation to Linear changes in Overjet, U1 to NA, L1 to NB and in relation to soft tissue changes significant treatment changes was observed in lower lip to SL, Upper lip to e line, Lower lip to e line and interlabial gap.

Whereas in the group 2 where en masse anterior using inter-radicular mini-implant (G2) significant treatment changes were observed in relation to the Angular changes in U1 to FH, Interincisal angle, U1 to NA, U1 to PP, L1 to MP; in relation to Linear changes to overjet, U1 to PP and in relation to soft tissues treatment changes observed in lower lip to SL, lower lip to e line and interlabial gap.

No significant changes in SNA and U1 to NA (linear) were observed in G2 but were observed in G1. Overall the treatment changes in relation to the dental and linear measurements as well as in soft tissue changes were similar in both the treatment groups. Both infrazygomatic crest mini-implant as well as inter-radicular mini-implants can be efficiently used for en masse retraction of anterior teeth. The findings common to both the study groups are that the changes related to the upper incisor position was significant. The axial angulation of the incisors with relation to the palatal plane, nasion to A point and to the FH line all showed significant changes as well the position of the incisor showed significant retraction.

Conclusion

There are no significant changes in the type of retraction brought about by infrazygomatic crest mini-implant and inter-radicular mini-implant. Infrazygomatic crest and inter-radicular mini-implants can both be used as temporary anchorage devices and prevent the mesial migration of the molar unit.

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