A COMPUTER AIDED INVESTIGATION OF THE CEPHALOMETRIC CHANGES RESULTING FROM KLOEHN CERVICAL HEADGEAR

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ABSTRACT

The purpose of this retrospective study was to examine the effects of Kloehn cervical headgear therapy. A group of Class II patients who were successfully treated nonextraction was drawn from the treatment files at the OHSU Graduate Orthodontic Clinic. A group of untreated Class II individuals was drawn from the Oregon Child Development Study. By closely matching the individuals for sex, age, time of observation, and Class II malocclusion it was hoped an increased understanding of the effects of Kloehn headgear could be gained.

Pretreatment and posttreatment cephalometric radiographs were digitized and various measurements were evaluated using Quick Ceph Image.™ The experimental and control groups exhibited very similar skeletal and dental malocclusions at the time of the initial radiograph. Both groups were then observed for equal periods of time. The differences between the groups at posttreatment was assumed to be the result of cervical anchorage combined with full orthodontic therapy.

The results of this investigation indicate that:

1.Kloehn cervical headgear coupled with full orthodontic treatment exerts a profound effect on maxillary protrusion, limiting the forward growth of both the maxilla and the maxillary dentition. This effect tends to improve the Class II skeletal and molar relationship, and the overjet. This does not occur in untreated subjects.

2.The untoward vertical side effects of cervical traction were smaller in this study than previously demonstrated. There was an insignificant tendency for increased growth in all the vertical linear measurements. It is possible that comprehensive orthodontic treatment may have decreased the eruption of the maxillary first molar and the subsequent vertical side effects of cervical traction. It is also possible that the use of a Class II control more accurately evaluates the vertical differences between the treated and untreated subjects.

3.An unfavorable effect on the horizontal position of the mandible and pogonion following cervical headgear treatment was not demonstrated in this study. Perhaps the use of a Class II control more accurately evaluates the possible projection of the mandible.

4.A small but statistically significant increase in mandibular plane was detected in this study. However, one degree of mandibular plane rotation may not be clinically relevant.

5.The use of Kloehn headgear proved effective in correcting the Class II molar relationship for the patients evaluated in this study. However, the experimental patients were selected on the basis of successful treatment. For this group of treated patients, the vertical side effects of cervical traction was small and little change in expected mandibular growth was detected. Both of these previously discussed side effects of cervical traction were probably not clinically significant. These results indicate that cervical traction can be an effective appliance for the correction of Class II malocclusions.

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Introduction

Individuals with an Angle Class II malocclusion comprise a significant percentage of the patients seeking orthodontic therapy. Treatment of both dental and skeletal Class II has consumed a great deal of clinical effort dating back at least as far as Kingsley in the late 1800's.[1] He was amongst the first to utilize extraoral traction in an attempt to correct these anteroposterior malocclusions. Many orthodontists continue to employ extraoral anchorage therapy in an attempt to modify the downward and forward growth of the maxilla and maxillary dentition. One of the most frequently used extraoral traction devices is the cervical headgear to a facebow attached to maxillary molars which was reintroduced to the orthodontic profession by Kloehn in 1953.[2]

Kloehn headgear therapy proved effective for correction of Class II malocclusion and shortly after its introduction, the use of cervical anchorage in orthodontic treatment became widespread. As its clinical utilization increased, researchers began to examine the effects of the Kloehn appliance system on the growth and development of the maxilla and dentoalveolar process. However, investigations of treatment and side effects of force systems have proven difficult in this and other areas of orthodontic therapy.[3] The most significant problem with clinical orthodontic research is, that out of necessity, it generally involves individual patients who present for treatment. This makes finding a well matched sample very difficult. The great variation between patients regarding initial malocclusion, treatment timing, individual growth and compliance are but a few of the many complicating factors surrounding clinical research.[4] Many previous experimental studies have even included both extraction and nonextraction cases in the same sample. The extraction cases will require space closure and likely some forward movement of the maxillary first molar. By including extraction and nonextraction cases in the same group the actual effect of Kloehn traction on the maxillary first molar may be misunderstood.

The second major problem of clinical research is that it involves a long term orthodontic treatment process. During the two or more years that a patient is undergoing therapy, decisions are made every appointment which subtly alter the original treatment plan. Different mechanical approaches to the headgear application and whether it is used

alone or in conjunction with comprehensive edgewise therapy further complicate the clinical research. Variations in the use of auxiliaries including biteplanes and elastics also present difficulties. These factors combine to ensure that a truly well matched treatment group is almost impossible to find.

Since growth modification is the objective of extraoral anchorage therapy, it is necessary to compare the results of treatment with the growth of an untreated control group. While locating a well matched group of treated patients is difficult, finding a group of untreated patients to act as a control is even more difficult. The treated patients begin with a Class II malocclusion indicating that some degree of dysplasia is present. The use of Class II subjects with a similar skeletal and dental dysplasia as a control would allow for stronger conclusions.[4] However, longitudinal records of the growth and development of individuals with a Class II malocclusion are not common. One way to gather such a group would be to delay orthodontic treatment of Class II individuals presenting for therapy until the end of their active growth period. However, since some growth modification is often used during treatment, this would limit their potential treatment outcome. Therefore the only access to the records of Class II growth must be found in the few organized growth studies that were carried out earlier in the 20th century.

The difficulty in gathering both uniformly treated patients and well matched Class II control subjects is apparent during an examination of the literature describing the effects of Kloehn headgear.[4] Because of these problems, the experimental groups are often small and untreated Class I individuals are often used as the control. Nevertheless, numerous clinical studies of Kloehn headgear have been conducted and their results published in the orthodontic literature. Despite the volume of clinical research published, differences related to experimental design and treatment mechanics persist and tend to obscure a thorough understanding of the effects of Kloehn cervical anchorage. Thus it was perceived that if some of the previous obstacles to clinical research could be overcome, further research evaluating the effects of Kloehn anchorage would be warranted.

The Oregon Child Development Study located at the Oregon Health Sciences University contains a group of almost thirty untreated individuals

with a Class II malocclusion who have been serially examined over several years. Orthodontic records including models and cephalometric radiographs were taken annually from early childhood until late adolescence or adulthood on many of these subjects. These records could provide a suitable control group with which to compare the effects of Kloehn cervical therapy for the correction of a Class II malocclusion.

The treatment records at the Oregon Health Sciences University Department of Orthodontics Graduate Clinic contains a group of Class II patients treated primarily with cervical headgear in conjunction with comprehensive edgewise therapy. Several of these patients were treated without extractions during their active growth period. The records of these former patients could comprise an experimental sample for evaluation of the effects of Kloehn headgear on the growth and development of the maxilla. The purpose of this study is to compare the treatment results and effects of a group of Class II patients undergoing Kloehn cervical headgear therapy with a well matched group of Class II untreated patients.

Literature Review

In 1947, Kloehn[5] presented two major tenets that formed the basis for the introduction of cervical traction therapy. First, Kloehn reiterated that teeth placed in correct functioning relationships did not result in increased bone growth as had been proposed by Angle. The placement of orthodontic appliances under the pretense of stimulating growth of the mandible was demonstrated as incorrect. Kloehn then restated the results of the initial cephalometric studies by Broadbent and Brodie demonstrating the constancy in pattern of facial development regardless of growth or orthodontic therapy. The realization of the orthodontic profession of these tenets led many practitioners to discontinue mixed dentition treatment. This resulted in the initiation of extraction therapy as the primary solution for many malocclusions. Kloehn suggested that bicuspid extraction does not change the underlying skeletal relationship but rather changes the relationship of the teeth to the skeletal bases. He proposed stopping the forward growth of the maxillary teeth and alveolar process with a headcap appliance until the forward growth of the mandible yielded a normal relationship of the teeth. Kloehn demonstrated the potential for headcap treatment with several case reports of successful correction of Class II malocclusion utilizing it rather than extraction therapy.

By 1953, Kloehn[2] promoted the philosophy that Class II malocclusion was largely hereditary in origin and that the jaw malrelation had a direct inhibitory effect on normal mandibular development. His treatment goal was to restore the normal relationship between the maxilla and mandible. He thought this would promote improved growth. Treatment was started early, during the mixed dentition, and the appliance was directed at those teeth that were in an abnormal position without disturbing those in good position. The face bow and cervical strap appliance was described as the mechanism for slowing the growth of the maxilla and the maxillary teeth. The mandible and mandibular dentition were allowed to continue their normal forward growth which eventually resulted in balance between the two jaws. The appliance was to be worn during the evening and while sleeping, ten to twelve hours per night. Relative to a headcap which attatched to the archwire and tended to cause undesirable distal tipping of the molar, the face bow, because it inserted into molar tubes, had the advantage of permitting better control of the axial inclinations of the applied force. Combination of the headgear and the archwire also helped

control axial inclinations. Kloehn bent the face bow downward if distal crown tipping was desired, but when distal root movement was required the outer bow was bent above the archwire. In combination with the cervical strap and face bow, a bite plane was often used to help unlock the occlusion and stimulate vertical growth to decrease overbite and permit maximum mandibular growth. Kloehn again displayed several successful case results which demonstrated the potential for Class II correction using an extraoral appliance designed for guiding growth toward a more normal relationship.

Following the reintroduction of extraoral traction to the orthodontic specialty, its use became widespread and it was advocated for the correction of many malocclusions. The earliest research into the effects of cervical headgear therapy involved comparisons of cephalometric radiographs taken before and after treatment. No control group was used. Graber,[6] in 1955, was one of the first to comment on the limitations of cervical headgear and to delineate its most effective use. A sample of 100 Class II, Division 1 cases, ranging in age from 3 to 19 years, with acceptable lower arches was treated with extraoral traction. A cervical headgear was attached via continuous loops at the canines to a .045" stainless steel labial arch wire with vertical spring loops at the molar bands. Bite plates were used in some cases as was elastic traction when necessary. Examining the results with the use of cephalometric radiographs, Graber concluded that marked improvements in basal relationships could be obtained with the use of extraoral force, but he also found excessive distal tipping of maxillary first molar crowns, and difficulty in controlling excessive overbite. He commented that growth is the primary factor in the correction and demonstrated that results were superior in the group treated during their pubertal growth spurt. Graber held there was no evidence that maxillary growth was affected, but rather perceived that it was only maxillary alveolar growth that was influenced.

King[7] (1957) was also amongst the first to use superimposed cephalometric radiographs taken before and after treatment to examine the results of extraoral anchorage. Fifty Class II, Division 1 patients in the late mixed or permanent dentition, ranging in age from 9 year, 5 months to 18 years, 9 months were studied. Treatment with full or partial edgewise appliances was carried out in conjunction with the cervical anchorage but neither the exact mechanics of the attachment nor the use of biteplane

were specified. Nearly half the cases also involved the extraction of four bicuspids. King concluded that extraoral anchorage does restrict the forward growth of the first molar and maxillary denture area relative to the forward growth of the face. Further, he felt that tipping of the maxillary first molar was controlled because edgewise appliances were in place. However, King reported that vertical growth exceeded forward growth in his sample. While the changes in both the occlusal and mandibular plane angles were small and not significant, King did note that the cases which exhibited the most vertical growth had the poorest response at pogonion. He also summarized that in general the treatment response with respect to forward growth at pogonion was disappointing.

Using a similar study design, Klein[8] (1957) evaluated cervical traction as proposed by Kloehn on a consecutive sample of 24 successfully treated Class II, Division 1 cases. The average age at the start of treatment was 8 years, 6 months. The facebow in this study was extended to a point anterior to the ear and bite planes were used in some instances. Klein concluded that distal movement of the maxillary first molar was possible and that tipping could be controlled by the force exerted by the facebow. Also noted was a vertical displacement of the upper first molar averaging 2.3 mm, however this was found to be correlated with the vertical growth of the mandible, the thought being that the growth of the mandible allowed the maxillary first molar to erupt. The occlusal plane was found to be stable, exhibiting little change on average. Relative to the Bolton plane the Y axis was found to increase on average 1 degree over the course of treatment. Facial convexity decreased by an average of 2.8 degrees, however in some cases the chin appeared to be less prominent. Finally, SNA decreased an average of 1.3 degrees and the palatal plane demonstrated a tendency to rotate clockwise, 1.75 degrees on average, causing Klein to conclude that the growth of the maxilla had been altered. In agreement with King,[7] Klein described some cases in which excess unfavorable mandibular rotation occurred and speculated that the headgear may have the unfavorable effect of increasing the mandibular plane angle. He called for a serial investigation of untreated Class II cases to help determine the patterns of growth in Class II cases.

Blueher,[9] in 1959, also compared before and after cephalometric radiographs in his study of thirty four Class II, Division 1 or Class II tendency cases. An early treatment group of 12 children, average age 10

years, started with the cervical headgear alone followed by full treatment after the eruption of permanent teeth while an older group of 22 children, average age 13 years, was treated with simultaneous neck strap and edgewise appliance. Neither the mechanics of the face bow nor the use of biteplanes was specified. Blueher found that forward growth of the maxillary anterior alveolar process was restricted as evidenced by decreases in both the SNA and linear distance SA along the Frankfurt plane. The palatal plane angle increased in 25 out of 34 cases; only 6 out of 34 cases exhibited a decrease. The mandibular findings were variable as SNB and SNPo remained constant in some patients, increased in some and decreased in others. An almost universal decrease in the angle of convexity averaging almost 5 degrees was observed. The bite opening tendency of the cervical appliance was again noted as the angle NSGn increased in two thirds of the patients but the mandibular plane angle showed more variable change, increasing in some while decreasing in an equal number of others. Blueher commented that wide variation in both growth and treatment response prohibit prediction of individual reaction based on the average response.

Hanes,[10] later in 1959, compared cephalometric changes in a group treated with cervical traction with those in a group treated with intermaxillary elastics. The cervical traction group included thirty two patients, average age 9 years, 9 months, and the appliance varied from headgear and a biteplane only to complete edgewise. The elastic group included thirty eight cases, average age 12 years, 3 months, many of whom also wore cervical headgear in combination with Class III elastics during anchorage preparation. Extractions were required in 4 of the headgear group and in nearly all, 26 of 38, of the elastic group. Using before and after superimposed cephalometric radiographs, Hanes found the groups to be very similar pretreatment except for the two and a half year age discrepancy. Despite the difference in treatment very similar changes resulted in both groups. Maxillary measures SNA and linear measures to A both showed significant decreases in both groups. Intermaxillary measures ANB and linear measure between A-B also decreased similar amounts in both groups. The mandibular measure SNB tended to decrease or worsen slightly in both groups but the linear measure to pogonion decreased in the headgear group while moving slightly forward in the elastic group. Also, the mandibular plane angle increased 2 degrees in the cervical traction group, but only .8 degrees in the elastic group. Hanes