CANINE RETRACTION: EFFICACY OF METHODS APPLIED OVER THE YEARS — A SYSTEMATIC REVIEW

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ABSTRACT

Objective of the present study was to assess the scientific evidence on the efficacy of various methods of canine retraction. A literature survey was performed by applying the Medline Database (Entrez PubMed). Medical Subject Heading (MeSH) was used. References from the selected articles were also hand searched.

The search strategy resulted in 129 articles. After applying the inclusion / exclusion criterion thirteen articles qualified for the final review analysis. The survey covered a period from 1983 to 2008. No one method can be considered superior to another in terms of faster tooth movement or limited side effects.

Key words: *Canine Retraction, Space Closure*

INTRODUCTION

The conflict between extraction and non-extraction treatment in Orthodontics has accompanied us from the era of Edward H Angle, Charles Tweed and Calvin Case to the present times.[1, 2, 3] This debate is never-ending.

Since 1930 onwards, extraction treatment has gained massive popularity.[4] This shift was to achieve stable end results.[5] Premolars have mostly been considered as the choice of extraction followed by canine retraction.[6-9]

As space closure is a routine procedure in orthodontic practice, researchers have always been interested in determining efficient methods of retracting canines.[10] In broad classification canines can be retracted by Frictional (Sliding) and Non-Frictional (Closing Loop) mechanics.[10, 11] This research review focused on frictional mechanics of canine retraction.

Frictional mechanics is the sliding of a tooth along an arch wire by application of a force.[12, 13] Quite a few methods of this force application are found in the literature regarding canine retraction.

The aim of the present systematic literature review was to determine the efficacy of different methods of canine retraction. Following questions needed to be answered:

- What type of force was applied?
- What was the rate of canine retraction?
- What were the side effects of each method?

METHODOLOGY

To identify all the studies that examined the relationship between the type of force applied and resultant canine retraction, a literature survey was done by applying the Medline database (Entrez PubMed, http://www.ncbi.nim.nih.gov/) MeSH headings of canine retraction, orthodontics were used. The electronic databases were not limited by type of study and time period, however only articles in English language were specified.

Selection criteria is explained in detail in Table 1. No restrictions were set for the sample size. In-vivo studies done only on human subjects were included. Studies with subjects who had undergone first premolar extraction followed by maxillary canine retraction

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were included in the review. Only sliding mechanics of canine retraction were studied. Age and gender restriction was not applied. Studies (in English) from any part of the world cited in referenced journals were reviewed. Where no abstract was available, studies were not included.

Data was collected and analyzed according to these headings: Study design, type of force application, magnitude of force, rate of canine retraction and side effects. Limitations encountered in the studies were all analyzed and discussed systematically.

RESULTS

The search protocol resulted in 129 articles. After the application of inclusion / exclusion criteria listed in Table 1 final selection was done. Table 2 gives the summary of the selected articles for the review.[10, 12-25.] Retraction evaluated at leveling and alignment stages,[26] application of different techniques for rapid dista-lization of canine like distraction osteogenesis,[27,29] and laser therapy before canine retraction,[30] were all excluded from the review because they did not meet the specific inclusion criteria mentioned.

Thirteen articles were finally reviewed to assess the efficacy of different methods of canine retraction.[10, 12-25] All articles were Randomized Control Trials with a split mouth study design for better comparison.

One article compared wires of two different sizes[12], one compared elastomeric auxiliaries in the form of Unitek Alastik Chain, Rocky Mountain elastic Chain and Elastik thread[14]. To compare frictional with frictionless mechanics one study compared alastic chain with Gjessing retraction spring[15] and one compared Rickett's retraction spring with NiTi coil spring[10]. Samules et al performed one study comparing medium NiTi coil spring with elastic module.[16] They further compared the light, medium and heavy NiTi coil springs with elastic modules to determine which treatment modality was more effective.[19] Three more studies were reviewed which compared elastomeric auxiliaries with NiTi coil spring,[20-23] one study evaluated the rate of canine retraction with reference to a continuous or an interrupted force delivery with magnets and a vertical loop respectively[18]. Two studies compared the tipping with bodily mechanics.[17, 24] One study explained the difference between steel ligature tied plastic bracket with a metal slot and frictionless Clear Snap brackets.[25]

Forces were in the range of 70 gms to 450 gms with a mean of 150-200 gms. NiTi coil spring produced a continuous force for the required interval whereas elastomeric auxiliaries had declining force application. Effects of both were evaluated.

The exact values for the rate of canine retraction with different treatment methods are given in Table 2. Three studies showed NiTi coil spring produced a faster rate of canine retraction, nonetheless power chain can be considered as effective.[20-23] However similar rates of space closure with NiTi coil spring and power chain were reported in two studies.[22, 23] Alastic chain compared with Gjessing retraction spring[15] and Rickett's retraction spring compared with NiTi coil spring[10] proved no statistically significant difference in rates of canine retraction. One study showed Alastik chain, Rocky Mountain elastic chain and elastic thread to be equally effective in retracting canines.[14] One study showed that rate of retraction was similar when size of the round wire was increased from 0.016" SS to 0.020" SS.[12] When tipping mechanics were compared with bodily mechanics one study reported no statistically significant difference[17], whereas one study showed a shorter duration of space closure with tipping mechanics[24].

Side Effects: Tipping was reported with quite a few studies[12, 15, 17], especially when wire of small diameter was used[12].With power chain force degradation was reported.[14, 16]This degradation of force was overcome by increasing the initial force application.[17] Rotation of

TABLE 1: SELECTION CRITERIA

INCLUSION CRITERIA	EXCLUSION CRITERIA
All journal articles including clinical trials, abstracts	Thesis, letters, editorials, case reports, where no abstract was available
All human subjects	All experimental animals
In-vivo studies	In-vitro studies
First maxillary premolar extractions	Non-extraction or extraction of teeth other than first maxillary premolars
Sliding mechanics of canine retraction Simple methods	Non-sliding mechanics of canine retraction Sliding methods augmented with procedures like distraction osteogenesis and laser therapy
Similar methodology applied for measurement of tooth movement in all the studies	Studies with different methodologies applied for the measurement of tooth movement

TABLE 2: SUMMARY OF SELECTED ARTICLES

Article	Study Design	Sample Size	Force Applied	Magnitude of Force	Rate of Canine Retraction	Side Effects	Conclusions
Hoffman DH, Way DC, 1986[12]	Split mouth	16	0.016" vs 0.020" SS Force applied with a Pletcher spring	200 gms	1.37 mm/ month And 1.20 mm/ month	Tipping with small sized wire was more than larger wire	N.S difference between the two wire sizes
Sonis AL, Vander PLas E, Gianelly A 1986[14]	Split mouth	25	Unitak Alastik chain Rocky Mountain chain Elastic thread	350-400 gms	1.28 mm/3wks 1.51 mm/3wks 1.55 mm/ 3wks	Force degradation of all the elastomeric auxiliaries occurred	N.S difference
Zielger P, Ingervall B. 1989[15]	Split mouth	21	Alastic chain Gjessing Retraction Spring	380 gms initial decaying to 200 gms 160 gms	1.4 mm/ 3-4wks 1.91 mm/3wks	Tipping, rotation of canine and anchorage loss of molars	N.S difference With spring tipping is less and rotation is more
Samuels RHA, Rodge SJ, Mair LH 1993 [16]	Split mouth	17	NiTi spring Elastic module	150 gms 400-450 gms	Not mentioned	Force degradation with elastic module	Spring delivers a greater and more consistent force than elastic module
Lotzof LP, Fine HA, Gisneros GJ 1996 [17]	Split mouth	12	Tipedge bracket vs edgewise bracket Force applied with power chain	200 gms	1.88 mm/3wks 1.63 mm/3wks	More tipping with tipedge Anchorage loss inconclusive due to small sample size	N.S difference
Daskalogia nnakis J, McLachlan KR 1996 [18]	Split mouth	6	Vertical loop magnets	70 gms	0.63 mm/28 days 1.62 mm/28 days		Light force of continuous nature is most efficient for tooth movement

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Article	Study Design	Sample Size	Force Applied	Magnitude of Force	Rate of Canine Retraction	Side Effects	Conclusions
Samuels RHA, Rudge SJ, Mair LH 1998 [19]	Split mouth	18	NiTi coil spring Light/ Medium/ Heavy Elastic module	 100 gms 150 gms 200 gms 	 0.16 mm/wk 0.26 mm/wk 0.24 mm/wk 0.19 mm/wk		Medium and heavy spring produces a faster and consistent rate of space closure than the light spring or elastic module
Dixon V, Read MJF O'Brien KD, Worthington HV, Mandall NA. 2002 [20,21]	RCT	12 10 11	Active ligatures Power chain NiTi coil springs	200 gms	0.35 mm/mnth 0.58 mm/mnth 0.81 mm/mnth		Fastest with NiTi coil spring Howeverf power chin provides with an equally effective and cheaper alternative
Nightingale C, Jones SP 2003 [22]	RCT	22	Elastomeric power chain NiTi coil spring	209-109 gms 300-149 gms	0.21 mm/wk 0.26 mm/wk	Modest sample size, timing of space closure, manay variables which could not be standardized	N.S difference
Cacciafesta V, Sfondrini MF, Ricciardi A, Scripante A, Klersy C, Auricchio F 2003 [13]	Split mouth	8	Rickett's spring NiTi coil spring	1 N	1.91 mm/30 days 1.41 mm/30 days	Small sample size	N.S difference
Bokas J, Woods M 2006 [23]	Split mouth	12	NiTi coil spring Power chain	200 gms	1.85 mm/mnth 1.68 mm/mnth	Anchorage loss	Similar rates by both the methods

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Article	Study Design	Sample Size	Force Applied	Magnitude of Force	Rate of Canine Retraction	Side Effects	Conclusions
Shpack N, Davidovitch M, Sarne O, Panayi N, Vardimon AD. 2008 [24]	Split mouth	14	Tipedge bracket Edgewise bracket Force applied with NiTi coil spring	0.5-0.75 N	Not mentioned	Rotation and anchorage loss Tipping was not forrlowed by root uprightening in tipedge	Tipping mechanics closed space in lesser tome than bodily mechanics
Deguchi T, Imai M, Sugawara Y, Ando R, Kushima K, Takano-Yamamoto T 2007 [25]	Split mouth	30	Plastic brackets with metal slot Clear snap brackets	Force applied with closed coil spring	Not mentioned Time measured instead		Clear snap brackets closed space quicker due to increased rate of canine retraction

canine and tipping effected the measurement of rate of canine retraction.[12, 15, 17, 24] Sample size was considered inconclusive in one study.[10] Anchorage loss was reported with most of the studies.[24, 23, 17]

DISCUSSION

The strict inclusion exclusion criteria applied for the present review might have resulted in a few articles for this review. However, strength of the evidence in a systematic review is more dependent on the quality of the included studies than on the degree of comprehensiveness.[31]

Due to different types of forces applied within the same arch it is believed that the arch wire may swivel under the influence.[22] This might have affected the results of rate of canine retraction in these studies. Since in these clinical trials it was quite difficult to keep the variables of individual response, fluctuations of oral environment, lapses between appointments, precise and repeatable method of measurement of the rate of canine retraction, the force systems, could not be compared accurately.[18, 22] Some believed that the diverse response to different methods of canine retraction was not dependant on the type of force; rather it was the varied individual metabolic response.[17] Sample size generally applied for these clinical trials is considered inconclusive in a few researches.[17, 18, 22]

Optimum force for movement has no specific value in the orthodontic literature.[32] However a range of 100 - 200 gms is suggested sufficient by Quinn and Yoshikawa[17, 12, 33] and this was the force range observed in this review. It is not the magnitude of force applied rather its duration that is considered important for good biologic tooth response.[18] Light continuous force up to a threshold can provide this optimum force.[18,14] High initial forces did not achieve greater space closure, but resulted in greater percentage of force decay.[22] NiTi coil springs are believed to provide this constant force[24], however one study contradicted this[22]. In sliding mechanics the force of friction is encountered which tends to reduce the force available eventually for effective tooth movement. This is verified in some of the selected articles [4, 12, 15, 16, 34] as well as quite a few other researches [12, 13, 35, 36].

CONCLUSIONS

Any method of force application would be considered effective as long as it is able to overcome this force of friction and at the same time give maximum rate of tooth movement with limited side effects. The data so far reviewed proved that elastomeric power chains, elastic threads, magnets, NiTi coil springs etc. all are able to provide optimum rate of tooth movements along with a few side effects. No one method is superior to another for retraction of canines.

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