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Assessment of total treatment time, pulp vitality, root resorption and crestal bone height in patients treated with corticotomy assisted as compared to conventional orthodontics at the completion of treatment

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ABSTRACT

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INTRODUCTION

Rationale - With the changing trends in our society, recent years have seen a rising influx of adult patients seeking orthodontic treatment. These patients have concerns regarding esthetic and longer duration of treatment. The lengthy duration of orthodontic treatment still remains a matter of concern for many patients seeking orthodontic treatment; however, this is not just an aesthetic or functional demand, as reducing treatment time is also necessary to avoid incidence of adverse effects such as oral hygiene difficulties or caries[1]. Also, prolonged treatment time is one of the definite risk factors of root resorption and periodontal damage[2]. All the accelerated orthodontic procedures have speculations regarding its effects on root integrity, pulp vitality and periodontium.

In an effort to accelerate the tooth movement, whether there's any effect on treatment time, pulp vitality, root resorption & crestal bone height was evaluated.

Objectives –

To evaluate and compare

- Total treatment time
- Root resorption
- Pulp vitality
- Crestal bone height
- in patients treated with corticotomy assisted as compared to conventional orthodontics at the completion of treatment.

Material and Methods -

Study setting: All the 32 individuals included in the present study were selected from patients reporting to the OPD of Department of Orthodontics and Dentofacial Orthopaedics, of Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur.

Inclusion Criteria:

1. Class I bimaxillary protrusion cases indicated for therapeutic extraction of first premolars in all the four quadrants
2. Age ranging from 18 to 25 yrs
3. Arch length discrepancy >5mm wherein crowding < or = 3mm

4. Systemically and periodontally healthy individuals
5. Good oral hygiene
6. No previous orthodontic treatment

Exclusion Criteria :

1. Patients without pre-treatment records.
2. Patient with endodontic treatment done in maxillary and mandibular anterior teeth.
3. Symptoms of temporomandibular disorders.
4. Patients with active periodontal disease.
5. Patients on long term medications which have effect on bone metabolism .

   Ex: patients on steroids, NSAID's or bisphosphonates
6. Patients with bleeding disorders, uncontrolled diabetes mellitus or smokers.
7. Pregnant and lactating women.
8. Patients with parafunctional habits.
9. Patients with cysts /tumour involving jaw bones & skeletal dysplasia

Study population - Patients reporting to the department of Orthodontics were screened with routine diagnostic procedures which included case history, analysis of the study casts, cephalometric analysis, dental radiography and periodontal examination.

Sample size with justification - 32 patients diagnosed as Angle's Class I malocclusion with bimaxillary protrusion, satisfying the above inclusion criteria were included in the study. Amongst 32, 16 patients were randomly allocated in group A(test group), in whom corticotomy assisted orthodontic retraction was carried out and 16 were allocated to group B (control group) in whom conventional orthodontic retraction was carried out without corticotomy. Informed consent was obtained from all the patients included in the study.

Sampling procedure - Amongst 32, 16 patients were randomly allocated in group A(test group), in whom corticotomy assisted orthodontic retraction was carried out and 16 were allocated to group B (control group) in whom conventional orthodontic retraction was carried out without corticotomy.

Measurements –

Initial orthodontics-

After proper case selection and group allocation, fixed orthodontic mechanotherapy was initiated with 0.022 slot MBT prescription in both the groups. Premolar extractions were deferred until the completion of alignment and leveling.

Mini-implant placement : Once alignment and leveling was completed, orthodontic mini-implants, self-drilling, bracket head type (1.5 mm diameter and 7 mm length for mandibular arch and 1.5 mm diameter and 8 mm length for maxillary arch) were placed between second premolar and first molar in all four quadrants as skeletal anchorage devices for complete anchorage preservation.

After mini-implant placement in both the groups, Group A patients were referred to the Department of Periodontics for corticotomy surgery and in Group B patients, routine orthodontic treatment was carried out.

Corticotomy surgery: Routine blood investigations like Complete blood count (CBC), Bleeding time (BT) and Clotting time (CT) were assessed prior to the surgical procedure.

The procedure undertaken was as follows:-

Flap design: The corticotomy procedure was carried out under local anaesthesia. A full thickness mucoperiosteal flap was raised on the labial aspect around all anterior teeth from mesial of one canine to the other. Wherever the width of attached gingiva was adequate, marginal gingiva was preserved and the internal bevel incision was given 3-4mm from the marginal gingiva with the help of BP no. 15C blade. Additionally vertical releasing incisions were also given on the distal aspect of both canines extending upto the vestibular depth ensuring proper access to the alveolar bone wherein corticotomies are to be performed.

Decortication: Once the alveolar bone was exposed decortications were performed in the form of vertical inter-radicular cuts with the help of piezoelectric unit (Satelec Acteon). The cuts were started 2-3 mm below the crest of bone to a point 2mm beyond the root apices. The vertical cuts were approximately 0.5-

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1 mm in width extending through the entire thickness of the cortical bone, barely entering the medullary bone as confirmed by the oozing of blood from the cuts. These vertical cuts were then joined by a horizontal corticotomy cut extending 2-3 mm below the root apices from distal of one canine to the other. The corticotomies were performed only on the labial aspect of upper and lower anteriors. The flaps were approximated with resorbable 5.0 vicryl suture without excessive tension.

Retraction : En-masse retraction of the upper and lower segments was carried out using sliding mechanics in both the groups (test and control group). Direct anchorage from mini-implants was utilized for retraction purpose. NiTi closed coil springs of 9mm length were stretched between the crimpable hooks and the mini-implants .Patients were recalled after every 3-4 weeks for orthodontic adjustments.The total time required was calculated by recording the time at the start of retraction to completion of treatment.

Pulp vitality of six anterior teeth in maxillary and mandibular arches was checked before the start of treatment and after completion of treatment. An electric vitality test was performed with the help of digital electric pulp tester. Pulp vitality was recorded for all the patients and any loss of pulp vitality was thereby checked by repeating the pulp vitality testing with the same electric pulp tester after completion of treatment.

Fig -1 Full thickness mucoperiosteal flat elevation (maxillary arch)

Fig -2 Full thickness mucoperiosteal flat elevation (mandibular arch)

Fig -3 Vertical and horizontal corticotomy. cuts (Maxillary arch)

Fig -4 Vertical and horizontal corticotomy cuts (Mandibular arch)

Data collection method

Methodology for evaluation of total treatment time-

After complete alignment and leveling of all the patients of both corticotomy assisted orthodontic retraction group and conventional orthodontic retraction group, the total time required was calculated by recording the time at the start of retraction to completion of treatment.

Methodology for evaluation of pulp vitality-

Pulp vitality of six anterior teeth in maxillary and mandibular arches was checked before the start of treatment and after completion of treatment. An electric vitality test was performed with the help of digital electric pulp tester (DY310-DenJoy). The teeth to be tested were strictly isolated from the surrounding saliva and were blow dried with the help of air syringe. Toothpaste was applied on the surface of teeth to be tested which acted as conducting medium between the test electrode and the selected tooth. Electrical circuit was completed by engaging a

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lip clip on one side of the patient's mouth. Then the probe of the pulp tester was placed on the incisal third of the labial enamel surface of anterior teeth and the current was increased gradually. Tingling sensation was felt by the patient once the current reached the pain threshold level and the reading from the device was recorded for each tooth. In this way pulp vitality was recorded for all the patients and any loss of pulp vitality was thereby checked by repeating the pulp vitality testing with the same electric pulp tester after completion of treatment.

Fig-5 Isolation and application of toothpaste (electrolytic gel) on incisal 1/3rd of teeth

Methodology for evaluation of root resorption –

To evaluate the amount of root resorption, IOPA's were taken for all upper and lower anteriors before the start of treatment and after completion of treatment and compared. Modified Sharpe's grading scale from 0 to 4 as given by Malmgren et al (1982) and Levander & Malmgren (1988)[19] was used to measure grades of root resorption.

Levander-Malmgren classification for root resorption –

Grade 0- No evidence for root resorption

Grade 1- Irregular root contour

Grade 2- Apical root resorption less than 2mm

Grade 3- Apical root resorption > 2mm and < 1/3 of original root length

Grade 4- Root resorption exceeding 1/3 of original root length

Methodology for evaluation of crestal bone height -

For crestal bone height evaluation, before the start of treatment and after completion of treatment, IOPA along with grid were taken for maxillary and mandibular anterior teeth and orthopantomogram was taken. On IOPA, evaluation of crestal bone height from measured from crest of alveolar bone to cemento-enamel junction of each tooth. After completion of treatment, both pre treatment and post treatment IOPA along with grid were compared.

IOPA for root resorption and crestal bone height with grid

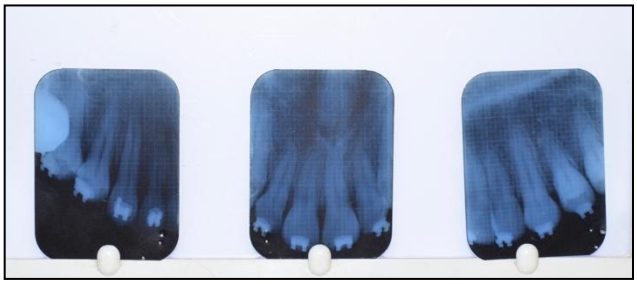


Fig-6 IOPA for maxillary teeth

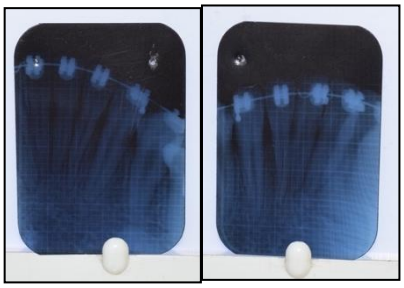
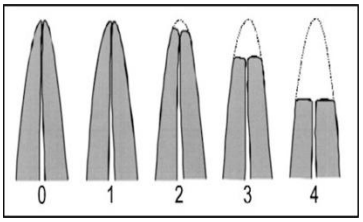


Fig-7 IOPA for mandibular teeth



Grade 0- No evidence for root resorption
Grade 1- Irregular root contour
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Grade 3- Apical root resorption > 2mm and < 1/3 of original root length
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Levander-Malmgren classification for root resorption

Statistical Analysis

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. The assumptions on data is made as; Dependent variables should be normally distributed & samples drawn from the population should be random, cases of the samples should be independent.

Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (Inter group analysis) on metric parameters. Leven`s test for homogeneity of variance has been performed to assess the homogeneity of variance. Student t test (two tailed, dependent) has been used to find the significance of study parameters on continuous scale with in each group.

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, Non-parametric setting for qualitative data analysis. Fisher Exact test used when cell samples are very small.

Statistical software: The Statistical software namely SPSS 22.0, and R environment ver.3.2.2 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

Results-

The demographic profile of subjects in two groups i.e. control and test groups were statistically similar.

Table 1 provides total treatment time months distribution in cases and controls studied. In control group , 13 cases required more than 20 months for completion of treatment and 2 cases required 15-20 months for treatment completion. Whereas , in test group 13 cases required less than 15 months and 2 cases required 15-20 months for treatment completion. This shows that total time required for completion of majority of cases of test group were significantly less(<15 months) as compared to control group which, majority of the cases required more than 20 months of total treatment time.

Table 1-

TTT Months	Test	Control	Total
<15	13(86.7%)	0(0%)	13(43.3%)
15-20	2(13.3%)	2(13.3%)	4(13.3%)
>20	0(0%)	13(86.7%)	13(43.3%)
Total	15(100%)	15(100%)	30(100%)

Table 2 The comparison of pulp vitality value in two groups after completion of treatment for upper arch. The difference in the values between test and control group was statistically insignificant as the p values of the upper anterior teeth (UR3 , UR2 , UR1 ,UL1 , UL2 , UL3) are more than 0.100

Table 2-

Pulp vitality	Test	Control	Total	P value
Pre				
UR3	15.73±2.37	15.93±3.08	15.83±2.70	0.844
UR2	16.60±2.64	15.60±2.41	16.10±2.54	0.288
UR1	16.73±3.20	17.00±2.73	16.87±2.92	0.808

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UL1	17.07±2.34	17.33±2.38	17.20±2.33	0.760
UL2	16.20±2.18	16.80±2.54	16.50±2.35	0.493
UL3	16.13±2.70	17.67±2.35	16.90±2.60	0.108
Post				
UR3	16.00±2.27	17.13±3.18	16.57±2.78	0.271
UR2	17.67±2.32	16.80±2.51	17.23±2.42	0.335
UR1	16.60±3.06	17.80±2.73	17.20±2.91	0.267
UL1	17.73±3.01	19.20±2.68	18.47±2.90	0.170
UL2	18.20±2.34	17.40±2.75	17.80±2.54	0.397
UL3	18.47±2.53	18.40±2.23	18.43±2.34	0.940

Table 3 The comparison of pulp vitality value in two groups after completion of treatment for lower arch . The difference in the values between test and control group was statistically insignificant as the p values of the lower anterior teeth (LR3, LR2, LR, LL2, LL3) are more than 0.100 except LL1. In LL1, it is significant as the p value is found to be p = 0.079 which is less than 0.100. The comparison of two group was evaluated using Student t test(unpaired).

Table 3-

Pulp vitality	Test	Control	Total	P value
Pre				
LR3	15.67±4.19	15.93±3.65	15.80±3.86	0.854
LR2	15.47±2.83	16.20±4.52	15.83±3.72	0.599
LR1	14.80±3.17	15.33±2.74	15.07±2.92	0.626
LL1	15.73±4.04	15.53±2.47	15.63±3.30	0.871
LL2	15.27±2.84	15.53±4.14	15.40±3.49	0.838
LL3	15.00±3.74	16.80±4.60	15.90±4.22	0.250
Post				
LR3	17.93±4.04	17.40±3.74	17.67±3.84	0.710
LR2	15.93±3.05	16.33±4.38	16.13±3.72	0.774
LR1	17.20±3.26	16.00±2.67	16.60±2.99	0.279
LL1	17.67±3.11	15.93±1.98	16.80±2.71	0.079+
LL2	17.20±2.31	15.93±3.47	16.57±2.97	0.249
LL3	16.87±2.90	17.53±3.91	17.20±3.40	0.600

Table 4 The comparison of Root resorption in two groups after completion of treatment for upper arch .The difference in values between test and control group was statistically insignificant as the p values of upper anterior teeth (UR3 , UR2 , UR1 , UL1 , UL2 , UL3) are more than 0.100

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Table 4-

Root resorption	Test (n=15)	Control (n=15)	Total (n=30)	P value
Pre				
UR3	0(0%)	0(0%)	0(0%)	1.000
UR2	0(0%)	0(0%)	0(0%)	1.000
UR1	0(0%)	0(0%)	0(0%)	1.000
UL1	0(0%)	0(0%)	0(0%)	1.000
UL2	0(0%)	0(0%)	0(0%)	1.000
UL3	0(0%)	0(0%)	0(0%)	1.000
Post				
UR3	1(6.7%)	2(13.3%)	3(10%)	1.000
UR2	3(20%)	7(46.7%)	10(33.3%)	0.121
UR1	3(20%)	7(46.7%)	10(33.3%)	0.121
UL1	4(26.7%)	7(46.7%)	11(36.7%)	0.256
UL2	1(6.7%)	4(26.7%)	5(16.7%)	0.330
UL3	2(13.3%)	2(13.3%)	4(13.3%)	1.000

Table 5 The comparison of Root resorption in two groups after completion of treatment for lower arch. The difference in values between test and control was statistically insignificant as the p values of lower anterior teeth (LR3 , LR2 ,LR1 , LL1 , LL2 , LL3) are more than 0.100The difference in root resorption value of two groups was evaluated using Chi-square /Fisher exact test and was found to be statistically insignificant for each tooth with p values more than 0.100

Table 5-

Root resorption	Test (n=15)	Control (n=15)	Total (n=30)	P value
Pre				
LR3	0(0%)	0(0%)	0(0%)	1.000
LR2	0(0%)	0(0%)	0(0%)	1.000
LR1	0(0%)	0(0%)	0(0%)	1.000
LL1	0(0%)	0(0%)	0(0%)	1.000
LL2	0(0%)	0(0%)	0(0%)	1.000
LL3	0(0%)	0(0%)	0(0%)	1.000
Post				

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LR3	2(13.3%)	4(26.7%)	6(20%)	0.651
LR2	1(6.7%)	2(13.3%)	3(10%)	1.000
LR1	1(6.7%)	3(20%)	4(13.3%)	0.598
LL1	1(6.7%)	5(33.3%)	6(20%)	0.169
LL2	2(13.3%)	2(13.3%)	4(13.3%)	1.000
LL3	1(6.7%)	3(20%)	4(13.3%)	0.598

Table 6: The comparison of Crestal bone height in two groups of patients studied for upper arch . The pre - treatment values of UR1 , UL1, UR2 , UL2 was found to be statistically significant with p value less than 0.100. Similarly the post treatment comparison of crestal bone height in two groups of patients studied was also found to be statistically significant with p value less than 0.100 whereas for UR3 and UL3, the values were statistically insignificant pre-treatment and post treatment. The comparison of two group was evaluated using Student t test(unpaired) .

Table 6-

Crestal bone height	Test	Control	Total	P value
Pre				
UR3	13.13±1.25	12.47±1.09	12.80±1.20	0.131
UR2	11.30±0.94	10.37±0.93	10.83±1.03	0.011*
UR1	10.73±1.07	9.63±0.88	10.18±1.11	0.005**
UL1	10.73±0.84	9.57±0.84	10.15±1.01	0.001**
UL2	11.33±0.92	10.37±0.85	10.85±1.01	0.001**
UL3	13.13±1.25	12.47±1.09	12.80±1.20	0.131
Post				
UR3	12.43±1.10	11.90±1.06	12.17±1.09	0.186
UR2	11.30±1.00	10.27±0.84	10.78±1.05	0.005**
UR1	10.63±1.01	9.57±0.94	10.10±1.10	0.006**
UL1	10.63±0.92	9.47±0.88	10.05±1.06	0.001**
UL2	11.23±0.90	10.27±0.84	10.75±0.99	0.005**
UL3	12.53±1.25	11.90±1.06	12.22±1.18	0.144

Table 7 The comparison of crestal bone height in two groups of patients studied for lower arch. The post treatment comparison of crestal bone height was also found to be statistically insignificant with p value less than 0.100 .The comparison of two group was evaluated using Student t test(unpaired) .

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Table 7-

Crestal bone height	Test	Control	Total	P value
Pre				
LR3	13.40±0.66	13.17±0.72	13.28±0.69	0.364
LR2	12.37±0.72	12.37±0.72	12.37±0.71	1.000
LR1	11.83±0.79	12.27±0.78	12.05±0.80	0.142
LL1	11.83±0.79	12.27±0.78	12.05±0.80	0.142
LL2	12.37±0.72	12.37±0.72	12.37±0.71	1.000
LL3	13.40±0.66	13.10±0.66	13.25±0.67	0.224
Post				
LR3	12.67±0.75	12.23±0.78	12.45±0.78	0.131
LR2	11.73±0.46	11.60±0.63	11.67±0.55	0.514
LR1	11.27±0.78	11.40±0.71	11.33±0.74	0.628
LL1	11.40±0.63	11.43±0.8	11.42±0.71	0.900
LL2	11.70±0.41	11.50±0.85	11.60±0.66	0.417
LL3	12.63±0.69	12.33±0.59	12.48±0.65	0.212

The results of our study indicate that Null hypothesis was rejected as corticotomy facilitated orthodontics (with piezocision) groups shows significantly reduced treatment time with no significant adverse effects in terms of Pulp vitality , Root resorption , Crestal bone height loss as compared to conventional orthodontics at the completion of treatment.

DISCUSSION

People seek treatment mostly for esthetic reasons i.e. to achieve lip competency and improve profile. But, adult population refrain themselves from seeking orthodontic treatment due to one major reason of longer treatment time. In an attempt to accelerate orthodontic treatment, whether there are any consequences of corticotomy assisted orthodontic treatment when compared to conventional orthodontic treatment was evaluated.

The work on corticotomy by Kole[6] and Suya[20] reported anecdotal findings of little apical root resorption. A transient osteoporotic state is induced by the corticotomy procedure which increases bone turnover and decreases bone density and may increase the risk of root resorption. Another theory is that, overcompression of the periodontal ligament

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leads to hyalinization necrosis of the PDL, the removal of which is associated with root resorption. So, the assessment of root resorption was also included in our study to find out the association of piezocision aided corticotomy and apical root changes.

Modifications in the original procedure of corticotomy, like preserving an intact spongiosa, have been made to minimize the injury of the vital structures. Newer procedures like piezosurgery have made the corticotomy procedure safe and non-traumatic. An appropriate corticotomy cut prevents iatrogenic insults to the periodontium and does not affect pulp vitality. However, the effect of rapid orthodontic treatment on pulp vitality was also included in the present study. Evidence also shows that if teeth are extracted just before commencing space closure, then space closure tends to be faster owing to the reduced bony resistance offered by the healing extraction socket. Thus, to take maximum advantage of the RAP response, delayed extraction of the first premolar was done in both the study and control groups.

In the surgical group, corticotomy was performed with the help of piezosurgical unit similar to that used by Al-Jundi A[21]. et al and Abbas IT- Moutamed GM[22]. In most of the studies cortical perforations have been made on both buccal and palatal surfaces, but in our study, we have performed corticotomies only on the buccal surface without reflection of a palatal flap. This is in corroboration with the procedure used in the studies of Germec et al[23], Aboul-Ela et al[24], Al-Jundi A[21]. et al, Nowzari H et al[25], and Arakal JA et al[26]. The justification for this is the assumption that the Regional Acceleratory Phenomenon (RAP) induced by the buccal corticotomy would readily involve the non-corticotomized palatal side. Additionally, it will also reduce surgical trauma and will elicit better patient compliance by reducing the surgical time and the need for an additional palatal flap elevation.

Table 1 shows total treatment time in control and test group. It has been found that total treatment time required for test group (corticotomy assisted retraction) was significantly lower as compared to control group (conventional assisted orthodontic retraction). In test group, out of 15 cases, 13 cases (86.7%) required less than 15 months and 2 cases(13.3%) required 15-20 months of total treatment time. When was compared to control group, only 2 cases (13.3%) required 15-20 months and 13 cases (86.7%) required more than 20 months for completion of treatment. This clearly shows that test group required less treatment time as compared to control group in which corticotomy procedure was not performed.

This results were found similar to studies done by Kole[27],Suya[28], Hajji[29], Chung[11], Wilcko[30], Converse[31]. They concluded corticotomy procedure significantly reduces the treatment time taking the advantage of RAP phenomenon, without any adverse effects of this accelerated treatment procedure.

Pulp vitality testing was done with the help of electric pulp tester (DenJoy DY310) at pre and post retraction stages in both the groups. As per the manufacturer's instructions, the grading for pulp vitality using DY310 electric pulp tester is as follows-

0-40 – normal pulp response, 40-80- part of the pulp is dead, >80- non-vital or necrosed pulp tissue

The difference between the pulp vitality values at pre and post-treatment stages showed insignificant difference (p-values more than 0.01) That means, in both the groups, pulp vitality testing showed normal response during the post treatment phase of orthodontic treatment since the values at both the stages are within the range of normal pulp response suggesting that there is no permanent damage to pulp in terms of vitality. Only in lower left central incisor, mild hypersensitivity to pulp was found in few cases, which could be due to heavier forces applied during orthodontic treatment phase. Also, the comparison of pulp vitality values at the post-retraction stage for both the groups, shows non-significant difference (p-values more than 0.01), suggesting that corticotomy and rapid orthodontic tooth movement did not induce any loss of pulp vitality as compared to the conventional orthodontic treatment. (Table 2 & 3)

These findings are in agreement with the studies conducted by Reddy CM et al[32] and Abed Bustani[33]. They assessed pulp vitality at pre-treatment, pre-corticotomy and post-treatment stages with Parkell's electric pulp tester. The readings of the pulp tester demonstrated that pulp vitality was intact with a marginal reduction during the orthodontic phase of intrusion and retraction. The corticotomy procedure

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did not have any serious effect on pulpal blood flow in this study as revealed by pulp vitality tests. In another study by Abed-Bustani[33], corticotomy assisted maxillary canine retraction was performed in 12 orthodontic patients. They assessed pulp vitality for all the patients at pre and post-surgical appointments with electric pulp tester and showed that there is no significant change in the pulp vitality response of the teeth after corticotomy surgery. Another study by Modaresi et al[34] evaluated the effect of orthodontic forces on tooth response to electric pulp test at 3 time points i.e. before treatment, just after initiation of treatment and 1 month post-treatment. The results showed that EPT values were increased upon initiation of orthodontic treatment, and after 1 month of treatment, the response threshold decreased but still remained higher than the pre-treatment records. Another study by Vlad et al[35] also reported the same findings on evaluating the influence of orthodontic treatment on dental pulp response to electric vitality testing.

Our finding that corticotomy procedure does not induce any loss of pulp vitality is documented by various other studies. Thus, no clinical signs of pulp vitality loss were reported in any of the studies undertaking corticotomy facilitated orthodontics. Thus, the findings of the present study are in accordance with the available literature.

Periapical radiographs were used to assess apical root changes at pre and post treatment stages in this study, to detect the presence of root resorption, if any. Modified Sharpe's grading scale with a grade scale from 0 to 4 as given by Malmgren et al (1982) and Levander & Malmgren (1988)[19] was used to measure grades of root resorption, similar to that used in the study by Reddy CM et al.

Table 4 gives the root resorption values for upper anterior teeth and table 5 gives the root resorption values for lower anterior teeth in control and test groups at pre and post treatment stages. In both the control and test groups, in all the 12 teeth, root resorption values at pre-retraction stage was 0, denoting that no root resorption was present in any of the teeth. Post-treatment values for upper and lower anteriors, in control and test groups shows that mild root resorption (ranging from grade 0 to 2) was observed in some teeth at post-treatment stages for both control and test groups. But the resorptions observed in both the groups are not statistically significant as indicated by p-values > 0.05. Further, comparison of post-treatment values of root resorption for the control and test groups reveals statistically insignificant differences for all the teeth, indicated by p-values more than 0.05. Thus, this study reveals that mild root resorption occurred as a part of orthodontic treatment in both conventional and corticotomy assisted orthodontic treatment and that corticotomy procedure did not induce any additional root resorption process. (Table 4 & 5)

The fact that orthodontic treatment causes root resorption has been documented in various other studies of Weltman et al[36], Harris et al[37], McLaughlin KD[38], Chan and Darendeliler[39], Levander-Malmgren et al[40], Sameshima and Sinclair[41], Liou et al[42] etc. Orthodontically induced inflammatory root resorption (OIIRR) is considered an undesirable consequence of orthodontic treatment. Root shortening is thought to result from a combination of complex biological activities in the region of periodontal ligament, which interacts with forces exerted during orthodontic treatment.Our finding of mild apical root resorption in both the groups is in accordance with the findings of Reddy CM et al[43], who conducted a study to compare the results of corticotomy facilitated orthodontics with conventional orthodontics in cases of bidental protrusion with spacing. They evaluated the root resorption after treatment completion on periapical radiographs which revealed that mild apical root resorption took place during the treatment in both the groups. Patterson BM et al[44], on the other hand, conducted a study on the effect of piezocision on orthodontically induced inflammatory root resorption and concluded that the piezocision procedure increases the chances of root resorption when used in conjunction with orthodontic forces, but root resorption in this study was mostly due to iatrogenic reasons and therefore this finding cannot be generalized to other studies.

Crestal bone height was evaluated using intra-oral periapical radiographs & OPG's . The measurement for crestal bone height on intra-oral periapical radiographs was done from crest of alveolar bone to cemento-enamel junction. This measurement to evaluate crestal bone height is used also used by Guilherme Janson[45], Morais[46]. Table 6 shows the crestal bone height in control and test group for upper

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arch and table 7 shows the crestal bone height in control and test group for lower arch. In both control and test group, out of 6 teeth in upper arch, statistically significant amount of crestal bone loss has been observed in central and lateral incisors of both sides whereas around canines and lower arch anterior teeth, bone loss was statistically insignificant. The reason behind the bone loss in central and lateral incisors could be due to heavier forces applied during orthodontic phase of treatment. Similar results were found by Guilherme Janson et al[45],Jon Artun[47],Alves[48] who concluded that some amount of bone loss is bound to occur in cases undergoing orthodontic treatment, the orthodontic load may contribute to the destruction of the bone support directly through the induction of proinflammatory cytokines and also by the decreasing expression of matrix proteins and osteogenic protein and not by gingival inflammation.

CONCLUSION-

In today's fast paced world, anything which saves time is very important. Therefore, importance of accelerated orthodontic treatment cannot be dodged. There are several procedures to accelerate the orthodontic treatment. In present study, efficacy of corticotomy assisted orthodontics was compared to conventional orthodontics in terms of total treatment time, pulp vitality, root resorption and crestal bone height at the completion of treatment.

Based on the results obtained from this study, following conclusions were drawn:

1. Piezocision aided corticotomy technique significantly reduces the total treatment time as compared to conventional orthodontics.
2. No loss of pulp vitality was observed in cases treated by corticotomy assisted orthodontic & conventional orthodontic treatment.
3. Root resorption occurs as a part of orthodontic treatment, but corticotomy procedure did not induce any additional amount of root resorption.
4. Mild crestal bone loss was observed in few cases in both corticotomy & conventional orthodontic cases, but no additional amount of crestal bone loss was observed in cases undergone corticotomy procedure.

Limitations:

Root resorption and crestal bone height was evaluated on IOPAs which is a 2D representation of a 3D object, so the assessed root resorption could be an underestimation of actual resorption process.

Future scope:

1) Root resorption and crestal bone height can be evaluated on CBCT for appropriate assessment.
2) Long term follow up should be considered

REFERENCES-

1. Fernandez-Ferrer L, Montiel-Company JM, Candel-Marti E, Almerich-Silla JM, Penarrocha-Diago M, Bellot-Arcis C. Corticotomies as a surgical procedure to accelerate tooth movement during orthodontic treatment: A systematic review. Med Oral Patol Oral Cir Bucal. 2016;21(6):703–12.
2. Jiang F, Chen J, Kula K, Gu H, Du Y, Eckert G. Root resorptions associated with canine retraction treatment. Am J Orthod Dentofac Orthop. 2017;152(3):348–54.
3. Abbas NH, Sabet NE, Hassan IT. Evaluation of corticotomy-facilitated orthodontics and piezocision in rapid canine retraction. Am J Orthod Dentofac Orthop 2016;149(4):473–80.
4. Harris EF, Robinson QC WM. An analysis of causes of root resorption in patients not treated orthodontically. Quintessence Int. 1993;24:417–28.
5. DM. K. Root resorption caused by orthodontic treatment: an evidence-based review of literature. Semin Orthod. 1999;5:128–33.
6. KD M. Qunatitative determination of root resorption during orthodontic treatment. Am J Orthod. 1964;50:143.
7. Brezniak N WA. Orthodontically induced inflammatory root resorption. Part I: the basic science aspects. Angle Orthod. 2002;72:175–9.
8. Shoreibah EA, Salama AE, Attia MS A-S. Corticotomy facilitated orthodontics in adults using a further modified technique. J Int Acad Periodontol. 2012;14(4):97–104.
9. Shoreibah EA, Ibrahim SA, Attia MS. Clinical and Radiographic Evaluation of Bone

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Grafting in Corticotomy-facilitated Orthodontics in Adults. 2012;105–13.
10. Lee JK, Chung KR BS. Treatment outcomes of orthodontic treatment, corticotomy-assisted orthodontic treatment and anterior segmental osteotomy for bimaxillary dentoalveolar protrusion. Plast Reconstr Surg. 2007;120:1027–36.
11. Akay MC, Aras A, Gunbay T, Akyalcin S KB. Enhanced effect of combined treatment with corticotomy and skeletal anchorage in open bite correction. J Oral Maxillofac Surg. 2009;67:563–9.
12. Abbas NH, Sabet NE HI. Effect of corticotomy facilitated orthodontics on root resorption. Egypt Dent J. 2011;57:3039–45.
13. Donald J. F, Machado I, Wilcko MT, Wilcko WM. Root resorption following periodontally accelerated osteogenic orthodontics. APOS Trends Orthod. 2016;6:78–84.
14. Patterson BM, Dalci O, Papadopoulou AK, Madukuri S, Mahon J, Petocz P, et al. Effect of piezocision on root resorption associated with orthodontic force: A microcomputed tomography study. Am J Orthod Dentofac Orthop. 2017;151(1):53–62.
15. AM S. Tissue changes incidental to orthodontic tooth movement. Int J Orthod Oral Surg Radiogr. 1932;18:331–52.
16. K R. Initial tissue behavior during apical root resorption. Angle Orthod. 1974;44:68–82.
17. Gantes B, Rathbun E AM. Effects on the periodontium following corticotomy facilitated orthodontics: case reports. J Periodontol. 1990;61:234–8.
18. Hernandez-Alfaro F, Guijarro-Martinez R. Endoscopically Assisted Tunnel Approach for Minimally Invasive Corticotomies: A Preliminary Report. J Periodontol. 2012;83(5):574–80.
19. Levander E, Malmgren O. Evaluation of the risk of root resorption during orthodontic treatment: A study of upper incisors. Eur J Orthod. 1988;10(1):30–8.
20. H. S. Corticotomy in orthodontics. In:Hosl E, Baldauf A. Mechanical and Biological Basis in Orthodontic Therapy. Heidelberg, Ger Hutlig B. 1991;207–26.
21. Al-Naoum F, Al-Sabbagh R, Al-Jundi A. Periodontally Accelerated Osteogenic Orthodontics versus Conventional Extraction - Based Orthodontics in Dental Decrowding : A Randomized Controlled Trial. Int Arab J Dent. 2015;6(1):9–19.
22. Abbas IT MG. Acceleration of orthodontic tooth movement by alveolar corticotomy using piezosurgery. J Am Sci. 2012;8(2):13–9.
23. Germeç D, Giray B, Kocadereli I, Enacar A. Lower incisor retraction with a modified corticotomy. Angle Orthod. 2006;76(5):882–90
24. Aboul-ela SMBE, El-beialy AR, El-sayed KMF, Mohamed E, Selim N, El-mangoury NH, et al. Miniscrew implant-supported maxillary canine retraction with and without corticotomy-facilitated orthodontics. Am J Orthod Dentofac Orthop 2011;139(2):252–9.
25. Nowzari H, Yorita F CH. Periodontally accelerated osteogenic orthodontics combined with autogenous bone grafting. Compend Contin Educ Dent. 2008;29(4):200–18.
26. Ahmed Arakkal J. Periodontally Accelerated Osteogenic Orthodontics: A Surgical Technique and Case Report. IOSR J Dent Med Sci 2015;14(3):2279–861.
27. H. K. Surgical operations on the alveolar ridge to correct occlusal abnormalities. Oral Surg Oral Med Oral Pathol. 1959;12(5):515–29
28. H. S. Corticotomy in orthodontics. In:Hosl E, Baldauf A. Mechanical and Biological Basis in Orthodontic Therapy. Heidelberg, Ger Hutlig B. 1991;207–26.
29. SS H. The influence of accelerated osteogenic response on mandibular decrowding [master's thesis]. J Dent Res. 2001;30:180
30. Wilcko WM, Wilcko T, Bouquot JE, Ferguson DJ. Rapid orthodontics with alveolar reshaping: two case reports of decrowding. Int J Periodontics Restorative Dent. 2001;21(1):9–19.
31. Converse JM, Horowitz SL. The surgical-orthodontic approach to the treatment of dentofacial deformities. Am J Orthod. 1969;55(3):217–43.

Volume 3, Issue 6; November-December 2020; Page No 672-685

32. Reddy DS. A Clinical Assessment of Corticotomy Facilitated Orthodontics in the Retraction of Maxillary Anterior Segment. 2014;291–300
33. Abed SS. Corticotomy assisted orthodontic canine retraction. 2013;25(1):160–6.
34. Modaresi J, Aghili H, Dianat O, Younessian F, Mahjour F. The effect of orthodontic forces on tooth response to electric pulp test. Iran Endod J. 2015;10(4):244–7.
35. Vlad R, Panainte I, Hantoiu L, Monea M. The Influence Of Orthodontic Treatment On Dental Pulp Response To Sensitivity Tests. Eur Sci Journal, ESJ. 2016;12(6):322.
36. Weltman B, Vig KWL, Fields HW, Shanker S, Kaizar EE. Root resorption associated with orthodontic tooth movement: A systematic review. Am J Orthod Dentofac Orthop. 2010;137(4):462–76.
37. Harris EF, Robinson QC WM. An analysis of causes of root resorption in patients not treated orthodontically. Quintessence Int. 1993;24:417–28.
38. KD M. Qunatitative determination of root resorption during orthodontic treatment. Am J Orthod. 1964;50:143.
39. Patterson BM, Dalci O, Papadopoulou AK, Madukuri S, Mahon J, Petocz P, et al. Effect of piezocision on root resorption associated with orthodontic force: A microcomputed tomography study. Am J Orthod Dentofac Orthop. 2017;151(1):53–62.
40. Levander E, Malmgren O. Evaluation of the risk of root resorption during orthodontic treatment: A study of upper incisors. Eur J Orthod. 1988;10(1):30–8.
41. Sameshima GT, Sinclair PM. Predicting and preventing root resorption: Part I. Diagnostic factors. Am J Orthod Dentofac Orthop. 2001;119(5):505–10.
42. Liou EJW, Chang PMH. Apical root resorption in orthodontic patients with en-masse maxillary anterior retraction and intrusion with miniscrews. Am J Orthod Dentofac Orthop. 2010;137(2):207–12.
43. Reddy DS. A Clinical Assessment of Corticotomy Facilitated Orthodontics in the Retraction of Maxillary Anterior Segment. 2014;291–300
44. Patterson BM, Dalci O, Papadopoulou AK, Madukuri S, Mahon J, Petocz P, et al. Effect of piezocision on root resorption associated with orthodontic force: A microcomputed tomography study. Am J Orthod Dentofac Orthop. 2017;151(1):53–62.
45. Janson G, Bombonatti R, Brandão AG, Castanha Henriques JF, De Freitas MR. Comparative radiographic evaluation of the alveolar bone crest after orthodontic treatment. Am J Orthod Dentofac Orthop. 2003;124(2):157–64.
46. Morais JF, Melsen B, De Freitas KMS, Branco NC, Garib DG, Cattaneo PM. Evaluation of maxillary buccal alveolar bone before and after orthodontic alignment without extractions: A cone beam computed tomographic study. Angle Orthod. 2018;88(6):748–56.
47. Jon Artun and Kolbjern S. Urbye. Bone Support in Patients With Advanced Loss of. Am J Orthod Dentofac Orthop. 1988;93(2):143–8.
48. Alves ACA. The impact of orthodontic treatment on periodontal support loss. Dental Press J Orthod. 2012;17(1):18–20.

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