

# Relationship of head posture and the rest position of the mandible

D. W. Darling, M.S., P.T.\* S. Kraus, P.T.\*\* and M. B. Glasheen-Wray, M.M.Sc., P.T.\*\*

Physical Therapy Orthopaedic Specialists Inc., Minneapolis, Minn., and Institute of Graduate Health Sciences, Atlanta, Ga.

The short-term effect of changes in head position on the rest position of the mandible is well documented.<sup>1-9</sup> Brodie<sup>1</sup> and Thompson and Brodie<sup>2</sup> cephalometrically studied growth and development of the head and factors that affect mandibular posture. They concluded that the rest position of the mandible is the result of coordination between the posterior cervical muscles and the muscles that lie anterior to the cervical spine that are used for inspiration, mastication, deglutition, and speech. Because the mandible is contained within this group of muscles, the rest position of the mandible is dependent on the balance of these muscles (Fig. 1).

Other researchers have noted changes in the activity of the masticatory muscles with changes in head position.<sup>5,9-11</sup> This change in activity also changes the vertical and horizontal position of the mandible.<sup>11</sup> Although research has shown that a short-term change in head position will affect the position of the mandible, there is no experimental evidence that a definitive change in the rest position of the mandible will be evident with a change in habitual head posture. When poor postural position of the head on the neck creates musculoskeletal imbalance, the rest position of the mandible can be expected to change as a more balanced state is attained through physical therapy procedures.<sup>12</sup> Pilot studies have shown that physical therapy procedures designed to improve the posture of the head and neck increase the vertical dimension of rest (VDR).<sup>13</sup> Changes in mandibular rest position are important to the dentist in prosthodontic treatment.<sup>14-22</sup>

The purposes of this study were (1) to determine if a change in habitual head posture affects the definitive rest position of the mandible, and (2) to substantiate whether physical therapy procedures are beneficial in the improvement of head posture.

## METHODS

A one-group pretest-posttest design was completed for eight subjects between June and September of 1982.<sup>23</sup> Two men and six women 26 to 33 years of age ( $\bar{X} = 29.3$ ,  $SD = \pm 2.6$ ) participated in the study. Each subject had all the natural teeth (except third molars) and a forward head posture. Forward head posture was determined by a profile view of the patient standing behind a plumb line. Subjects were aligned with the base of the plumb line just anterior to the lateral malleolus of the fibula. If the earlobe and shoulder were anterior to the plumb line, a forward head posture was recorded.<sup>24</sup>

## Instrumentation

The most apparent clinical changes in rest position are observed in the evaluation of the VDR.<sup>25,26</sup> From the several methods used to measure VDR, we selected a photographic approach.

To establish the reliability of photographic measurements, dots were placed on the nose and chin of five normal subjects. A dentist measured the vertical distance between the points with the teeth in occlusion.<sup>27</sup> Three measurements were made for each subject, and the mean was recorded. Three full-face photographs were made of the subjects standing next to a plumb line with a millimeter ruler attached to it at the level of the tip of the nose. Photographs were also made with the teeth in occlusion. The film transparencies were projected onto a vertical piece of paper, and the vertical distance between the dots was measured as calibrated to the millimeter ruler in the photograph. The mean of the three measurements was recorded. The photographic measurements were compared with the clinical measurements by determining the interclass correlation coefficient ( $ICC = .98$ ;  $F = 83.3$ ;  $df = 4, 5$ ;  $p < .01$ ).<sup>28</sup> This comparison was significant, which indicated agreement between the methods of measuring VDR.

The reliability of reproducing the points to measure VDR over time was also tested. The same five subjects had profile photographs made while facing a plumb

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\*Physical therapist, Physical Therapy Orthopaedic Specialists Inc.

\*\*Physical therapist, Institute of Graduate Health Sciences.

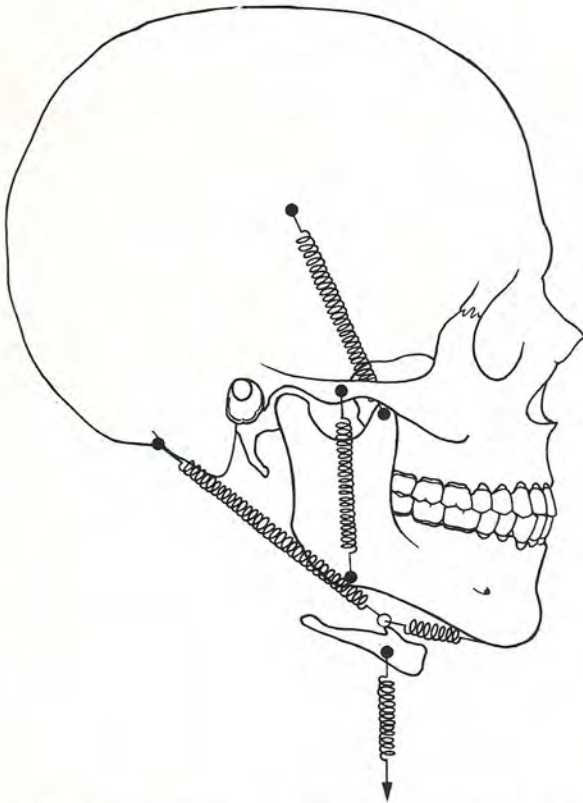


Fig. 1. Diagram illustrates interrelationship of muscles of craniocervical region. (Reproduced with permission from Cohen, B., and Kramer, R.H.: Scientific Foundations of Dentistry, London, 1976, William Heinemann Medical Books Ltd.)

line and gazing at their eyes in a vertical mirror to maintain a constant head position.<sup>29</sup> A millimeter ruler was attached to the plumb line at the level of the face (Fig. 2). Three lateral photographs were made of the subjects with the mandible in the rest position. The first photograph was made after the subject had pronounced the letter /m/ three times and relaxed the mandible.<sup>30</sup> The second photograph was made after the mandible had been opened, the teeth closed together, and the mandible relaxed.<sup>31</sup> The third photograph was made after swallowing and relaxing the mandible.<sup>25,26</sup> The film transparencies were projected onto a vertical piece of paper, and a horizontal line was drawn from the most anterior point on the chin and the most anterior point on the nose to the millimeter ruler (Fig. 2). The VDR was the vertical distance between the two lines as calibrated to the millimeter ruler in the photograph (Fig. 2). The mean VDR measurement of the three photographs was recorded for each subject. The same procedure was repeated approximately 4 weeks later, and the measurements were compared

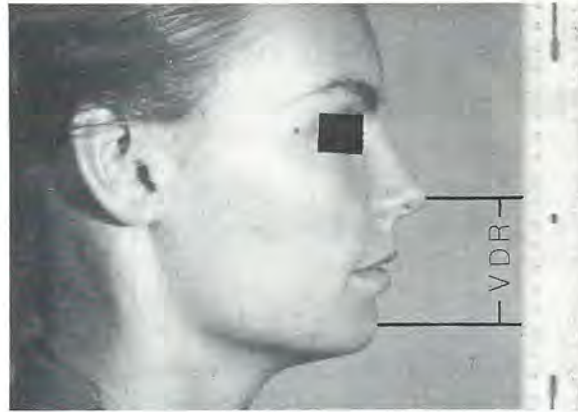


Fig. 2. Method of photographic measurement of VDR. Distance between most anterior point on nose and chin is calculated.

with the original by determining the interclass correlation coefficient ( $ICC = .97$ ;  $F = 5.7$ ;  $df = 4, 5$ ;  $p < .01$ ).<sup>28</sup> The values indicated reliability in reproducing the points for measuring VDR. The same measurements were made to evaluate changes in VDR after physical therapy treatment.

To assess changes in forward head posture, three profile photographs were made of the subjects facing a plumb line while they stared at their eyes in a vertical mirror. A wooden pointer was attached to the tip of the convexity of the seventh cervical spinous process to identify this landmark in the photograph. The vertebra was identified as the most prominent cervical vertebra located just below the vertebra that glides away from the palpating finger with cervical backward bending.<sup>32</sup> Subjects were instructed to stand in a normal, relaxed position while the photograph was made. The film transparencies were projected onto a vertical piece of paper, and a horizontal line was drawn through the wooden pointer to mark the seventh cervical vertebra. Another line was drawn from this point through the most posterior point of the tragus of the ear. The angle formed by these two lines was measured by a protractor and recorded in degrees (Fig. 3).<sup>33,34</sup> The mean value of the angles formed in the three photographs was recorded.

General observation of posture; palpation to the head and neck; assessment of tongue position, swallowing and breathing; and active and passive range of motion of the cervical spine were also noted for each subject. Physical therapy treatment was provided for 4 weeks with two to three 40-minute sessions per week ( $\bar{X} = 8.5$ ,  $SD = \pm .7$ ). The treatment included soft tissue and muscle stretching; manipulation of the cervical apophyseal joints; instruction in proper tongue



Fig. 3. Method of photographically measuring forward head posture. Angle of head to cervical spine is observed between a horizontal line drawn through seventh cervical vertebra and a line from superior aspect of seventh cervical vertebra to tragus of ear.

position, swallowing, breathing, and posture; and a home exercise program. The treatment program was individualized according to the needs of the subject. All pretreatment measurements were repeated after 2 and 4 weeks of physical therapy.

#### Data analysis

An analysis of variance (ANOVA) for repeated measures was used to determine significant changes in both VDR and head posture after physical therapy ( $\alpha = .05$ ).<sup>35</sup> In addition, a Bonferroni test was used to determine if the significant changes in VDR and head posture occurred between the first and second, first and third, or second and third measurements.

#### RESULTS

Changes in mean VDR for the first, second, and third measurements for the eight subjects showed that the VDR increased in all subjects between the first and second measurements ( $\bar{X} = 2.3$ ,  $SD = \pm 1.4$  mm), and the first and third measurements ( $\bar{X} = 3.7$ ,  $SD = \pm 1.1$  mm) (Fig. 4). Increase in VDR was noted in six of the eight subjects between the second and third measurements ( $\bar{X} = 1.9$ ,  $SD = \pm 1.6$  mm). Both changes in VDR were significant ( $F = 20.77$ ;  $df = 2, 14$ ;  $p < .01$ ) as confirmed by the Bonferroni test. Although a statistically significant change did not occur between the second and third measurement, the VDR continued to increase in six of the eight subjects.

The change in the angle of the head posture also showed an increase in all subjects between the first and second ( $\bar{X} = 3.1$ ,  $SD = \pm 2.4$  degrees), and the first and third measurements ( $\bar{X} = 5.0$ ,  $SD = \pm 3.3$

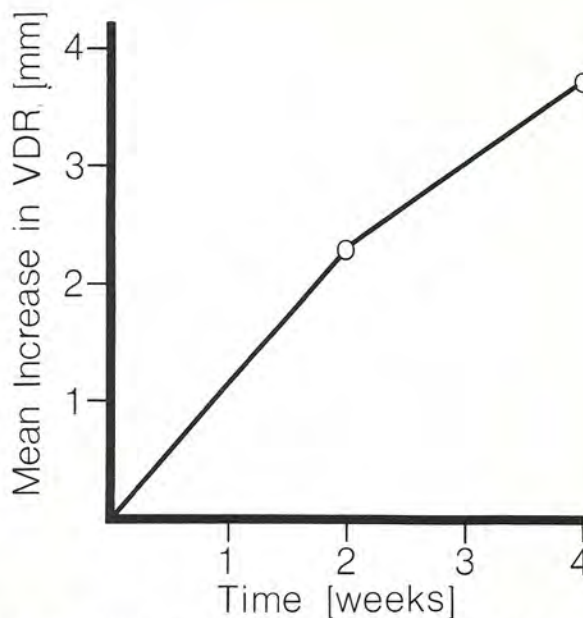


Fig. 4. Mean increase in VDR over 4 weeks of physical therapy for eight subjects.

degrees) (Fig. 5). Both changes in head posture were significant ( $F = 14.18$ ;  $df = 2, 14$ ;  $p < .01$ ) as confirmed by the Bonferroni test.<sup>35</sup> All but one subject increased the angle of head posture between the second and third measurements ( $\bar{X} = 2.0$ ,  $SD = \pm 1.4$  degrees). Although a statistically significant change did not occur between the second and third measurements, the measurement continued to increase in seven of eight subjects.

#### DISCUSSION

This study suggests that an increase in VDR occurs with an increase in the angle of habitual head posture. With these increases, less retrusion of the mandible was also evident in the final photographs when compared with the originals. With forward head posture, the posterior cervical muscles are shortened isometrically while the anterior submandibular muscles are stretched to cause retrusive forces on the mandible.<sup>24,36</sup> In this study the posterior cervical muscles, soft tissue, and joints were stretched with physical therapy, which resulted in a more ideal head position and a more balanced state of the soft tissues of the head and neck. The improved head position may also decrease the stretch of the anterior cervical muscles with a resultant decrease in the retrusive forces on the mandible.

When compared with the findings of Darvell and Spratley,<sup>37</sup> the observed change in VDR in this study was significant clinically as well as statistically. The

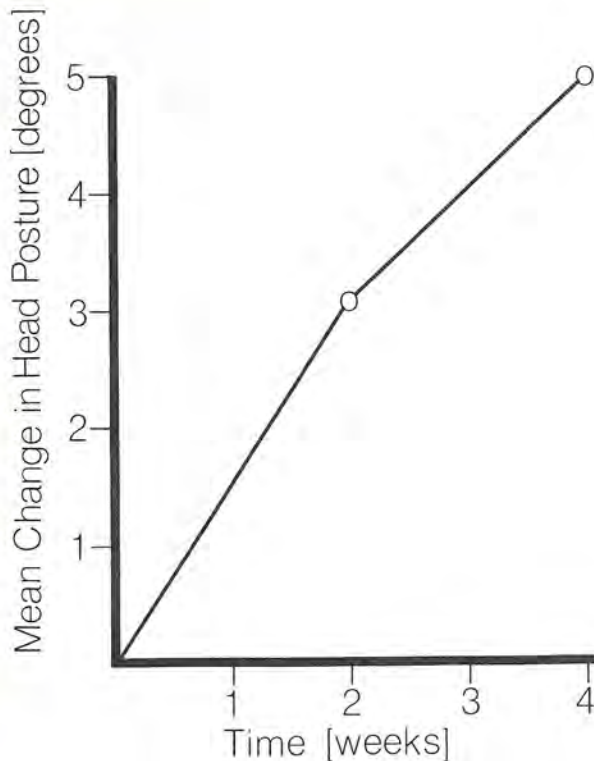


Fig. 5. Mean change in head posture over 4 weeks of physical therapy treatment for eight subjects.

dentist should recognize the relationship between habitual head posture and the rest position of the mandible in the practice of orthodontics and prosthodontics. An inaccurate determination of VDR in a patient with poor head and neck posture may result in clenching and grinding of teeth, resorption of tissue, temporomandibular joint dysfunction, pain, and loss of esthetics.<sup>17,26,38</sup> If poor head and neck posture is noted by the dentist, a 2- to 4-week period of physical therapy may be indicated to improve head posture.

In this study, head posture was recorded as the angle formed by a horizontal line drawn from the seventh cervical vertebra and a line from this vertebra through the tragus of the ear (Fig. 3). The normal angle for head posture is 50 to 60 degrees; and an increase in this angle, as shown in this study, reflects movement of the head closer to a more ideal position.<sup>35,39</sup> All subjects exhibited head posture within the normal range after 4 weeks of physical therapy, and all showed an improvement in posture. Improved motion and flexibility was also noted in the cervical regions as treatment progressed. The exact reason for improvement is not documented, but there are several possible explanations. Initially, the increased motion and flexibility from soft tissue stretch and joint manipulation may

have allowed the subjects to move the head to a more ideal position. Secondly, instruction in correct posture may have increased the subjects' awareness of poor posture. Finally, the home exercise program may have enabled the subjects to maintain the changes achieved with physical therapy.

## SUMMARY AND CONCLUSIONS

Eight subjects were evaluated to assess the relationship between VDR and head posture. Photographic evaluation of head position and VDR was performed initially to quantify a baseline recording. All subjects were then given 4 weeks of physical therapy to improve head posture. Photographs were remade after 2 and 4 weeks of therapy. An increase in the VDR and in the angle of the head to the cervical vertebra was noted in all patients. Although further study is indicated to confirm the findings of this pilot study, it appears that the VDR is influenced by head position. This finding should be considered when prosthodontic problems are treated.

## REFERENCES

1. Brodie, A. G.: Anatomy and physiology of head and neck muscles. *Am J Orthod* 36:831, 1950.
2. Thompson, J. R., and Brodie, A. C.: Factors in the position of the mandible. *J Am Dent Assoc* 29:925, 1942.
3. Atwood, D. A.: A review of the fundamentals of rest position and vertical dimension. *Int Dent J* 9:6, 1959.
4. Cohn, S.: A cephalometric study of rest position in edentulous persons: Influence of variations in head position. *J PROSTHET DENT* 7:467, 1957.
5. Funakoshi, M.: Effects of the tonic neck reflex on the jaw muscles of the rat. *J Dent Res* 52:668, 1973.
6. McLean, L. F., Brenman, J. H., and Friedman, M. G.: Effects of changing body position on dental occlusion. *J Dent Res* 52:1041, 1973.
7. Mohl, N. D.: Head posture and its role in occlusion. *NY State Dent J* 42:17, 1976.
8. Murphy, W. M.: Rest position of the mandible. *J PROSTHET DENT* 17:329, 1967.
9. Wyke, B.: Neurology of the cervical spinal joints. *Physiotherapy* 65:72, 1979.
10. Funakoshi, M., Fujita, N., and Takehana, S.: Relations between occlusal interference and jaw muscle activities in response to changes in head position. *J Dent Res* 55:684, 1976.
11. Lund, P., Nishiyama, T., and Moller, E.: Postural activity in the muscles of mastication with the subjects upright, inclined, and supine. *Scand J Dent Res* 78:419, 1970.
12. American Academy of Orthopedic Surgeons: Posture and its relationships to orthopedic disabilities. A report of the posture committee. 1947.
13. Ayub, E., Glasheen-Wray, M., and Kraus, S.: Head posture: A case study of the effects on the rest position of the mandible. *J Orthop Sports Phys Ther* 5:179, 1984.
14. Brill, N., Lammie, G. A., Osborne, J., and Perry, H. T.:

- Mandibular positions and mandibular movements. *Br Dent J* 106:391, 1959.
15. Duncan, E. T., and Williams, S. T.: Evaluation of rest position as a guide to prosthetic treatment. *J PROSTHET DENT* 10:643, 1960.
  16. Fish, F.: The functional anatomy of the rest position of the mandible. *Dent Pract (Bristol)* 11:178, 1961.
  17. Gattozzi, J. G., Nicol, B. R., Somes, G. W., and Ellinger, C. W.: Variations in mandibular rest position with and without dentures in place. *J PROSTHET DENT* 36:159, 1978.
  18. Gillis, R. R.: Establishing vertical dimension in full denture construction. *J Am Dent Assoc* 28:430, 1941.
  19. Krajicek, D.: Clinical and electromyographic study of mandibular rest position. *J PROSTHET DENT* 11:826, 1961.
  20. Posselt, U.: Studies on the mobility of the human mandible. *Acta Odontol Scand* 10:1, 1952.
  21. Thompson, J. R.: The constancy of the rest position of the mandible and its influence on prosthetic restorations. *Ill Dent J* 12:242, 1943.
  22. Thompson, J. R.: The rest position of the mandible and its significance to dental science. *J Am Dent Assoc* 33:131, 1946.
  23. Campbell, D. T., and Stanley, J. C.: *Experimental and Quasi-experimental Designs for Research on Teaching*. Chicago, 1963, Rand-McNally.
  24. Kendall, H. O., Kendall, F. P., and Boynton, D. A.: *Posture and Pain*. Huntington, New York, 1952, Robert E. Krieger Publishing Co. Inc., pp 29, 103, & 113.
  25. Atwood, D. A.: A critique of research of the rest position of the mandible. *J PROSTHET DENT* 16:848, 1966.
  26. McGee, G. F.: Use of facial measurements in determining vertical dimension. *J Am Dent Assoc* 35:342, 1947.
  27. Schwarz, A. M.: Positions of the head and malrelations of the jaw. *Int J Orthod Oral Surg Radiol* 14:50, 1928.
  28. Barth, J., and Carpenter, W.: On the methods and theory of reliability. *J Nerv Ment Dis* 163:307, 1976.
  29. Moorrees, G. F., and Kean, M. R.: Natural head position: A basic consideration in the interpretation of cephalometric radiographs. *Am J Phys Anthropol* 16:213, 1958.
  30. Turrell, A. J.: Clinical assessment of vertical dimension. *J PROSTHET DENT* 28:238, 1972.
  31. Heath, M. R.: The contact relax method to establish rest position and assess interocclusal distance. *Br Dent J* 149:181, 1980.
  32. Grieve, G.: *Common Vertebral Joint Problems*. London, 1981, Churchill Livingstone, p 32.
  33. Cureton, T. K., Wickens, J. S., and Elder, H. P.: Reliability and objectivity of the Springfield postural measurements. *Res Q* 6:81, 1935.
  34. Walgoose, C.: *Evaluation in Health, Education, and Physical Education*. New York, 1961, McGraw-Hill Book Company, Inc.
  35. Netter, J., and Wasserman, W.: *Applied Linear Statistical Models*. Homewood, Ill., 1974, Richard Irwin, Publisher, pp 722-743.
  36. Cailliet, R.: *Soft Tissue Pain and Disability*, ed 2. Philadelphia, 1979, F. A. Davis Co.
  37. Darvell, B. W., and Spratley, M. H.: The inapplicability of the formulae to determine vertical dimension. *Aust Dent J* 24:48, 1979.
  38. Shpuntoff, H., and Shpuntoff, W. A.: A study of the physiologic rest position and centric position by electromyography. *J PROSTHET DENT* 6:621, 1956.
  39. Cureton, T.: Bodily posture as an indicator of fitness. *Res Q* 12:348, 1941.

*Reprint requests to:*

DONALD W. DARLING, M.S., P.T.  
 PHYSICAL THERAPY ORTHOPAEDIC SPECIALISTS INC.  
 800 EAST 28th STREET AT CHICAGO AVE.  
 MINNEAPOLIS, MN 55407