The Relationship between Sex and Age on Dental Arch Change after Treatment with the Reverse Pull Face Mask Appliance of Class III Malocclusion: a Randomized Clinical Trial

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Abstract

This study aims to evaluate the relationship between sex and age on dental arch change in the reverse-pull face mask appliance on dental study model measurements.

This study is a randomized clinical trial consisted of 48 (21 males, 27 females) Malay children with Class III malocclusion allocated to two groups. A total of 48 children received reverse-pull face mask appliance for a period eight months therapy. The children were again divided into early and late treatment groups. The first treatment group is comprising 23 children treated in the early mixed dentition with a mean age of 8.50 (SD=0.20) years. The second treatment group is comprising 25 children treated in the late mixed dentition with a mean age of 10.54 (SD=0.30) years. The inclusion criteria were reverse overjet and Class III deciduous canine relationship and Class III molar relationship. Upper and lower impressions are taken at the beginning and end of treatment. Multiple regressions used to analyse the data. The significance level set at 0.05.

There is no relationship between age and sex, affecting the dentoskeletal changes after treatment with a reverse pull face mask appliance. Assessment of post-treatment study models showed that both appliances changed the maxillary and mandibular dental arch shape but did not affect the inter-teeth distances.

There are no effects of sex and age on dental arch change measurements after treatment with a reverse pull face mask appliance for the treatment of Class III malocclusion.

Introduction

Class III malocclusion occurred when the lower molar is mesially positioned relative to the upper molar according to Angles classification, which gives adequate categorization for malocclusions in the anteroposterior relationship. On the other hand, the British Orthodontic Society introduced a classification for malocclusions based on the incisal relationship[1].

According to the British Classification (1992), Class III relationship was defined as the lower incisor edges lie anterior to the cingulum plateau of the upper incisors in situations whereby the overjet is reduced or reversed.

The objective of early Class III malocclusion treatment is to create an environment in which a more favorable dentofacial development can occur[2]. More prominently, early treatment can potentially alter the facial profile, leading to a development in the self-esteem of the growing child[3,4,5]. The malocclusion in children can cause psychological[6], functional[7], and aesthetic[8] concerns. Therefore, it is essential to treat these children accordingly. However, the modalities of treatment are varying. Some orthodontists prefer to introduce the treatment using functional appliances at an early age. Early intervention believed will reduce the complexity of fixed orthodontic treatment at the later stage[9,10].

On the other hand, some orthodontists did not practice the early stage of treatment because they argued that the growth of mandible could not be predicted[2]. Several evidences have shown that functional and extra-oral traction appliances treatment effectively cause favorable skeletodental changes[11]. The changes are as

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follows; redirection of mandibular growth backward and downward, forward growth of maxilla, anterior proclination of upper teeth, and posterior proclination of lower teeth. However, in growing children, sex and age are factors that need to consider in the management of malocclusion[12]. Bishara and Ferguson[2] showed that Class III malocclusion males and females grow at different rates for different age groups. Reverse pull face mask appliance is one of the management approaches for orthopedic treatment in Class III malocclusion. The orthopedic face mask has three essential components: face mask, a bonded maxillary splint, and elastic. A face mask is an extraoral tool composed of a forehead pad and a chin pad that are linked by a heavy steel supporting rod. The intra-oral part consists of a banded maxillary acrylic splint with vestibular hooks and heavy elastics. Elastics are attached from the hooks to the hold bar of the facemask in a downward and forward vector, producing orthopedic force levels of approximately 400 g per side. Reverse pull face mask is an accepted appliance in the treatment of Class III malocclusion, which has used in previous studies with different names like protraction face mask[13], reverse headgear[14], maxillary protraction[15] and facemask therapy. These differences in names were due to different manufacturers, but all these appliances have similar mechanisms of action.

Sex dimorphism within mandibular development differs between males and females, and this might affect orthodontic management[16,17,18]. Ochoa and Nanda[16] found that Caucasian female subjects would demonstrate pubertal development two years earlier than the male subjects between the ages of 10 and 14 years, while males had the maximum changes from ages 12 to 16 and still up to age 18 years.

So far, there has not been any randomized clinical trial on Class III malocclusion in Malay to determine the relationship between sex and age on dental arch change in the reverse-pull face mask appliance based on dental study model measurements. Even though the effect of reverse-pull face mask appliance in Malay children is unknown, but studies conducted in different populations have suggested the benefits of reverse-pull face mask appliance in treating Class III malocclusion. Therefore, this study designed to determine the

best time to start treatment with a reverse pull face mask appliance, either at eight years or delayed to 10 years of age, between both males and females of Class III malocclusion.

Materials and methods

Subjects

This study is a randomized clinical trial consisted of 48 Malay children with Class III malocclusion who have selected from 22 primary schools at Kelantan stat, Malaysia allocated to four groups. Ethical approval obtained from the human research committee. All children were treated with Reverse pull face mask appliance at School of Dental Sciences, Universiti Sains Malaysia, Malaysia. The age ranges of between 8 to 9 years old and 10 to 11 years.

A total of 48 children received the reverse-pull face mask appliance (21 males, 27 females). The children again divided into early and late treatment groups. The first treatment group is comprising 23 children treated in the early mixed dentition with a mean age of 8.50 (SD=0.20) years, and the late treatment group comprising 25 children treated in the late mixed dentition with a mean age of 10.54 (SD=0.30) years. The inclusion criteria for sample selection were reverse overjet and Class III deciduous canine relationship and/or Class III molar relationship. Subjects with craniofacial anomalies, previous orthodontic appliance therapy, and history of facial trauma excluded from the study. The study models for all the subjects coded with an identification number so that the operator blinded from identifying the patient group.

Treatment progress

An adjustable reverse-pull face mask (Leone, Italy) fitted with elastics that delivered approximately 400 g of force on each side. The components of orthopedic face mask therapy included a face mask, a banded maxillary acrylic splint with vestibular hooks, and heavy elastics. Full coverage banded acrylic cap splint appliance that covered all the maxillary dentition constructed. The thickness of the acrylic was about 2 to 3 mm of acrylic was constructed on the occlusal and buccal surfaces of the teeth. The acrylic occlusal pads served to control the vertical dimension. Bands fitted to the two permanent maxillary first molars and two deciduous maxillary first molars. Treatment began with the placement of a banded maxillary

acrylic splint to which were attached maxillary vestibular hooks extending anteriorly. These hocks made from a 1.0 mm wire was attached bilaterally to the buccal aspects of the molar bands and extended anteriorly and superior direction to the canine area. The direction of elastic traction was forward and downward from the hooks attached to the crossbar of the face mask so that the elastics did not interfere with the function of the lips. Elastics were attached from the hooks to the support bar of the facemask in a downward and forward vector, producing orthopedic force levels of approximately 400 g per side (as measured by a gauge). Patients instructed to wear the facemask for at least 14 hours per day. Traction was continued for eight months until sufficient clinical movement of the maxilla had achieved to improve the midface esthetics. A Standardized lateral cephalogram taken at the beginning of treatment at the end of active facemask treatment.

The study models labelled with patient's name and registration number. Two dimensional digital images of the dental cast obtained using a flat-bed scanner (EPSON GT-1500) at 300 dpi in 24-bit colour. The images saved in bitmap (bmp) format which is a requirement of MorphoStudio software to import the data into its digitizer program. The images also saved in JPEG format for arch depth arch analyses using VixWin PRO software.

The images of the maxillary and mandibular dental casts processed by the data digitizer, an auxiliary program of the MorphoStudio software. After importing the images into the digitizer program, the images were scaled by marking the superior, inferior, left and right directions for all maxillary and mandibular dental cast images which act as a standardized calibration scale. The calibration scale determined the distances between the vertical and horizontal points which were constant for all images (60 mm horizontal and 60 mm vertical). Seven homologous landmarks of maxillary dental cast and seven homologous landmarks of mandibular dental cast.

Identification of tooth landmarks performed according to Ash and Nelson[19] and Taner et al.[20]was adapted.

Finite element analysis is a method of comparison between forms. Using MorphoStudio v 3.01 software, FEA can be used to determine changes in the shape of configurations based upon triangles. FEA is a method for comparison of a reference form representing the initial configuration of a set of landmarks on an object and a target form representing the final configuration of the same set of landmarks on another object. FEA uses a pseudo colour scale to visualize any change in shape and to determine if these changes are increased or decreased. The colour value of the pseudo colour scale represents the amount of change, where the value ≈ 1 means insignificant difference between both groups, the value <1 indicates decreased in shape and the value >1 indicates increased in shape. VixWin PRO software (Italy) has used to measure arch depth of maxillary and mandibular dental casts

Results

The data were entered and analyzed with Statistical Package for the Social Sciences (SPSS, Chicago, Illinois, USA). Before analyses the data was checked for any errors in data entry. Each variable was checked for maximum and minimum values to ensure that all numbers were correct and within the normal value of each variable. Both categorical and numerical variables checked for any outliers. This was to ensure that the differences due to biological differences and not due to errors in data entry. Multiple regression analysis used to evaluate the relationship between age and sex on the skeletal change and dental arches change after treatment with reverse pull face mask appliance. The level of significance set at 0.05.

The level of significance set at 0.05. To determine errors associated with cephalometric tracings and measurements, lateral cephalometric x-rays randomly selected and measured. After two weeks the same measurements were repeated. The differences between repeated measurements tested using a paired t test. The degree of reproducibility of measurements calculated using intraclass correlation coefficient (ICC).

The results show that there were no significant differences in dental arches change between males and females after treatment with reverse pull face mask appliance and in late and early age groups (Table 1). All measurements which include the inter-canine and inter-molar distances and arch depth did not show any significant difference with age and sex and

whether the treatment done early or late. Assessment of post treatment study models showed that both appliances changed the maxillary and mandibular dental arch shape but do not affect the inter-teeth distances.

Measurement Change (Dependent)	Mean Changes (Post-Pre)	Predictors	Adj.b[a]	95%CI Lower bound	95%CI Upper bound	t-stat.	P value
UICWC (mm)	1.03	UICW (mm)	-0.043	-0.125	0.039	-1.049	0.300
		Sex	-0.111	-0.433	0.220	-0.676	0.502
		Age	-0.042	-0.339	0.255	-0.286	0.776
UIMWC (mm)	0.86	UIMW (mm)	-0.044	-0.118	0.030	-1.191	0.240
		Sex	0.040	-0.400	0.319	-0.225	0.823
		Age	-0.191	-0.124	0.506	1.222	0.228
UADC (mm)	1.28	UAD (mm)	-0.103	-0.208	0.002	-1.972	0.055
		Sex	-0.393	-0.887	0.102	-1.600	0.117
		Age	0.125	-0.353	0.604	0.528	0.600
LICWC (mm)	1.03	LICW (mm)	0.022	-0.064	0.109	0.515	0.609
		Sex	0.068	-0.254	0.390	0.424	0.674
		Age	-0.095	-0.380	0.191	-0.670	0.506
LIMWC (mm)	1.12	LIMW (mm)	0.022	-0.032	0.075	0.816	0.419
		Sex	0.155	-0.147	0.458	1.034	0.307
		Age	-0.057	-0.364	0.249	-0.376	0.709
LADC (mm)	1.31	LAD (mm)	0.006	-0.030	0.042	0.359	0.721
		Sex	-0.043	-0.200	0.133	0.557	0.581
		Age	0.024	-0.133	0.180	0.304	0.763

Table 1. The relationship between age and sex on the dental arches changes after treatment with reverse pull face mask appliance.

[a]Adjusted regression coefficient
n=48
Upper inter-canine width (UICW), Upper inter-molar width (UIMW), Upper arch depth (UAD), Lower inter-canine width (LICW), Lower inter-molar width (LIMW), Lower arch depth (LAD), Upper inter-canine width change (UICWC), Upper inter-molar width change (UIMWC), Upper arch depth change (UADC), Lower inter-canine width change (LICWC), Lower inter-molar width change (LIMWC), Lower arch depth change (LADC)

Discussion

The results of this study based on dental cast measurements. In order to ensure these measurements were reliable, two examinations performed: intra-class correlation coefficient for inter-examiner and intra-examiner reliability. Inter-examiner analysis values indicated an excellent correlation of dental cast measurements. Intra-examiner analysis also showed an excellent correlation between first and second first and second dental cast measurements recorded by the researcher. The reproducibility of the measurements of the dental cast measurements films showed that the intra-class correlation coefficient was very good.

The inclusion and exclusion criteria for the trial helped minimize confounding factors. It has reported that differences in craniofacial features occur according to ethnicity and many studies have conducted on various ethnic groups, but no study has conducted on Malay children. It is also well-known that patients with craniofacial deformities have unusual craniofacial growth patterns or tooth dimensions as compared with the norm. These patients therefore excluded.

The result of the present study showed no relationship between sex and age on maxillary and mandibular dental arches change after treatment with reverse pull face mask appliance. There were no sex differences in the dental arch characteristics in males and females at mixed dentition stage. Arslan et al.[21] had also reported no sexual dimorphism in arch dimension changes during the examination period from mixed dentition to permanent dentition. In the present study, FEA indicated that the upper and lower arches of males and females at eight years when treated with reverse pull face mask appliance demonstrated non-homogenous shape changes. In late mixed dentition groups, the upper and lower arch of 10 years old males and females showed non-homogenous shape changes. The non-homogenous shape changes that occurred in both late and early mixed dentition were due to the comparable growth of both arches at the mixed dentition stage. Sillman[22] also observed that growth of the maxilla and the mandible occurs between 4 to 12 years. This is the first time an investigation on maxillary and mandibular dental arches change during early and late treatment was done in males and females Malay children following treatment with reverse pull face mask appliance in Class III malocclusion.

Conclusions

There are no effects of sex and age on dental arch change measurements after treatment with reverse pull face mask appliance for the treatment of Class III malocclusion.

Acknowledgments

Declaration of Interest

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