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Assessing The Effect of Modified Bluegrass Vs Conventional Lingual Spurs in The Correction of Open Bite associated with Tongue Thrust: Comparative study

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Abstract

Introduction : the aim of this comparative randomized clinical trail (RCT), was to study the effect of Modified Bluegrass "Non-Punitive therapy" on tongue thrust and dentoalvolar structure and to compare it with Conventional Lingual Spurs "Punitive therapy" for an early correction of anterior open bite in mixed and early permanent dentition.

Material and Methods: The sample consisted of 20 subjects recruited at Ain Shams university ,orthodontic clinic Ain Shams University. Randomly allocated into 2 groups of subjects, with anterior open bite and Class I malocclusion , 5 subjects were excluded due to not completing follow up process . Group 1(G1) comprised 7 patients treated with Conventional lingual spurs with a mean initial age of 11.14 years (SD, ±1.86). Group 2(G2) consisted of 8 patients treated with Modified Bluegrass appliance, with a mean age of 10.38 years (SD, ±2.45).

Results: Baseline demographic and cephalometric characteristics were similar between groups. There were significantly greater overbite improvement in both groups, slightly more in G1(3.2±2.69) than in the G2,(2.2±1.32),with no statistical

Conclusions: Both appliances resulted in an improvement of overbite and tongue position during an early open-bite correction , with similar dentoskeletal changes were observed in both groups after I year of treatment. However ,the C.L.S group showed significant reduction in Mandibular plane angle than the M.B.G group .

Key words: Early treatment , Open bite; Interceptive orthodontics

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Introduction

An anterior Open bite (AOB) malocclusion has long been recognized as one of the most difficult orthodontic problem to ever be treated and stabilized…(Beane RA et al 1999)[1], The incidence of AOB disparate among age, with a high prevalence (17.7%) in mixed dentition Cozza et al (2005) [2] The etiology of AOB is a multifactorial , a combination of skeletal, dentoalveolar, functional, and habit related factors. Ngan P (1998)[3,] Worms FW(1971) [4,] Watson WG(1981) [5] .

Several ,early treatment approaches of AOB were performed with fixed and removable lingual cribs and spurs that may be used with chin cup or high-pull Head Gear . Cozza et al (2005) [2,] Feres MFN(2016) [6,] Pisani L(2016) [7] . Previous reports condemned anterior tongue posture as a potential reason for the long-term stability of AOB treatment to be quite strenuous . however, It has been found that banded-spurs were able to redirect anterior tongue position and retain the long-term stability of AOB correction Haung et al(1990) [8,] Justus R(2001) [9,] Greenlee GM(2010) [10].

For quite a while, the use of Conventional Lingual Spurs appliances C.L.S(as a punitive approach), was a subject of wary as it evoked, negative patient or parent reactions[9] . Accordingly , this aspect pave the path for the next approach (none punitive one) of early AOB correction , with Bluegrass appliance(B.G) , later on with the Modified Bluegrass Appliance (M.B.G) .

Despite the favorable arguments about effectiveness of (B.G) Appliances in correction of sucking habit Haskell BS, Mink JR (1991)[11,] Suwwan IY(2008) [12] their non-punitive approach has yet to be investigated in the correction of AOB related with tongue thrust ,nor have been compared with the punitive one of ”C.L.S”. Consequently , the purpose of this study was to assess the effect of (M.B.G) on tongue thrust and dento-alveolar structure and to compare it with (C.L.S) .

Materials and Methods

Ethical approval for this prospective comparative unicenter (RCT) was obtained from the research ethics committee of the Ain Shams University. An informed consent/assent/parental permission obtained from all patients who have met inclusion criteria,

The sample was conducted on 20 patients who have been recruited from an Orthodontics Clinic at the Faculty of Dentistry. The allocation process was done by simple randomization … (Baghbaninaghadehi F 2016)[13].

The subjects were selected according to the following criteria: (age rang of 7 and 13 years, Angle Class I malocclusions, AOB equal to or greater than 1 mm, with signs of tongue thrust, erupted upper and lower permanent central incisors [4]), exclusion criteria were presence of: any systemic or syndromic condition , any other habits such as (mouth breathing) ,gross caries or loss of permanent teeth .

Two treatment approaches were used in this study, the punitive approach with Conventional lingual spurs (C.L.S) appliance and non-punitive one with Modified Bluegrass appliance (M.B.G), (figure I) . G1 consisted of 7 subjects (mean age was 11.14 ±1.86 years) and (mean AOB was 4.01, ±2.11 mm).The protocol applied for G1 was (C.L.S) according to **Haryett et al (1967) [9],Justus et al (2001)** [14] was constructed from: 0.045-inch stainless steel wire, soldered to pre fitted bands, blunt 0.026-inch spurs, were soldered to the anterior part of the wire. The spurs were positioned 3 mm away from the cingula of the upper incisors and directed at an angle (downward and backward) to encourage correct tongue posture ,The spurs breadth extended throughout the AOB width, while their length extended to the cingula of lower incisors [15].

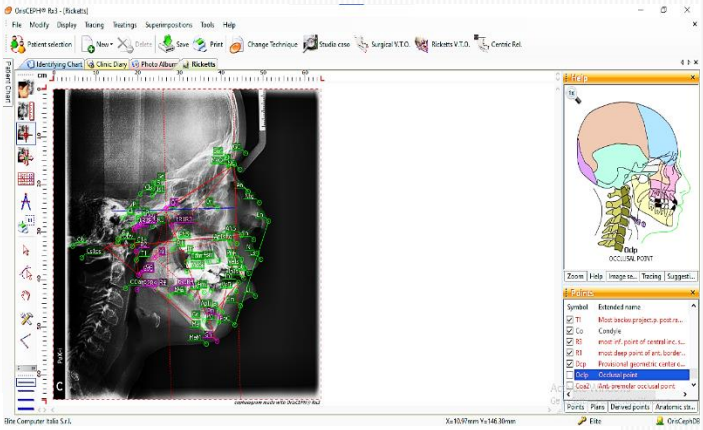
The G2 consisted of 8 subjects (mean age 10.38±2.45 years) and (mean AOB -2.9 ±1.91mm). The protocol applied for this group was (M.B.G) appliance according to **Diwanji A**

et al (2013) [16]. Made of 0.09mm" stainless-steel wire soldered to a pre-fitted molar bands, with additional bends distal to the 3 Acrylic beads ,that attached to the anterior aspect of the wire , to enhance the neuromuscular perception of the tongue and made in laboratory using dental monomer and polymer and the child was instructed to play with the roller with the tip of his/her tongue instead of performing the oral habit, then both appliances cemented with Glass Ionomer Cement (ProMedica Medicem), Subjects were followed on a monthly basis for 12 months.

Pre and post treatment records were photographs, digital radiograph (Lateral cephalometric and Panoramic x-rays and study models, to measure up the open bite ,overjet and inter molar palatal width (IMW) **Howe et al (1983)**[17]

The lateral cephalometric radiographs were then traced by the same investigator (A.A) using "OrisCeph® Rx3 software". The variables were listed in **(Figure 1).** These data were stored in a computer, and the software corrected the image magnification factor of the control group, which was 10% **Cozza et al** (2007) [18].

Figure I : The Conventional Lingual Spurs and Modified Bluegrass Appliances



(Figure II): linear and angular cephalometric measurements :

Intra- operator reliability tests were also performed to assess the reliability of this measurement, Two weeks later after the first measurement, 15 digitized lateral radiographs and study models were selected and remeasured by the same examiner (A.T.H.A.A.).

Statistical analyses :

Numerical data were explored for normality by checking the data distribution calculating the mean and medians values and using Kolmogorov- Smirnov and Shapiro -Wilk tests. Data showed parametric distribution so , it was represented by means and standard deviation (SD) values , inter and intra- observer reliability were assessed by intraclass correlation coefficient (ICC).Inter and intragroup comparison were done by independent and paired t-test respectively . the significant level was set p <0.05 within all tests . Statistical analysis was performed with R statistical analysis software version 4.0.5 for Windows

Results :

At the pretreatment stage, the groups were comparable regarding age, anterior open-bite severity, observation period, craniofacial growth pattern, and sex distribution

During treatment, no significant difference of anteroposterior skeletal measurements recorded posttreatment (P>0.05). for both group of appliances ,whereas in the vertical skeletal measurements only MP/SN showed statistically significant decrease (p=0.049), in C.L.S group ,while all other parameters showed no significant difference in both groups (P>0.05).

In both groups dental measurements, showed significant increase in Overbite after treatment

(p=0.007 for C.L.S) and (p=0.009 for M.B.G) ,while OJ, U1 - SN °, IMPA° parameters showed significant reduction respectively (P=0.03 ,0.047 ,0.048) for C.L.S group and (p=0.02 ,0.015, 0.049) for M.B.G group. (P≤0.05). with no statistical differences between the groups ,whereas the remaining values showed no statical significant

Soft tissue parameters showed no statistical differences between the 2 groups (p>0.05), however, IMW showed significant increase after treatment for both groups(p<0.001 for C.L.S) and (p<0.026 for M.B.G)with no statistical differences between the 2 appliances, all the above mentioned measurements showed in (Table I).

(Table 2) : Mean Different Changes Occurring Between Both Groups During the Study Period (T2–T1): Mean, Standard Deviation (SD),and t-Test (P) and intergroup T-test(P) differences

(Table 2) : Mean Different Changes Occurring Between Both Groups During the Study Period (T2–T1): Mean, Standard Deviation (SD),and t-Test (P) and intergroup T-test(P) differences

	CLS group (n = 7)			MBG group (n = 8)			
measurments	T1 Mean /SD	T2 Mean /SD	P -value	T1 Mean SD	T2 Mean SD	P -value	intergroup differences T-test(P)
SNB angle	84.30±2.96	84.73±3.12	0.259ns	82.20±4.42	82.30±4.25	0.875ns	0.817ns
SNA angle	78.27±2.56	79.17±2.38	0.062ns	77.20±4.73	77.61±4.28	0.434ns	0.425ns
ANB	6.13±2.22	5.59±2.81	0.128ns	5.06±1.80	4.81±1.69	0.275ns	0.446ns
MP/SN	41.87±6.25	38.27±4.53	0.0495*	38.49±8.49	37.17±7.79	0.766ns	0.05 *
PP/MP	37.26±4.02	35.99±3.59	0.06 ns	35.11±8.35	34.59±8.91	0.631ns	0.060ns
Co-Go-Me (R and L)	134.44±7.72	130.61±4.12	0.102ns	128.88±9.75	126.50±9.35	0.055ns	0.430ns
Y-axis/FH	71.98±4.44	69.91±5.19	0.07 ns	69.91±5.96	70.11±5.97	0.841ns	0.052ns
UAFH:LAFH	54.94±2.64	54.76±2.65	0.717ns	53.54±3.39	54.15±3.68	0.056ns	0.290ns
Overbite (mm)	-4.06±2.11	3.07±2.39	0.008*	-2. 98±1.91	2.15±1.87	0.01*	0.163ns
Overjet (mm)	3.83±1.55	2.4±1.03	0.039*	4.51±1.71	2.16±1.39	0.02*	0.650ns
U1 - SN (°)	111.21±6.81	108.86±6.07	0.047*	112.71±4.92	109.57±6.08	0.015*	0.612ns
U1 - NA (°)	25.21±8.04	24.44±7.28	0.543ns	27.97±8.92	25.36±3.22	0.37ns	0.715ns
U1 - NA (mm)	5.05±2.55	4.76±2.29	0.510ns	5.91±3.99	5.91±3.01	1.000ns	0.736ns
L1 - NB (°)	36.84±9.37	35.40±6.94	0.360ns	33.21±5.45	33.23±4.28	0.979ns	0.376ns
L1 - NB (mm)	9.20±3.10	9.30±4.23	0.911ns	7.91±2.39	7.79±2.38	0.830ns	0.829ns
IMPA (°)	95.70±6.51	92. 2±4.70	0.048*	100.80±7.30	95.79±7.27	0.049*	0.360ns
Ls-E line	2.90±1.41	1.86±1.88	0.104ns	1.99±1.31	2.09±1.91	0.817ns	0.209ns
Li-E line	5.03±2.16	4.27±2.66	0.239ns	3.56±1.46	3.44±2.23	0.790ns	0.383ns
Cm-Sn-Ls	92.20±9.31	91.00±8.58	0.715ns	91.57±5.35	92.29±4.96	0.775ns	0.636ns

Discussion

Initially, both groups were similar , regarding several parameters that could affect this comparison, such as initial chronological age and cephalometric characteristics , the overall sample was 20 subjects,5 of them were excluded from the study , only 15 cases (7 cases in CLS group and 8 cases in MBG group) upon which the study was conducted .

In relation to the sample selection criteria, all the subjects have similar AOB pattern with signs of tongue thrust and 1 mm or more of severity, the mean AOB in CLS group was (-4.±2.4mm) and (-2.9±1.9) in the MBG group , other studies used samples with similar AOB severity at pretreatment **Greenlee et al (2011)** [10,] **Insabralde et al** (**2016**)[19] .

The duration of treatment is an important factor that affects 2 different outcomes; mainly, the success of habit breaking and the improvement in malocclusion [20,9] . In this study, the total treatment time was 12 months ,and it was successful in the correction of A.O.B with tongue thrust habit, and was comparable with that of **Rossato et al(2018)** [21,] **Castillo et al(2021)** [22] , others used protocols of a longer time as **Cozza et al(2007)** [18] where the appliances were worn for 2 years .

The mean time of bite closure for M.B.G group was (8.07±1.61 months) which was longer than C.L.S (6.1±1.10 months) with no statistical significance, and was quite similar to a comparative study by **Suwwan(2008)**[17]

All values of anteroposterior skeletal measurements revealed that no statistical significant difference was found (P>0.05) for both CLS and MBG groups .This finding was paralleled with other similar studies regarding early AOB treatment, as **Cassis et al (2012)**[23], **Cozza et al(2007)** [18] **,Insabralde et al(2016)** [19] **,Rossato et al(2018)**[21]

The cephalometric parameters of the vertical skeletal measurements showed, only MP-SN exhibited significant reduction after treatment with C.L.S appliance (P<0.049) than with M.B.G (0.766), this finding was consistent with MP-SN (<0.05) in study reported by **Erverdi N et al(1992)**[15], who had explained that (as mentioned in the literature [24]**)**, an altered tongue posture can affect the direction of mandibular growth .while the other vertical parameters MP-PP , Co-Go-Me , exhibited slight reduction , for both group of appliance, though it was none significant , yet other studies ,reported slight reduction for the same vertical parameters **Castillo et al(2021)** [22].

The cephalometric dental measurements **OJ, U1 - SN (°) ,IMPA (°)** showed significant reduction in both group C.L.S appliances (P=0.03 ,0.047 ,0.048) , and M.B.G appliance ((P=0.017, 0.02 ,0.015), with no statistical difference between the 2 groups ,the

interpretation of this findings contributed to the greater palatal tipping of incisors in both groups ,as consequence of preventing the protrusive tongue activity, hence the equilibrium between the lips and the tongue was altered in favor of the lips, ,other authors have reported similar results with fixed spurs **Huang GJ et al(1990)**[8], **Erverdi N et al(1992)** [15], **Meyer-Marcotty P et al(2007)**[25] .

This findings were paralleled with other studies investigated the effect of the bondable lingual spurs and compared it with the conventional ones **McRae(2010)**[26] and **Canuto et al(2015)** [27] .

According to **Insabralde et al (2016)**[19], who used a removable palatal crib, bonded spurs, and chin cup therapy on children with AOB reported significantly larger lingual tipping and retrusion, owing to the potency of a crib in the blocking of the tongue pressure, and the active action of the labial arch wire on upper incisors

The cephalometric and cast measurements of OB, were similar and showed there was significantly increase in OB after treatment for both groups the C.L.S (M=3.1 mm) and M.B.G (2.15mm) appliances , which was closely related to the cast measurements (C.L.S M= 3.2mm), (M.B.G M=2.2mm) While no statistical difference between them was found , These changes were similar to that of **Rossato et al al(2018)**[21] and **Cozza et al(2007)**[11] and smaller than those observed in a previous studies used high pull chin cup and posterior bite block , as **Cassis et al(2012)** [23] and **Torres et al(2011)**[28] with mean of AOB closure (M>5.44) mm and **Castillo et al (2021)**[22] in a mean of (M=4.84mm) , this could be attributed, to the younger age group, the initial acceptable skeletal growth pattern ,along with the use of additional appliance **Suwwan (2008)** [12].
Meyer-Marcotty et al(2007)[25] and **McRae(2010)**[26] who have reported mean of bite closure (M <.2mm) resulted by the use older age group (mean age 13 years, 10 months) ,and explained as it reported in the literatures ,the younger the patient the earlier the AOB correction **Cozza P et al (2005)**[2], **Suwwan (2008)** [12] .

An increase in transverse distances was observed to be significant for IMW measurement for both group of appliances C.L.S and M.B.G , (P=0.001 -0.026) consequently, it might be mainly related to the reeducation of tongue posture and the expected normal transverse arch development[9,15] this findings were also paralleled with **Slaviero et al(2017)** [29] and stated that, there was a statistically significant difference in the upper arch for the UMCP upper mesiobuccal cusp points; UDCP, upper distobuccal cusp points; (P=0.002-0.004) , another report by **Suwwan(2010)** [12] compared the treatment effect of B.G vs M.F.T and proclaimed that Inter-molar width increased with a mean difference of 1.00 mm ± 0.91 (P = 0.12) but that was not significant , this could be entitled by the shorter treatment time than 1 year.

Conclusion

Both treatment protocols (C.L.S and M.B.G) appliances, were effective in reducing AOB in of 86.6% after 12 months of treatment [3]. AOB reduction occurred mainly as a result of dentoalveolar changes , with incisor extrusion and lingual incisors inclination, which were contributed to the mean increase of (3.2mm)-(2.2 mm) overbite, consequently, for the (C.L.S and M.B.G) appliances.

M.B.G appliance had better acceptation during chewing and eating, in the first few days, however, the children adjusted to the spurs after 1 week or less of treatment.

An overbite improvement could be used as a standard to assess breaking the habit, where the clinical evaluation might be helpful in that assessment. In addition to the patient's and parents' report of habit breaking, this would provide another way to assess the success of habit breaking strategies[9], [12].

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