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Correction of the Maxillary Occlusal Plane Relieves Persistent Headache and Shoulder Stiffness

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Ueda, H., Yamada, T., Ohrui, T., Ebihara, S., Kuraishi, M., Kobayashi, Y., Tamura, M., Shimizu, A., He, M. and Sasaki, H. *Correction of the Maxillary Occlusal Plane Relieves Persistent Headache and Shoulder Stiffness*. Tohoku J. Exp. Med., 2005, **205** (4), 319-325 —— It has been known for many years that deformations of the occlusal plane of the teeth cause indefinite symptoms such as headaches or stiffness of the shoulders. However, how the occlusal plane of the teeth should be corrected remains uncertain. The purpose of this study was to examine whether a correction of the deviation of the maxillary occlusal plane (MOP) from the center of dens of axis vertebrae (DAV) improves symptoms in patients having intractable headache or shoulder-stiffness. Forty patients who complained of dental abnormalities and persistent headache or shoulder-stiffness that had not responded to conventional medical treatment and 17 healthy controls were recruited. All subjects received a lateral cephalometric x-ray examination to measure a distance from the MOP and the center of DAV. In the healthy subjects, both the upper and the lower shift of the MOP from the center of DAV were minimal (the upper shift was 1 ± 2 [mean ± s.d.] mm and the lower shift was 4 ± 4 mm). By contrast, the patients had a significantly greater deviation of the MOP from the center of DAV. Dental adjustment treatment was performed in fourteen patients who had a substantial deviation of the MOP from the center of DAV. Those patients were asked about their symptoms which were scored using a point system and were compared before and after treatment. An adjustment procedure of the MOP passing through the DAV significantly relieved clinical symptoms in these patients (before 42.5 ± 34.4 vs after 7.0 ± 8.2, $p < 0.01$). Correction of the MOP passing through the near center of DAV might be effective in relieving clinical symptoms associated with dental deformities. ——— maxillary occlusal plane; dens; cervical vertebrae; clinical symptoms; neck rotation

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It has been known for many years that deformations between the occlusal plane of the teeth not only cause adverse effects on the periodontal tissues, but occasionally they may also result in various indefinite physical symptoms such as headaches or stiffness of the shoulders (Huggare et al. 1991; Tsang et al. 1997; Milani et al. 1998; Motoyoshi et al. 2000; Yagi et al. 2003). Although these physical symptoms due to dental deformities may be relieved by correcting these deformities of the teeth, how the occlusal plane of the teeth should be corrected still remains uncertain (Motoyoshi et al. 2000). The occlusion of the teeth may bring various effects on the skull and neck (Solow and Sonnesen 1998). The force on the occlusal plane generated by the mandibula is as strong as 40 to 60 kg at the first molar (Jenkins 1978). Since the dens of axis vertebrae (DAV) is an unique one which has an axis to rotate the atlas, the occlusal plane of the teeth through the dens might be the most effective way to transfer the rotating force to the neck. On the contrary, if the occlusal plane of the teeth crosses cervical vertebrae other than the DAV, the rotating force of the head might not be as smooth as that on the DAV because there is no axis for rotation. The DAV through which the occlusal plane of the teeth passes, is assumed to be the only special process providing support when the neck is rotated left and right.

We hypothesized that the deviation of the maxillary occlusal plane (MOP) from the center of dens of axis vertebrae (DAV) might be responsible for symptoms in patients with intractable headache or shoulder-stiffness. To test this hypothesis, in the present study, we examined the occlusal planes in healthy volunteers and those in patients who suffered from persistent physical symptoms such as headaches or shoulder stiffness that had not responded to conventional medical treatment. We adjusted the occlusal planes of the teeth passing through the DAV and examined whether clinical symptoms were relieved or not in these patients.

Materials and Methods

Forty patients visiting a dental clinic due to dental abnormalities as well as physical symptoms such as headaches and stiffness of the shoulders, who had not responded to conventional medical care for more than two years, (23 women / 17 men, age 47 ± 15 [mean ± S.D.] years, age range 18-82 years) were examined by lateral cephalometric x-rays (Tsang et al. 1997) to investigate whether the occlusal plane connecting the second premolar and the first molar passed through the DAV or not. This was because the teeth demonstrating the strongest force on the occlusal planes are the second premolar and the first molar. In order to investigate the occlusal planes passing through the second premolar and the first molar of the maxilla, a straight orthodontic wire was fixed to the right and left sides of the maxilla and then lateral cephalometric x-rays were taken. The patients sat inside the x-ray lucent frame, in a natural head position. From the frame, two rods were extended and attached to the external auditories of both sides in order to fix the head straight forward. The positions of the two rods fixing the head were used for repeated cephalometric x-rays. The distance from the x-ray source to the x-ray film was 165 cm and that from the center of the head to the x-ray film was 15 cm. Therefore, there would be approximately 10% magnification error in measuring the shift of the occlusal plane from the DAV. Seventeen healthy subjects who had no complaints of dental abnormalities and physical symptoms with at least 24 teeth and were over 70 years old (5 women / 12 men, age 78 ± 8 years, age range 70-96 years) were also examined to see if the MOP passed through the DAV or not. The healthy subjects were those who were recognized to be in excellent condition by a physical examination including a regular community dental examination conducted annually by a community organization.

All of the patients received regular treatment for dental caries and periodontal diseases. The patients were randomly (by random numbers table) divided into two groups. One was a control (11 women / 9 men, age 49 ± 14 years) who received only regular treatment for dental caries and periodontal diseases, and the other was a treated group (12 women / 8 men, age 46 ± 16 years) who received not only regular dental treatments but also adjustments of the occlusal plane by occlusal reshaping or by wearing resin splints on the teeth so that the maxillary occlusal plane (MOP) passed through the DAV as much as possible during a period of one month to a maximum

of one year, but mostly for half a year. Adjustments of the occlusal plane were checked by lateral cephalometric x-rays when necessary.

The patients were asked about their clinical symptoms before and after dental treatment, and the symptoms were scored using a point system for a follow-up study. The symptoms of which the patients complained were 84 modified items of dental distress syndrome ranging from tooth pain to a feeling of physical symptoms that were relatively diverse including shoulder stiffness, trembling of hands, easy fatigue, nausea, eye twitching, chronic diseases, etc (Fonder 1989). Regarding each item, the patients were questioned intermittently based on four categories. When no symptoms were detected, 0 points were given, and 1, 2 and the highest 3 points were given based on the severity of the symptoms. The total points were monitored before treatment, one month after treatment and to a maximum of one year. The total points were zero if there were no symptoms and the maximum points were $84 \times 3 = 252$ points.

Comparisons were made between pre- and post-treatment values of occlusal planes as well as clinical symptoms using the paired *t*-test. Significance was accepted at $p < 0.05$. The Tohoku University Ethics Committee granted ethical approval, and a full explanation concerning the influence of the occlusal plane was given and informed consent of the treatment was obtained from each patient.

Results

Fig. 1 shows examples of cephalometric x-rays where the MOPs are across the center of the DAV (Fig. 1A), shifted upward to the direction of the DAV (Fig. 1B) and shifted downward to the direction of the DAV (Fig. 1C). The center of the DAV is marked as the middle crossing points of the dens extending from the axis vertebrae (height of approximately 11 mm) and the width of dens (approximately 5 mm). The shift of the occlusal planes was not changed by the upward or downward movement of the skull. In the healthy subjects, the upper shift of the MOP from the center of DAV was 1 ± 2 mm and the lower shift was 4 ± 4 mm. These results revealed that the area covering the upper 3 mm or the lower 8 mm from the center of the DAV (0 mm) was recognized as a normal range at a risk of 95%.

Among the 40 patients, 17 control patients (12 women / 5 men, age 43 ± 16 years) and 14 treated patients (8 women / 6 men, age 51 ± 15 years) completed the study. Fig. 2 shows an example of a patient in whom right and left MOPs were dislocated to the upper side of the center of the DAV. After the dental adjustment treatment, the bilateral MOPs entered the DAV and the scores of indefinite symptoms declined from 82 points to 19 points. Deviation of the MOP from the center of the DAV was recorded as 0 mm (at the center of the dens) and the upward (negative) shift or downward (positive) shift as 1mm interval after dental adjustment treatment.

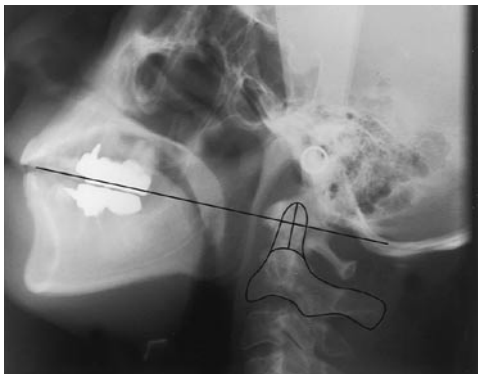
Fig. 3 shows the distance from the MOP to the center of the DAV in the group of patients showing lower (positive) shifts or upper (negative) shifts. The control group of patients showed no changes in the occlusal plane before and after regular treatments for dental caries and periodontal diseases (data not shown). In contrast, the MOP of patients with both regular dental treatment and dental adjustment treatment was significantly corrected toward the center of the DAV both in the right and in the left sides (Fig. 3).

Fig. 4 shows the change in symptom scores in patients with only regular dental treatment (control) or in those with both regular dental treatment and adjustment treatment, before and after treatment. The symptom scores of the control group showed no significant differences. On the other hand, the symptom scores in the adjustment treatment group were significantly improved (before 42.5 ± 34.4 vs after 7.0 ± 8.2, $p < 0.01$). However, no correlations were found between the baseline symptom scores and the absolute values of the shifts of the MOP from the center of DAV in either positive or negative shift.

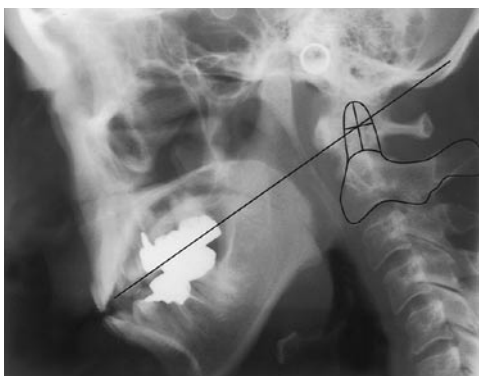
Discussion

Numerous investigators describe the effect of an altered mandibular position on cranial posture (Costianes 1983; Fonder 1989; Alonen 2002). Forward and lateral positions change the mandible, hyoid bone, and tongue (Darnell 1983). There is compression in the upper cervical facet joints, causing muscular nerve entrapments. Nerve root compression or posterior vertebrae

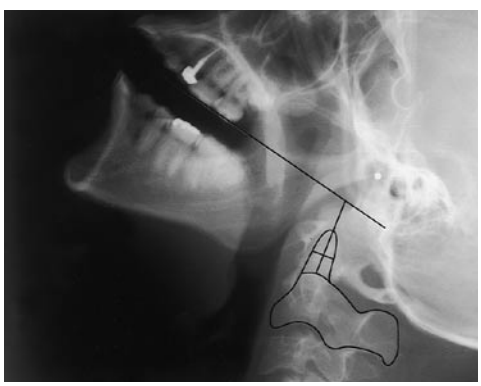
A-a



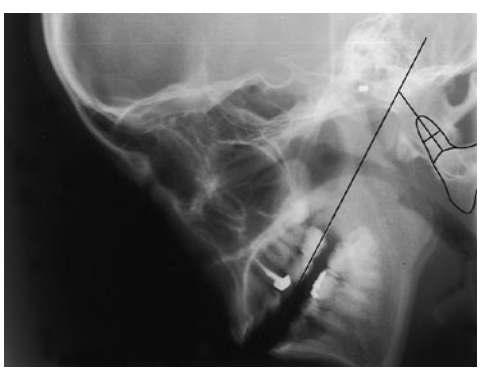
A-b



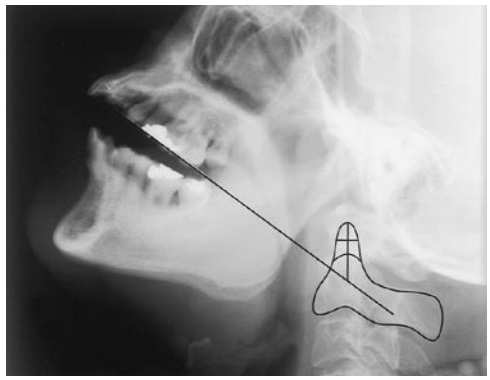
B-a



B-b



C-a



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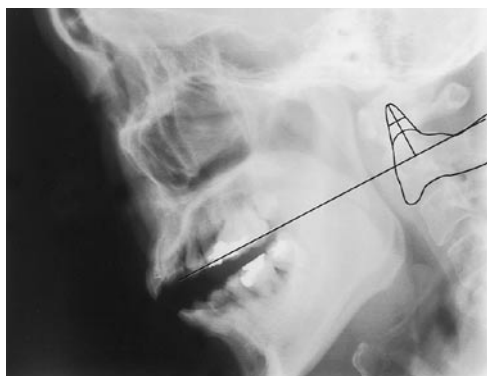
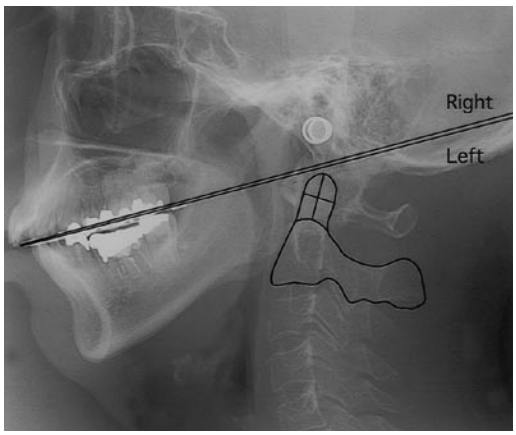


Fig. 1. Lateral cephalometric x-rays showing the three different local relationships between the occlusal plane and the dense.
Examples of lateral cephalometric x-rays show that shifts of the maxillary occlusal planes from the dens are fixed despite the upward (a) and downward movements (b) of the skull in three different local relationships between the occlusal planes and the dens (A, B, C). Straight orthodontic wires were fixed to the left sides of the maxilla, from which liner extraporations show how far the occlussal planes shift from the dens. Anatomical configurations were traced on the films.

A



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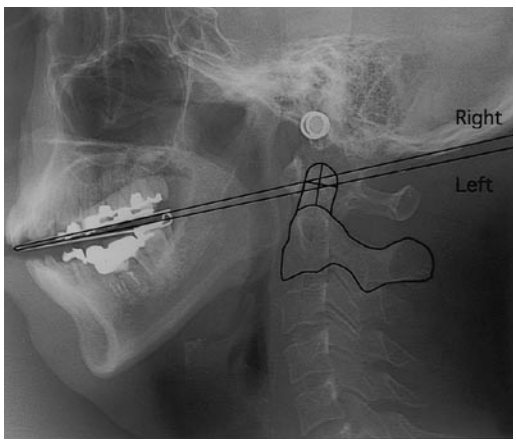

Fig. 2. Representative lateral cephalometric x-ray profiles in a patient before and after dental adjustment treatment.
Two rings show the external auditories of both sides. Zero mm of the dens is shown as a rectangular cross point (center). Before treatment, the occlusal plane shifted upwards by 9 mm on the right and 7 mm on the left side from the center of the dens (A). After dental adjustment treatment, the occlusal plane passed through the dens (B) and clinical symptom scores were reduced from 82 points to 19 points.

facet irritation or restriction result in peripheral entrapment neuropathies (Kopell and Thompson 1976). One common entrapment is the greater or lesser suboccipital nerves that pass between the occipit and atlas (Jones 1984). This may cause headaches or pain in the facial region. Many dental teams investigated and treated maloccluded teeth providing ideal dental occlusion by acrylic overlay fillings placed on all mandibular and maxillary first and second molars, and observed relief of clinical symptoms (Costianes 1983; Fonder 1989; Alonen 2002). However, they did not adjust the occlusal plane to the center of the dens of the axis of cervical vertebrae. According to this procedure, the rotating force of the neck would be most effectively applied to the dens but not to the other cervical vertebrae. In the present study, we have shown that patients who visited dentists due to dental problems as well as physical symptoms demonstrated significantly higher frequency of shifts from the center of the DAV compared with healthy subjects. This report will be the first which proved that an adjustment of the MOP crossing the DAV would be effective in reducing physical symptoms associated with dental deformities.

A very complex structure and functions are found in the oral cavity. Considering mastication of foods as an example, a strong force is generated on the occlusal plane daily and it is natural to assume that even a slight inefficiency causes an accumulated load. In addition to the concept that the teeth are aligned neatly, if the occlusal plane is corrected to pass through the near center of the dens, the dens supports the neck to avoid shifts by minimizing the loads in the right and left side of the neck during mastication of food and, as a result, a stable neck may be obtained.

However, a precise mechanism for the effect of correction of MOP on physical symptoms such as headache or shoulder stiffness was not clarified in the present study. It might or might not be that all known mammals have an occlusal plane almost passing through the 1st and the 2nd cervical vertebrae, which might be very important in making the cervical vertebrae stable. In the future, it is necessary to find out whether the same phenomenon occurs in mammals or to prove the phenomenon by measuring the loads of the forces to the vertebrae. The present method demonstrated an initial step in showing a direction of the correction of the dental occlusal plane. There are many elderly people with dentures who complain of the unpleasant feeling of dentures, which might be caused by not being aware of an inadequate

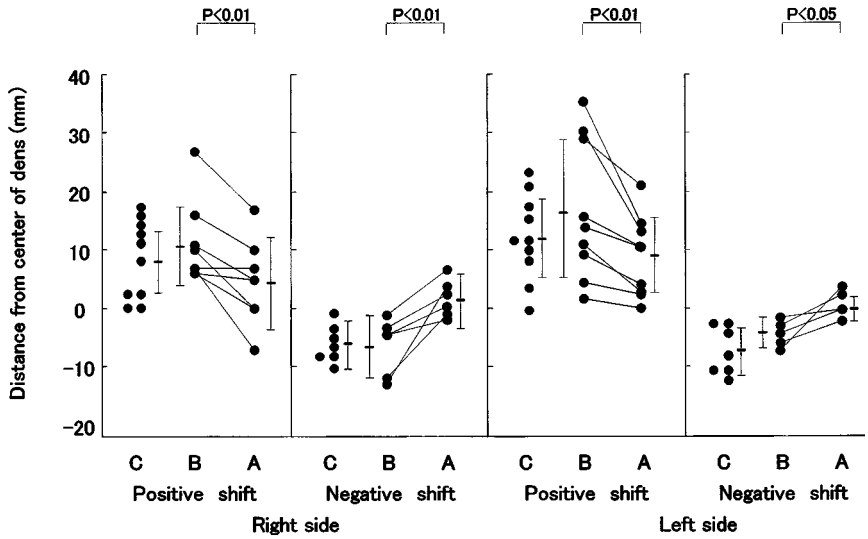

Fig. 3. The actual distance from the maxillary occlusal plane to the center of the dense.
The vertical bar indicates the actual distance from the maxillary occlusal plane to the center of the dens. Data were obtained from patients without dental adjustment treatment (C), those from patients with dental adjustment treatment before (B) and after treatment (A) in either right or left side. A connected line means that the data corresponds to the same patient before and after treatment. Mean ± S.D. are indicated by the bold horizontal bars and thin vertical bars, respectively. There was no significant difference between group C and B. There were significant differences between *B* and *A* ($p < 0.01$ or $p < 0.05$) as shown in this figure.

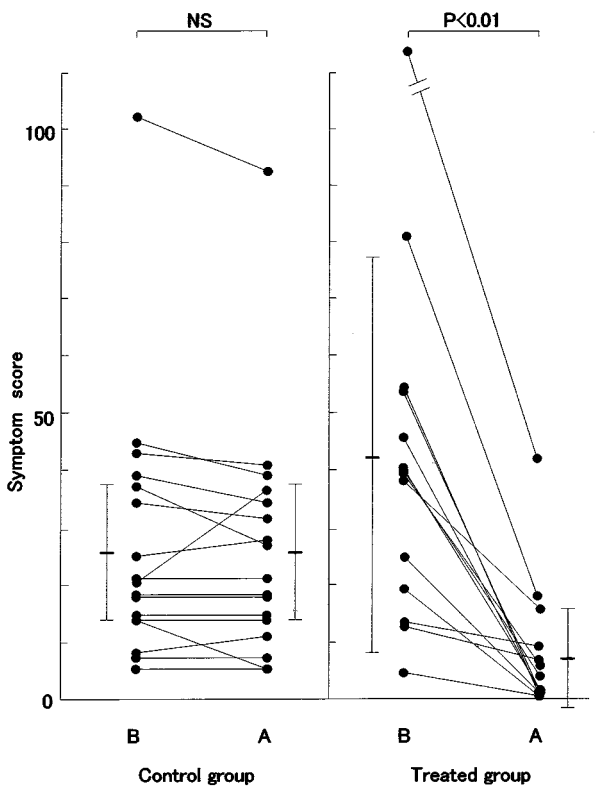

Fig. 4. Symptom scores in the control group and in the treated group, before and after dental treatment.
Symptom scores are shown in patients with only caries treatment (Control group) and with both dental caries and adjustment treatments (Treated group) before (B) and after (A) treatment. A connected line means that the data corresponds to the same patient. There was no significant difference between symptom scores obtained before and after treatment in the control group ($p = 0.86$). Symptom scores after treatment were significantly decreased compared with those before treatment in the treated group ($p < 0.01$). The highest score before treatment in the treated group was 142 points, and this decreased to 42 points after treatment.

maxillary occlusal plane. It is suggested that for elderly people with dentures it should also be determined if they have an adequate MOP passing through the center of the DAV.

In conclusion, our results suggest that correction of the maxillary occlusal plane passing through the near center of the dens of the cervical vertebrae might be effective in relieving clinical symptoms associated with dental deformities.

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