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Comparative evaluation of effects of space closure with and without canine retraction

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Abstract
Objective: To evaluate the efficacy of closing loop during retraction by comparing the effect on incisors and anchorage unit with and without canine retraction.
Materials and Methods: 30 patients treated with first bicuspid extraction were randomly divided into two groups. In Group I canine retraction was carried out before space closure after which tear drop shaped closing loop was given. In Group II no canine retraction was carried out and tear drop loop was given for space closure. The duration of the study was four months. Lateral Cephalograms were taken at the start (T_0) and end of study period (T_4).
Results: Group II shows statistically significant reduction in incisor inclination in relation to the NA and SN line. A statistically significant change was seen on the anchorage unit on comparing the two groups. The horizontal distance from molar to ptv was increased in Group II. Group I showed lesser mesial movement of the molar in relation to ptv**.**
Conclusion: The effects found during retraction were different in both the groups. The incisor inclination and mesial movement of molars was significantly greater in group II as compared to the group I.

Keywords: Retraction, closing loop, canine retraction, en masse, two step retraction, anchorage

Introduction
Space closure is one of the challenging processes in Orthodontics. Teeth extraction, interproximal reduction, expansion of dental arches, and molar distalization, among other procedures, has been part of orthodontic armamentarium to correct various malocclusions with which the orthodontist should deal. The biomechanical basis of space closure enables the clinicians to determine anchorage and other treatment options, reach the prognosis of various alternatives, as well as decide specific adjustments that can improve the outcomes of care [1].
There are two mainstream methods of space closure in orthodontic treatment after tooth extractions. One is sliding mechanics, in which a plain archwire slides through the brackets and tubes on the posterior teeth. The other is loop mechanics, in which space closure is achieved by activation of closing loops incorporated into an archwire. Although sliding mechanics are quite advantageous in regard to reducing the amount of wire bending, which leads to simplified mechanics and improved patient comfort and oral hygiene, a great amount of friction could inhibit tooth movement during space closure. An essential characteristic's of loops is to move the group of teeth with more accurately defined force systems for more precise anchorage control to achieve treatment goals more readily. An essential part before space closure is for the clinician to decide whether canine retraction is to be carried out before retracting the incisors. This decision is built on the amount of crowding and anchorage requirement in the case.
Thus, the present clinical investigation was conducted with the objective to evaluate the efficacy of closing loop during incisor retraction by comparing the effect on incisors and anchorage unit in groups with and without canine retraction.

Materials and Methods
This clinical study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, Government Dental College and Hospital, Srinagar. The study consisted of thirty patients, which were randomly divided into two groups. In Group I canine retraction was carried out before space closure after which tear drop shaped closing loop was given.

In Group II no canine retraction was carried out and tear drop loop was given for space closure.

The Inclusion criteria were as follows: (1) Patients undergoing routine orthodontic treatment with 0.018 MBT-fixed appliances by extraction of upper first premolar were selected as participants. (2) Patients in between the age group of 15-25 years.

Exclusion criteria included: Teeth with root resorption, dilacerated roots, periodontal pathologies or any systemic disorders that contraindicate orthodontic treatment.

Lateral cephalograms were collected at the beginning (T_0) and the end of study period after four months (T_4). As a standardization protocol 0.016×0.022 SS wire was used for the fabrication of loops. The dimensions of loops were standardized. The loop used was a tear drop loop with the dimension of 8mm height and 4mm width. The gable bends given in the loops were also standardized with α- 10° β- 20°. The participants were recalled after 1 month for the checkup and activation of loop by 1mm/month.

Lateral cephalograms collected at T_0 and T_4 were traced manually by single operator and following measurements were recorded: Angular measurements: (1) Upper incisor to NA (2) Upper incisor to SN. Linear measurement: (1) Palatal plane to incisal edge (2) Molar to PTV. (Fig.1)

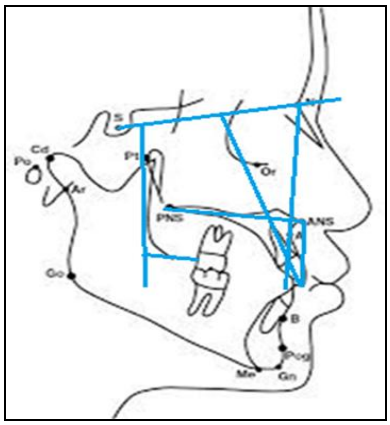

Fig 1: Lateral Cephalogram showing Angular and linear measurements.

Statistical Method

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS version 20.0 (SPSS Inc. Chicago Illinois, USA). Data were expressed as Mean ±SD. Student's independent t test was employed for inter-group analysis of data. For Intra-group analysis, Paired t-test was applied. Graphically the data was presented by bar diagrams. P-value less than 0.05 were considered statistically significant.

Results

The mean and standard deviation of various measurements in group I at T0 and T4 are shown in Table 1. The change in inclination of upper incisors was not significant from T0 to T4 in relation to SN plane and NA line.

Incisal edge to palatal plane has reduced but the change is not statistically significant. The molar to ptv shows a slight increase the distance but is not significant.

The mean and standard deviation of various measurements in group II at T0 and T4 are shown in Table 2. The inclination of upper incisors was significantly changed from T0 to T4 in relation to SN plane and NA line. The vertical distance of incisal edge to palatal plane has reduced significantly. The distance from molar to ptv shows increase in the distance at T4 which is statistically significant.

The comparative changes between the means of group I and group II from T0 to T4 are given in Table 3.

On comparing the changes between the two groups, Group II shows more reduction in incisor inclination in relation the NA and SN line. The difference is statistically significant.

The vertical distance from the palatal plane to incisal edge showed slightly more reduction in the group II depicting an intrusive movement, but the changes are not statistically significant on comparing both groups.

A statistically significant change was seen on the anchorage unit on comparing the two groups. The horizontal distance from molar to ptv was increased in Group II. Group I showed lesser mesial movement of the molar in relation to ptv.

The results are shown graphically using a bar diagram in Fig 2, 3 and 4.

Table 1: Comparison of various parameters in Group I

	T0		T4		P-value
	Mean	SD	Mean	SD	
Upper incisor to Na (º)	23.60	4.03	23.93	4.53	0.725
Upper incisor to SN (º)	107.60	6.06	107.47	5.93	0.912
Palatal Plane to incisal edge (mm)	27.53	4.22	27.33	3.27	0.803
Molar to ptv (mm)	18.00	3.74	18.10	3.88	0.857

*Statistically Significant Difference (P-value<0.05); P-value by paired t-test

Table 2: Comparison of various parameters in Group II

	T0		T4		P-value
	Mean	SD	Mean	SD	
Upper incisor to Na (º)	26.93	4.99	18.67	4.56	<0.001*
Upper incisor to SN (º)	106.80	4.26	97.67	4.25	<0.001*
Palatal Plane to incisal edge (mm)	26.20	3.12	25.40	2.56	0.034*
Molar to ptv (mm)	12.73	2.34	13.80	3.28	0.032*

*Statistically Significant Difference (P-value<0.05); P-value by paired t-test

Table 3: Comparison of various parameters in two groups

	Group I (T0-T4)		Group II (T0-T4)		P-value
	Mean	SD	Mean	SD	
Upper incisor to Na (º)	-0.33	3.59	8.27	5.56	<0.001*
Upper incisor to SN (º)	0.13	4.58	9.13	5.66	<0.001*
Palatal Plane to incisal edge (mm)	0.2	3.05	0.8	1.32	0.491
Molar to ptv (mm)	-0.1	2.11	-1.07	1.75	0.027*

*Statistically Significant Difference (P-value<0.05); P-value by Student's independent t-test

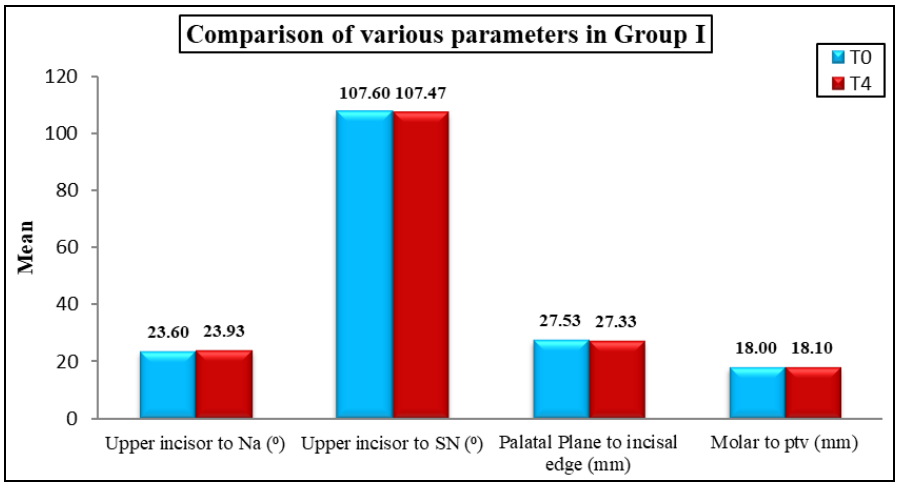

Fig 2: Comparison of various parameters in Group I.

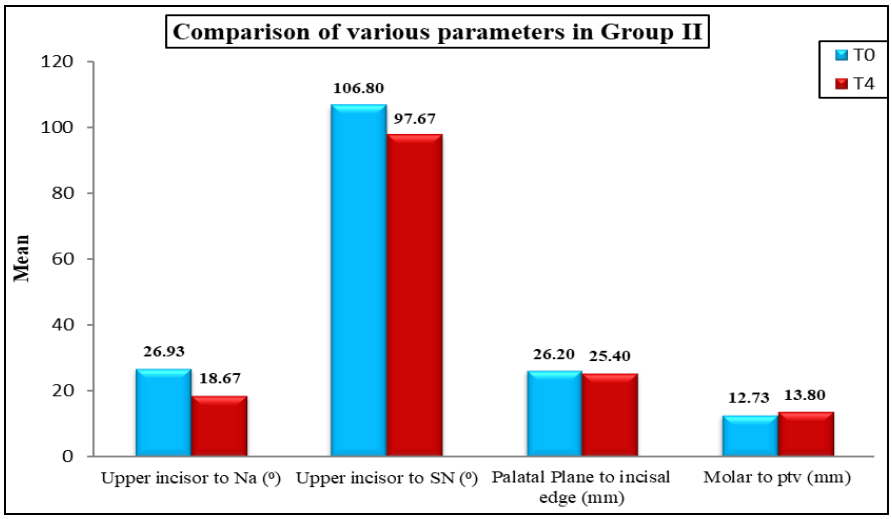

Fig 3: Comparison of various parameters in Group I.

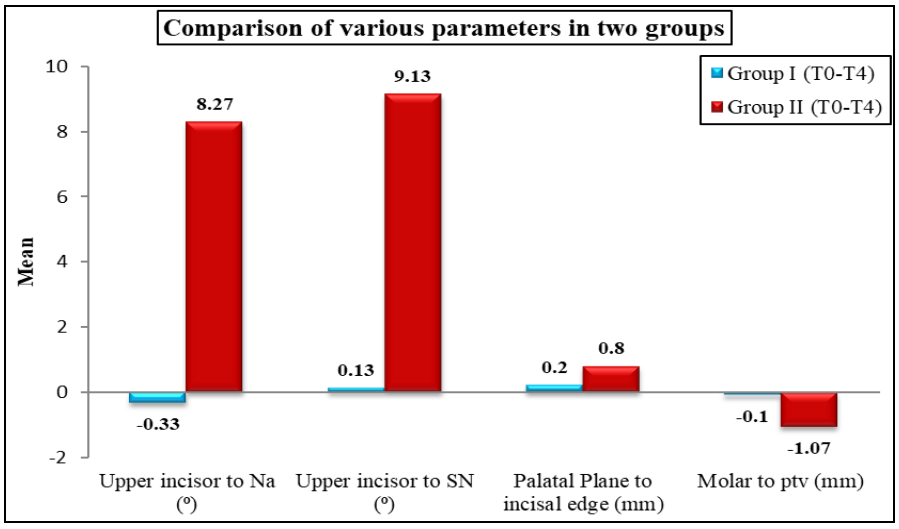

Fig 4: Comparison of Group I and Group II.

Discussion

Space closure is an important factor for success of orthodontic treatment. Several orthodontic mechanics were designed for closing the spaces. There are many ranges of loops which may be incorporated into continuous or segmented arches for closure of spaces. Due to large number of options, a great deal of attention must be paid while selecting the appropriate loop. The force system produced by the loops depends on many variables including wire size, loop shape, loop position and activation.[2] It is of the utmost importance for the professional to determine precisely the system of forces generated, i.e. it is important for the orthodontist to know the magnitude of the forces and the moments released when these devices are activated.[3] When used in an improper manner, orthodontic loops for closing spaces could cause undesirable effects such as loss of anchorage and root resorption. These effects in addition to increase in treatment time may also cause irreversible damage to patients. So, knowledge of mechanical behavior of orthodontic appliance is an important for better treatment results and good clinical outcomes. The closing of extraction spaces can be performed using two main retraction techniques: en masse retraction or two-step retraction. For space closure achieved by en masse retraction, incisors and canines are retracted in just one step and as if it were a single block [4]. In Two Step Retraction, the first step involves independently retracting the canines until they reach full contact with the second premolar; then they are incorporated into the posterior block of teeth composed of the second premolar and first and second molars. In the second step, this posterior block is used as an anchorage unit to retract the incisors [5, 6] There are two schools of thought whether canine should be individually retracted or not after levelling and alignment. The choice between these two methods is the clinician's preference, [7] but most orthodontists decide to use two step retraction in cases in which posterior anchorage control is critical [1].

In this study effects were studied on the incisor unit and anchorage unit during retraction with closing loop. In Group I canine retraction was carried out before space closure after which tear drop shaped closing loop was given. In Group II no canine retraction was carried out and tear drop loop was given for space closure/ incisal retraction. Lateral cephalograms were collected at the beginning (T_0) and the end of study period after four months (T_4). As a standardization protocol 0.016×0.022 SS wire was used for the fabrication of loops. The dimensions of loops were standardized. The loop used was a tear drop loop with the dimension of 8mm height and 4mm width. The gable bends given in the loops were also standardized with α- 10° β- 20°. The participants were recalled after 1 month for the checkup and activation of loop by 1mm/month.

This investigation revealed a significant change in the incisor inclination in group II without canine retraction as compared with group I. This could be because of the difference in force values between the two groups. Burstone [8] showed that if a higher moment-to-force ratio is required, it is necessary to use a greater vertical height. The amount of wire incorporated in the loop is very important factor. The length of the wire is inversely proportional with the magnitude of force.[9] The effect on spring characteristics changes by changing the wire size, the design of the loop, the inter bracket span. Even though the loop length and diameter was standardized in both the groups, the other factors come into the play for example: the amount of initial incisor inclination in the sample.

The vertical changes in the incisors were studied in both the groups. Statistically no significat differences were seen in vertical distance in incisor during retraction in both the groups. In previous study extrusive movement was reported as a side effect of Two Step Retraction [7] and was considered too small to be of clinical significance, [10] since it did not compromise the final results of treatment. The mesial movement of molars was seen to be significantly greater in the group II. Traditionally, it has been believed that independent canine retraction is considered to produce less mesial force for posterior teeth and could yield less anchorage loss [4, 11]. However, others [1, 10, 12] believe that Two Step Retraction is complicated because it requires a longer treatment time. They claim that performing separate canine retraction doesn't change the overall effect on posterior anchorage loss [6, 7]

Conclusion

When comparing the closure of space between groups, the following was concluded:

- Both the methods are effective to achieve space closure.
- Significant differences exist in the incisor inclination in both the groups.
- Significant anchorage loss of molars was seen in group where canine retraction was not carried out.

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