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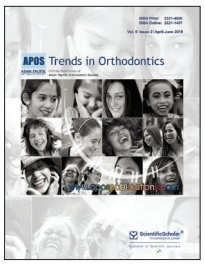

Original Article

Comparison of alignment efficacy and arch dimensions changes with superelastic-, heat-activated-, and seven stranded coaxial nickel-titanium archwires during fixed orthodontic treatment – A double-blind randomized clinical trial

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ABSTRACT

Objectives: The objectives of this study were to compare the alignment efficacy, changes in arch dimensions, and pain experience with three different nickel-titanium (NiTi) archwires.

Material and Methods: Forty-five subjects were subjected to indirect bonding in the mandibular arch, and allocated to three groups using block randomization; Group 1 (0.014" Superelastic NiTi), Group 2 (0.014" 27° Copper NiTi), and Group 3 (0.016" seven stranded coaxial NiTi archwire). The mandibular study models were retrieved periodically at 4-week intervals for 12 weeks, which were blinded to measure the change in Little's irregularity index (LII) and dental arch dimensions. Pain and discomfort were recorded with visual analog scale at five different time intervals, namely, immediately after bonding (0) and at 1-, 4-, 8-, and 12-h for initial 7 days. Repeated analysis of variance, Wilcoxon Signed-Rank test, *post hoc* Bonferroni test, and Friedman's test was applied for the comparison and was used for data analysis.

Results: A significant reduction of LII score and increase inarch length, intercanine, interpremolar, and intermolar width ($P \leq 0.001$) were observed after 12 weeks among all groups. However, intergroup comparison showed significant mean changes only for intercanine width (Group 1 versus 3) and interpremolar width (Groups 1 and 3; Groups 2 and 3). All other variables were found to be insignificant at all-time intervals when compared among each group. The increase in pain score was maximum with Group 1and least with Group 3.

Conclusion: All archwires were found to be effective in reducing the LII score. Nevertheless, Group 3 archwire could achieve reduction of LII to zero in 14% of subjects than Groups 1 and 2.

Keywords: Alignment, Superelastic nickel-titanium, Coaxial superelastic nickel-titanium, Copper nickel-titanium, Heat-activated nickel-titanium, Supercable

INTRODUCTION

The Phase I of fixed orthodontic therapy aims to achieve initial alignment and leveling.[1] Nickel-Titanium (NiTi) archwire is extremely useful during the initial alignment of the teeth due to its ability to apply a light and continuous force over a large range of activation producing optimal force to stimulate cellular activity.[2] With the addition of copper, the NiTi archwires have lower loading stress and relatively high unloading stress for more effective orthodontic tooth movement.[3] Berger *et al.*[4] increased flexibility and a reduced load deflection rate of superelastic

NiTi archwires by multi-stranding and these wires are known as seven-stranded round coaxial superelastic NiTi archwire (Supercable wire). Laboratory tests have reported that these wires exert only 36–70% of the force of conventional NiTi wires.[4]

The earlier studies reported either superior[5] or similar[6] reduction in the crowding of lower anterior teeth by coaxial seven stranded NiTi compared to superelastic NiTi archwires. Aydın *et al*.[7] found similar alignment efficiency of nitinol- and heat-activated copper NiTi after an assessment period of 12 weeks. The superelastic and copper NiTi archwires were also reported to be equally effective in reducing the moderate crowding of maxillary teeth with 0.022 slot Roth prescription orthodontic brackets.[8]

No studies in the literature have compared superelastic-, heat-activated, and seven stranded coaxial NiTi archwires during the alignment phase in 0.018" slot with MBT prescription. Sebastian have purported the use of lesser dimensions of solid NITI archwire like 0.014" in lower anterior crowding cases at the cost of losing better uprighting, leveling, and rotational control and, in effect, alignment capability as attained with a 0.016-inch dimension wire.[5] Hence, this study was aimed to evaluate and compare the clinical efficacy of superelastic NiTi, heat-activated copper NiTi, and supercable (Seven stranded coaxial superelastic archwire) NiTi archwires. The primary objective of the study was evaluated and compared Little's irregularity index (LII) for the three alignment archwires. The secondary objectives were to compare the changes in the arch length, intercanine width, interpremolar width, and intermolar width and depth of Curve of Spee.

MATERIAL AND METHODS

This double-blind randomized clinical trial was conducted following the guidelines of the Declaration of Helsinki and approved by the Institutional Ethical Committee (NK/4827/MDS/299). The trial was registered in Clinical Trials Registry (www.ctri.nic.in) as CTRI/2019/06/019647. The sample size was calculated with G* Power statistical software at an alpha error of 0.05 and power of 95%. This required a minimum of 15 patients in each group to establish a significant difference between different archwire groups based on the study by Aydın *et al*.[7]

Subjects in the age range of 12–25 years, LII score of 4–6 mm, and planned for a non-extraction treatment were included in the study. The subjects with craniofacial syndromes, facial cleft, trauma, prior orthodontic treatment, and severely misaligned teeth not allowing bracket placement were excluded in the study.

Forty-five subjects were randomized using block randomization (block size: 15) with computerized software (Sealed Envelope™ Ltd.). Three blocks were generated with random assignment of unique alphanumeric codes to 15 subjects in each group to obtain 1:1 allocation. The codes were manually picked up from opaque envelopes and assigned to individual subjects. Informed consent was obtained from each individual to participate in the study. All subjects were blinded to the following treatment groups based on archwire used: Group 1: 0.014-inch Superelastic NiTi archwires (NT3, American Orthodontics, Sheboygan, Wisconsin, USA), Group 2:0.014-inch Copper NiTi (27°) archwires (Tanzo, premium heat activated, American Orthodontics, Sheboygan, Wisconsin, USA), and Group 3: 0.016-inch seven stranded Coaxial NiTi archwires (Speed system Orthodontics, Ontario, Canada). Since the Coaxial NITI wire manufactured by speed orthodontics is available with smallest size of 0.016," we chose this dimension. [Figure 1] reveals the CONSORT diagram for the selection of participant and inclusion in this study.

The mandibular teeth in all the patients were bonded by a single operator (SS) with an indirect bonding technique using light cure adhesive (3M Transbond™ XT, St. Paul, Minnesota, USA), as shown in [Figure 2a-f]. The brackets of 0.018 × 0.025-in slot MBT prescription (3M Gemini Unitek™, Monrovia, Calif., USA) were bonded in all the patients. All the archwires were secured with 0.010" stainless steel ligature wire. The alginate impressions were made and mandibular study models prepared by the same operator at 4-time intervals, that is, before treatment (T0), at 4- (T1), 8- (T2), and 12-weeks (T3). The study models thus obtained were handed over to another investigator for blinding. All study models were given random numbers and the principal investigator was blinded before the assessment of the following parameters:

LII score[9] intercanine, interpremolar, intermolar arch width and Curve of Spee with digital Vernier calliper (Mitutoyo, Japan 673-275), and arch length with depth gauge,[7,10] as shown in [Figure 2g-l].

Intraexaminer reliability

The principal investigator re-measured randomly selected 10% of total study models at a time interval of 4 weeks, and intraoperator reliability was assessed using the intraclass correlation coefficient (ICC). The ICC value was found to be <0.9 for all the variables, signifying excellent reliability [Table 1].

Statistical analysis

The Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, version 25.0) was used for analysis. Descriptive data were analyzed as mean and standard deviation. Wilcoxon Signed-Rank test, *post hoc* Bonferroni test, repeated one-way analysis of variance (ANOVA) test, and Friedman's test

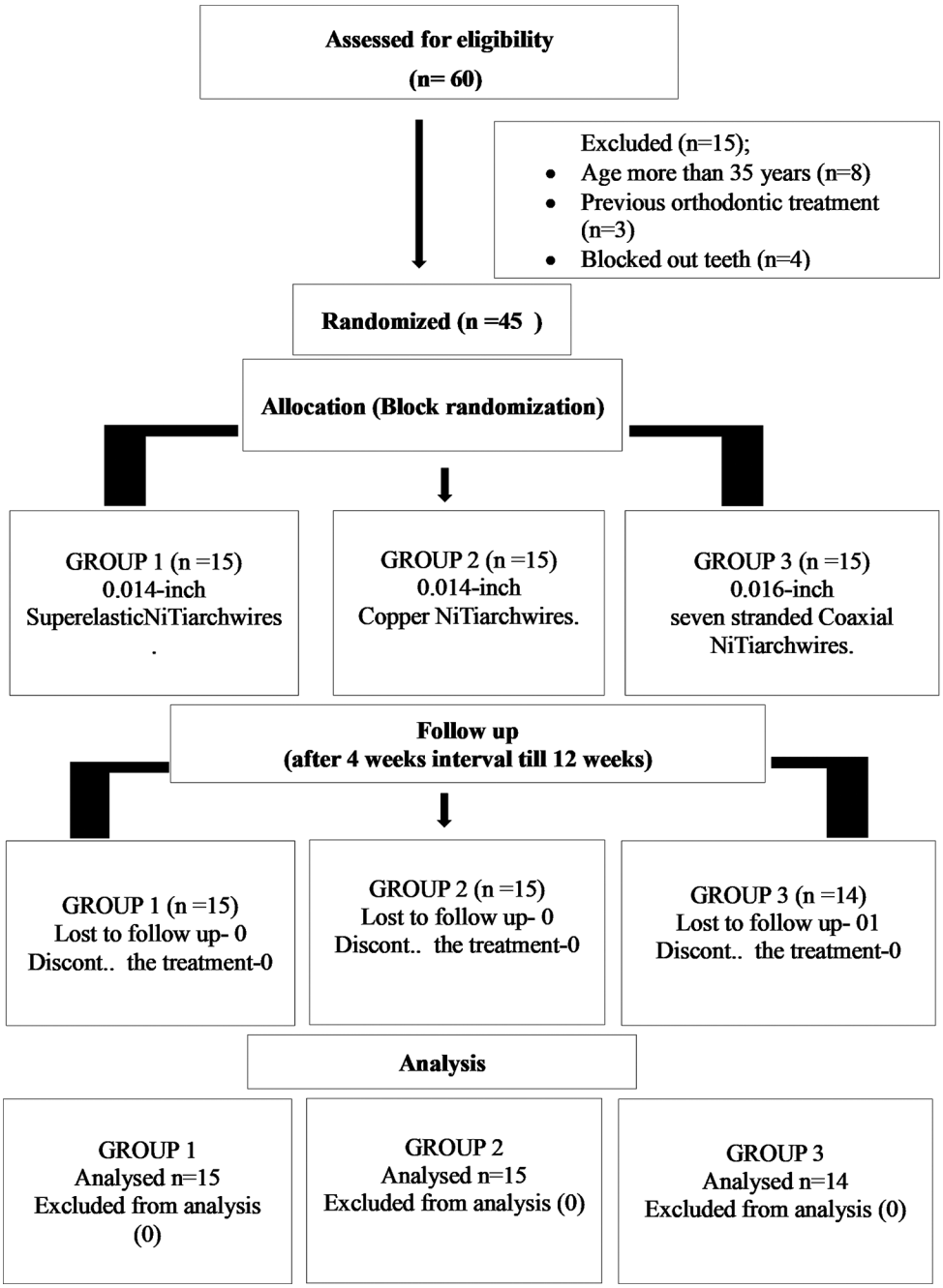

Figure 1: Consort diagram.

were applied for the comparison. For time related variables, repeated measures ANOVA test, followed by *post hoc* multiple comparisons test (Bonferroni correction), was used for within group comparison. The level of significance was set at $\alpha = 0.05$.

RESULTS

Forty-five subjects included in the study were randomly allocated to Group 1 (11 females; four males; mean age, 14.93 ± 3.45years), Group 2 (five females; ten males; mean age, 14.4 ± 2.45years), and Group 3 (nine females; six males; mean age, 16.8 ± 2.58 years). [Table 2] shows the demographic and baseline characteristics of the study. The baseline characteristics of all the groups showed non-significant mean differences except intercanine and interpremolar widths. In Group 3, one subject was lost to follow-up at T2; therefore, 14 subjects were followed up for final analysis.

[Table 3] shows the time-related intragroup comparisons of the of LII scores, arch length, intercanine arch width,

Table 1: Intraexaminer reliability for all the parameters assessed using ICC.

Dental measurements	ICC	*P*-value
Little irregularity index score	0.938	<0.001**
Arch length	0.927	<0.001**
Intercanine arch width	0.966	<0.001**
Interpremolar arch width	0.980	<0.001**
Intermolar arch width	0.973	<0.001**
Curve of Spee	0.919	<0.001**

P-value, NS: Non-significant, significant <0.05*, highly significant <0.01**, very highly significant <0.001***. ICC: Intraclass correlation coefficient

interpremolar arch width, and intermolar arch width and Curve of Spee. The mean value of LII decreased significantly at all the time intervals for Groups 1, 2, and 3, respectively ($P < 0.001$). In Group 1, the arch length and interpremolar width increased significantly at 8 and 12 weeks and intercanine and intermolar arch increased significantly at 4, 8 and 12 weeks. In Group 2, there were non-significant mean changes in arch length but intercanine and interpremolar increased at 8 weeks and 12 weeks and intermolar arch width at 12 weeks. In Group 3, the arch length increased significantly at 8 weeks and 12 weeks and intercanine, interpremolar, and intermolar arch width increased significantly at 4, 8

Table 2: Demographic and baseline data for the groups.

Variable	Group 1 (*n*=15)	Group 2 (*n*=15)	Group 3 (*n*=15)	*P*-value
Gender				
Female (*n*=25)	11	5	9	0.08^{NS}
Male (*n*=20)	4	10	6	
Age (years)	14.93±3.45	14.4±2.45	16.8±2.58	0.270^{NS}
Little's irregularity score (mm)	4.84±0.85	5.44±1.49	4.83±1.05	0.269^{NS}
Arch length (mm)	22.60±2.44	23.53±1.52	22.37±1.43	0.201^{NS}
Intercanine width (mm)	26.63±1.91	26.17±1.96	24.73±1.72	0.021*
Interpremolar width (mm)	34.93±2.43	34.28±3.17	32.32±2.79	0.039*
Intermolar width (mm)	43.92±2.88	44.05±4.11	43.45±3.51	0.887^{NS}
Curve of Spee (mm)	1.05±0.72	1.57±0.94	1.39±1.04	0.293^{NS}
Pain score	1.14±1.31	1.03±1.40	0.60±0.61	0.109^{NS}

P-value, NS: Non-significant, Significant <0.05*, Highly significant <0.01**, Very highly significant <0.001***

Figure 2: (a) Bracket positioning, (b) pressure molding of biostar sheet, (c and d) retrieval of brackets, (e) etching procedure, (f) tray removal, (g) measurement of Little's irregularity score, (h) arch length, (i) intercanine archwidth, (j) interpremolar archwidth, (k) Intermolar arch width, and (l) curve of Spee.

Table 3: Intragroup comparison of change in Mean±SD values (mm) of LII scores, arch length, intercanine arch width, interpremolar arch width, and intermolar arch width and Curve of Spee among three groups.

Group	LII scores	Arch length	Intercanine arch width	Interpremolar arch width	Intermolar arch width	Curve of Spee
Group 1 (n=15)						
T0	4.84±0.85	22.60±2.44	26.63±1.91	34.93±2.43	43.92±2.88	1.05±0.72
T1	1.89±1.21	23.20±1.96	27.64±1.29	35.58±1.78	44.72±2.67	1.46±0.77
T2	1.32±1.33	23.50±1.91	27.73±1.06	36.10±1.60	45.03±2.63	1.43±0.82
T3	0.53±0.62	23.60±1.82	28.06±1.15	36.53±1.65	45.31±2.77	1.41±0.77
T0–T1	2.95±1.21***	−0.60±1.04^{NS}	−1.01±1.12*	−0.65±1.28^{NS}	−0.95±0.88*	−0.41±0.72^{NS}
T0–T2	3.52±1.41***	−0.90±1.02*	−1.11±1.26*	−1.17±1.56*	−1.51±1.34**	−0.37±0.65*
T0–T3	4.31±1.03***	−1.00±1.13*	−1.43±1.37**	−1.60±1.48**	−1.84±1.47**	−0.36±0.53^{NS}
T1–T2	0.57±0.78*	−0.30±0.68^{NS}	−0.09±0.56^{NS}	−0.52±0.51 **	−0.56±0.62^{NS}	0.04±0.32^{NS}
T1–T3	1.37±0.85***	−0.40±0.78^{NS}	−0.42±0.58^{NS}	−0.95±0.59***	−0.89±0.74*	0.05±0.30^{NS}
T2–T3	0.79±0.78***	−0.60±0.34^{NS}	−0.33±0.62*	−0.57±0.59^{NS}	−0.28±0.55*	−0.02±0.38^{NS}
Group 2 (n=15)						
T0	5.44±1.49	23.53±1.52	26.17±1.96	34.28±3.17	44.05±4.11	1.57±0.94
T1	2.36±1.23	23.57±1.55	26.66±2.03	35.23±2.78	44.17±4.10	1.54±0.80
T2	1.56±1.04	23.67±1.71	26.93±1.66	35.79±2.42	44.38±3.95	1.38±0.79
T3	0.67±0.81	23.70±1.75	27.12±1.57	36.12±2.23	44.57±3.83	1.46±0.77
T0–T1	3.08±1.47***	−0.03±1.03^{NS}	−0.49±1.07^{NS}	−0.95±1.07*	−0.11±0.72^{NS}	0.03±0.94^{NS}
T0–T2	3.88±1.61***	−0.13±0.97^{NS}	−0.77±1.24*	−1.51±1.40**	−0.33±1.00^{NS}	0.19±0.80^{NS}
T0–T3	4.77±1.60***	−0.17±1.03^{NS}	−0.95±1.26*	−1.84±1.68**	−0.52±1.08*	0.11±0.99^{NS}
T1–T2	0.80±0.65**	−0.10±0.63^{NS}	−0.27±0.63^{NS}	−0.56±0.83^{NS}	−0.21±0.50^{NS}	0.16±0.49^{NS}
T1–T3	1.69±1.05***	−0.13±0.72^{NS}	−0.46±0.85^{NS}	−0.89±1.10*	−0.41±0.60*	0.08±0.60^{NS}
T2–T3	0.92±1.40***	−0.13±0.13^{NS}	−0.19±0.58^{NS}	−0.33±0.45 *	−0.19±0.24^{NS}	0.08±0.36^{NS}
Group 3 (n=14)ǂ						
T0	4.83±1.05	22.37±1.43	24.73±1.72	32.32±2.79	43.45±3.51	1.39±1.04
T1	1.83±1.06	22.80±1.4	25.97±1.82	33.05±2.33	44.32±3.42	1.31±0.95
T2	1.37±0.93	23.20±1.39	25.97±1.69	33.17±2.22	44.45±3.26	1.28±0.88
T3	0.94±0.68	23.53±1.62	26.23±1.65	33.53±2.10	44.71±3.33	1.26±0.93
T0–T1	3.01±1.30***	−0.43±1.07^{NS}	−1.25±1.02**	−0.73±0.95*	−0.87±0.99*	0.08±1.04^{NS}
T0–T2	3.56±1.23***	−0.83±1.06*	−1.24±0.96***	−0.85±1.07*	−0.99±1.03*	0.11±0.44^{NS}
T0–T3	3.99±1.13***	−1.17±1.36*	−1.50±1.02***	−1.21±1.19**	−1.26±1.05**	0.13±0.37^{NS}
T1–T2	0.56±0.80*	−0.40±0.43*	0.01±0.44^{NS}	−0.12±0.44^{NS}	−0.13±0.46^{NS}	0.03±0.27^{NS}
T1–T3	0.98±0.81**	−0.73±0.78*	−0.25±0.63^{NS}	−0.48±0.64^{NS}	−0.39±0.47*	0.05±0.22^{NS}
T2–T3	0.42±0.42***	−0.43±0.70^{NS}	−0.26±0.43**	−0.36±0.51*	−0.26±0.44*	0.02±0.20^{NS}

ǂLoss of subject during follow up at T2. *P*-value, NS: Non-significant, Significant <0.05*, Highly significant <0.01**, Very highly significant <0.001***, LII: Little's irregularity index

and 12 weeks. The mean changes in the Curve of Spee were statistically significant at 8 weeks in Group 1. The mean changes were non-significant in all the three groups at all other time intervals.

[Table 4] shows the intergroup comparison of LII scores, arch length, intercanine arch width, interpremolar arch width, and intermolar arch width and Curve of Spee at different time intervals. The intergroup comparison revealed non-significant changes of LII over 12 weeks. The mean changes in intercanine width between Group 1 and Group 3 were found to be statistically significant ($P < 0.001$) at all-time intervals. The mean differences in interpremolar width were statistically significant ($P < 0.001$) for Groups 1 and 3 and Groups 2 and 3 at all the time intervals. The mean changes in arch length and intermolar width were non-significant among all three groups [Tables 4 and 5]. Intergroup comparison showed non-significant mean changes in the curve spee at all-time intervals.

[Table 5] shows the distribution of LII scores of either zero or less than two among three groups at 4-, 8-, and 12-weeks. After 12 weeks, the LII score of zero was attained in seven participants in Groups 1 and 2 and only two participants in Group 3. However, the score of the LII value of less than two over 12 weeks intervals was achieved by 100% participants for Groups 1 and 3 and 93% for Group 2.

DISCUSSION

Although the previous studies have compared the alignment efficiency between different alignment wires available;[5,6,8,10-12,15-19] however, no previous study has compared

Table 4: Intergroup comparison of LII scores, arch length, intercanine arch width, interpremolar arch width, intermolar arch width and Curve of Spee.

Groups	LII scores	Arch length	Intercanine arch width	Interpremolar arch width	Intermolar arch width	Curve of Spee
Group 1 Versus 2						
T0	−0.60±0.18^{NS}	−0.93±0.23^{NS}	0.46±0.10^{NS}	0.65±0.13^{NS}	−0.13±0.04^{NS}	−0.52±0.13^{NS}
T1	−0.47±0.15^{NS}	−0.37±0.12^{NS}	0.98±0.19^{NS}	0.35±0.08^{NS}	0.55±0.15^{NS}	−0.08±0.03^{NS}
T2	−0.24±0.11^{NS}	−0.17±0.05^{NS}	0.80±0.21^{NS}	0.31±0.08^{NS}	0.65±0.15^{NS}	0.04±0.01^{NS}
T3	−0.14±0.04^{NS}	−0.10±0.03^{NS}	0.94±0.18^{NS}	0.41±0.11^{NS}	0.74±0.14^{NS}	−0.05±0.02^{NS}
Group 1 Versus 3						
T0	0.01±0.02^{NS}	−0.23±0.06^{NS}	1.90±0.46*	2.61±0.56*	0.47±0.12^{NS}	−0.34±0.06^{NS}
T1	0.07±0.03^{NS}	0.40±0.13^{NS}	1.67±0.53*	2.53±0.51*	0.40±0.11^{NS}	0.15±0.04^{NS}
T2	−0.05±0.03^{NS}	0.30±0.09^{NS}	1.77±0.57**	2.93±0.55***	0.59±0.13^{NS}	0.15±0.04^{NS}
T3	−0.41±0.10^{NS}	0.07±0.02^{NS}	1.83±0.59**	3.00±0.76***	0.60±0.13^{NS}	0.16±0.04^{NS}
Group 2 Versus 3						
T0	0.61±0.19^{NS}	1.17±0.34^{NS}	1.44±0.44^{NS}	1.96±0.39*	0.60±0.14^{NS}	0.18±0.04^{NS}
T1	0.53±0.13^{NS}	0.77±0.19^{NS}	0.69±0.16^{NS}	2.17±0.45*	−0.15±0.06^{NS}	0.23±0.06^{NS}
T2	0.19±0.07^{NS}	0.47±0.16^{NS}	0.97±0.19^{NS}	2.61±0.54*	−0.07±0.03^{NS}	0.11±0.03^{NS}
T3	−0.27±0.06^{NS}	0.17±0.06^{NS}	0.89±0.21^{NS}	2.59±0.66**	−0.14±0.04^{NS}	0.21±0.06^{NS}

P-value, NS: Non significant, Significant <0.05*, Highly significant <0.01**, Very highly significant <0.001***, LII: Little's irregularity index

Table 5: Number of participants achieving LII score of zero and less than two at time intervals; 4, 8, and 12 weeks.

Group	T1		T2		T3	
	LII Zero	LII<2	LII Zero	LII<2	LII Zero (%)	LII<2 (%)
Group 1 (*n*=15)	1	9	4	11	7 (46.6)	15 (100)
Group 2 (*n*=15)	0	7	1	10	7 (46.6)	14 (93)
Group 3 (*n*=14)[ǂ]	0	9	1	12	2 (14.3)	14 (100)

[ǂ]Denotes subject lost to follow-up. LII: Little's irregularity index

the different variants, namely, superelastic, copper, and seven stranded coaxial supercable NiTi and different dimensions, namely, 0.014" in superelastic and Copper NITI and 0.016" in seven stranded coaxial supercable NITI archwire for initial leveling and alignment in 0.018-in slot with MBT prescription.

Moreover, the recent systematic reviews[20-22] suggested the need for well-designed randomized clinical trials. Hence, this study was undertaken to compare the alignment efficiency among superelastic, copper, and seven stranded coaxial supercable NiTi archwires in 0.018-in slot MBT appliance in the mandibular arch.

The results of the present study showed a significant reduction in the LII score after alignment with all three NiTi archwires for 12 weeks, and thus, all the archwires were equally effective in reducing the moderate crowding. The comparison between the three different groups did not show any significant difference. Our results were similar to the studies, namely, West *et al.*,[23] Cobb *et al.*,[17] Pandis *et al.*,[16] Cioffi *et al.*,[14] Gok *et al.*,[10] Sandhu *et al.*,[24] Abdelrahman *et al.*,[15] Sebastian *et al.*,[6] Aydın *et al.*,[7] and Nordstrom *et al.*[11] that showed a significant reduction of LII scores in all their groups and there were no statistically significant differences among the groups. However, trials by Gravina *et al.*[18] and Vimalathithan *et al.*[19] had reported superior performance of NiTi than multistranded stainless steel wire.

Contrary to the above studies, Sebastian[5] found that seven stranded NiTi was better in reducing the mandibular crowding than superelastic NiTi. The author reasoned that due to the multistranded structure of the supercable wire, the complete engagement of relatively greater archwire into the bracket slot at the start of the orthodontic treatment is possible with a low force delivery. For the same reason, the authors advocated the use of lesser dimension of solid NITI archwire, namely, 0.014" for the full engagement when comparing to 0.016" supercable NITI.

The reduction of LII score to zero at 12 weeks was observed in 46.6% of subjects in Groups 1 and 2, whereas only 14% of the subjects scored the LII score of zero in Group 3. Thus, the reduction in the irregularity with the seven stranded coxial wires is less efficient for complete alignment compared to the superelastic and heat activated NITi. However, all the subjects (100%) in Groups 1 and 3 and 93.3% of Group 2 achieved LII score ≤2.

Arch length was increased within all three groups; however, the maximum increase was found in Group 3 than Groups 1

and 2 (−1.17 ± 1.36; $P < 0.05$, −1.00 ± 1.13; $P < 0.05$ and −0.17 ± 1.03; $P > 0.05$) after 12 weeks. The probable reason for this can be a difference in the alloy contents (copper regulated the transition temperature and low hysteresis) and structure (solid versus multistranded) among these archwires.

The intercanine width increased significantly among all the groups, and the mean change was maximum for Group 3 (−1.50 ± 1.02; $P < 0.001$) followed by Group 1 (−1.43 ± 1.37; $P < 0.001$) and Group 2 (−0.95 ± 1.26; $P < 0.05$) when compared at T0 and T3. This finding can be explained with the fact that coaxial NITI archwire due to its multi-stranded structure, it can be ligated completely into the bracket slot at the beginning of the treatment than the conventional solid NITI archwire and result in the more uprighting and de-rotation of the teeth.[5]

The intergroup comparison of the intercanine and interpremolar width revealed that super-elastic NITI archwire showed similar increase as that of copper NITI which is similar to the study by Gok *et al.*[10] However, when compared to the seven stranded coaxial NITI archwire, superelastic NITI showed more increase at 4-, 8-, and 12-week time period. Since this is the maiden trial comparing these archwire, it can be explained on the basis of arch-form that is regained better by the superelastic NITI than supercable NITI.

The studies by Nordstrom *et al.*[11] and Gok *et al.*[10] also have not reported any significant increase in the intercanine width. However, other studies[7,25-27] have reported an increase in intercanine widths between 0.54 and 1.96 mm.

Interpremolar arch width in this study showed a significant increase at among all the groups and mean change was maximum for Group 2 after 12 weeks. The probable reason for this finding can be attributed to the eruption path of the premolar teeth which is in lingual-direction and after the application of buccally directed force leads to expansion in this region.[7]

Aydın *et al.*[7] have also reported the same finding that copper NiTi resulted in more increase at interpremolar width than NiTi. However, Gok *et al.*[10] reported that conventional NiTi and copper NiTi were similar in increasing the interpremolar width. Our study showed a significant increase in intermolar arch width at all-time intervals among all the groups and no significant intergroup differences. The results of our study were in accordance with Aydın *et al.*[7] and Gok *et al.*[10] In this study, the changes in the Curve of Spee for Group 1, Group 2, and Group 3; however, this was statistically insignificant and this finding was similar to the study by AlQabandi *et al.*[13]and Gravina *et al.*,[18] who also evaluated the alignment and leveling of lower dental arches**.**

A recently reported prospective clinical trial by Keerthana and Chitra have shown both superelastic and heat activated NITI archwires of 0.014 inch were equally effective in alleviating the lower crowding over an interval of 12 weeks. They enrolled a total of 30 participants and used 0.022-in slot.[28] Similarly, Nabbat and Yassir reported a multicentric randomized clinical trial comprised 34 participants recruited from four centers, to compare the effectiveness of heat activated- and superelastic NITI archwire of 0.014- and 0.016-inch in reducing the lower incisors crowding after 4- and 8 weeks interval. The authors concluded that both the archwires were equally effective in the alleviation of lower incisor crowding at 4- and 8-week interval.,[29]

Clinical relevance

Seven stranded coaxial NiTi archwire decreased the LII score to zero scores only among 14% (lowest) subjects compared to 46% subjects each in superelastic and copper NiTi. Coaxial wire with very light forces may be indicated in severe crowding, but it can be inferred that the expectancy of final alignment (achieving irregularity score of zero) is least with seven stranded coaxial NiTi wire in moderate crowding, and change to a higher wire is necessary. This is the maiden study that has compared the LII following three variants of NITI in 0.018" slot with MBT prescription. Future studies comparing the 0.018" versus 0.022" slot can be conducted.

CONCLUSION

Super elastic, seven stranded coaxial, and copper NiTi archwires were effective in reducing the LII score. Seven stranded coaxial NiTi archwire (14%) was less effective in reducing the LII score to zero compared to superelastic (46%) and copper NiTi in moderate crowding cases. The increase in the intercanine and interpremolar width was significantly greater with superelastic NiTi compared to seven stranded coaxial archwires. Copper NiTi significantly increased the interpremolar width compared to coaxial archwire. The increase in arch length and intermolar width was similar for all the groups.

Declaration of patient consent

The Institutional Review Board (IRB) permission obtained for the study.

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Conflicts of interest

There are no conflicts of interest.

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