

A newer approach in positioning teeth for dental prosthetics using lateral cephalometric, trans-cranial radiographs, and the Denar-Witzig articulator: a case of hypodontia in an adolescent patient

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Traditionally in full denture prosthetics, anterior teeth are set on the models, independent of the effects on the face. More enlightened dentists, will then adjust the wax-up for speech, and some effects on the lips. Consideration is infrequently given to restoring the face by repositioning the teeth and mandible. Rarely is thought given to the effects of occlusion on the posture of the body. This report uses several techniques to restore facial esthetics and body posture. The techniques used include a cephalometric radiograph, transcranial radiographs, an articulator that has an adjustable "TMJ" (Denar-Witzig), and Symmetrigrav Posture Chart[®].

This clinical report describes a newer approach in the positioning of maxillary anterior teeth for a patient with hypodontia and nail dysplasia syndrome, and the overall effect of this approach on the face and posture of the patient.

Conventionally the precise form of the maxillary wax rim is fabricated with considerable variation from technician to another, based on the technicians training. This variation is evident on the position of the labial aspect of the rim horizontally and vertically. The wax rim is then further adjusted chair side based on subjective evaluation of the face. The maxillary anterior teeth position is established without considering that the lip position is not yet accustomed to the wax rim.

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LITERATURE REVIEW

Medical background

Ectodermal dysplasia is a diverse group of syndromes with over 120 documented. The principle dysplastic feature involves ectodermal structures such as hair, nails, sweat glands, and teeth.

The genetic modes of transmission include autosomal dominant, autosomal recessive, and X-linked recessive. Witkop classified the condition into the following:^{47,48}

Type I: X-linked hypohidrotic with widespread manifestations

Type II: Autosomal dominant with hypodontia and dysplastic nails, but with normal hair and eyebrows (tooth-and-nail syndrome, Witkop's syndrome)

Type III: Unusual form that has both X-linked and autosomal dominant features, primarily a hair and nail defect in which the teeth are normal.

The autosomal dominant type of ectodermal dysplasia (type II) described by Witkop *et al.*^{46,47} as the tooth-and-nail syndrome. Generally hair is normal in distribution and density, but may be finely textured. The characteristic features are centrally hollowed, dysplastic toenails, and the growth is extremely slow and very thin. The primary dentition is essentially normal. Hypodontia and on rare occasions anodontia of the permanent dentition is present.^{2,9,15,22,32,38,45}

The facial features of these patients are usually effected, and are commonly referred to as "old man" faces. This has a damaging impact on the personality of the child, confidence and self-esteem. The normal social and psychological growth of these patients dictates that they look and feel as normally as possible.^{10,21,34,46} Therefore, dental and facial appearance is extremely important.

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Dental treatment

Early and extensive dental treatment is needed throughout childhood. Several approaches have been documented. Fixed prosthetics has been considered, but the fact that minimal number of teeth is present, and that the patients are still actively growing, generally limits this option. The use of implants has been advocated to overcome the concern of limited number of natural abutments. Another approach that is commonly used is removable prosthetics in the form of complete dentures, overdentures (tooth supported or implant supported), or removable partial dentures.

4,5,7,9,14,27,33,35,37

The use of overdentures has proven to be very effective in restoring facial esthetics and oral function in a very simple and economical approach.^{5,12,40}

Head Posture

Several authors have studied the role of mandibular position and the head posture. In this sense, Rocabado states that “there is a dynamic relationship between head posture and dental occlusion”.³¹ The forward head position is characterized by a dorso-extension of the head together with the upper cervical spine (C1-C3), accompanied by a flexion of the lower cervical spine (C4-C7), whereby the cervical curvature is increased, a condition called hyperlordosis.¹⁷ This abnormal postural position is most frequently adopted and maintained by patients as a response to a psycho-affective or pathological condition, exercising a deep structural as well as functional influence on the stomatognathic system.¹⁷ Solow, and Tallgren determined that the extension of the head on the cervical spine is associated to a significant mandibular retrusion⁴⁴ In a study by Rocabado *et al.* they noted a close relationship in upper cervical spine lordosis to reduced vertical dimension.³¹

The technique

The conventional way of setting teeth for overdentures follows the outline of complete dentures, which involves the making of a wax rim. This wax rim has to be adjusted chair side to restore the facial esthetics.^{19,25,26,29,41,42,51} Moss's functional matrix theory indicates that the craniofacial structures grow and adjust to the functional needs of the cranial content, the lips and tongue have accommodated to the missing or malpositioned anterior teeth.³⁰ With this in mind the wax rim when adjusted, is in relationship to the upper lip; which has not adjusted to it yet. The use of the nasolabial angle to establish facial esthetics has been questioned.⁶

The conventional method of establishing the basic horizontal relationship is terminal hinge axis, which is located by a series of controlled opening and closing movements of the jaws when the mandible is held in its most retruded position relative to the maxillae. However, the preferred position for the condyle is not only the anterior, superior position, but also slightly down-

ward and forward position relative to the overall outline of the fossa with the disc in perfect position between the moving condylar head and stationary articular eminential pathway.

Gelb described this position as the Gelb 4/7 position.^{16,49} Several methods have been used to visualize and analyze the TMJ and TMJ space. One such method is the transcranial radiograph. It is regarded as a simple, inexpensive, and reliable method to image the TMJ,^{8,13,39,36} while some authors have thought that it has little if any value.¹¹

CASE REPORT

A 17 year old male patient presented to Tufts University School of Dental Medicine, Department of Pediatric Dentistry with his mother, after being to several dentists. The patient and chief complaint from the mother was “what can you do for my face and smile”. The mother wears dentures and is thus somewhat knowledgeable about these issues.

The medical history of the patient included a history of ADHD: Attention deficit (with hyperactivity) disorder,¹⁸ on Catapres,⁵⁰ with no known drug allergies.

ADHD is often associated with:¹⁸ low self-esteem, mood lability, low frustration tolerance, temper tantrums, and learning disabilities.

The clinical exam of the patient revealed the following: thin and grooved nails (Figure 1), a height to age of 50th percentile and weight to age of 30th percentile. The head and neck exam was negative to palpation, and no palpable lymphadenopathy. The face was overall symmetrical, with parallel eye and ear planes, however, a significant forward head posture was evident, and a loss of vertical dimension with averted lips. The head was tilted to the left side as well (Figure 2). The TMJ exam was negative clinically. The hair on the head was normal in distribution and density, but was finely textured.

The intra-oral exam was significant with only the following permanent teeth present: the maxillary two central incisors, two peg shaped laterals and 1st premolars, while the mandible had one 1st molar, and peg shaped premolars. The remaining teeth are retained primary teeth (Figure 3). The maxillary mid line was coincident with the face. The soft tissues were unremarkable other than a high maxillary labial frenum attachment.

The mother had the similar problems of congenitally missing teeth and defective nails. We were informed that the sister of the patient had congenitally missing lateral incisors. No significant information was known about the grandparents other than they lost their teeth early.

The radiographic exam revealed the following:

Panoramic view

Deviated nasal septum, no bony tissue pathology, maxillary sinus approximating the alveolar ridge, and localized resorption of the primary teeth roots. (Figure 4)



Figure 1. Thin and grooved nails.



Figure 2. Significant forward head posture, loss of vertical dimension with averted lips, and the head is tilted to the left side.

Figure (1) • Thin and grooved nails



Figure 3. Intra oral exam.



Figure 4. Panoramic radiograph.

Transcranial view

Distalized condyles in a 2/5 position (Figure 5).

Lateral cephalometric view

A 35-point analysis was done, and the following significant points were noted: the distance of point “A” from NP [-5] {adult norm: 1} P4 and the mandibular plane = 14° {the adult norm is at 26°}(Figure 6).

The maxillary labial frenum was removed with a laser (Figure 7).

Maxillary and mandibular impressions were taken, and the casts mounted using a Denar face-bow on a Denar-Witzig articulator at a zero position. The deep bite was very obvious at this time. Using the transcranial radiograph an analysis was done and the condyles placed in the Gelb 4/7 position (Figure 8). Measurements were done on both “X” and “Y” axis from the original position 2/5 to the Gelb 4/7 position in millimeters.⁴⁹ These measurements were then transferred

to the articulator using the conversion tables of the manufacturer, and the appropriate screws adjusted to reposition the articulator condylar elements (Figure 9). This change in condylar position increased the vertical dimension by 5mm.

A base plate was then made using a light cured resin material (Triad[®]), the posterior occlusal area was exposed, and the maxillary anterior area was thinned until the incisal edges were visible. A wax rim was made from 2nd premolar to 2nd premolar.

Using the measurements from the lateral cephalometric radiograph, the mandibular plane needed to be adjusted by approximately 10mm down to put the plane within the normal range, 5mm were already achieved by adjusting the condylar elements on the articulator (Figure 10). The position of the maxillary centrals needed to be moved anteriorly by 5mm to improve the facial profile (Figure 11).

The wax rim was adjusted to these measurements; the tip of the rim was placed 5mm labially and 5mm incisally from the exposed incisal edge (Figure 12). Teeth selection was based on the golden proportion

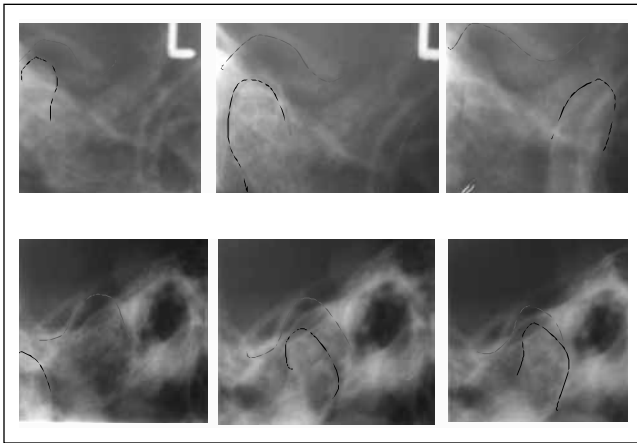


Figure 5. Transcranial radiograph, showing the condyles in a distalized position.

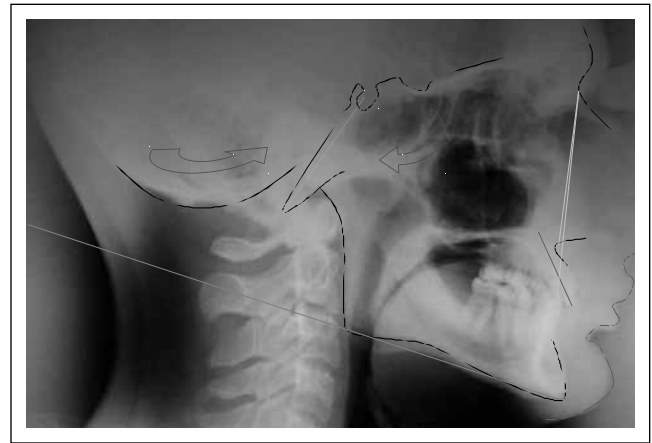


Figure 6. Lateral cephalometric radiograph.



Figure 7. Maxillary labial frenectomy.

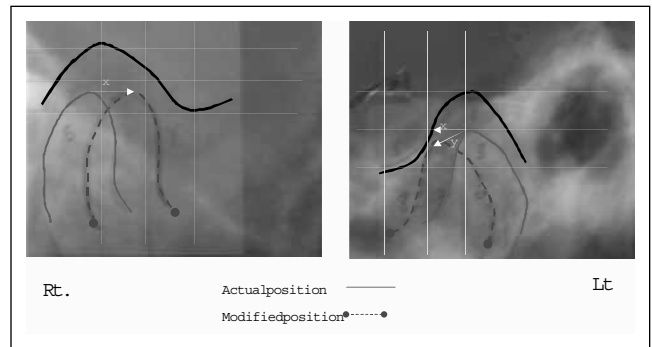


Figure 8. Repositioning of the condyles on the transcranial radiograph.

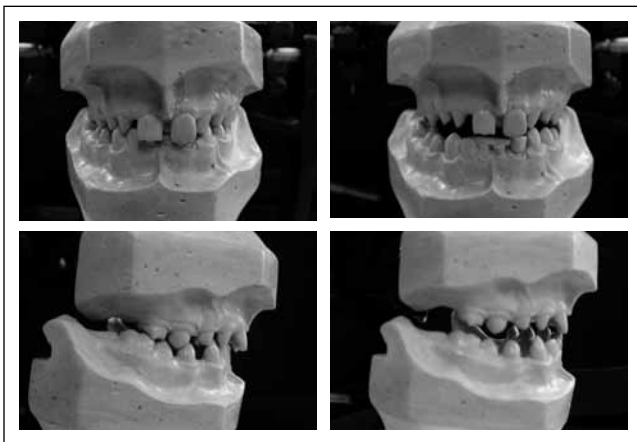


Figure 9. Mounted castes before and after articulator adjustments.

to the face. The central incisors were of appropriate size, so acrylic teeth were used that matched the teeth size and color of the patient. Maxillary and mandibular anterior teeth were set into the wax rim

with an appropriate overjet and overbite relation. (Figure 13)

The set up was then tried-in and the posterior maxillary plane was adjusted using the conventional approach of paralleling it with the ala-tragus line and the inter-pupillary line.⁵¹ The anterior set-up was not adjusted at all, phonetics, esthetics were checked at this time. The patient was concerned that it was difficult to speak at this time. The mother was ecstatic at the results the prosthesis had on the face of her son, as compared to her face. Both patient and mother were reassured about the speech, and that it was a matter practicing with the overdentures.

The set-up was sent to the lab and a total of four maxillary and four mandibular premolars were added to the adjusted posterior plane, posteriorly the patient was provided a flat plane appliance. The appliances were processed in the conventional way, finished and polished for delivery. On the day of delivery the fitting and the occlusal surfaces were adjusted, and instructions were given. The significant observations made at this time were that the lips were not accustomed to the appliance, and that the head posture had changed slightly. A 24-hour follow-up showed that minor adjust-

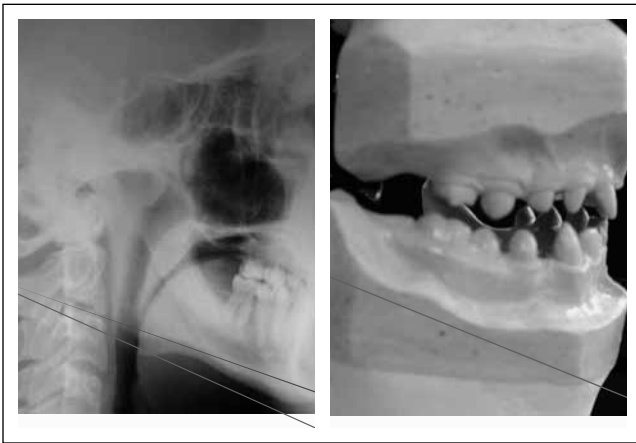


Figure 10. The mandibular plane = 14° and the adult norm is at 26°. total adjustment needed is 10 mm, 5 mm were achieved by the adjustment of the condylar position.



Figure 11. The distance of point "A" from NP [-5] {adult norm: 1} P4.

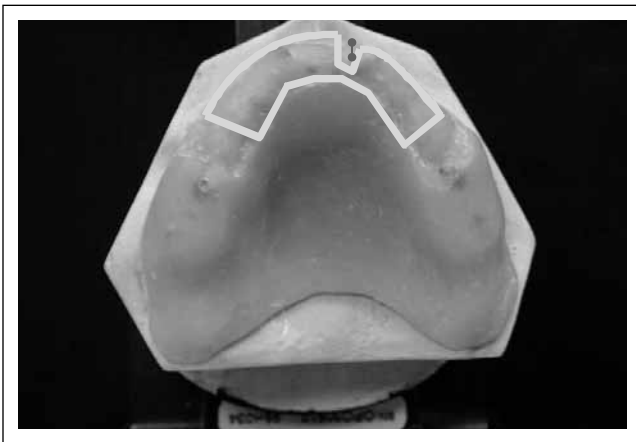


Figure 12. Maxillary wax rims were constructed with the tip 5 mm horizontally and vertically from the incisal edge.

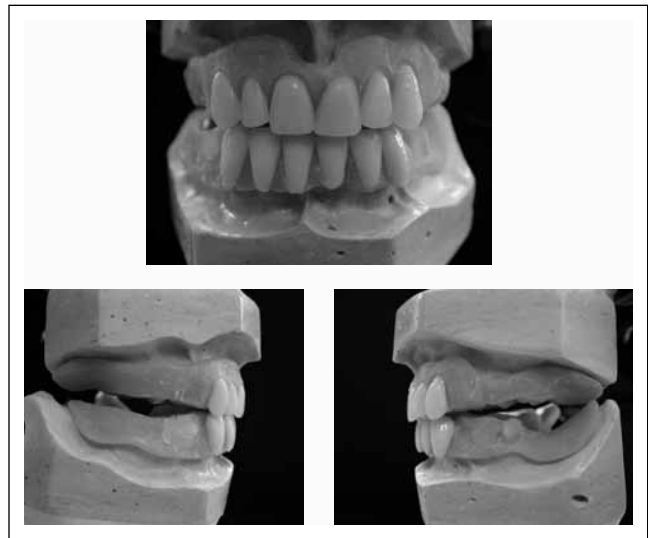


Figure 13. Maxillary and mandibular anterior setup.

ments were needed for the fitting surface. The patient was still not comfortable speaking with the appliances.

At the 7-day follow up visit, the patient had a drastic change in speech and appearance. The lip position was very natural in relation to the new teeth;²⁸ minor adjustments were made to the fitting surface. Eating with the appliances was still a concern to the patient. But the most significant observation other than the esthetic results; was that the patient's head posture had changed. The head was no longer in a forward position and neither tilted to the side (Figure 14).

DISCUSSION

Medical background

The patient and his mother in this case report had most of the classical signs of the autosomal dominant type of ectodermal dysplasia (type II) described by Witkop *et al.*^{46,47} (i.e. Tooth-and-nail syndrome), of normal hair in distribution and density, but fine textured.



Figure 14. Change in head posture [front and profile]

Effected nails, normal primary dentition, and hypodontia of the permanent dentition.^{2,9,15,22,32,38,45} The older sister had the permanent lateral missing only, however no information was available about the grandparents other than that they lost their teeth early.

Dental treatment

The faces of the patient and the mother were significantly affected with the classical appearance of loss of vertical dimension, and inappropriate facial proportions (old man vs. baby face). The fact that the patient had attention deficit (with hyperactivity) disorder (ADHD), and one of the signs associated with ADHD is low self-esteem,¹⁸ complicated his condition even further.

Based on these facts the facial esthetics were of high significance in treating this case appropriately. However the family preferred not to use any form of invasive treatment (e.g. combination of orthodontic, implants, and fixed prosthetics), hence the agreement was to go with maxillary and mandibular overdentures.

Head Posture

One of the significant observations made here was the change in the head posture from a forward and laterally tilted head posture to a much favorable posture anterior-posteriorly and medio-laterally. This finding correlates with the study results of several authors. In a study by Rocabado *et al.* they noted changes in upper cervical spine lordosis after an occlusal splint was used to increase the vertical dimension.³¹ The vertical dimension increase in their study was within the therapeutic range of 4mm to 5.5mm.³¹ It is true that the increase achieved with two appliances with our patient was 10mm, and several studies have demonstrated a decrease in tonic elevator muscle activity from the occlusal vertical dimension to a range of 11mm.^{17,23,24} However, the increase in this case was 5 mm after the condylar position was modified from the superior posterior position to a more biological position (Gelb 4/7). Several studies have demonstrated an increase in cervical muscle strength with the modification of the occlusal plane by increasing the vertical dimension.^{1,3} In a study by Huggare and Raustia they stated that the appliance therapy did not alter the craniocervical angulation.²⁰

The technique

Applying Moss's functional matrix theory, the craniofacial structures grow and adjust to the functional needs of the cranial content. The tongue and lip accommodate to the oral cavity without or with minimal tooth structures,³⁰ so the fact of using these structures to design and locate the anterior teeth may be inappropriate. This was very evident with our patient at the try-in when the overdentures were inserted, the lips appeared to be puffed out. But once the lips accommo-

dated to the teeth that were placed in proportion to the facial structures horizontally and vertically through the lateral cephalometric analysis the second significant observation was that the esthetic result matched the face perfectly.²⁸

The muscles of mastication are key elements in the TMJ dysfunction problem. When muscles become involved in TMJ problems, they exhibit two symptoms: pain, which was not evident with our patient, and dysfunction. Dysfunction of muscles is observed when they display less-than-normal strength or reduced ranges of motion or they just plain quit working altogether (a physiological form of rebellion known as myospasm). So the appliances not only increased the vertical dimension; they placed the condyles in a more "bilaminar zone-favoring" forward position.⁴⁹ The conventional terminal hinge axis will not support this theory.⁴⁴ In a study Salonen *et al.* oral rehabilitation with complete maxillary denture and restoration of posterior occlusion by means of a removable partial mandibular denture did not result in significant changes in cephalometric values.⁴³

SUMMARY

Using the combination of lateral cephalometric, transcranial radiographs, and the Denar-Witzig articulator presented an esthetically superior overdenture prosthesis, and appeared to alter the facial esthetics and head posture of the patient significantly, who had hypodontia. Further studies are needed to evaluate this technique sensitive approach in comparison with a controlled conventional approach. In addition the validity of this approach for fixed prosthesis tooth or implant supported prosthesis is encouraged.

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