

Original Research Article

Ultrasonographic Study of Masseter and Orbicularis Oris Muscles after Cessation of Thumb Sucking Habit – A Pilot Study

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Abstract: The objective of the study was to evaluate post treatment changes in functional status of masseter & orbicularis oris muscles using ultrasonography in a group of patients with digit sucking habit. Ten patients with digit sucking habit who required habit breaking appliance therapy were selected. Using M-Mode ultrasonography with a 5-12 MHz high frequency linear probe, pre-treatment fractional shortening (FS) values for the masseter (left & right) & orbicularis oris(upper & lower) muscles were calculated following which fixed anti-digit sucking appliances were cemented. At the end of 6 months 6 out of 10 patients had stopped the habit completely. Post treatment fractional shortening (FS) values for the muscles were recorded for all the six patients. Paired ‘t’ test was used for statistical comparison. Fractional shortening value of orbicularis oris- upper showed a mean decrease and those of masseter left, masseter right and orbicularis oris- lower lip showed a mean increase in the post treatment period which were not statistically significant at $P < 0.05$. From the result it was concluded that, M-Mode ultrasonography will be very useful in analyzing changes in functional status of circumolar & masticatory muscles in children having aberrant oral habits so that one can carefully time the orthodontic treatment so as to avoid unnecessary relapse due to muscle malfunctioning.

Keywords: Masseter muscle, Ultrasonography, Finger sucking habits, Orthodontic appliance

INTRODUCTION

Abnormal oral habits result in unbalanced functional forces which in turn affect normal dentofacial growth & development. This is in accordance with Functional matrix theory. Much of this damage occurs during the transition period from primary to permanent dentition. Elimination of aberrant pressure habits is important because they can nullify the orthodontic treatment plan and cause orthodontic relapse [1]. Intensive activity of the circumolar and masticatory musculature in these children results in hypertrophy of these muscles which can perpetuate the malocclusion. Hence it becomes essential to study the magnitude of changes that occur in these muscles. Many studies have been conducted to study the circumolar & masticatory muscle activity in various malocclusions and oral dysfunctions using

EMG. Ahlgren studied lip and cheek activity in sucking habits using EMG. Both thumb and dummy sucking produced profound lip and mentalis activity & moderate buccinator activity. At rest pronounced perioral muscle activity was observed among thumb and dummy suckers whereas the control group of children who was not thumb suckers showed less lip and cheek activity, both at rest and during sucking [2]. Baril and Moyers, in their electromyographic observation of temporalis, orbicularis oris and mentalis muscles in thumb/digit suckers found that the dominant muscle was either the orbicularis oris or the mentalis [3]. Lindner and Helsing, found the circumolar muscles to be significantly active during sucking behavior [4].

Considering the many disadvantages of electromyography, ultrasound came to be used to

study muscles. M- Mode ultrasonography in cardiac mode helps assess functional status of the muscle studied. Fractional shortening is the important contributing factor for contractility of a muscle. Assessing Fractional shortening in follow up studies in patients with muscular hypertrophy, hypoplasia & atrophy would help evaluate recovery of muscle function [5].

Agnihotri *et al.*; compared the function of masticatory and circumoral musculature in patients with and without thumb-sucking habit by using M-mode ultrasonography. On comparing the standardized fractional shortening values, a difference in fractional shortening was observed for all muscles studied; however the difference was statistically significant only for the masseter midbelly and lateral pterygoid muscles during protrusive and retrusive movements [6]. Hence the present study was done to assess changes in functional status of masseter, orbicularis oris muscles following habit breaking appliance therapy in a group of children with thumb/digit sucking habit.

MATERIALS AND METHODS

The study sample consisted of 10 children with thumb/digit sucking habits that required reminder therapy for habit breaking (5 females, 5 males, age 8-13 years, mean 10.3years). History revealed the failures in the attempts at psychological management of the sucking habit. The children had well established abnormal perioral muscle activity and proclined upper anterior teeth and/or anterior open bite dental changes. It was ensured that the patients were not on any kind of orthodontic appliance therapy. The study was approved by the institutional ethical committee. Written consent was obtained from the parent of each participant.

The masseter and orbicularis oris muscles were imaged using M-Mode ultrasonography with a 5-12 MHz high frequency linear probe (Philips ATL 5000). The M- mode curve for the right and left masseter muscles at the midbelly region was recorded while the patient clenched and relaxed the teeth alternately. The thickness of the muscle in the contracted and relaxed state was then measured in millimetres. The M-mode curve for the orbicularis muscle was obtained by

placing the probe in the upper and lower lips at the midline while the patient closed and opened the “V” of a V-shaped acetate paper slip (1.5 X 0.5 cm). The lower lip was imaged about 0.5 cm down from the vermillion border in the midline in order to include the mentalis muscle also. The thickness of the muscle in contracted and relaxed state was then measured in millimetres. The difference in thickness of muscles in contracted and relaxed states gave the amplitude of contraction. The value of fractional shortening (F.S) was obtained by the following formula.

$$FS = \frac{\text{Amplitude Contraction}}{\text{Thickness of Contacted Muscle}} \times 100$$

Fixed anti-thumb sucking appliances (palatal arch) were then cemented. Regular follow up appointments were scheduled to ensure patient compliance. At the end of the 6 months’ six out of ten thumb/digit suckers (3 females and 3 males) stopped the habit completely. The remaining 4 patients (2 females and 2 males) were found to continue the habit. The six patients who had stopped the habit were subjected to ultrasonography to record post treatment values. In all the six patients there were notable dental changes in terms of increase in overbite.

STATISTICAL ANALYSIS

The data were represented as Mean, Mean Standard Error and Standard Deviation. The data was analyzed by paired ‘t’ test and P value<0.05 was considered as significance.

RESULTS

Table 1 shows the mean and standard deviation of pre-treatment & post treatment fractional shortening values. A difference in pre-treatment and post treatment fractional shortening values for all the muscles is evident. Table 2 shows statistical analysis of pre & post treatment fractional shortening values using Paired ‘t’ test. There was a mean increase in post treatment FS value for masseter left, masseter right and orbicularis oris lower lip which were not statistically significant. There was a reduction in fractional shortening of orbicularis oris- upper in the post treatment period which was not statistically significant at P< 0.05.

Table 1: Descriptive Statistics for Fractional Shortening at T₁ (Pre Treatment) & T₂ (Post Treatment)

MUSCLE	FRACTIONAL SHORTENING AT T ₁			FRACTIONAL SHORTENING AT T ₂			
	Mean	Mean Std. Error	Std. Deviation	Mean	Mean Std. Error	Std. Deviation	Std. Deviation
MASSETER LEFT	37.73	3.10	7.60	42.07	4.34	10.62	
MASSETER RIGHT	36.04	6.49	15.90	38.88	4.82	11.81	
ORBICULARIS ORIS UPPER	25.39	6.04	14.78	15.55	6.26S	15.33	
ORBICULARIS ORIS LOWER	20.24	6.44	15.78	20.80	6.47	15.84	

Table 2: Differences in Fractional Shortening values from T₁ (Pre Treatment) to T₂ (Post Treatment)

MUSCLE	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		't' Value	df	P value (2-tailed)
				Lower	Upper			
MASSETER LEFT	-4.34	7.99	3.26	-12.73	4.05	-1.33	5	0.24
MASSETER RIGHT	-2.84	18.90	7.72	-22.68	17.00	-0.37	5	0.73
ORBICULARIS ORIS UPPER	9.84	18.25	7.45	-9.32	28.99	1.32	5	0.24
ORBICULARIS ORIS LOWER	-0.56	25.42	10.38	-27.24	26.12	-0.05	5	0.96

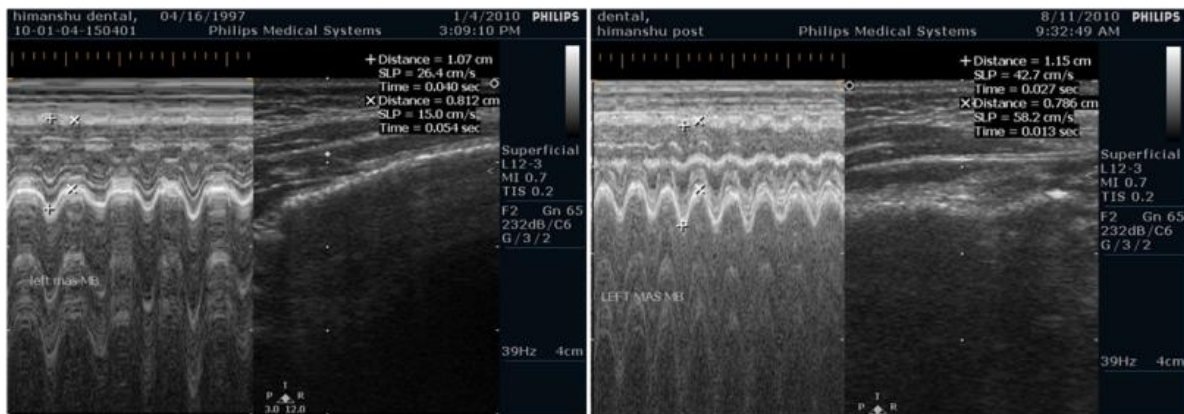


Fig 1: Pre & Post treatment M-Mode Curves for Masseter -left

Pre Treatment amplitude is 2.58 mm; Post Treatment amplitude is 3.64 mm
 Pre Treatment Fractional shortening is 24.11%; Post Treatment Fractional shortening is 31.65 %

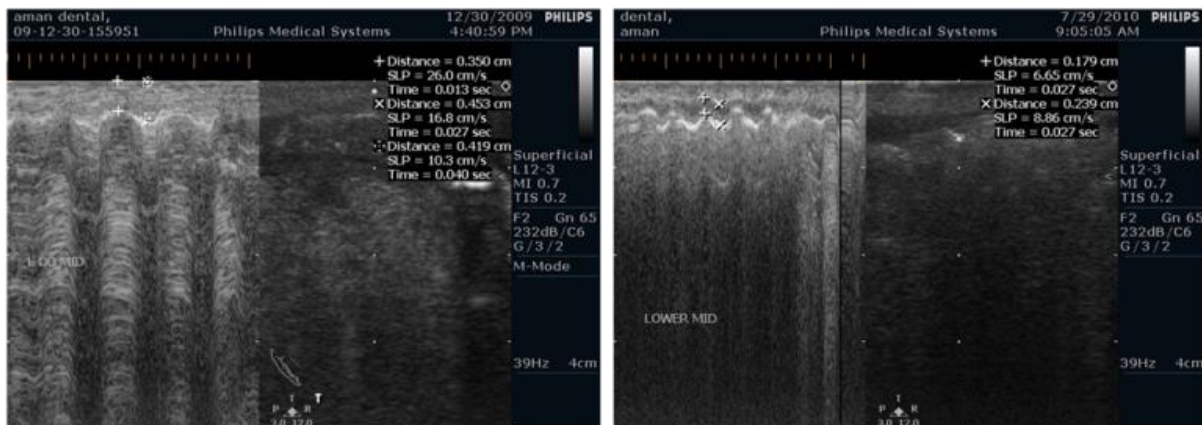


Fig 2: Pre & Post treatment M-Mode curves for Orbicularis Oris - Lower

Pre Treatment amplitude – 0.69 mm; Post Treatment amplitude- 0.6 mm
 Pre Treatment fractional shortening – 16.47 %; Post Treatment Fractional Shortening – 25.1 %

DISCUSSION

Digit sucking results in deformation of the occlusion and the permanence of this deformation increases markedly if the habit continues beyond three and a half years of age. Perioral musculature is an important assist in this process by way of compensatory activity on the disturbed occlusion thus accentuating the deformity [7]. This oral dysfunction results in hyper or hypo activity of the musculature involved [8]. Among the methods used to study muscles, M- mode ultrasonography in

cardiac mode was found to provide information on the functional status of the muscle studied. It was used to assess the effect of drug therapy on left ventricular function in hypertensive patients with ventricular hypertrophy. An improvement in cardiac function was noted by an increase in fractional shortening which indicates a reduction in hypertrophy [9]. Also ultrasonography is a more rapid, easily accessible, repeatable, and cheap and radiation free imaging modality. Rajaram *et al.*; in their observation on the M

mode echomyography of the right masseter midbelly of an acromegaly patient found that the hypertrophied muscle in acromegaly patient was able to obtain optimum contractility for masticatory function with lesser fractional shortening compared to a smaller muscle which had to contract more vigorously i.e. it had to undergo more fractional shortening to obtain equal amplitude [5]. The possible effects of digit sucking on orofacial musculature are; an abnormal hyperactivity of lower lip orbicularis-mentalis complex and a hypotonic functionless, short upper lip [7]. Baril and Moyers observed in a group of thumb or digit suckers, that the dominant muscle was either the orbicularis oris or the mentalis [3]. It is stated that muscles which are under repeated stress develop hypertrophy & they undergo lesser amount of shortening (less effort) to obtain certain amplitude of contraction [6].

Habit breaking appliances work at establishing muscular balance by discouraging the practice of the oral habit. In this study, fixed palatal arch appliances were used to control the habit. At the end of the observation period of 6 months, only six out of the ten children had stopped the habit completely and treatment effects were analyzed only in those six patients. Considering the age (mean age 10.3yrs) of the digit suckers and the psychological effects of using a palatal crib, it was decided to give a palatal arch as a reminder appliance for these children. This appliance though effective as a reminder, is not sufficiently efficient in breaking the suction effect during thumb sucking and the patient can still obtain pleasure during sucking. This could be the reason why four of our patients were not able to stop the habit at the end of the six months observation. The analyses showed an increase in post treatment fractional shortening values of masseter (left & right) and orbicularis oris (lower) muscles. However the changes were not statistically significant. Strikingly, there was a reduction in fractional shortening of orbicularis oris- upper in the post treatment period which was not statistically significant.

These findings confirm the fact that the hypertrophied masseter left, masseter right and orbicularis oris lower muscles did return to normal status, as indicated by the increase in their FS values at the post treatment period. Also the once functionless orbicularis oris upper muscle had increased in thickness at the post treatment period, as indicated by the decrease in its FS value. It should be noted that the lower lip was imaged about 0.5 cm down from the vermilion border in the midline in order to include the mentalis muscle also. This muscle adds to the thickness of the lower lip & shows hyperactivity in digit suckers. However there was only a slight increase in the FS of orbicularis oris-lower which means that the lower lip muscle complex remained hypertrophic and hyperactive. One reason for these observations, especially with regards to the lower lip could be due to the fact that the six months period could be too early a

time to see notable changes in thickness of the involved muscles. Secondly, as Baril and Moyers, had stated, the abnormal muscle activity will not disappear simultaneously with the cessation of the thumb habit unless attempts are made to correct the abnormal habitual muscular behavior in the circumoral region [3]. In this study no such attempts were made. They also emphasize the need to reduce contractions of mentalis to prevent its interference with orthodontic treatment. There is a lack of information in the orthodontic literature about the influence of cessation of digit sucking habits on the changes in ultrasonographically measured functional status of masticatory and circumoral muscles, which makes comparison of the results of this study difficult. Our findings in the group of digit suckers, who stopped the habit within the observation period, showed that the muscles were able to return back to normal state within a short span of time. Combining orofacial myofunctional therapy with interceptive orthodontic appliance therapy would create a more conducive environment for 'nature to take its course' in the growth and development. Longitudinal assessments made at regular intervals during this course of normal growth & development will give more valid conclusions. The sample chosen was an actively growing sample & hence a control group would be needed to see if the ultrasonographic changes were due to growth or only habit cessation or both together. The results of this pilot study suggest that the study may be carried forward with a larger sample and an untreated control group and also combine myofunctional exercises along with the appliance therapy to manage the habit.

CONCLUSION

M-Mode ultrasonography will be very useful in analyzing changes in functional status of circumoral & masticatory muscles in children having aberrant oral habits so that one can carefully time the orthodontic treatment so as to avoid unnecessary relapse due to muscle malfunctioning.

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