MUSICAL INSTRUMENT: AN ADJUNCT TO CLASS 2 CORRECTORS

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ABSTRACT

Intraoral devices which utilize exercises for neuromuscular re-education involve in myofunctional therapy. The stable position of the teeth represents equilibrium of all the forces exerted by muscles of the tongue, buccinators complex. Myofunctional therapy may be aided by the use of tools that are not strictly Orthodontic such as a musical instrument. A musical instrument introduces a complex of new pressures which could be evaluated, measured, and understood.

Strayer first recommended the use of specific instruments for their beneficial effects in certain malocclusions. He divided the wind instruments into four categories according to the type of mouthpiece used:
*1. **Class A**- All cup-shaped mouthpieces, as in the trumpet, trombone, tuba, all horns, and brasses.*
*2. **Class B** - Single-reed mouthpieces, as in the clarinet and the saxophone.*
*3. **Class C** - Double-reed mouthpieces, as in the oboe and bassoon.*
*4. **Class D** - Mouthpieces with a small aperture or opening at the head, as in the flute and piccolo.*
Class A or cup-shaped mouthpieces have a tendency to reduce overjet and overbite. Class B or single-reed mouthpieces such as the clarinet or saxophone tend to increase overet and overbite. Class C or double-reed mouthpieces and Class D or aperture mouthpieces have a tendency to reduce overjet and increase overbite. Class 2 division 1 malocclusion with protruding upper incisors and hypotonicity of the facial musculature will be benefited by the use of class A instruments Therefore, Class A instruments can be helpful adjuncts in correcting Class 2 division 1 malocccclusion

Keywords: *musical instrument, myofunctional theapy, class 2 division 1 malocclusion*

INTRODUCTION:

Functional therapy utilizes devices, primarily intraoral those which utilize gymnastic exercises or exercises for neuromuscular re-education[1]. The position of teeth depends on the forces and pressures exerted on them. The stable position represents equilibrium of all the forces exerted by muscles of the tongue, buccinators complex. The balanced position refers to the "Neutral zone". Myofunctional therapy may be aided by the use of tools that are not strictly Orthodontic such as a musical instrument[1]**.** A musical instrument introduces a complex of new pressures which should be evaluated, measured, and understood[2]. Engelman[3] used a "Transducer" to measure the perioral pressures involved in the playing of wind instruments. He asserted that "the effect of musical instruments on the dentition warrants investigation, since the forces produced by them may be of sufficient magnitude, duration, and direction to help produce a malocclusion or conceivably to help correct one".

Strayer[4] first recommended the use of specific instruments for their beneficial effects in certain malocclusions. He divided the wind instruments into four categories according to the type of mouthpiece used:

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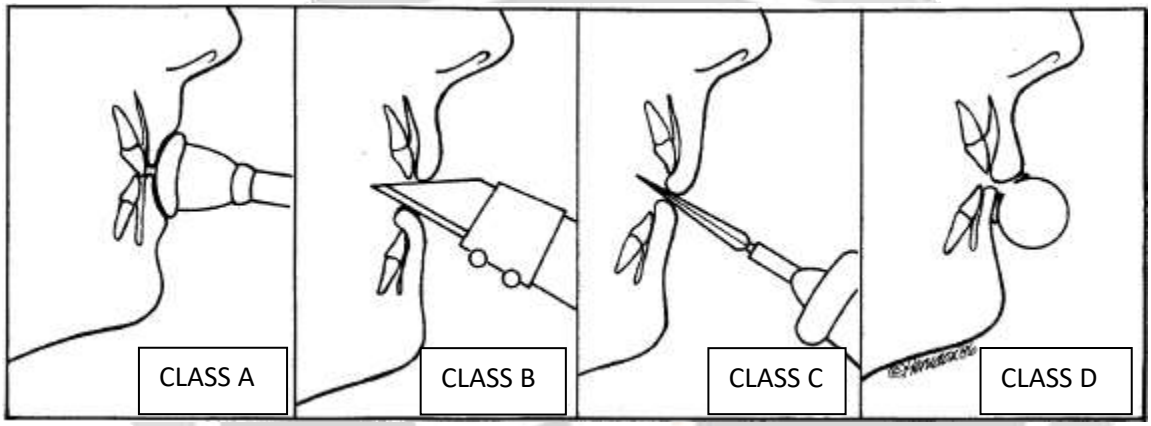
Class A instruments: The mouthpiece of the instruments applies backward pressure, compressing the lips against the upper and lower incisors. During playing the border of the lips are positioned inside the mouthpiece and vibrate. Precise lip control is required as the borders must vibrate at a different frequency for each note played[5].

Class B instruments: The mouthpieces are wedge shaped with a single reed. The reed is clamped over a rectangular smooth and flat opening on the undersurface. During placing the mouthpiece, the lower lip is curled over the edge of the lower incisors. This forms a cusion for the reed[5].

Class C instruments: The double reed with a buttonhole shaped aperture is inserted between the upper and lower lips. The lips are then curled backward over the incisors. Sound is produced by the two flexible, almost parallel reeds vibrating against the lips[5].

Class D instruments: The aperture in the head of the instrument rests against the lower lip. The lip is rolled along the side of the instrument and is active in stabilizing the position of the instrument. The upper lip is stretched and drawn downward over the upper incisors to provide a narrow opening between the lips. It permits a controlled stream of exhaled air to flow into and across the aperture[5].



Depending upon the type of mouthpiece and the position of the teeth and lip, the forces introduced by tongue and facial muscles can alter the equilibrium between dental and skeletal structures[3]. The adaptability of the orofacial complex to this muscular force is age related. Alteration in occlusion occurs in the growing individual especially during the period of permanent tooth eruption. Proper instrument selection can enhance the orofacial form and function and improve dental relationships through the repetitive application of the muscle forces[5]. Class A or cup-shaped mouthpieces have a tendency to reduce overjet and overbite. Class B or single-reed mouthpieces such as the clarinet or saxophone tend to increase overet and overbite. Class C or double-reed mouthpieces and class D or aperture mouthpieces have a tendency to reduce overjet and increase overbite. Therefore, class A instruments can be helpful adjuncts in correcting Class 2 division 1 maloccclusion[2]. Various studies prove that the instruments provide enough pressure to produce the tooth movements.

Table 1: Range of mouthpiece forces and displacements, measured with different instruments (minimum and maximum individual values). Negative displacements are due to tongue pressure[6].

	Trumpet	French horn	Tenor horn	Turba
Force(N)	5-25	0-50	5-40	0-35
Displacement(µm)	20-140	70-180	5-100	-12-55
Central incisor				
Displacement((µm)	0-75	-2-70	-3-65	-3-75
Lateral incisor				

Mouthpiece forces and tooth displacements were highest with trumpet playing. Displacement of central incisors occur more than lateral incisors

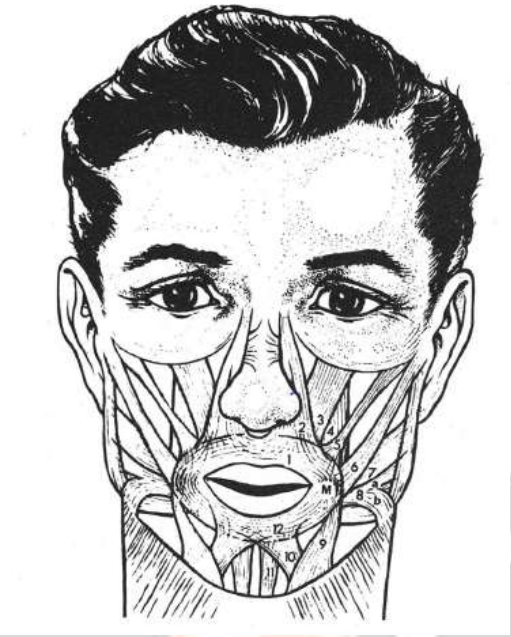
Harman[2] conducted a 2-year longitudinal investigation involving 11 to 13-year-old children to determine the type tooth movements occur resulted from the playing of certain musical instruments. This study started with 220 instrumentalists and ended with 91 participants. The control group started with 56 students and ended with 36. Questionnaires, interviews, oral examinations, and dental casts were used at the start of instrumental study, after one year, and then after a second year. Statistically significant anterior tooth movements occurred in majority of the instrumentalists, while negligible movements were recorded for the controls over this period. The reduction in overjet was 0.36 mm. ($p < 0.1$) after 1 year and 0.75 mm. ($p < 0.05$) after 2 years in Group A instruments(Table 2).

Table 2: Overjet (OJ) and overbite (OB) mean measurements(mm) with standerd deviations(SD) of the control and instrumental groups at the start and after 1 and 2 years[2].

	Controls		Group A	
	OJ ± SD	OB ± SD	OJ ± SD	OB ± SD
Start	2.76 ± 1.34	1.33 ± 1.26	2.80 ± 1.57	1.09 ± 2.18
After 1 yr	2.67 ± 1.12	1.44 ± 0.65	2.24 ± 1.04	1.12 ± 1.17
Difference from start	-0.09	0.11	-0.56	0.03
Percent difference	3.2%	8.2%	20%	2.7%
t test	0.48	0.51	1.39	0.26
Significant level	NS	NS	0.1	NS
Afer 2 yrs	2.65 ± 0.95	1.53 ± 0.65	2.05 ± 1.07	1 ± 1.38
Difference from start	-0.11	0.20	-0.75	-0.09
Percent difference	3.97%	15%	26.7%	8.2%
t test	0.72	0.82	1.81	0.09
Significance level	NS	NS	0.05	NS

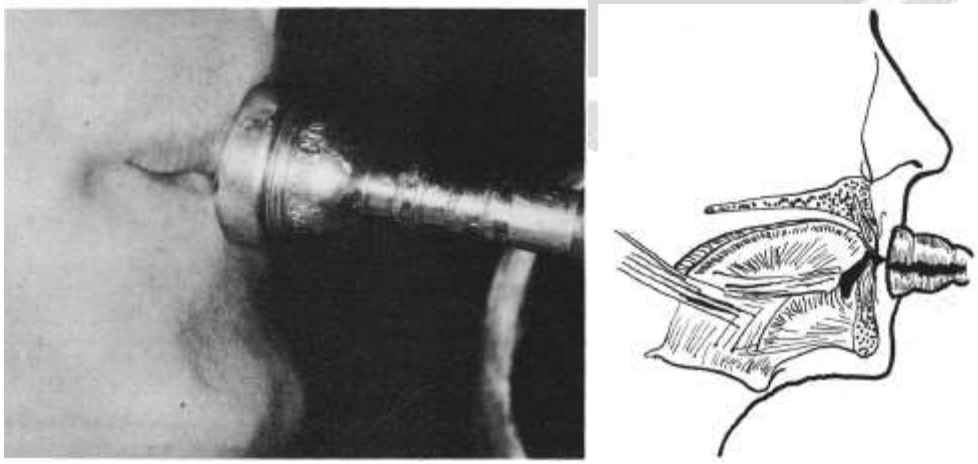
So, the group A type of instruments can be used as an adjunct to class II corrector. However, this requires further studies to determine the clinically useful conclusion.

DISCUSSION: The importance of regular, properly directed exercises in the prevention of malocclusion and their use during the corrective and retention period is attributed to the work of Rogers[7]. He believed faulty facial posture and muscular malfunction are the most important etiologic factors in malocclusions. Brekhus, Armstrong, and Simon[8] showed the effect of stimulation of the masticatory muscles. They concluded that the strength of the muscles is directly proportional to their use. In 1906, Rogers[7] proposed corrective exercises to overcome "faulty facial posture and malfunction of facial muscles ." The term myofunctional therapy was later proposed by Lischer[9] for these exercises. Most orthodontic patients have Class 2 malocclusions, categorized by posterior distocclusion and maxillary anterior protrusion. A class A instrument is the preferred one to effect some improvement. The instrument requires tremendous pressure from labial aspect against the maxillary anterior teeth. Severe compression of the lip muscle occur. The mandible is forced forward to align with the maxilla to form the proper embouchure. The embouchure is the manner in which the mouth is applied to the mouthpiece of a wind instrument. The lips are of primary importance. The muscles include orbicularis oris muscle of the mouth and the 11 sets of muscles that radiate from it on each side. These muscles produce a proper and correct relationship to the mouthpiece. These muscles cause various amounts of tension in the face to emit a controlled air stream through the lips. The embouchure controls sound production, tone, quality, articulation, and dynamics. In the formation of the embouchure, the lips act as a washer. These prevent the leakage of air. The tongue, by its extrinsic and intrinsic muscles, acts as a valve to control the flow of air. The mouth funnels the air traveling from the lungs to the instrument. The teeth and jaws support the soft tissues[10].

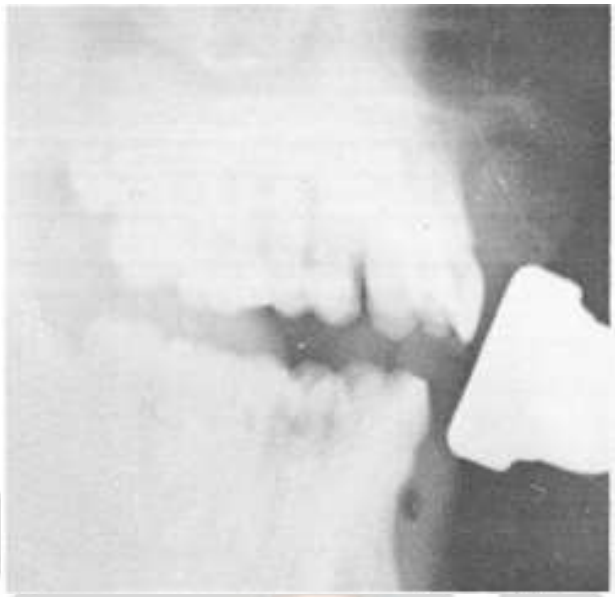


Scheme of musculature of embouchure. 1. Orbicular muscle of mouth(upper lip portion), 2. Levator muscle of upper lip and ala of nose, 3. Levator muscle of upper lip 4. Levator muscle of angle of mouth, 5. Lessor zygomatic muscle, 6. Greater zygomatic muscle, 7. Buccinators muscle, 8a. masseteric strand of risorious muscle. 8b. platysma strand of risorious muscle. 9. Depressor muscle of angle of mouth. 10. Depressor muscle of lower lip. 11. Chin muscle. 12. Orbicular muscle of mouth (lower lip portion). And M-Modulous.

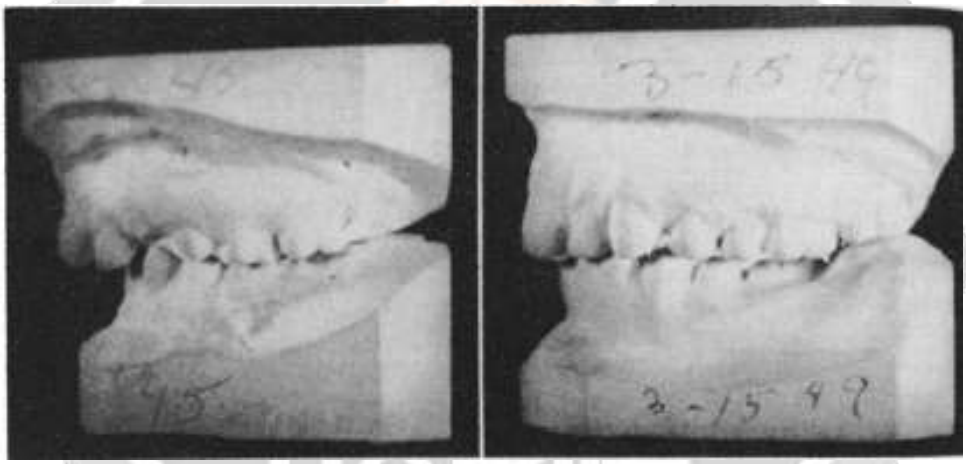
During playing the class A instruments, external pterygoid muscle moves the lower jaw forward into playing position. The tongue functions within the vault of the mouth and against the anterior teeth to start the tones. When the embouchure is placed against the mouthpiece, there is contraction of the muscle fibers. This causes strong musculature tonicity. This allows a small aperture in the lips through which the column of air is directed to the instrument. The musculature is tensed more for the higher tone and tensed less for the lower notes. A person with short, flabby lips will be benefitted by the increased tonicity and strength of the lips during playing the instruments. A broad, flat protrusive tongue is reduced to a more pointed shape, and thus tongue-thrusters will be benefitted by the instruments. Deep, regular breathing is required to provide sufficient air for playing this instrument. This will improve the respiratory function by stimulating narrow and constricted nasal passages to develop into normal size and contour to allow a free passage of air[4].



Position of mouth and jaws during playing trumpet



lateral cephalogram shows severe compression of the lips



Cast at left, made in 1945, shows severe class 2 malocclusion in 11 years old boy. Cast at right, made in 1949. Boy had played trumpet during four years period. (No orthodontic treatment was performed)

The cases of class 2 division 1 malocclusion with protruding upper incisors and hypotonicity of the facial musculature will be benefited by the use of class A instruments. A short upper lip is thought to contribute to protrusion of upper incisor. When a short hypotoned upper lip is present, the use of trumpet type instruments will help to strengthen the lips. The area of the lips which comes in contact with the mouthpiece feels a stimulating effect from the tension created due to the mouthpiece. This stimulating effect cause free and full flow of blood to the musculature. Hypotoned tissue will develop normal tonicity due to the continued use of this instrument. Short flabby lips will be lenghened and take on a new contour. When hypotonicity is extreame and the lips are extreamely bulky, then class A instruments with a larger mouthpiece, can be used as advantage[4].

Ingervall and Eliasson[11] studied the effect of lip training in growing children with short upper lip with lip incompetency and inability to form lip seal. They compared 10 controls with 15 children who received specific lip trainin exercises over a period of one year. They demonstrated that it clerly is possible to influence the morphology of the lips with exercise. A significant increase in the height of both lips and a decrease in lip seperation occurred in the exercise group with no chnge in control.

A professional musician can practice for about 5 hours per day[12]. So, the pressure applied during playing can be considered an intermittent force, Engelman (1965)[3] used an intraoral pressure transducer to measure the magnitude of lingually directed forces exerted by the upper lip on the maxillary anterior teeth during various activities

including thumb sucking, swallowing, whistling and playing brass (cup-shaped mouthpiece) instruments, reed instruments and the flute. 20 subjects of 10-17 years were selected. Engelman concluded that the mean pressure exerted by the upper lip to the upper incisors was highest for the brass group, followed by the reed group and it was lowest for the flute group. Furthermore, it was of interest to find that playing a brass instrument for certain subjects exerted a higher force on the maxillary incisors than thumb sucking. Based on this, Engelman concluded that the forces exerted on the dentition while playing a wind instrument may be of sufficient magnitude to produce or help to correct a malocclusion.

There are three forces and three moments are applied to the mouthpiece while it is being played. The largest force (FL) will be that applied longitudinally. It is parallel to the axis of the mouthpiece. The mouthpiece is not played at right angles to the lips. So, there is a force (Fs) acting at right angles to the mouthpiece axis in the sagittal direction. It is also possible that there will be transverse force. The upper and lower lips do not apply an equal force to the mouthpiece. The resultant of the longitudinal forces applied by upper and lower lips cause the sagittal displacement of the mouthpiece from the axis. It produces a bending moment. A lateral displacement of the axial force produces an additional lateral moment. There may be a moment about the axis of the mouthpiece, due to the construction of the mouthpiece-instrument junction[13].

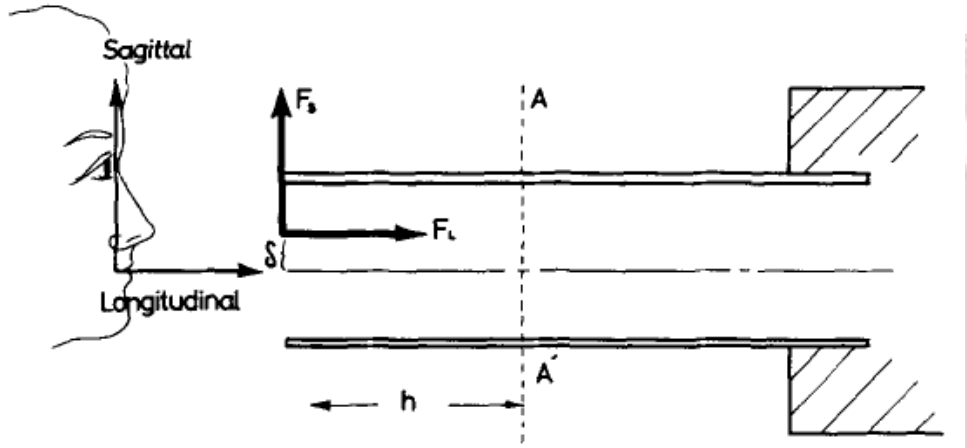


Fig. 1. Forces applied to mouthpiece transducer.

F_S – Sagittal force, F_L – Longitudinal force, δ - Axial offset of the longitudinal force , AA'- Two symmetrical points on the upper and lower surfaces, h – distance of acting sagittal force on AA'.

There are some problems reported in musicians using wind instrument[5].

1) Problems adjusting to the embouchure included lip and facial muscle fatigue, difficulty in posturing the lower jaw far forward, lip irritation, air leakage around the mouthpiece
2) Parotid swelling, viral parotitis, cheilitis, contact dermatitis, localised acneiform eruption of the lips can occur.
3) Periodontal disease, loss of supporting bone, mobility of the teeth, diffuse calcification on the pulp, shrinkage of pulp canal may occur. In the presence of good oral hygiene, playing a wind instrument does not increase the risk of alveolar bone loss or periodontal disease.
4) Temporomandibular joint clicking, crepitus can occur in patients whose mandible move upward and backward from the rest position when embrochure is formed.

CONCLUSION:

The choice of the musical instrument in treatment specific malocclusion is based on studies concerning overjet and overbite values measurements among musicians. Orthodontists and all dental professionals should have a basic knowledge of the relationship of the mouth to various types of musical wind instruments. The jaws, the tooth, the lips, and associated structures arc used continuously in the playing of wind instruments. Adaptation of the muscle of

the lip and associated structures occur during forming the embouchure. The instruments apply sufficient forces on the dentofacial structures to have a myofunctional effect. The effect can be positive if the correct instrument is used in specific type of malocclusion. Group A instruments provide sufficient amount of pressure to reduce overjet and overbite in class 2 division 1 malocclusion case. These instruments also improve the condition of lip hypotonicity by strengthening their lips. So, the instrument can brings about some improvement in class 2 division 1 condition. It should not replace the class II corrector but may be used as an adjunct. Further research is required in this field to provide the valid data establish the use of these instruments regarding the correction of malcclusion.

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