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Springback Property of Newer Archwires: An Invitro Study

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Abstract: *The present study has been conducted to compare the springback characteristic of newer orthodontic wires. The experimental work has been carried out on profile projector in Department Of Industrial And Production Engineering Of Shri Govindram Seksaria Institute Of Technology And Science, Indore. Round archwires of 0.016 dimensions of 9 different alloys were studied. Ten specimens of each archwire alloys were used for evaluating springback property. Data observed had following findings CuNiTi posses maximum springback property. Esthetic wire (double phase wire) and NiTi also showed springback characteristic comparable to CuNiTi. Chinese and Esthetic wire (single phase) show comparable springback characteristics.TMA wire shows least springback characteristic. Nearly same characteristic of springback property recorded for Thermal and Japanese archwires.CNA also have similar characteristics to TMA wire. CuNiTi posses maximum springback property. An archwire undergo permanent deformation beyond 4mm result in permanent deformation and tissues damage.*

Keywords: *Archwires, springback property and tissues damage.*

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I. Introduction

Gold alloy wires were the material of choice by orthodontists in earlier decades of century. But because of the limitation in manipulations, lack of springback property and its higher cost the use of gold wires declined especially with the introduction of stainless steel in 1940's .In order to improve the elasticity and range of activation of the wires different methods were adopted like reducing the diameter of the wire and incorporation of different loops in the archwire. But both these changes have the disadvantages of possible distortion by patient resulting in alteration of the magnitude and direction of the forces. To overcome these defects braided and twisted wires were introduced, giving more flexibility to the wire with improved elastic recovery. In 1960's William F .Buehler introduced a new orthodontic wire "Nitinol" at Naval Orthodontic Laboratory. This came as a breakthrough in orthodontics, which stimulated the scientists and opened a new field for research and development .Since then numerous nickel titanium wires have been introduced into the market like Chinese NiTi, Japanese NiTi, Sentinol Titanol etc claiming superb elastic property and built in memory[1]. Orthodontics wires must possess following properties wire should deliver low constant force, good strength ,good springback, high range, biocompatible, low tarnish, easy formability[2].

Due to wide variety of archwire with some property and other missing property it is very confusing and difficult to find out best one. Hence it is very important to have knowledge of important property of orthodontic archwires so that its implementation can be done at different treatment level to achieve good treatment results [3].

Sakima MT, Dalstra M and Melsen B in 2006 they aim to evaluate differences on the forces exerted by seven commercially available 0.019 × 0.025 inch NiTi archwires. Their results were behaviour of all wires was different and Copper NiTi showed the lowest and the most constant force level, followed by Neo Sentalloy. On the other hand, these wires may not work properly in mouth breathers as no forces were exerted below 35°C[4]. Quintão C.C.A.; Brunharo, I.H.V.P in 2009 state that because of incorporation of copper in CuNiTi these wires have better control on tooth movement[3]. In 2013 Gravina MA, Brunharo I.H.V.P, Canavarro C, Elias C.N., Quintão C.C.A in their study CuNiTi shown lower deformation percentage as compare to other seven different types of orthodontic archwires[5]. In 2014Ambekar A, Kangane S, Joshi Y, Marure P evaluates initial archwire which helps in relieving dental crowding. They were put in 3 groups of 10 each. Group I, allotted 0.018 NiTi, group II allotted 0.018 Cu-NiTi and group III allotted 0.0175 MSS. To measure crowding, Robert Little's "Irregularity index" used. Results showed, Cu-NiTi archwire demonstrated maximum unraveling of crowding over a period of time. NiTi and Multistranded archwire demonstrated same efficiency in unraveling of crowding over a period of time[6].

II. Aims and objective

To compare the deflection range of newer archwires and to find out that, within particular limit how much a particular wire could be deflected.

III. Materials And Methods

The present study has been conducted to compare the springback characteristic of newer orthodontic wires. In Department Of Industrial And Production Engineering Of Shri Govindram Seksaria Institute Of Technology And Science, Indore this study was carried out on profile projector (fig 1). 0.016(round) dimensions orthodontic archwires of 9 different alloys were studied. To evaluate springback property of different alloy ten sample of each archwire alloy were used.

They were as follows in Table 1

S.No	Name of wire	Name of company	Quantity	
1.	0.016 NiTi	Prime orthodontics	10	W1
2.	0.016 Thermal heat activated NiTi wire	Dentaurum	10	W2
3.	0.016 Japanese NiTi wire(Sentalloy)	Dentsply	10	W3
4.	0.016 Chinese NiTi	China made	10	W4
5.	0.016 Cu NiTi	Ormco	10	W5
6.	0.016 TMA rematitan special	Dentaurum	10	W6
7.	0.016 Beta III CNA wire ,nickel free	Rabbit	10	W7
8.	0.016 NiTi T.C. double phasing white coated	Prime orthodontics	10	W8
9.	0.016 FLI wire ,NiTi (single front phasing white coated)	RMO	10	W9

This study was carried out for standardization of methodology using nine different types of wire and nine sample of each wire. Acrylic teeth moulds of upper arch were taken only (Fig 2). A specially prepared typodont with class I molar relation, crowding were taken. Every alternate tooth starting from left canine was displaced palatally from the standard archform from 2-4mm till right canine .Thus 2 points of displacement is left lateral with 3.5mm and right lateral with 4mm of palatal displacement in the archform along with highly placed canine.

Their position confirmed by vernier caliper. Preadjusted MBT bracket were bonded on preformed typodont model on each tooth at a distance of 4mm from incisal edges .The interbracket distance were than measured as the shortest distance from the undisplaced bracket to another and was recorded to the nearest 0.20 mm.Midline of each preformed archwire was marked. The archwire was engaged in all irregularly placed teeth with ligature wire of 0.020 mm. In the displaced teeth the wire was gently engaged into the bracket with ligature tucker and then ligated with 0.20 mm ligature wire.

Fig1

fig 2

The areas of wire corresponding to the bracket engagement of displaced teeth were marked with a glass marking pencil/permanent marker. The wire was then left ligated in place for an hour. The ligatures where then cut and wire was then allowed to disengage from the bracket. The elastic recovery of the wire was measured as the shortest distance from the bracket slot to the measure point with profile projector. Elastic recovery was measured by getting difference between the initial value (before) engaging wire and final value (after) engagement. Wire image traced on butter paper before engagement by keeping a constant distance of 16mm from an inbuilt scale from x axis and midline of wire placed coincide with y axis co ordinate.3.5mm macroscopic value measured 12.15mm microscopically through 20X scale and 12.10mm at 4mm distance. Trace wire image before engagement and procedure was repeated after disengagement of wire. Then measure the distance/difference through inbuilt scale between non engaged and engaged image at displaced point.

All readings were recorded with three decimal points. All the readings were taken twice by the two observers. To reduce personal error average of the two readings was taken.

IV. Result

The springback characteristic of different wires has been evaluated by the distance the wire returned back to its original position, when the wire was disengaged after 1hour of the deflected tooth position .The recovery values for each wire has been noted down. The t test indicates that the changes in all the wires are highly significant (p>0.001) at all levels of tooth deflection. So t test was applied shows reading of each wire which were compared with the other wire at all levels of tooth deflection. Given below tables shows statistical analysis of data obtained.

Standard deviation and‘t’ test values for elastic recovery of w1 – w9 wires at 12.15 mm and 12.10mm are shown in **TABLE 2**

wires	Size	Mean	SD	T Value	p Value
W-1	12.15 mm	12.03	0.29	1.0613	0.3026
	12.10 mm	12.17	0.29		
W-2	12.15 mm	11.86	0.41	8.9139	<0.0001
	12.10 mm	13.69	0.51		
W-3	12.15 mm	11.39	0.92	4.2470	0.0005
	12.10 mm	12.87	0.61		
W-4	12.15 mm	12.29	0.41	2.4838	0.0231
	12.10 mm	12.76	0.44		
W-5	12.15 mm	12.14	0.05	1.9248	0.0720
	12.10 mm	12.11	0.04		
W-6	12.15 mm	12.04	0.06	15.8782	<0.0001
	12.10 mm	14.39	0.47		
W-7	12.15 mm	12.18	0.86	3.1554	0.0055
	12.10 mm	13.04	0.04		
W-8	12.15 mm	12.22	0.29	0.9954	0.3327
	12.10 mm	12.12	0.03		
W-9	12.15 mm	12.43	0.39	2.5804	0.0189
	12.10 mm	12.02	0.30		

Summary of ANOVA for elastic recovery at 12.15 mm tooth deflection shown in **TABLE 3**

Tooth Deflection		N	Mean	Std. Deviation	F Value	P Value
12.15 mm	W-1	10	12.0320	.29799	3.619	0.001
	W-2	10	11.8640	.40467		
	W-3	10	11.3870	.92106		
	W-4	10	12.2890	.41316		
	W-5	10	12.1440	.04719		
	W-6	10	12.0390	.06027		
	W-7	10	12.1830	.85982		
	W-8	10	12.2150	.29722		
	W-9	10	12.4310	.39968		
	Total	90	12.0649	.55758		

Summary of ANOVA for elastic recovery at 12.10 mm tooth deflection shown in **TABLE 4**

Tooth Deflection		N	Mean	Std. Deviation	F Value	P Value
12.10mm	W-1	10	12.1720	.29192	49.431	<0.0001
	W-2	10	13.6870	.50447		
	W-3	10	12.8680	.60635		
	W-4	10	12.7630	.43987		
	W-5	10	12.1060	.04088		
	W-6	10	14.3920	.46473		
	W-7	10	13.0420	.04237		
	W-8	10	12.1210	.02885		
	W-9	10	12.0220	.30246		
	Total	90	12.7970	.84928		

V. Observations From Table Are

1. Overall: T-6 wire is best among all wires for 12.15 mm and 12.10 mm.
2. Table of observation at 12.15 mm: There was significant variation between all wires and according to data T-6 is best wire.
3. Table of observation at 12.10 mm: There was significant variation between all wires and according to data T-6 is best wire.

VI. Conclusion

Springback property of 9 different wire material namely NiTi , Thermal NiTi ,Japanese NiTi, Chinese NiTi ,CuNiTi ,TMA, CNA, Double phasing and Single phasing has been studied at deflection level 3mm and 4mm.

6.1 Finding are enlisted below

1. Maximum springback property shown by CuNiTi archwire.
2. Similar springback characterstic to CuNiTi was shown by NiTi and Esthetic (double phase)archwire.
3. comparable springback characteristics was shown by Chinese and Esthetic wire (single phase) .
4. Least springback property was shown by TMA wire.
5. Similar characteristic of springback property shown by Thermal and Japanese archwires.
6. CNA archwire has equivalent springback property asTMA wire.
7. 7) At 4mm archwire undergo permanent defomation which result in tissues damage in.
8. This conclusion may serve as a guideline in tying and activation of archwire especially in cases with severe crowding or where individuals tooth is too much displaced from the arch.

References

[1]. Andreasen GF, Hilleman TB.An evaluation of 555 cobalt substituded nitinol wires for use in orthodontics. J Am Dent Assoc 1971 Jun;82(6):1373-5.

[2]. Kapila S, Sachadeva R .Mechanical properties and clinical application of orthodontic wires. Am J Orthod Dentofacial Orthop 1989; 96:100-109.

[3]. Quintão C. C. A.; Brunharo, I. H. V. P Dental Press J. Orthod. 144 Maringá, v. 14, n. 6, p. 144-157, nov. /dez. 2009.

[4]. Maurício Tatsuei Sakima, Michel Dalstra, and Birte Melsen. How does temperature influence the properties of rectangular nickel–titanium wires?. Eur J Orthod. 2006; 28 (3): 282-291.

[5]. Gravina MA, Brunharo I.H.V.P, Canavarro C, Elias C.N., Quintão C.C.A Dental Press J Orthod 2013 Jul-Aug;18(4):35-42.

[6]. Ambekar A, Kangane S. Joshi YK, Marure PK. Comparison of clinical efficiency of three different arch wires in initial phase of treatment. January, 2014. Orthodontic Cyber Journal.http://orthocj.com.

[7]. Burstone CJ, Goldberg AJ. Beta titanium: A new orthodontic alloy**.** Am. J. Orthod. 1980; 77:121–132.

[8]. Kusy RP. Ongoing Innovations in Biomechanics and Materials for the New Millennium. The Angle Orthodontist: October 2000, Vol. 70, No. 5, pp. 366-376.

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