Heading

Abstract

ABSTRACT

Background Orthodontic treatment leads to a change in the patients occlusion condition as improvement in the state of malocclusion occurs. However, soft tissue changes play a major role in treatment outcomes and require a careful evaluation before the treatment begins. The focus of the treatment is to arrange the teeth in most aesthetic and optimal functional position.

Certain factor are responsible for maintaining the equilibrium of the teeth in optimum occlusion such as lip, tongue and cheek pressure. These tissue have an important role in maintain the results of the treatment such as the retraction of the incisors. A controversial debate has been carried on regarding the effects of the tongue and lip pressure on the incisors. Some studies presented with significant results while other found no change. Our study main focus was on the change of soft tissue pressure on the incisors before and after retraction in the resting position only.

Objectives: the objective of this study will be:

1. The focus of the study is to assess the difference in lip and tongue pressure before and after the retraction of the teeth using a flexi force sensor.
2. A secondary objective is to measure difference in lip and tongue pressure on incisors between class I and class II malocclusion groups.

- **Methods:** A Quasi-experimental study will be conducted at, Orthodontic department. The study included 64 patients aged 15-35 years selected and excluded on the basis of the following criteria:

- Patients who sign informed consent
- Cases with severe crowding
- Previous glossectomies
- Paralysis or paresis of lips or tongue
- Current speech or language therapy
- Nasal obstruction at the time of evaluation
- Cognitive impairment
- Temporomandibular joint dysfunction.
- Craniomandibular anomalies, malformed to missing permanent teeth or systemic muscle or joint disorders.
- Craniofacial syndromes
- Excessive hypodivergent or hyperdivergent patients that require orthognathic surgical treatment

- No previous orthodontic treatment.

The collected data was statistically analyzed using Statistical Package for Social Sciences (SPSS) Version 22 software. The results were described in terms of Mean and standard deviations for all quantitative variables. Paired *t* test was used for the analysis of the soft tissue pressure before and after incisor retraction by comparing the mean difference. Furthermore, difference in soft tissue pressure between class I and class II treatment group was carried out using independent *t* test.

Result:

The paired t test displayed significant difference in lip pressure over the labial surface on the incisors with p- value equal to 0.01 ; however, tongue did not show any significant difference on the lingual side of the incisors.

The results of the independent test indicated no significant difference in the soft tissue pressure before and after the retraction of the incisor.

Conclusion: In conclusion our study alternate hypothesis was successfully proven that soft tissue pressure changes are evident while the anteriors are retracted over the labial surface. However, the lingual force can be evaluated and measured easily through during the swallowing.

Key Words: tongue pressure, force sensor gauge, lip pressure, lip closing force.

Evolution has brought about extensive changes in each field of medicine including dentistry. The trends have changed from using hand techniques towards effective use of mechanics in the treatment of the disease. Orthodontics is a similar field, which has evolved and used different mechanics for successful treatment; however, success only depends upon one major variable that is retention of the final position of the teeth after treatment.(1) The focus of the treatment is to arrange the teeth in most aesthetic and optimal functional position.

Certain factors are required for maintenance of the retention that includes number of the teeth moved, characterisitcs of occlusion, patient's age, time period for the treatment, arch size, type of malocclusion and oral habits(2). Although the teeth is embedded in the bone, which is the hardest tissue of the body; however, in case of any pressure applied on the bone cause changes in the oral cavity environment that leads to change in the position of the teeth in order to restore harmony(3). Most of the dental professions accept the theory that the forces created by the tongue, lips and cheeks are responsible for arranging the teeth in the neutral equilibrium position(4).

These pressure and forces are created by the location and position of the soft tissues in the oral cavity(4). These pressure not only depends upon the natural pressure of the soft tissue but also on the oral habits of the patients. Oral habits such as thumb suckling are one of the causes for the malalignment of the teeth(5). When a patient sucks the thumb, the erupting teeth against the pressure exerted by the thumb apart from soft tissue pressure causes the disorderly position of the teeth.

Another determinants affecting the positioning of the teeth is seen as tongue thrusting. The subjects who are habitual of tongue thrusting can face the issue of relapse of the teeth position after the retraction(5, 6). Many authors debated over the fact the tongue is the main determinant that is

responsible for causing the malocculsion while others claim that it has the ability to adjust according to the occlusion(6). Many studies indicated that the shape and abnormal size of the tongue equally plays an important role in affecting the occlusion. However, with time and other opposing factor involvement the force of tongue at time gets nullified and it gets adjust to the state of occlusion(7). Some authors claimed that swallowing has a major impact as it gives a thrust that may lead to the placing a force on the teeth(8). Therefore, it is seen as a major factor causing the relapse of the treatment. Patients with evident anterior open bite are a good example of strong tongue thrust(9). Different studies were conducted upon this, stating that lips, cheek and tongue pressure levels differ in males and females; adult and child and angles classification. Similar difference noticed in patient who also under go surgical correction(10).

Furthermore, as per the literature, the forces of the tongue are found to be greater than the lips(11). Although the concept revolves around the fact that the teeth are in equilibrium under both the pressure applied at the same time; however, any pressure increased from either side can result in the movement of the teeth in the opposite direction(3, 11). Therefore, during the treatment of the any such condition in which either the teeth are retracted or protruded, it is the responsibility of the orthodontist to evaluate every possible abnormal forces that caused the disruption in order to neutralize it before completing the treatment. Hence, otherwise it would result in relapse(4).

Apart from these two major forces, supplementary forces are also needed to be kept in mind that support these forces. However, these light forces exerted by the lips, cheeks and tongue are more significant than intermittent supplementary force such as swallowing, speaking and mastication(12).

One of the problems the orthodontist face is the relapse because they ignore the fact that although the bone allows the movement of the teeth but once it is stabilized , there is require for retention in order to stablise against the soft tissues pressure(1). These soft tissues requires certain time to adjust to the new position of the teeth and keep them in new neutral equilibrium. Often orthodontist advice the patient for appliances for a certain time period but the importance of the appliance is not clearly explained or the patient does not take it seriously; hence, result in relapse(13). Sometimes the relapse happens despite the proper use of retention appliances. Proper assessment of the soft tissue pressure has not be evaluated before and after the retraction of the incisor.

Furthermore, ukei et al claimed to have a significant difference in the soft tissue pressure depending upon the type of the angles classification. Class II is one of the most common classification encountered by the orthodontist(14). Therefore, a detail independent evaluation between these classifications is necessary to collect enough data for a significant evidence.

These pressure are evaluated in the rest state as well in the active state through use of various gauges that includes include strain gauge transducers and hydraulic capillary infusion systems to calculate these values(15). A study was conducted that measured the Normal lip and tongue pressure in adults and children and in individuals who underwent maxillary expansion prior to orthodontic treatment but there is minimal data available to show changes in lip and tongue pressure changes after extraction of teeth and retraction of incisors(15). Therefore, our study aimed for evaluating the rest soft tissue pressure before and after the retraction of the maxillary incisors.

Literature review

In a comparative study in japan, the children between age 8-11 years were recruited to evaluate the lip closure forces along tongue pressure(16). These lip pressure forces were measured through the multi directional lip closing force measurement system; however, for tongue pressure a scale is used. It was observed that the normal tongue pressure in children with class one occlusion was 5.031 Ns and those in class III occlusion was 2.770 Ns(16).

Furthermore, in a randomized clinical trials in Japan, they enrolled females mean age 26.4 years to compare the difference between two forces, maximum lip closing pressure and tongue pressure according to lateral craniofacial morphology in those with class I, II and III malocclusions and those with normal occlusion. The results showed the maximum Lip Closing Force was 10.4 N in those with normal occlusion(17). Those with class I malocclusion recorded maximum LCF of 7.0 N, those with class II had maximum LCF of 6.2N and those with class III had 8.4 N. This indicated that those with class II malocclusion had the lowest LCF as compared to other malocclusions(17).

Furthermore, it is observed that maximum tongue pressure in subjects with normal occlusion is 7N. It was recorded as 5.6 N, and 6.5 N in subjects with class I, class II and class III malocclusion respectively, indicating that tongue pressure has no association with malocclusion(18). In addition, it was displayed by various studies that LCF is positively associated with FMIA and angle II; whereas, there is a negative relation with IMPA and overjet(19). However, in case of tongue pressure there was no relation between the tongue pressure and these factors.

In another retrospective studies, the subjects who underwent the orthognathic surgery were evaluated for lip closing pressure, occlusal force and contact area(14). The study sample consisted of 54 subjects who displayed that the maximum lip closing force in men was much higher than the

preoperative value. Furthermore, it was seen that this pressure increased as time passed by. This was furthermore testified by another retrospective study, 63 subjects with class III malocclusion were evaluated for difference in maximum and minimum lip closing pressure between genders(20). It showed that although the pressure increased; however, it did not recover to normal values after surgery.

Brazil further examined the force on maxillary incisor by lip and tongue at rest and during normal swallowing in the subjects. The patients presented that forces at rest position of tongue was 0 N and lip force was 0.02 N. however, during the swallowing there is a change in the pressure of the tongue to 0.31 and 0.15 for the lip(21).

This study used the technique of using the force sensors to estimate the force during the swallowing on the incisors. After the sensors were attached to the tooth surface, the evaluator awaited for 30 seconds so that the subject adjust to the sensor. Then the subjects were guided to swallow the saliva; hence, recording the first reading. The swallowing pattern of each participant guides the evaluator to note each measurement carefully. The evaluator guides the patient to maintain the position of the tongue and lips and prepare the subject for another repeated reading.

The maximum tongue and lip pressure on the tooth and the duration the tongue is pressing against the tooth when the person swallows on instruction. However, in between rest period the spontaneous swallow will also be noted. Among the five reading, the highest force noted is the maximum force of the tongue.

To check the balance between the tongue and lip pressure force, the lip force is subtracted from the tongue force to attain the average tongue force on the tooth in habitual position and during the swallowing. This was performed for the reading before and after the retraction.

In another research, a force sensing resistor device was utilized to assess malocclusion lip pressure at rest and swallowing in 50 patients. The result indicated that the mean lip pressure was 24.59 g/cm^2 and during swallowing it was slightly higher with a value of 24.87g/cm^2, but showed no significant difference(22). Although this study did not supported the result of other study; however, it assured that there is a relation between lip pressure and age. With increasing age the pressure also increases. Certain factors are identified that are involved influencing the tongue and lip pressure such as age, gender, malocclusion and oral and parafunctional habits(23).

Nevertheless, a study prove that there was no correlation between age and lip, and tongue pressure. However, the myometer displayed that male showed higher values of pressure than female and there was significant P value that showed difference between class I and class II division I subjects(3, 24).

In a prospective study, the pressure was evaluated after the maxillary arch expansion for analysis effects of the pressure on teeth. This study aided in the assessing the retention of the teeth position after and before the surgery. In 13 subjects, the netural zone was evaluated with the help of stents of different thickness(4). The outcome of the process displayed that increasing the thickness of the stent showed increased pressure in the area of lips and cheeks especially in the canine area that recorded highest pressure(23). This indicated that expansion should be done in anterior, posterior and lateral areas to create space for alignment and to maintain post expansion retention.

In addition, some of the authors, explain the significance of pressure of the cheeks, lips and tongue on the position of the teeth despite the fact there is no malocclusion in the maxillary arch. The pressure is applied on main three point maxillary incisor, canine and first molar. This highlight

the pressure dispersal in the maxillary arch through the hydraulic capillary infusion system. The normal pressure over the first molar recorded is 1.28 g/cm^2, while at central incisor it was slightly higher with a mean of 1.96 g/cm^2 (25). The pressure at the canine region was highest with a mean value of 5.00 g/cm^2. However, the lateral incisor and first premolar area also showed recorded pressures greater than the first molar area.

Another way to assess the pressure of the soft tissue is through usage of the cervical head gear under two different force condition 500 gm and 1200gm. It was found that the tongue pressure increased with the increased head gear force. These pressure from appliances were recorded through use of piezo resistive relative pressure sensor. The cervical head gear is responsible for the retraction of the incisors in the class II malocclusion. It acted by not only affecting the soft tissue change but majorly affecting the skeletal changes that are responsible for long term retention. However, the results did not display a significant change in the lip closing pressure becuas eof variation in the soft tissue structure(26).

The authors evaluated the pressure rate even in the patients who underwent cleft lip and palate surgery. 30 Japanese children displayed that the lip closing force on non-cleft side was significantly greater than on unilateral cleft lip and cleft lip, and palate(27). In the beginnings the intrinsic factor was felt as main factor in the developmental deficiency. However, with time it was seen that contraction of the repair is a part of the negative effects of surgical repair(27). The study further evaluated that lip closure pressure as the main factor in causing increase pressure in surgical repair area in those patients who did not stabilised the repair area through the orthodontic treatment.

Majority of the studies have conducted their studies on the basis of some theories such as the equilibrium theory. Various factors are responsible for influencing the equilibrium of the teeth. The resting pressure arises from tongue and lips, the vertical forces are applied from the occlusion,

respiratory affects the positioning of the jaws, head and tongue position. In addition, swallowing, was also seen responsible for any sort of deviation of teeth.

These soft tissue pressures were evaluated dated back to 1969 by Luffingham. The author conducted the study to analyse the lip and cheek pressure exert upon the teeth. The author was unable to find any association between the amount of the incisor overjet and some soft tissue pressures(28). Many authors suggested clinically the tongue seems to apply vertical force on the equilibrium of the teeth; however, less information was generated on resting lip pressure during swallowing(23). nevertheless, recent clinical trials were successful in displaying that the formation of the dental arches are influenced by the resting pressure, the musculature and the resting posture of tongue and lips seen more important than pressures during swallowing or speech.

Few of the authors pointed out that the position of the upper maxillary incisors depends upon the high lower lip pressure in class II/2 malocculsion. Highest lower lip resting pressures can be explained by the hypertonic lower lip with increased mentalis activity in Class III subjects exerting increased pressure. The explanation for the lowest lower lip resting pressures in Class II div 2 I is the increase overbite; thus the lower lip resting more on the upper incisors as explained by Millet et al (29). Further attesting, another author presented with similar result stating more the over jet the higher the perioral pressure(5). Nevertheless, similar study claimed that the tightening of the lips leads to hardness; hence, results in the decrease vertical lip pressure(30).

Another factor that might determine the occlusion is the bite. According to the authors, the biting force of each person is a determinant for the positioning of the teeth(30). This even varies from gender to gender. The male have biting force more than the females; hence, this helps maintaining normal occlusion. As per the author the higher the biting force the better the positioning of the teeth into the normal class I occlusion following it is class II malocclusion then class I malocclusion and then class III malocclusion(14).

Rationale of the study

The aim of the study is to evaluate and measure the difference in the tongue and lip pressure before and after the incisor retraction. According to the theories, the teeth are supposed remain in equilibrium under the two opposing pressure; labial and lingual pressure. These two forces act upon the teeth by cancelling each other. After the teeth are moved under the pressure of orthodontic appliances, the change in position changes the pressure of the soft tissue on the teeth. However, it takes some time for the soft tissue to adapt to change in the teeth positioning. Therefore, in order to avoid the relapse of the teeth after the treatment; hence, retention is necessary for certain period. Measuring the lip and tongue pressure will help in determination that how much an orthodontic treatment brings about a change in the pressure of the soft tissues in order to understand the effect of the soft tissue pressure afterwards. In the treatment, the intermolar and intercanine width will remain same, the only change will be the change in the position of the incisors as per planned treatment.

This study will determine whether the soft tissue surrounding teeth adapts themselves to the new position or not, because if the teeth are not in the balanced position from labial and lingual forces the chances of the relapse becomes high.

Objectives:

The focus of the study is to assess the difference in lip and tongue pressure before and after the retraction of the teeth using a flexi force sensor.

A secondary objective will be to measure difference in lip and tongue pressure on incisors between class I and class II malocclusion groups.

1.1 Hypotheses

Null hypothesis: No difference exists in lip and tongue pressure on maxillary incisors measured before and after incisor retraction.

Alternative hypothesis: A difference exists between lip and tongue pressure on maxillary incisors measured before and after incisor retraction.

1.2 Operational Definitions

Soft tissue pressure gauge: A Flexi force sensor used to determine the soft tissue pressure exerted on teeth. It consists of a piezoresistive force sensor, average lip and tongue forces on the teeth, in Newtons, during habitual position is tongue 0.00 N, lip 0.02 N as per the literature.

Flexiforce sensor works using the technology that is based on restivity. When the appliances used applies the force on the teeth, it changes the pressure in the particular area which is detected by the senor as there will be change in the resistance in the sensitive area. This displays an inverse relation between the resistance and the applied force. The structure of the sensor is encapsulated ; hence, their movements are restricted in order to prevent any errors in the measurement of the generated signals. In addition, this sensor has a force applicator guide attached along.

In order to acquire an accurate and repeatable readings of the force, one should be careful in order to make sure that the applied load is distributed evenly in the sensitive area of the sensor and is not supported by the external area. The signal conditioning uses operational amplifiers for signal linearization and conversion of electrical resistance into electrical voltage. The signal pass through an amplification system to ensure the optimum quality of the outcome, since the data acquisition system was at a significant distance from the measuring point.

CHAPTER 2: METHODOLOGY

2.1 Study Design:

The study design is Quasi experimental.

2.2 Study Setting:

In the orthodontic depart of the Dow university of health sciences.

2.3 Study Duration:

Took 1 year after the approval of the synopsis.

2.4 Study Population:

The sample subjects selected according to the following criteria:

i) Inclusion Criteria:

- Patients having extraction treatment of right and left maxillary premolars with canine retraction.
- Patients who sign informed consent
- 15 to 35 years of age.

ii) Exclusion Criteria:

- Cases with severe crowding
- Previous glossectomies
- Paralysis or paresis of lips or tongue
- Current speech or language therapy
- Nasal obstruction at the time of evaluation
- Cognitive impairment
- Temporomandibular joint dysfunction.
- Craniomandibular anomalies, malformed to missing permanent teeth or systemic muscle or joint disorders.

- Craniofacial syndromes
- Excessive hypodivergent or hyperdivergent patients that require orthognathic surgical treatment
- No previous orthodontic treatment.

2.5 Sample Size:

Following settings were made in order to calculate the sample size

Reference PASS version 1 software

Power of test 99%

Confidence interval 99%

Mean and standard deviation of tongue and lip at habitual rest position: 0.2 ± 0.2 N

Sample size calculated is 28 for each group.

Due to patient attrition and the rate of loss to follow up 15% extra of the sample size that is 32 subjects were recruited for each group.

1. Class I extraction cases = 32
2. Class II extraction cases = 32

Total sample size = 64 subjects

Sampling technique

The sampling technique used in this study is purposive sampling also known as selective sampling. In this technique the selection of the subjects is based on the type of the patient required for the study. Purposive sampling is a non probability technique, a convenience sampling as it depends on the choice of the researcher to include the patient, only after the informed consent is taken from the patients.

As per research, Randomised selection is always preferred; however, in cases where the treatment is limited to certain subjects, in those cases best possible way to assess the problem is through purposive sampling. This type of the sampling is cost effective and time saving technique. However, this technique beholds some disadvantage such as that such study has increase chances of error, biasness and the results are unlikely to be generalised.

Data collection procedure

In this study the data collection was collected at two intervals, before and after retraction. The patients who came for orthodontic consultation and were fitting our inclusion criteria were provided with an informed consent and were invited to become a part of the study. The treatment was provided evenly to all the patient despite whether they were or not the part of the study.

In the next step, the labial and lingual pressure were measured at the rest position before the treatment begins. After the treatment was completed that is the retraction was performed from canine to canine, the final reading was noted for both pressures applied over the maxillary incisors.

INSTRUMENT FOR TESTING SOFT TISSUE PRESSURE:

Soft tissue pressure will be measured using flexi force sensor purchased from Tekscan (Tekscan, Inc.307 West First Street South Boston, MA 02127-1309, USA).(4) Flexiforce sensor is 0.2 mm thick, it will be covered by polythene sleeve which is 0.1mm thick on both sides making it 0.4 mm, and 0.1 mm thickness will be taken by the adhesive gel, so the overall thickness will be less than 1 mm.

The device consist of thin and flexible piezoresistive force sensor its physical properties are

Thickness 0.203 mm (0.008 in.)

Length 191 mm (7.5 in.)* (optional trimmed lengths: 152 mm (6 in.), 102 mm (4 in.), 51 mm (2 in.)

Width 14 mm (0.55 in.)

Sensing Area 9.53 mm (0.375 in.) diameter

Connector 3-pin Male Square Pin (center pin is inactive)

Substrate Polyester (ex: Mylar) Pin Spacing 2.54 mm (0.1 in.)

The flexiforce resistive sensors (Tekscan, Boston, MA,USA) were used in this study to measure the labial and lingual pressure on the maxillary incisors. The sensor rods were attached on the right and left surface of the tooth with the help of the denture adhesive paste. The range of the measurement noted is from 0 N to 0.4 N(31). Sensors were connected to an amplifier circuit ,acquisition board system NI USB 6008 (national

instrument ,Austin , TX,USA),and a computer ,sample rate displayed 70 Hz ,and the data shown in force time history graphs of two sensors with the help of LabVIEW (National Instrument ,Austin ,TX,USA)(31, 32)

The patients were explained the complete procedure and were asked to relax for 30 seconds after which the readings of the perioral muscles were noted . A second reading was recorded after one minute for unbiased reading and a mean value was deduced after repeated five reading for each patient over 10 mins period. All readings will be taken with the patient in natural head position.

2.7 Study Variables

Dependent variable: Soft tissue pressure

Independent variable: Class I and Class II malocclusion

2.8 Statistical Analyses:

Collected data was calculated with the help of statistical analysis using Statistical Package for Social Sciences (SPSS) Version 22 software and the results were described in terms of Mean and standard deviations for all quantitative variables. Paired *t* test was used for the analysis of the soft tissue pressure before and after incisor retraction by comparing the mean difference. Furthermore, difference in soft tissue pressure between class I and class II treatment group was carried out using independent *t* test.

2.9 Study Time Line

S.NO	WORKING STEPS	TIME (MONTHS)						
		1	3	6	9	10	11	12
1.	Synopsis writing & approval							
2.	Data collection							
3.	Data processing							
4.	Thesis writing							

2.10 Budget:

Material requirement	Quantity	Approx/price	Total Cost
Flexi force sensor	1	1@800	800 $ = 83400 Rs.
3M MBT bracket kit	50	32@1800	57600Rs.
Instrument(examination set, Mathieu, cutters)	200	200@150	30,000 Rs.
Bands	200	200@62	12,400Rs.
Seperators	200	200@1	200Rs.

NiTi wires	150	150@89	13,350Rs.
Denture adhesive paste	10 tubes	10@400	4000 Rs
Plastic disposable covering for sensor	100	100@3	300Rs
S.S wires	150	150@70	10,500Rs.
Total			**Rs. 211750 Rs**

Subjects

The total patients enrolled were 64 that is 33 subjects were enrolled for each group, class I and 31 subjects in class II malocclusion. The mean age for the patient is 24 years +/- 5. 50 subjects were females while rest of the subjects were males. The patient complete oral examination was conducted to assess the condition of the oral hygiene and state of the teeth and occlusion. The occlusion was then classified according to Angle's classification. Patients complete medical history was taken to assure any health issues related to the patient that can be one of the reason for the associated malocclusion. Furthermore, any associated habits were inquired from the patient to assess the cause of the type of the occlusion.

The occlusal assessment was performed as well to evaluate the bite of the patient. The anterior teeth bite was assessed with the help of the tongue blade. The classification of the blade included normal, over bite, overjet, open bite, crossbite, edge-to-edge bite, or with crowding or spacing.

After the complete assessment and history taking, the patient were given an informed consent to participate in the study after explaining the study in detail. Out of 70 subjects 64 agreed to be a part of the study.

Technique:

The system used two flexi force resistive sensors(Tekscan, Boston, MA, USA) with a 9.53-mm diameter, 0.2-mm thickness, and measurement range from 0.0 to 4.4 N to measure the applied force in the areas under assessment(22). These sensors are connected to an amplifier circuit, an acquisition board system NI USB 6008 (National Instruments, Austin, TX, USA), and a computer(32). The sample rate are at 70 Hz and data is displayed in a program developed with LabVIEW (National Instruments, Austin, TX, USA), that shows a force-time history graph for each of the two channels(31). One sensor was placed on the labial surface and the other, on the palatal surface.

Results:

The study consist of total 64 subjects enrolled at the orthodontics department. These patients came in the opd for treatment of the malocclusion. Two types of the patient were recruited in this study, class I and class II division 1. Class I is a normal state of occlusion with normal overjet except there is slight malocclusion and crowding in the dentition. However, in class II division 1 the central incisor are proclined; hence, displaying an

increase overjet in the dentition. Literature states that Class II patient often display an increase in lip pressure because of the protrusion of the teeth that exerts stretches them. The study consisted of 53 females and 11 males. Total of 2 groups were formed each consisting of 32 subjects despite the sample size calculated for 28 for each group in order to avoid any loss to follow ups.

male and female * angles classification Crosstabulation

Count

		angles classification		Total
		class I	class II	
male and female	male	9	2	11
	female	24	29	53
Total		33	31	64

Table 1 classification of the male and females as per the angles classification

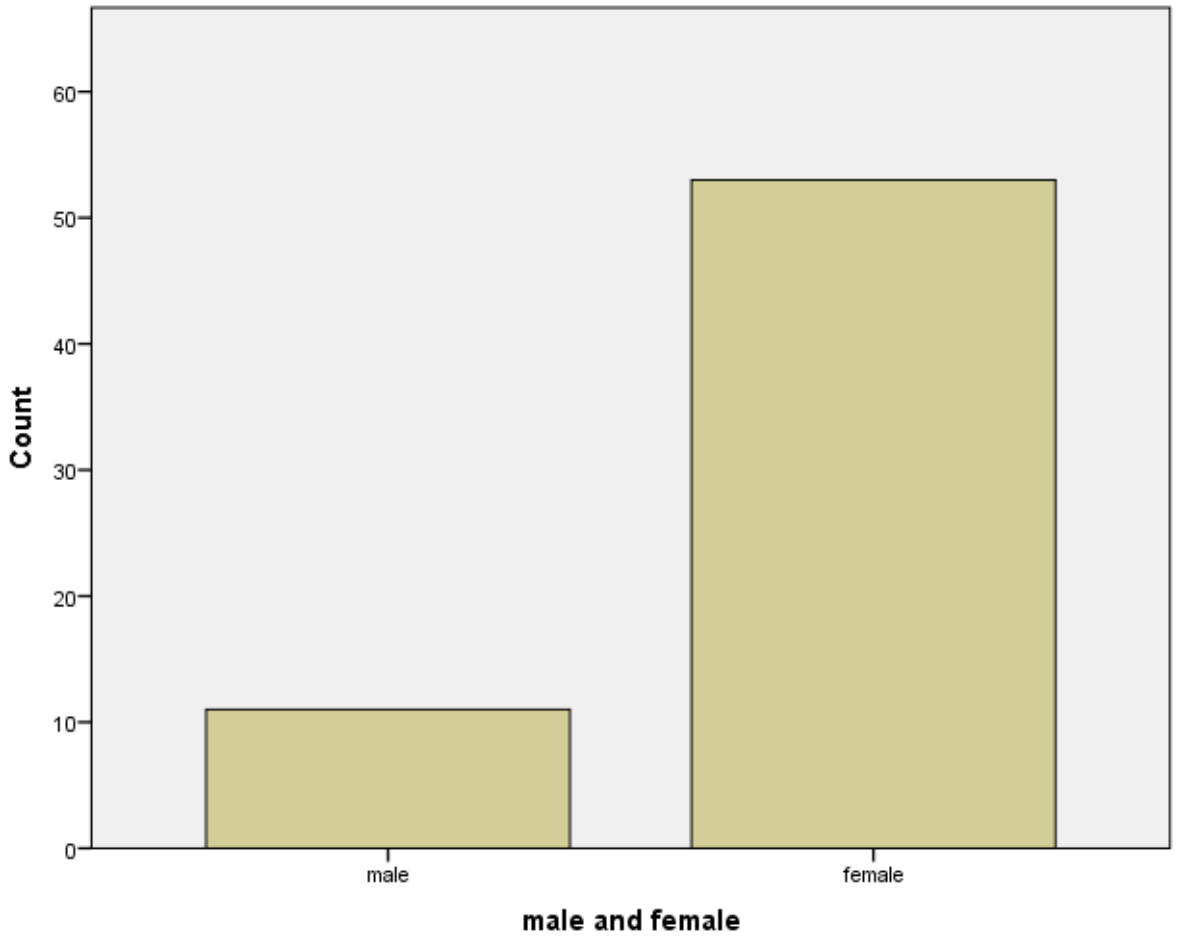

Figure 1 percentage of the gender

As per our study, the result indicated that the patients who had class II malocclusion presented with more pressure on the labial surface in comparison to the lingual side. Both class I and class II had no pressure applied by the tongue in the rest position. Majority of the patients displayed 0 N pressure exerted on the lingual side on the incisors except in few cases of class II where the tongue applied pressure ranging from 0.03N to 0.01 N.

Furthermore, when the results were compared of the first reading to final reading. The paired T test pointed out that there was a significant difference in pressure application of the soft tissue over the labial surface before and after retraction of the teeth. However, the lingual surface did not show any significant difference in the outcome before and after the retraction of the teeth that is the soft tissue pressure before and after retraction of the incisors were comparatively same in the lingual side that is 0 N.

In our study, 8 categories were formed namely: central incisor right labial surface, central incisor right lingual surface, central incisor left labial surface, central incisor left lingual surface, lateral incisor right labial surface, lateral incisor right lingual surface, lateral incisor left labial surface and lateral incisor left lingual surface.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	before retraction reading central incisor labial surface right - after retraction reading central incisor labial surface right	1.703	2.037	.255	1.194	2.212	6.689	63	.000
Pair 2	before retraction reading central incisor lingual surface right - after retraction reading central incisor lingual surface right	-.156	.570	.071	-.299	-.014	-2.195	63	.032
Pair 3	before retraction reading central incisor labial surface left - after retraction reading central incisor labial surface left	2.281	4.756	.594	1.093	3.469	3.837	63	.000

Pair 4	before retraction reading central incisor lingual surface left - after retraction reading central incisor lingual surface left	-.125	1.031	.129	-.383	.133	-.970	63	.336
Pair 5	before retraction reading lateral incisor labial surface right - after retraction reading lateral incisor labial surface right	.984	2.082	.260	.464	1.504	3.783	63	.000
Pair 6	before retraction reading lateral incisor lingual surface right - after retraction reading lateral incisor lingual surface right	-.078	.674	.084	-.246	.090	-.927	63	.357
Pair 7	before retraction reading lateral incisor labial surface left - after retraction reading lateral incisor labial surface left	.938	1.918	.240	.458	1.417	3.910	63	.000
Pair 8	before retraction reading lateral incisor lingual surface left - after retraction reading lateral incisor lingual surface left	-.109	.538	.067	-.244	.025	-1.626	63	.109

The result calculated from the help of paired T test is:

Pair 1 comparison between central right side labial is significant to 0.01.

Pair 2 comparison between the central lingual side right is significant is 0.032

Pair 3 comparison between central labial left sides is significant to 0.01

Pair 4 comparison between central lingual left sides is not significant.

Pair 5 compare between lateral labial right is significant

Pair 6 compare between lateral lingual right is not significant.

Pair 7 compare between lateral labial left is significant

Pair 8 compare between lateral lingual left is not significant.

Evaluating the gender distribution, our study consisted mostly of females than males. According to the history, the prevalence of the orthodontic treatment in girls is higher than males. In our study, majority of the subjects recruited were females in which 29 females were having the class II div 1 had while 24 females had class I malocclusion; however, males although were low in number were still more in the category of class I that is 2 : 9 respectively. Therefore, this clearly points out that firstly females are more prone suffer from class malocclusion II. In present-day society, the white race and females are considered to be aesthetically for presentable when they have a convex profile with with full, protruded lips, slightly

prominent chin and small size nose with dorsum is slightly bending upwards. In men, the contemporary aesthetic ideal represents a straight profile, normally-positioned lips (neither protruded nor retruded), a long, straight nose and prominent chin. Therefore, class II malocclusion profile seems to be more aesthetically appealing in females than men. Hence, class II is a genetic factor that mostly affects the females more. Despite that men's seem to have a strong muscular strength; hence, their biting force is enough to induce jaw growth leading to class 1 malocclusion while female have less biting force; hence, have short jaw growth. This leads to malocclusion class II.

Furthermore, the angles classification was seen for each pair category, the results are as follows:

9 subjects in class I malocclusion the teeth were retracted there was no significant difference seen. 20 subjects having malocclusion class I showed reduction in the force on the labial surface of the central incisor to 0N. This shows when the teeth were retracted, this released the pressure applied over the teeth; hence, the chances of relapse increases because of no lip pressure. Where as in class II div 1 subjects 12 subjects showed no change in pressure difference while rest 14 subjects showed reduction of the force to 0 N. comparing class I to class II, class II subjects showed slightly less lip pressure over the central incisor before the retraction of the incisor; however, the class I malocclusion showed slightly more reduction in force to 0 N that is 29 subjects.

In addition in central right incisor the lingual side did not show any change in 58 subjects in both class malocclusion; however, total 6 subjects 3 from each showed increase force on lingual side. The reason deduced size of the tongue is as per the space it has in the oral cavity, any retraction of the teeth reduces that spaces; hence, adds to the pressure applied when it is pushed toward the tongue(11).

Furthermore, when the effects of soft tissue pressure was measured on the central incisor left labial surface which pointed out that almost similar to the right side 10 subjects did not show any change in force that is 0 N while rest 19 displayed reduction in lip pressure force on the labial surface for class I malocclusion. Similarly, 17 subjects faced reduction in the force to 0 N. overall in both side central incisor rest subjects face reduction but not completely to zero.

Nevertheless, some of the subjects presented with an increase lip activity in both side central incisors mostly in class II malocclusion that is 3 subjects while 1 subject in right side class I malocclusion. While left side showed slightly more subjects increase in labial force that right side that is 2 subjects in class I malocclusion while total 4 subjects in class II malocclusion. Where as in case of lingual side on central right side for both class malocclusion 6 subjects displayed increase in the lingual side force from the tongue. However, 3 subjects showed increase of force in lingual area in the left side in central incisor.

Observing right side lateral incisor, it can be seen that 20 subjects displayed no change in the force that is 0 N while 9 subjects presented with reduction in the force to 0 N and 1 subject to 0.03 N. however, 3 subjects displayed increase in force on labial surface after the retraction in class I malocclusion while 5 subjects displayed increase labial force in class II malocclusion. However, 30 subjects showed no change in the force that is 0 N in lingual side of the lateral incisor while 1 subject presented with decrease in force from 0.01 N to 0 N in class 1 malocclusion. In addition, in class II malocclusion subjects 29 subjects displayed no change in force pressure from the tongue side that is 0 N. however, 4 subjects presented with increase force from the tongue side.

Furthermore, observing the left side of the lateral incisor 19 subjects displayed no change in the labial force that is 0 N while 12 subjects demonstrated a decrease in the labial force from 0.07 N and 0.03 N to 0 N in class I malocclusion. Where as in class II malocclusion 15 subjects demonstrated no change in lip pressure force that is 0 N while 12 subjects displays decrease the lip pressure. However, 3 subjects displayed increase in the labial force by the upper lip in the class II malocclusion and 2 subjects in class malocclusion I.

Furthermore, evaluating the left side of the lateral incisor on the lingual surface it was observed 32 subjects displayed no change in tongue pressure force that is 0 N in class I malocclusion while 29 subjects in class II malocclusion. However, 1 subject in class I malocclusion and 2 subjects in class II malocclusion demonstrated increase in the tongue pressure lingually.

Moreover, when the lip pressure is compared between the incisors, it can be clearly demonstrated from the paired T test that the lip pressure force is noticed over the central incisors than lateral incisor. Majority of the subjects displayed no difference in the lip pressure force in lateral incisors rather than central incisors. This clearly showed that major lip pressure lies over the central incisor rather than lateral incisor. However, when the lingual tongue pressure was assessed between the central and lateral incisors, it can be observed that equal number of subjects faced similar tongue pressure after the retraction of the teeth.

It can be; therefore, claimed that the increase pressure on the central incisor labially is majorly due to the pressure of the frenum attachment which exerts the force on the central incisor while in case of lingual side tongue equally spreads it force over the incisors(8, 33). This often is seen in those patients who have high frenum attachment that creates tension on the tissue while chewing, speaking and smiling(34, 35).

Furthermore, the soft tissue pressure was compared over the anterior teeth between male and female. Although the number of males were less compared to females; however, the results indicated that total 45 subjects had maximum 0.07 N in which 25 subject had 0.03 N compared to 15 subjects who had no lip pressure force over the right central incisor in comparison to males who had 10 subjects with maximum lip pressure 0.03 N, from which 6 of them were having 0 N while others having 0.03 N.

However, the results for the left central incisors were different than the right side. The males subject maximum lip pressure was 0.07 N with 6 subjects having resting lip pressure 0.03 N and 4 subjects with 0 N. however, for females similar results were seen 16 subjects had no lip pressure, 18 subjects showed 0.03 N while others pressure above maximum up to 0.09 N.

Evaluating the lingual side of the right central incisor, females were seen to have more tongue pressure exerted than males up to 0.03 N. total 5 subjects showed increase in pressure with 3 subjects 0.01 N and 2 subjects 0.03N while male's maximum increase in lip pressure is 0.01N that was 1 subject. However, the tongue applied less tongue pressure than the right side.

It can be deduced that the left side incisors tends to protrude out more than right side one; hence, right side had more labial pressure before the retraction while on retraction right side faces more lingual pressure than left lingual side.

Furthermore, similar comparison was made for the lateral incisor. The maximum lip pressure for both male and female was 0.07 N. however, for both 7 male and 30 female that is majority of the subjects had 0 N over the right lateral incisor while only 13 female subjects and 3 male subjects had 0.03N pressure over labial surface before retraction. Similarly, left lateral incisor displayed 9 female subject and 30 female displayed no labial

pressure before retraction while only 13 female subject and 2 male subject had 0.03 N. the maximum pressure measured here seen in female was 0.07 N while in male 0.03 N. however, few subjects showed increase in labial pressure after retraction of the teeth. This mainly is due to the lip pressure the lateral incisor felt after the teeth were aligned and lip covered all the anterior teeth equally.

For the lingual right side of the lateral incisor 2 female subject and 2 male subject showed increase in the tongue pressure after the retraction from 64 subjects in total. Majority had no pressure applied from lingual side before and after retraction, this indicated the tongue mostly applies pressure over the central incisor. Similar results were seen in left side lateral incisor as well.

Following the paired test an independent t test was performed to compare the effect on each tooth of the soft tissue in terms of different angles classification. The results of the independent test indicated no significant difference in the soft tissue pressure before and after the retraction of the incisor. Authors suggested that different class malocclusion is responsible for the changes in the musculature. Hence, soft tissue evaluation is important factor to determine the cause for the malocclusion. However, our study was not successful in displaying that there is a significant difference between the soft tissue pressures of different angles classes.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
before retraction reading central incisor labial surface right	Equal variances assumed	.888	.350	1.178	62	.243	.561	.476	-.391	1.513
	Equal variances not assumed			1.175	60.737	.245	.561	.478	-.394	1.516
before retraction reading central incisor labial surface left	Equal variances assumed	2.881	.095	1.930	62	.058	1.112	.576	-.040	2.264
	Equal variances not assumed			1.956	54.812	.056	1.112	.569	-.027	2.252

before retraction reading central incisor lingual surface left	Equal variances assumed	4.000	.050	.969	62	.336	.091	.094	-.097	.278
	Equal variances not assumed			1.000	32.000	.325	.091	.091	-.094	.276
before retraction reading lateral incisor labial surface right	Equal variances assumed	1.121	.294	-1.575	62	.120	-.808	.513	-1.835	.218
	Equal variances not assumed			-1.569	59.972	.122	-.808	.515	-1.839	.222
before retraction reading lateral incisor lingual surface right	Equal variances assumed	4.000	.050	.969	62	.336	.091	.094	-.097	.278
	Equal variances not assumed			1.000	32.000	.325	.091	.091	-.094	.276
	Equal variances assumed	4.967	.029	-1.129	62	.263	-.510	.452	-1.413	.393

before retraction reading lateral incisor labial surface left	Equal variances not assumed			-1.113	48.745	.271	-.510	.459	-1.432	.411
after retraction reading central incisor labial surface right	Equal variances assumed	.131	.719	-.230	62	.818	-.052	.225	-.501	.397
	Equal variances not assumed			-.230	61.407	.819	-.052	.225	-.502	.398
after retraction reading central incisor lingual surface right	Equal variances assumed	.016	.899	-.068	62	.946	-.010	.144	-.297	.277
	Equal variances not assumed			-.068	61.464	.946	-.010	.144	-.297	.278
after retraction reading central incisor labial surface left	Equal variances assumed	1.409	.240	.530	62	.598	.162	.306	-.450	.775
	Equal variances not assumed			.537	54.027	.593	.162	.302	-.443	.768

after retraction reading central incisor lingual surface left	Equal variances assumed	1.923	.170	-.699	62	.487	-.167	.239	-.645	.311
	Equal variances not assumed			-.684	39.441	.498	-.167	.245	-.662	.327
after retraction reading lateral incisor labial surface right	Equal variances assumed	9.439	.003	-1.677	62	.099	-.403	.240	-.883	.077
	Equal variances not assumed			-1.656	51.400	.104	-.403	.243	-.891	.085
after retraction reading lateral incisor lingual surface right	Equal variances assumed	.012	.913	-.056	62	.955	-.008	.138	-.285	.269
	Equal variances not assumed			-.056	61.456	.955	-.008	.139	-.285	.269
	Equal variances assumed	4.856	.031	-1.083	62	.283	-.201	.186	-.573	.170

after retraction reading lateral incisor labial surface left	Equal variances not assumed			-1.067	48.523	.291	-.201	.189	-.581	.178
after retraction reading lateral incisor lingual surface left	Equal variances assumed	6.691	.012	-1.218	62	.228	-.163	.134	-.431	.105
	Equal variances not assumed			-1.184	33.040	.245	-.163	.138	-.444	.117

One of the limitation of the study is that equal amount of gender distribution is not able to be achieved. Therefore, this study may lead to biasness in the study and overestimation or underestimation of the study's outcome. It is known that soft tissue affect the skeletal changes as well as dental changes. Our study only measured the dental changes that affected the soft tissue pressure. As per the studies, the changes of the upper lip pressure are temporary unless the soft tissue relapse and incisor protrusion are kept in mind as a part of the treatment.

Another limitation of the study was it did not examine the soft tissue pressure during any swallowing movements in order to check any applied intermittent force over the teeth by the tongue and lip pressure. Further investigation is required to fill the gap in the literature.

Discussion:

Perioral structure is an important part of the body that has a major impact on the occlusion of the patient(36). The position of the teeth in the oral cavity are majorly influenced by the soft tissue. These soft tissues includes the cheeks, tongue and lips in addition to the muscle and other perioral structure acting upon the positioning of the teeth(5). The selected patients were evaluated for further inquiry regarding any abnormal habits such as thumb sucking and mouth breathing because the state of the occlusion of the patient is not only affected by genetics but environmental factor play an important role is influencing them(37).

Following the balance theory, that states the position of the teeth are in equilibrium under two opposing force that negate each other, tongue pressure from inside and cheek and lip pressure from outside(38). Although the force applied by the soft tissue is minimal; however, the movement of the teeth is possible if the forces from any sides is unbalanced over a certain period. Authors claimed that the force of the muscle are directly related to the morphology of the muscle(39). Any change in the morphology of the muscle affects the current state of occlusion. Hence, classifying the state of occlusion according to the Angles classification is necessary. Moreover, detail assessment of the soft tissue is important to analyze the reason for type of the malocclusion. For planning the treatment the associated etiology is necessary to identify in order to avoid the relapse of the treatment. Our study aims is to evaluate effect of soft tissue pressure before and after the retraction of the incisors in order to understand the role it plays in maintaining the new position of the teeth in the occlusion.

Upper lip pressures are related to incisor inclinations, overjet and skeletal morphology these pressure are influenced by numerous factors at a single time. With age, the effect of genetics and environmental factors brings about change in the skeletal morphology(40). The changes in the skeletal structure along with the influence of the environmental factor define the final position of the incisors(40). At the beginning of the unstable position of the teeth, the soft tissue displays variation; however, with time they get adjusted and maintain a constant soft tissue pressure to keep the teeth in equilibrium. Our study focused on measuring the resting pressure; however, many studies pointed out that Swallowing pressures are much higher than the resting pressures. While performing these actions, it exerts minute force these intermittent forces. These intermittent forces play a major role in the positioning of the teeth while they are in the state of movement. Therefore, after the treatment end such as retraction of the teeth, the soft tissue pressure should be kept in mind and thoroughly evaluated in order to avoid any relapse of the treatment. Hence, retention during the phase of soft tissue is necessary until they adjust to the new position and exert equilibrium force. Our study only demonstrated successfully the change in the labial pressure while the lingual pressure did not show any significant change. Hence, proving that retention is necessary because the reduction of the labial force will allow easy relapse of the retracted teeth to their original position. In order to maintain the new position at times permanent retention is applied so that relapse is not evident and the lip can take its time to adjust.

In cases of orthodontic treatment, the mechanical stimuli are responsible for creating movements like retraction and as the teeth move there is continuous remodeling of the bone and periodontal ligaments that is responsible for retention of the tooth in its current position. Nimeri et al stated that after the teeth are moved by the means of mechanical pressure, if the bone is deficient in the apical area the teeth would relapse under the soft tissue pressure(41). During this process, the osteoclastic activity is high that continuously makes space for the movement for the tooth. With age

it is observed that the amount of osteoclast decreases. Therefore, young people have sensitive and active bone responses while in adults the bone formation and resorption is slow process(42). Hence, the treatment is quick in the young people; therefore, chances of relapse under the soft tissue pressure is more easier rather than an adult(42).

Our study was able to achieve a significant result stating that the p value was significant in proving our hypothesis correct and valid. The value of p was less than 0.05 for the labial lip pressure changes before and after the retraction of the incisors; hence, it is important to keep in mind the significance of the lip pressure during the treatment because most of the subjects showed reduction in the pressure which means there is a chance of relapse because of lack of opposing force to keep the teeth in their position. The reason being because the teeth were in movement; hence, requires an opposite force to avoid the relapse to its previous position. In addition, to maintain the dynamics of the tooth retention is necessary until the lips adjust to the new position. However, the lingual side showed no significance except in the central right side that might be due to some extreme values presence that needed to be adjusted. This signifies that the tongue pressure only plays an important role while performing any activity such as chewing, swallowing and tongue thrusting. Hence, the tongue pressure needs to be evaluated through a different method to determine its effect on the teeth positioning.

Many authors measured the soft tissue pressure through measuring the thickness of the muscle through electromyographic measurement(39, 43). This is a reliable method for assessing the soft tissues pressure and force on the teeth because literature points out that the lip exerts pressure like fluid(44). Therefore, detection of the sensitive pressure instead of force with the help machines is beneficial because it is precise and accurate method. Other studies used a device IOPI in investigating the pressure of soft tissue during swallowing and resting; as this device is responsible

for measuring the soft tissue pressure with accuracy and displays no risk of contamination and lab process(45). However, unlike this study our focus is on measuring the pressure applied by the soft tissue on the maxillary incisor in the rest position and with ease in availability and to use, we selected to use the flexi sensor device in our study.

In previous studies, it was stated that the perioral structure pressure has direct relation with the posture of the head that is it depends upon the positioning of the head(46). Any head extension other than natural head position increases the soft pressure. Hence, our study focused to eliminate confounding variables and kept the natural head position as a baseline in order keep the pressure constant for each patient(46). However, partal Irmak, and Muge Aksua presented a consensus related to the types of malocclusion and perioral pressure has not been achieved yet (47). Nevertheless, one of the authors presented that the perioral pressure on the maxillary incisor is higher in class II malocclusion than class I malocclusion(30). However, another study opposed this study's result and displayed that maximum lip pressure was lowest in the class II/I study occlusion(48). Nevertheless, our study followed the literature of the same studies to assess the maximum lip pressure and tongue pressure but in the resting position only before and after the retraction of the upper incisors. The study however, failed to provide a significant difference in the between the class I and class II malocclusion.

One of the authors declared the result of his study stating that the upper lip pressure on the upper incisors is lowest in class II/2 malocclusion while the highest in the malocclusion class II/ 1(49). However, lower lip did not show a significant difference in both the malocclusions. A similar study was conducted upon children and adults. The outcome did not show a significant difference. Many studies displayed change in the lower lip pressure as they stated that the lower lip pressure is responsible for the upper incisor in class II div 2 position(50). They believed that the lower lip

plays an equal role in affecting the position of the upper incisors. Therefore, they demonstrated the difference of the applied pressure through measuring the lower lip pressure and vertical lip pressure(14, 30). However, our study only measured the changes of upper lip pressure and tongue pressure to evaluate the independent effect of the upper lip pressure on the incisors to determine the long term effects on the retraction.

Furthermore, when the tongue pressure was assessed in the similar patients it was noted that the tongue pressure did not display significant difference. In our study, it was clearly observed that there was no change in the pressure applied on the lingual side during the resting position before and after the retraction of the anterior teeth. This indicates that there is a significant resting space between the tongue and the anterior teeth. However, some subjects displayed increase in the tongue pressure because of the lack of resting space between tongue and the incisors; hence, caused resting tongue pressure placed on the lingual side which could be the reason for causing relapse of the teeth current teeth position. In this type of cases long term retention are suggested until the tongue adjust with time.

Some studies pointed out that the tongue pressures are always greater than the labial pressure in the upper region in all the classification(51). While other studies presented with the tongue pressure in the lower jaw to be highest than upper especially in class 1 malocclusion while lowest in the class 2 malocclusion(14, 51). The literature suggested that generally tongue pressures in the mandible in all classifications except Class I was lowest than the resting tongue pressures in the maxillary region. However, our study displayed no such results and presented with no significant change in the pressure before and after the retraction in upper jaw region except in the central incisors. This variation of the outcome for the upper right central is expected due to deviating value. Nevertheless, these results further needs to be adjusted.

Furthermore, the authors related the power of the lips to be responsible for the pressure exerted that is affect by age(52). The studies conducted stated that as the age increases the power of the force by the perioral increases(47, 52). In our study, the upper lip pressure was observed to decrease in the retention period of the subjects in both groups in half of the subjects while some of them equally showed no change in pressure that is 0 N before and after the retraction. Observing the lip pressure force to be zero newton gives a clear indication that when the lips are at the rest position it doesn't exert any force; however, it was observed that class I malocclusion showed slightly more increase in force in subjects than class II malocclusion. The reason deduced is that in class II malocclusion division 1 the lips are in stretched position; hence, when the teeth are retracted the lips are now in state of relax mode rather than the class I malocclusion.

Supporting this another study presented that increasing age directly affects the pressure that is the reason given by the author was that with time the orbicularis oris matures and the strength of the muscle increases(14). In addition, another study children with large overjet presented with high upper lip pressure. This might be evident in our study as well but in comparison to the class I malocclusion it was observed to be less. However, our study did not encompass of children rather than it was examining the soft tissue pressure in the teenagers to adults. It can be deduced that the malocclusion class II when the teeth are proclined the lip are pushed away causing the more visible of the teeth causing the lip incompetency. With time these lips gets adjusted to the state of the position; hence, more lips were seen to exert 0 N force in class II than class I malocclusion. These class I malocclusion lip pressure exertion are a sign that they prevented the anterior teeth from proclining; thus, lead to the crowding of the teeth. Another possible explanation can be abnormal habitual activities involvement that lead to active lip pressure over the anterior teeth in both the class malocclusion like thumb suckling or continuous chewing.

The designated malocclusion affects the morphology and the strength of the tongue and lips which in turn affects pressure on the teeth(52). It was observed that with increase in age the lip strength increase because in children it was seen the biting force are low and the lip pressure increases; hence, children tend to have malocclusion class II and large overjet(40). Therefore, the children have maxillary prognathism. If the environmental factor and genetic factor are present there than they act as an opponent to the developing biting force; hence, resulting in final occlusion. However, our study doesn't include children and focuses on the age group from 15 years to 35 years. It is seen that in many cases that the average age for the low prevalence and relapse is 17 years old whereas there is a possibility of relapse if the growth spurt is still present. Aiding growth spurt is the change in the soft tissue pressure and muscle activity. Therefore, watchful eye is required over these factors.

Saccucci, et al stated in his the study, lip pressure and lip strength do not have any association with each other. The reason understood was that due to the intra individual variation the two variables were independent of each other(53). The electromyographic displayed no significant difference between muscle activity during the rest position and chewing(53). Nevertheless, our first expression is that there is a clear correlation between the lip strength and the angles classification. Hence, it is seen that the pressure in the maxillary prognathism is more than in class I malocculsion.

However, our study presented that subjects of both class malocclusion had no significant difference in the change in the soft tissue pressure. This did not comply with the study that pointed out that the outcome of the study showed a significant correlation of class II malocculsion divison 2 and resting lip pressure(28, 54). Nevertheless, this is not necessary, it can be assumed as a possibility because at various points' lower lip was identified as a determinant for the retroclining of the upper incisors(25).

As per authors the lip resting pressure adjust with the position of the teeth with time. The pressure that is idenitifed above the incisors is due to the drapping of the soft tissue against the dentition. However, electromyographic reading in another study indicated that there is no relation of the amount of retraction of incisor in subjects and the upper lip activity.

Many research studies demonstrated that a significant percentage of relapse after orthodontic treatment was noted in the subjects that might be related to orofacial muscle imbalance and deviated swallowing. Ko, et al observed that a dental relapse is evident due to skeletal relapse which is seen only in cases in which normal perioral function, including normal lip closure and absence of tongue thrust swallowing has not been established after orthodontic treatment(55). Gurel, et al reported that in patients with excellent retention of maxillary expansion, the tongue may spontaneously position itself closer to the palatal roof, thus counteracting buccal pressure(56).

Many studies were successful in pointing out that tongue thrust plays an important role in causing the protusion of the teeth. Therefore, the excessive pressure from the internal side resulted in proclination of upper teeth; hence, lip pressure was more in class II div 1. The increase in the overjet; moreover, the authors supported that there is a profound connection between tongue and dental morphology. The dental changes in tongue thruster patient was seen to be due to increase activity of the genioglossus muscle and prolong duration of swallowing. Many study pointed out that the effect of the tongue thrust on the dental aspect depends upon several factors that includes frequency of the swallowing, severity of the force exerted on tooth the counteraction of these factors by other muscular structures such as the lips, the resistance of dentoalveolar structures to displacement, and finally the resting posture of the tongue when no swallowing is occurring(4, 11). The average swallowing time denoted for an average person is 2 seconds. The average time span identified for the swallowing is 1.7 to 3.4 seconds(3, 20). Another study supported similar

reading that denoted the duration of swallowing ranging from 1.1 to 2.9 seconds(47). Even though the tongue forces are low but if the duration of the swallowing is greater than it may cause movement of the tooth on long term basis. It is important for orthodontists to understand the effect of tongue function while correcting malocclusion and maintaining stability after treatment. Furthermore, it has been evaluated that tongue thrust action is applied during the treatment also especially when extra spaces are formed for retraction or when the tongue space is reduced(3, 4). Therefore it can be deduced that before planning any such treatment the habitual tongue thrusting condition should be resolved, this offer better long term stability and retention of the current position of the tooth after the treatment. For such patient initially myofunctional therapy is required in order to avoid relapse of the treatment along with the crib therapy(11). However, some of the authors did not support this. Nevertheless, we made sure that none of our subjects were involved in any habitual activity currently and were warned regarding any such activity so that the treatment remains successful. However, tongue thrusting and other such activity cannot be easily noted while the subjects are in rest position.

Furthermore, the soft tissue pressure measured was compared between the males and females. Although our number of males in the study is low comparatively to females because it has been observed that females are more aesthetically caution in comparison to the males. In the study, the soft tissue pressure in lateral incisor seems to increase after the retraction of the incisor mostly in females rather than in males. The reason deduced can be that during the crowding the tissue was not applying any force; however, after they were aligned there was equal forces spreading over the anterior(47, 57). Apart from this, the result showed more resting pressure labially before on the left side than right which signifies that mostly left side applies lip strength is more than the right side; hence, they bear more lip resting pressure (24, 58, 59). However, on retraction no significant difference was seen in the lingual pressure. In few subjects there was slight increase in the tongue pressure. This usually arises due to the size,

shape and position of the tongue in the cavity(20). However, true tongue pressure can be assessed through the process of swallowing. This gives a clear idea of the tongue pressure applied on the teeth as swallowing applies small intermittent forces throughout the day.

A study indicated that the upper incisors faced more exposure to the resting lip pressure in CII division 2 malocclusion compared to Class I occlusion(4). However, in a similar another study, it presented that maximum lip pressure was the lowest in individuals with CII division 2 malocclusion(52). Nevertheless, in both studies, the individuals were older and also the methodology of these studies was different from our study. Our study focused on teenagers and young adult displaying no significant difference in the two classes. This was further supported by a similar study that pointed out that both young and adult individuals, ULP change between Class I and Class II malocclusions did not show significant difference. In addition another study further stated that the tongue pressure also did not show any significant difference in the any of the malocclusion classes(47). Moreover, a study displayed that the difference decreased when the lower buccal pressure decreased after the protrusion which lead to no significant difference(2).

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Kim testified that the lip pressure against upper incisors in the rest position has a direct relation with overjet, higher in subjects with increased overjet than in those with normal overjet(40). These observations relates to our findings as well, indicating the adaptive character of lip pressure. Therefore, it can be concluded that the resting lip pressure is a result of the position of the incisors and pressure symbolises the passive drape of the soft tissue against the dentition and facial/skeletal morphology.

Therefore, it can be deduced that the lip and tongue pressure are not the one only determinants that affects the retention of the tooth position after the retraction, other factors are equally responsible to act upon it.

Conclusion

In conclusion our study alternate hypothesis was successfully proven that soft tissue pressure changes are evident while the anteriors are retracted. Many authors claimed that these soft tissue pressures are responsible for the applying the pressure during the retention phase that can cause the relapse of the corrected occlusion because during the movement of the teeth to their desired position cause a change in the soft tissue pressure. These soft tissue require time to adjust according to the new position of the teeth.

As per our study the retraction of the teeth in two types of angle classfictin, class I and class II div 1 displayed significant change in the lip pressure after the retraction of the teeth while the pressure from the tongue side was not significant except in the upper right central. These pressure recorded were at the rest position. As per other studies the tongue pressure was recorded when there was some functional movements performed such as the swallowing. These intermittent pressure as per the authors also play an important role in the relapse of the treatment of the movement of the treatment.

Majority of the teeth showed 0 N force indicating that no force from either side was responsible for maintaining the teeth in a neutral zone that is a balance zone in which teeth are at equilibrium under an equal and constant force from both the sides.

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