Evaluation of canine retraction and anchorage loss in fixed orthodontic treatment

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Abstract:

Introduction: *Anchorage loss is one of the main problems of orthodontic treatment. Treatment desires maximum anchorage and minimal anchorage loss of extraction cases. Mesial migrations of anchor teeth or anchorage loss lead to prevent correction of anteroposterior malocclusion and diminish facial esthetic.*

Aim: *The aim of this study to detect the amount of mesial migration of anchor tooth or anchorage loss and the amount of canine retraction or extracted space closure.*

Materials and Methods: *136 patients were selected for the study who were treated in the Department of Orthodontics, Faculty of Dentistry, Bangabandhu Sheikh Mujib Medical University. The patient were either class I malocclusion with crowding which need extraction of first premolar to relieve the crowding; or class I or class II malocclusion. Those patients have overjet more than 5 mm and need extraction of first premolar. The patient was selected above 12 years .This study was developing from pre and post treatment study cast of each sample or patient. All the measurement have been done on the pre and post treatment dental casts by using vernia.*

Result: *The result showed that, type of malocclusion was an important factor of anchorage loss. Class II malocclusions have greater anchorage loss than Class I crowding. The male have higher canine retraction than female. The growing group showed larger canine retraction than non growing group.*

Conclusion: *The type of malocclusion is an important factor which affecting anchorage loss and canine retraction.*

Key Words: *Anchorage loss, Canine retraction, Fixed orthodontic treatment.*

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Introduction:

Crowded, irregular and protruding teeth have been a problem, which attempts to correct this disorder go back at least to 1000 BC[1]. In 1728, the French pioneer Fauchard introduced the first appliance and noted that, to exert mechanical pressure by the means of an apparatus, sufficient resistance to the force must be exerted. Today anchorage control is a major concern in the orthodontic treatment.

Anchorage is the resistance to unwanted tooth movement and is commonly described as the desired reaction to posterior teeth to space closure mechanotherapy to achieve treatment goals. Based on the anchorage demand if extraction case i.e. maximum anchorage, moderate anchorage and minimum anchorage.[1,2]

Anchorage loss is a reciprocal reaction that reduces the success of orthodontic treatment by complication the anterior posterior correction of malocclusion and aesthetic problem.

Orthodontic tooth movements are based on the ability of bone to react to mechanical stresses with the deposition and resorption of alveolar bone.[3]

The concept of a well-interdigitated occlusion acting to enhance molar anchorage accepted dogma. Greekmore (1997) found that the posterior teeth occupy one-third to one-half of extraction space first and second premolar extraction, respectively.

The rate of tooth movement during orthodontic treatment is dependent on a number of mechanical and biologic variables. The variables implicated in bracket-wire friction included bracket material and quality of manufacture, slot size, wire alloy type, wire size, ligature material and force of ligation. Careful selection of appropriate brackets, wire and ligatures may be used to predictably control the relative rates of tooth movement and to enhance or reduce anchorage.[5]

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Space closure requiring precise anchorage control is more difficult in extraction cases. Control of molar position is an obvious necessity in space closure. Inadvertent anchorage loss can prevent correction of anteroposterior malocclusions. This can be especially important in extraction space closure associated with class II correction. Mesial movement of the maxillary posterior teeth may make it very difficult to obtain correction of the malocclusion.[6]

If on upper canine is to be retracted with bodily movement using fixed appliance, the force applied to the tooth will be approximately 100 gm. Force in the opposite direction varying from 67 gm on the first molar to 33 gm on the second premolar resist this. Low level will produce negligible tooth movement and in the effect of a light force of 100 gm would be to retract the canine with minimal anterior unwanted movement of anchored teeth. However, if the force level is increased to 300 gm the force level on the anchored teeth increased dramatically to the level where unwanted teeth movement will occur[7]. So, optimal force should be used for tooth movement. The current concept of optimal force is on the hypothesis that a force of a certain magnitude and temporal characteristics would be capable of producing a maximum rate of tooth movement without tissue damage and maximum patient comfort.[1]

Anchorage loss depend on some factors such as malocclusion, type and extent of tooth movement , root angulations and length, missing teeth, intraoral/extra oral mechanics, patient compliance, crowding, overjet, extraction site, alveolar bone contour, inter arch interdigitation, skeletal patter, third molars and pathology(ankylosis, periodontitis) affect anchorage loss. Most of the anchorage loss studies focus on biomechanical solution.[7,8,9,10,11,12,13]

Vasquez *et al.* (2001) suggested several clinical principles that can be followed to enhance anchorage in adult patients.

1. Incorporating more teeth in the anchor unit, thus distributing the force over a greater root area.
2. Tying the anchor unit together more rigidly.
3. Varying the movement-to-force ratio so that the active unite is tipped while the anchor unit is translated.
4. Applying forces to the anchor unit that could be neutralized by occlusal forces.

Force levels between the active and anchor unit is to vary due to the friction. Since the force that acts at the root surface is the result of applied force, minus the force or reduce the force due to friction.

In recent years, endosseous implants have been used as orthdontic anchorage.[14]

Materials and methods:

136 patients were selected for the study which was treated in the Department of Orthodontics, Faculty of Dentistry, Bangabandhu Sheikh Mujib Medical University (BSMMU). The patient was either class I malocclusion with crowding which need extraction of first premolar to relieve the crowding; or class I or class II malocclusion. Those patients have overjet more than 5 mm and need extraction of first premolar. All the patients above 12 years received orthodontic treatment.

The treatment method, all the patient was treated with edge-wise fixed appliance using stainless steel 0.018 x 0.025 inch Roth brackets and according to standardized moderate anchorage control.

The two maxillary first premolars was extracted, the space closure by individual sliding of canine using round stainless steel wire 0.016 inch for canine retraction. Canine retraction by using elastic chain was change every 3 weeks. Then, the en-mass incisors retraction using 0.017 x 0.025 inch rectangular arch wire containing tear-drop loops activated 1 mm every 3 weeks, this regimen of activation produce initial force of 150 gm per side.[15,16] The arch wire activated with tip back bend mesial to the first molars. After finishing and completion of the treatment, another study cast was taken for each sample or patient. So there was pre and past treatment study cast.

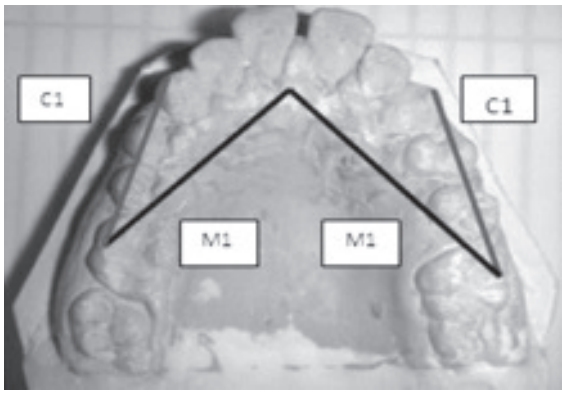

Fig.-1: *Pre-treatment measurements*

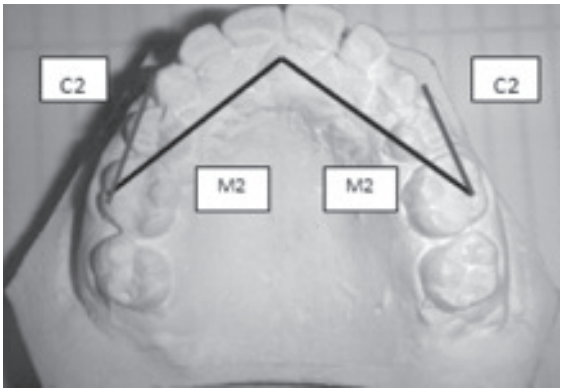

Fig.-2: *Post-treatment measurements*

Procedure for collecting data:

All the measurement had been done on the pre and post treatment dental casts by using vernia. Those measurements are-

Distance of Canine (C): The length between tip of the canine to the buccal groove of the first molar. The difference of canine distance (C) between pre-treatment (C1) and post- treatment (C2) which will give the amount of canine retraction (distal movement of canine)

Distance of Molar (M): The length between the buccal groove of first molar to the centre of incisive papilla. This anatomical landmark are taken as a constant reference point that not affected by teeth movement (Agha, 2006; Haruki & Little, 1998; Hoggan & Sadowsky, 2002). So, the difference of molar distance between pre-treatment (M1) and post treatment (M2) record will give the amount of anchorage loss, or mesial migration of first molar.

Fig.-3: *Measurement of pretreatment and post-treatment dental cast by vernier caliper in mm.*

Result:

In this study 136 cases were include 40 male, 96 female and who were treated with fixed orthodontic appliance. Data were obtained from the pre-treatment and post – treatment dental cast of 136 patients, 68 Angle class I crowding and 68 Angle class II increase overjet.

Table -I shows, the age group minimum 12 y maximum 32 years. The mean value of canine retraction was 5.25 mm and anchorage loss 3.16 mm.

Table-II demonstrated the comparison between male and female. Canine retraction in male higher mean value than female and the difference also was significant (P vlue-0.03). Anchorage loss in female had greater mean value than male but not significant.

Table-III Showed the difference between the class I and Class II, the canine retraction in class I (mean 6.09) was higher than class II (mean 4.41) but not significant. Anchorage loss was higher in class II (mean 3.91) than class I (mean 2.40) malocclusion, was not significant.

Table-IV demonstrated the comparison between male and female in class II malocclusion. Canine retraction and anchorage loss was not significant.

Table-V showed the comparison between male and female in class I malocclusion. Canine retraction and anchorage loss was not significant.

Table-VI demonstrated the comparison between growing and non growing group. Canine retraction in growing group (mean 5.38 mm) higher than the non growing group (mean 5.12) and the difference was significant (*P*=0.03). Anchorage loss in growing and non growing was not significant.

Table -I

Description of the age, canine retraction and anchorage loss

	Mean	N	Std. Deviation	Minimum	Maximum	Range
Age	19.43	136	4.698	12	32	20
Canine retraction	5.254	136	1.4049	2.3	8.9	6.6
Anchor loss	3.160	136	1.1157	.7	6.2	5.5

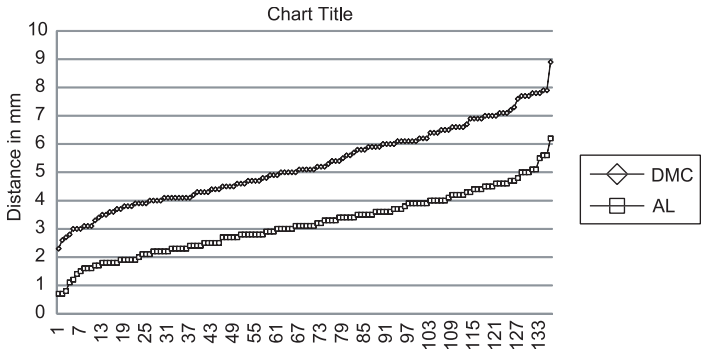

Fig.-4: *Canine retraction and anchorage loss of individual case arranged in increasing order.*

Table-II

Comparison between male and female in canine retraction and anchorage loss

	Sex	N	Mean(mm)	Std. Deviation	p value
Canine retraction	Male	40	5.410	1.6380	0.033
	Female	96	5.189	1.2995	
Anchor loss	Male	40	3.030	1.3086	0.060
	Female	96	3.214	1.0276	

Table-III

Comparison between class I crowding & class II increased overjet in canine retraction and anchorage loss.

	Malocclusion	N	Mean(mm)	Std. Deviation	p value
Canine retraction	Class I crowding	68	6.093	1.2605	0.066
	Increase overjet	68	4.415	.9795	
Anchor loss	Class I crowding	68	2.409	.7940	0.445
	Increase overjet	68	3.910	.8566	

Table-IV

Comparison between male and female in class II malocclusion

	Sex	N	Mean(mm)	Std. Deviation	P value
Canine retraction	Male	17	4.312	1.0529	0.753
	Female	51	4.449	.9624	
Anchor loss	Male	17	4.135	.8544	0.621
	Female	51	3.835	.8525	

Table-V

Comparison between male and female in class I malocclusion.

	Sex	N	Mean(mm)	Std. Deviation	P value
Canine retraction	Male	23	6.222	1.5261	0.107
	Female	45	6.027	1.1142	
Anchor loss	Male	23	2.213	.9290	0.278
	Female	45	2.509	.7058	

Table-VI

Comparison between growing & non growing group in canine retraction and anchorage loss.

	Growth	N	Mean(mm)	Std. Deviation	P value
Canine retraction	growing	66	5.389	1.5353	0.039
	non growing	70	5.126	1.2676	
Anchor loss	growing	66	3.139	1.1758	0.158
	non growing	70	3.179	1.0642	

Discussion:

Relatively few studies have measured the amount of canine retraction and anchorage loss. This study was aimed at evaluating the canine retraction and anchorage loss in class I crowding and class II malocclusion overjet more than 5 mm. 5% to 50% of the total extraction space can be taken up by an anchor unit made up of the first molar and second premolar when used to retract a canine[17].

In this research, anchorage loss in class I crowding and class II malocclusion, the female had larger mean value

than male group. The deference between male and female group in anchorage loss was not significant. The male have higher canine retraction (mean 5.41) than female (mean 5.81) and the difference was significant. This finding was supported by Agha (2006). But further study is required supporting the findings.

In anchorage loss, the class II malocclusion had greater mean value (3.91) than class I crowing (2.40). The same finding was reported by Agha (2006). He found greater anchorage loss occur in treatment of class II than class I malocclusion. This may be due to the amount of arch length deficiency. Less anchorage is required to relieve crowding than to reduce overjet. So, the greater the crowding lowers the anchorage loss. Gerons *et al* (2003) and Ong & woods (2001) supported the interpretation of the present research because on account of less crowding they reported greater anchorage loss. But the statement contradict the other author, Differential moment have been reported to reduce anchorage loss by 0.6-0.7 mm. When maximaum anchorage is required, anchorage loss was greater in class I (0.60mm) than in class II (0.28 mm) malocclusion.[7,8]

The age of the patient considered as an important factor in orthodontic treatment. In this research, the anchorage losses in non-growing group had greater mean value (3.17) than growing group (3.13), with no significant net difference. The same finding was reported by Gerons *et al*. (2003). They found greater anchorage loss was in the adult group when postero-anterior maxillary growth was compared with adolescent group. But Harris *et al*. (1991) they found growing patient had greater anchorage loss (2.55 mm) than non-growing patient (0.2 mm), which suggests that this factor merits further study.

The growing group had larger mean value (5.38) for canine retraction than non-growing group (5.12).The growing patient had greater bone remodeling cells than adult and facilitate tooth movement.

Conclusion:

The type of malocclusion is important in affecting anchorage loss. There was higher record of anchorage loss in class II malocclusion than class I crowding, but not significant. The male had higher canine retraction than female. The growing patient showed larger canine retraction than non-growing patient.

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