Clinical Use Of The Frontal Headfilm

JAMES F. MULICK, D.D.S., M.S.D.*
Woodland Hills, California

INTRODUCTION

Numerous longitudinal and cross-sectional studies of both nontreated and treated subjects in virtually all age groups have been reported utilizing the standardized lateral cephalometric headfilm. These studies have added immeasurably to our knowledge of growth in both vertical and anteroposterior directions, known from anthropometric times as the two dimensions which increased the greatest amounts during growth and development of the human face.

Very few studies, however, have been done utilizing the frontal headfilm. Because of a lack of comparative material studied from this viewpoint, the clinical orthodontist has tended to eliminate the frontal view from his cephalometric appraisal of the developing human face. Although additional fundamental information needs to be known using this roentgenographic projection, it is possible for the sophisticated clinician today to use the frontal headfilm in his diagnostic armamentarium. There is virtually no other way to study in a serial manner the development in width of the facial skeleton, or the eruption paths of certain teeth. It is the purpose of this paper, therefore, to present fundamental information regarding the use of the frontal headfilm in routine clinical orthodontic practice.

HISTORY

Davis[3] was the first to use the P.A. film for study of asymmetry of the paranasal sinuses. Broadbent[1] combined both lateral and frontal projections for orthodiagraphic analysis. Doering,[4] Woods[21] and Warren[20] studied the frontal headfilm for dimensional changes during growth, both Woods and Warren correcting their measurements for size distortion in two planes of space. Harvold's[6,7] classical study of asymmetry in the unilateral cleft palate subject proposed the first parameters for asymmetry of the upper facial skeleton. Subtelny[18] used the laminagraphic technique frontally for a comparative study of normal children and unoperated cleft palate children. Mulick[9,10] studied the frontal headfilm in a triplet series longitudinally for comparative effects of age, sex and craniofacial region on asymmetry.

The use of the frontal headfilm for gross radiological diagnostic use in medicine has been summarized by Ritvo,[14] Steel,[17] Pendergrass, Schaeffer and Hodes[11] and Etter.[5] Krogman and Sassouni[8] analyzed both the frontal and lateral cephalometric headfilms on a section-by-section basis.

ROENTGENOGRAPHIC TECHNIQUES

Of utmost importance in studying the frontal headfilm is the degree of accuracy of registration. This implies proper seating of the patient in the cephalometer and maintenance of proper orientation during the comparatively longer frontal headfilm exposure. Failure to use proper orientation technique has been fully evaluated by Stackler.[16] All of the errors seen in positional artifacts in the lateral headfilm are magnified when the frontal headfilm is considered. Standardization of the patient by a close-fitting head-holding

*Clinical Instructor in Pediatrics, U.C.L.A., Center for the Health Sciences, Los Angeles, California.
Presented before 1st Inter-American Orthodontic Seminar, Los Angeles, California — Mazatlan, Mexico, June, 1964.

device is important, and the ability to hold the patient in a comparable position for both lateral and frontal exposures is imperative. Therefore, if it is necessary to rotate the patient and the cephalometer 90 degrees, and, in addition, allow time for a cassette change during the securing of the headfilm, considerable error can result unless certain precautions are observed.

For the production of consistently acceptable frontal headfilms, a variable exposure technique based either on posteroanterior head width (measured by calipers) or body weight should be followed. The anteroposterior dimension of the head is far more variable than the width. The basic exposure in the author's office is as follows:

FACTOR	AMOUNT
MA	15
KV	90
Time	0.8 sec.
Film	Kodak Royal Blue
Screen	Patterson High-Speed
Grid	Micro-line, 80 lines per inch

The basic exposure is varied as indicated above and in all cases full development of the film is used.

Interpreting the Film

In previous studies,[9,10] the author studied simultaneous mounting of both lateral and frontal films by orthogonal projection, that is, deriving lateral, vertical and anteroposterior measurements simultaneously from both films and correcting them for size distortion by quadratic equations after Schwartz.[15] Point-to-point relationships in space could then be ascertained by solid geometry. This, however, even with the aid of a computer is at best a research tool and does not lend itself to clinical application at the present time.

The author's routine use, therefore, is to mount the P.A. film alone on the view box, tracing in major craniofacial

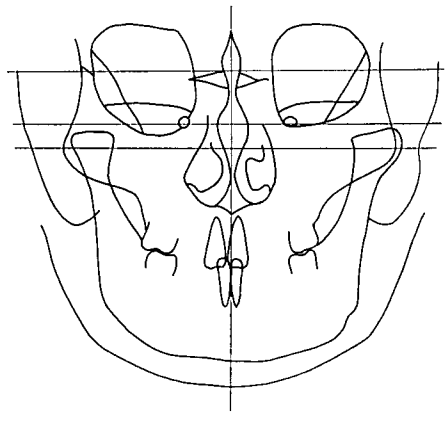

Figure 1 The vertical axis is the maximum midline structure axis. Horizontal axes, starting from the top, are zygomaticofrontal suture axis; foramen rotundum axis; and porionic axis. Outlines of nasal skeleton, orbits, zygomatic arches, the maxilla, and the mandible are traced.

landmarks. To this framework is added as many of the dental structures as are visible on any given film.

Horizontal and vertical reference lines can then be added. One horizontal reference of interest is the transporionic axis connecting right and left poria. As long as the selection is consistent, either machine registration or anthropometric poria can be utilized. On the basis of Subtelny's work[18] and that of Ricketts[12,13] the transforamen rotunda axis is suggested (connecting the left and right foramen rotunda). Harvold[6,7] utilized a more topographical horizontal axis, the transzygomaticofrontal suture axis. All three of the above suggested horizontal axes or reference lines represent different levels or coronal depth as visualized on the frontal headfilm, the transporionic axis being the farthest away from the face and the zygomaticofrontal suture axis being the closest to the face.

The vertical reference axis can be constructed primarily in one of two ways: (1) as a perpendicular to any of the three horizontal axes drawn through

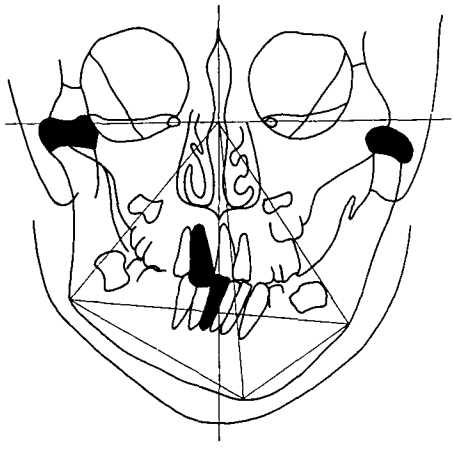

Figure 2 Patient K. H., age 13, exhibits maxillary and mandibular midline shifts (left incisors are black). Occlusal tilt is in direction of longer ramal development. Facial asymmetry is displayed by supplementary lines drawn to gonial angles. This later proved to be a progressive asymmetry.

maximum midline anatomic structures, or (2) as an absolute vertical drawn through maximum midline anatomic structures. The term "maximum midline anatomic structures" refers to such anatomic entities as the Crista galli, the midpalatal suture, and the stalk of the vomer. As in the selection of suitable horizontal reference lines, consistency should be the rule for the clinician, that is, selecting a suitable horizontal and vertical reference axis for use routinely. The author has routinely used the transforamen rotunda axis horizontally and the absolute maximum midline anatomic structure axis vertically (Fig. 1).

Clinical Use

Using the technique described above, the following problem areas in orthodontics can be more closely evaluated.

Midline Shifts. Shifts of maxillary and mandibular midlines classically have been taken from dental cast analysis or from clinical examination. The use of the frontal headfilm in the analysis of midline disturbances is primarily as a re-check of dental cast and clinical findings. It is useful in that it relates dental midlines to the underlying skeleton in a more descriptive manner (Fig. 2).

Occlusal Plane Disturbances. One of the more frustrating problems in clinical orthodontics is the occlusal plane in either the maxillary or mandibular arch which is oriented in a tipped fashion. This cannot be readily visualized in records, except possibly by a correctly oriented frontal intraoral photograph. The frontal headfilm accomplishes this role admirably for it also shows the angulation of the roots as well as the crowns involved in the tilted occlusal plane (Figure 2).

Facial Asymmetry. The study of facial asymmetry in the living human is an impossible task without employing the frontal headfilm. Because of our lack of knowledge concerning the development and response to treatment of patients with facial asymmetries, many cases are left untreated. The simplest test for facial asymmetry was devised by Ricketts.[12] Differences of 5 degrees or more between right and left angles indicate facial imbalance (Figure 2).

Functional Shift of the Mandible. Functional shifts can, of course, be diagnosed clinically and recorded by means of the wax bite technique.[19] However, it is of interest to have roentgenographic evidence of the shift. The frontal headfilm can record the condition and can be used as a teaching aid for consultations with the parents of the child to be treated (Figure 3).

Morphological Typing. The frontal headfilm is of great value in the morphological typing of the subject during the diagnostic evaluation. For example, obvious differences between brachycephalic and dolichocephalic

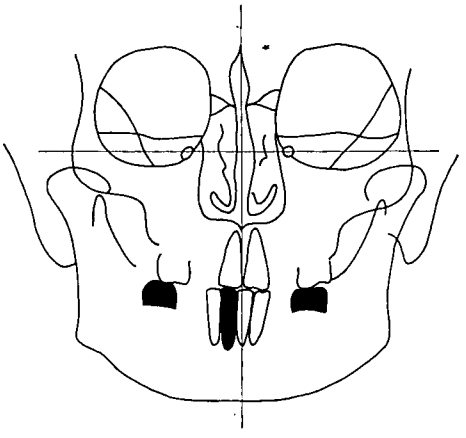

Figure 3 Note shift to left of mandible as visualized by interdigitation of molars. Note unequal relation of ascending rami of mandible to mastoid processes, and unequal width between rami and buccal surfaces of maxilla. These factors can be used to differentially diagnose functional shifts from true skeletal asymmetries.

patterns can be seen in the frontal headfilm (Figure 4).

Dental Evaluation. The frontal headfilm supplies the missing dimension in the assessment of the spatial relationships of unerupted or ectopic dental units as well as a check on the possibility of missing or primordial teeth. Unerupted cuspids, the enigma of all orthodontists, can be studied via the frontal headfilm in a new perspective (Figure 5). Development and eruption of the mandibular and maxillary third molars, frequently seen in the orthodontic-age subject, can also be studied with more thoroughness.

Congenital Deformities. The frontal headfilm is of particular value in the study of distortions of the craniofacial complex such as those found in unilateral complete cleft palate, craniofacial dysostosis, and hemihypertrophy and hemiatrophy of the maxilla or mandible. Longitudinal data utilizing this approach is sorely needed for study and evaluation (Figure 6).

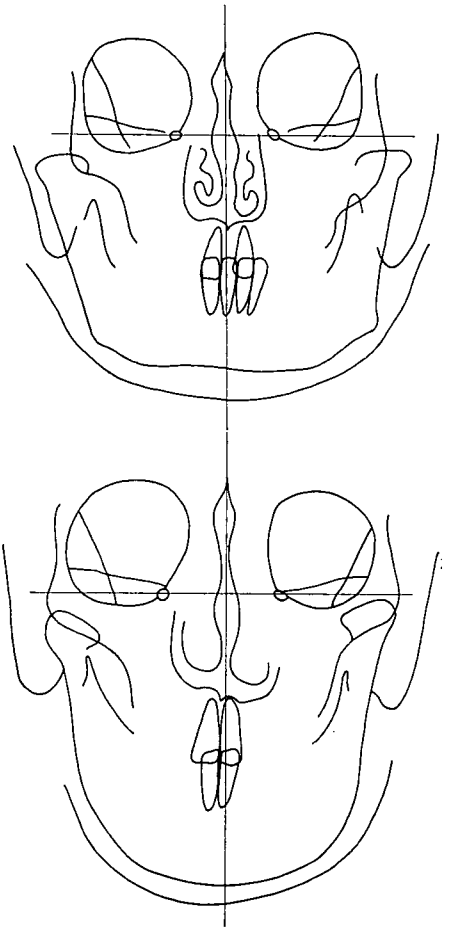

Figure 4 Above: Brachycephalic pattern with characteristic closed bite. Spacing of maxillary incisors and shift of mandibular dental midline. Below: Dolichocephalic pattern. Asymmetric development of nasal skeleton. This patient also presents a warped palatal shelf in conjunction with the skeletal warpage. Note the difference in facial height: both patients are skeletally and chronologically aged 11 years.

Summary

A simple technique and series of uses for the frontal headfilm has been outlined. Despite lack of knowledge in large longitudinal samples, the fact remains that, at the present time, there is no other way for the clinician to view growth and development in width of

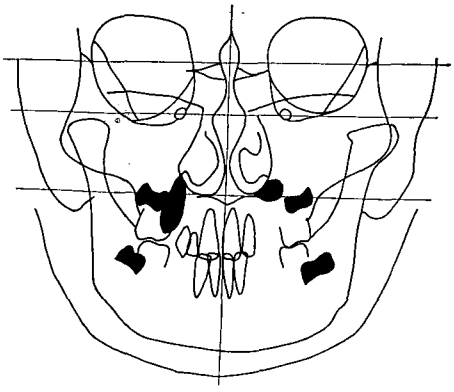

Figure 5 Maxillary and mandibular third molars are in acceptable relationships. Maxillary cuspids, however, both erupting ectopically. Maxillary right cuspid is in horizontally impacted position, palatal to maxillary arch. Maxillary left cuspid is erupting between maxillary first and second premolars. Retention of primary left maxillary lateral incisor and cuspid. This patient sought treatment because of a bulge under the lip (maxillary left cuspid).

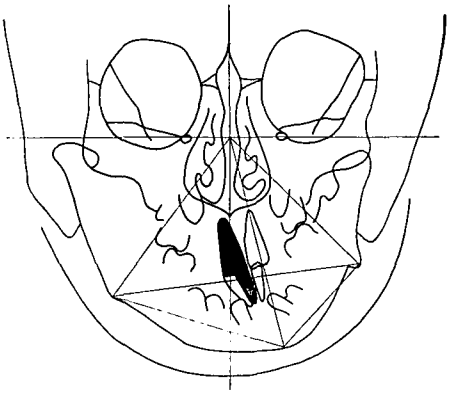

Figure 6 Abscess of the right temporomandibular joint at age six months produced this progressive facial asymmetry. Patient was age seven and one half at time of this tracing. Left incisors are shaded black for identification.

the human face. It becomes incumbent upon the clinician, therefore, to learn to use the frontal headfilm as a tool in his diagnostic armamentarium. Certain technical necessities for consistently good quality headfilms have been outlined. Criteria for reference axes have been discussed. Application of the frontal headfilm for studies in midline deviation, occlusal plane tilts, facial asymmetry, functional shifts of the mandible, morphological typing, dental evaluations, and congenital deformity analyses have been presented.

5351 Topanga Canyon Boulevard

REFERENCES

1. Broadbent, B. H. A New X-Ray Technique and Its Application to Orthodontia, *Angle Ortho.*, 1: 45-66, 1931.
2. Cheney, E. The Influence of Dentofacial Asymmetries upon Treatment Procedures, *Amer. J. Ortho.*, 38: 934-45, 1952.
3. Davis, W. B. Anatomy of the Nasal Accessory Sinuses in Infancy and Childhood, *Ann. Otol. Rhin. Laryng.*, 27: 940, 1918.
4. Doering, W. B. A Statistical Analysis of Cranial and Facial Dimensions in the Frontal Plane, M.S.D. Thesis, Northwestern University, 1950.
5. Etter, L. E. *Atlas of Roentgen Anatomy of the Skull,* Chas. C. Thomas, Springfield, 1955.
6. Harvold, E. *A Roentgen Study of the Postnatal Morphogenesis of the Facial Skeleton in Cleft Palate,* Anat. Institute Univ. of Oslo, 1954.
7. ———— Cleft Lip and Palate, *Amer. J. Ortho.*, 40: 493-506, July 1954.
8. Krogman, W. and Sassouni. V. *Syllabus in Roentgenographic Cephalometry,* Phila. Center for Research in Child Growth, 1957.
9. Mulick, J. F. An Investigation of Craniofacial Asymmetry Using the Serial Twin-Study Method, M.S.D. Thesis Univ. of Wash. 1961.
10. ———— Condylar Deformities and Asymmetry: a Serial Investigation, Research Section, Amer. Assoc. Ortho., Los Angeles, 1962.
11. Pendergrass, E. P., Schaeffer, J. P. and Hodes, P. J. *The Head and Neck in Roentgen Diagnosis,* Chas. C.

Thomas, Springfield, 1956.
12. Ricketts, R. M. Cephalometric Synthesis, *Amer. J. Ortho.*, 46: 647-73, Sept., 1960.
13. ———— Cephalometric Analysis and Synthesis, *Angle Ortho.*, 31: 141-56, July, 1961.
14. Ritvo, M. *Bone and Joint Disease*, Lea and Febiger, Phila. 1955.
15. Schwartz, H. A Method of Measuring Points in Space as Recorded by the Broadbent-Bolton Cephalometric Technique, M.S.D. Thesis, Northwestern University, 1943.
16. Stackler, H. An Evaluation of the Error in Cephalometric Roentgenography Introduced by Variation in Positioning of the Head. M.S.D. Thesis, Northwestern University, 1948.
17. Steel, D. *Roentgen Anatomy*, Chas. C. Thomas, Springfield, 1951.
18. Subtelny, J. D. Width of the Nasopharynx and Related Anatomic Structures in Normal and Unoperated Cleft Palate Children, *Amer. J. Ortho.*, 41: 889-909, Sept. 1955.
19. Thompson, J. R. Asymmetry of the Face, *J.A.D.A.*, 30: 1859-71, 1943. ———— Function — the Neglected Phase of Orthodontics, *Angle Ortho.*, 26: 129, July, 1956.
20. Warren, E. B. A Study of the Correlation of Denture and Skeletal Widths, M.S.D. Thesis, Univ. of Tenn. 1959.
21. Woods, G. A. Changes in Width Dimensions Between Certain Teeth and Facial Points during Facial Growth, *Amer. J. Ortho.*, 36: 676-700, Sept. 1950.