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A Clinical Examination and Electromyographic Evaluation in Edentulous Patient with MPD Syndrome

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Summary

It is not easy to establish the proper maxillo-mandibular relations and occlusion in order to construct complete dentures for edentulous patients who have lost all their natural teeth and surrounding structures. For this reason, many practitioners have studied the accurate procedures for jaw measurement. However, if edentulous patients have an improper measurement of occlusal vertical dimension and/or maxillo-mandibular relations in prosthetic treatment, they often complain of functional disorder of the masticatory system and the interaction between the muscles, the joints and occlusion. In these patients the functional demand exceeds the adaptive capacity of the neuromusculature. As a result, these patients exhibit muscle pain, deviation of the mandible on opening, joint noises, limited opening of the jaws, or other symptoms associated with the syndrome. In complete denture wearers with myofascial pain-dysfunction (MPD) syndrome, symptoms disappeared after improvement of the occlusal vertical dimension with the lower treatment denture. There were clear differences between before and after prosthetic treatment with electromyographic (EMG) activity of the masseter muscles.

Introduction

Not only has the effect of complete dentures on the supporting soft and hard-tissues been extensively studied from various aspects, but also the influence on the temporomandibular joint, vertical dimension and jaw relations in complete denture construction. The myofascial pain-dysfuction (MPD) syndrome is a problem of special interests to dentists and has been well described in the literature[1~20]. Basically, the MPD syndrome is sometimes found in patients who are disposed to stress and who, when under stress, place undue demands upon the masticatory apparatus. However, the origin and pathophysiologic characteristics of this syndrome are still unclear, and

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precise diagnostic criteria have been difficult to define. The disagreement in reported series might be due partly to confusion of terminology. It might, therefore, be valuable first to give a list of the most common symptoms found in functional disorders of the masticatory system. For instance, "temporomandibular joint (TMJ) dysfunction", "mandibular pain dysfunction", "MPD syndrome" are some of the expressions used for this clinical entity. Therefore, the MPD syndrome and the TMJ dysfunction syndrome have been topics of controversy in the dental field. The reason for this controversy are that a large proportion of the population is affected, and aetiologies of these disorders have not been conclusively established. Furthermore, a great deal of confusion exists in relation to the differential diagnosis and treatment of these sydromes. The basis for this confusion partially lies in the similarity of the symptoms associated with each disorder. Moss and Adams defined the TMJ dysfunction and MPD syndrome as the presence of one or more three symptoms: (a) pain and tenderness in the region of the muscle of mastication and TMJ; (b) sounds during condylar movements (e.g. popping or clicking of the jaw); (c) limitation of mandibular movement (Rugh & Solberg,1976[21]). The differential diagnosis of MPD syndrome is made on two additional criteria: (a) the absence of clinical or radiographic evidence of organic changes in the TMJ and (b) the lack of tenderness in the TMJ when this area is palpated in the external auditory meatus.

In this case, the main complaint of the patient was not the pain but a discomfort and numbness, detected by palpation, in his head, one third of the inferior maxillofacial part, and both buccal regions. The purpose of this report was to examine the cause of symptoms and to evaluate the EMG activity of the masseter muscles before and after prosthetic treatment.

Patient and Methods

Patient

Initial observations. A 64-year-old male complete denture wearer was refered to the Prosthodonitic Clinic at the Matsumoto Dental College Hospital for evaluation of discomfort thought to be of dental origin. He complained of discomfort and numbness in his head, one third of the inferior maxillo-facial part and the buccal regions on both side (Fig. 1). In particular, these symptoms would develop after he had three meals in one day. Further questioning revealed that he had experienced

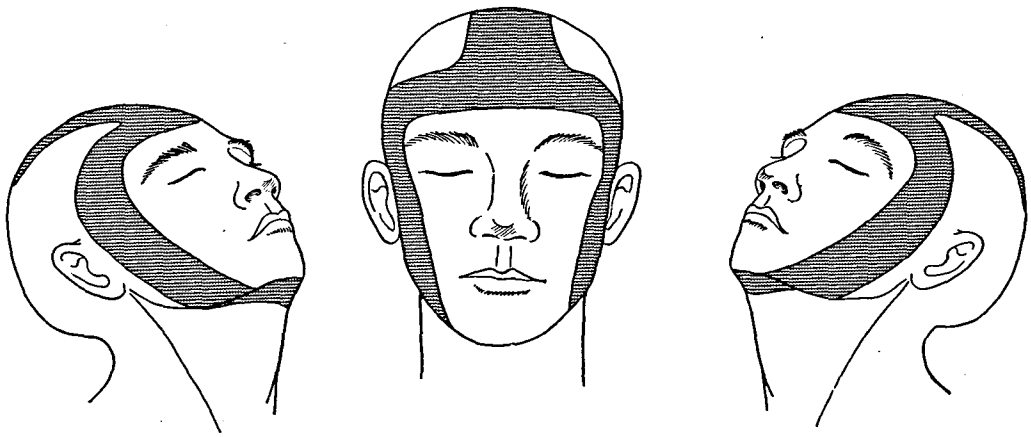

Fig. 1. Discomfort and numbness in patient at the initial observation

these regions discomfort and numbness to some degree following removal of right and left lower premolars 4 months previously, after which he had new complete dentures. After a week or so he began to have discomfort in his cheeks, which soon spread to the inferior part of the mandible, temporal, frontal and parietal regions. These symptoms relieved when he removed the lower denture out of his mouth. Furthermore, he complained of insufficient interocclusal distance in his dentures and of difficulty in talking, due to a clicking noise when the teeth made contact.

Medical and dental history. The medical and dental histories were unremarkable with the exception of the arrhythmia about 10 years previous, and the extractions of right and left lower premolar 5 months before.

Clinical examinations. The upper and lower edentulous arches were ideal in shape and relation with the exception of a slight resorption of lower posterior regions ; in the radiographic examination, the panoramic film provided good conditions. No problems were observed to palpate the regions of the greater palatines, incisive and mental foramen. Deviation and limitation of the mandible on opening or lateral movement, pain and tenderness on palpation of masticatory muscles and temporomandibular joint (TMJ) were not observed. Therefore, no psychological disorders were suspected.

Occlusal examinations. Some investigators have suggested a justification for the equilibration of occlusal disharmonies in the fact that tooth-contacts occurs during mastication. The neurophysiologic basis by which occlusal disharmonies might act in the creation of MPD syndrome is connected with the possible role of tooth-contacts and tooth-sliding during functional or dysfuctional movements in denture wearers. We, therefore, examined the relation of occlusal contacts between the upper and lower artificial teeth in centric position or centric occlusion, as well as the anterior and the lateral excursion, using the articulating paper. As a result, there was no problem in these relations, and it seemed that the occlusal equilibrium was established.

Methods

Measurement of the free-way space. During the examination of existing complete dentures, it is very important to examine the interocclusal distance (free-way space) between the occluding surfaces of the maxillary and mandibular teeth when the mandible is in its physiologic rest position. The interocclusal distance usually average between 2 or 4mm. If the vertical dimension is altered appreciably in either direction (overclosed or unduly opened), problems in speech and mastication, as well as temporomandibular joint dysfunction, may result. A lack of interocclusal distance can create soreness of the supporting tissues and make the region a target for rapid bone resorption. Clicking of complete dentures can also be attributed to a vertical dimension that have been utilized in determining occlusal vertical dimension. The patient's existing dentures, swallowing threshold, esthetics, tactile sense, and parallelism of the ridges in the posterior region are used with varing degrees of success. However, there is no precise scientific method for determining the correct occlusal vertical dimension.

We used a slide caliper in dental use in order to measure the rest and the occlusal vertical dimension between the mark on nose and on the chin, a method suggested by Niswonger (Table 1). These measurements were done 7 times and the maximum and minimum values were omitted. As another method of measuring vertical dimension, the Mandibular Kinesiograph (MKG) can be used to measure the vertical dimension of physiologic rest position. For the Kinesiograph preparation, a magnet was attached with acrylic resin on the lower anterior artificial teeth out of occlusion in accord with the manufacturer's instructions. The magnet could be snapped off and exactly re-

Table 1. The interocclusal distance (free-way space) in existing dentures

Type	Existing Denture			
Instru-ment	M. K. G.			S. C.
sec	T_{10}	T_{20}	T_{30}	
1 : ○	0. 2	0. 4	0. 3	0. 6
2 : ●	0. 3	0. 4	0. 4	0. 4
3 : △	0. 4	0. 5	0. 4	0. 8
4 : ▲	0. 3	0. 4	0. 5	0. 2
5 : □	0. 2	0. 3	0. 6	0. 5
$\bar{X}$: ×	0. 3	0. 4	0. 4	0. 5

mm

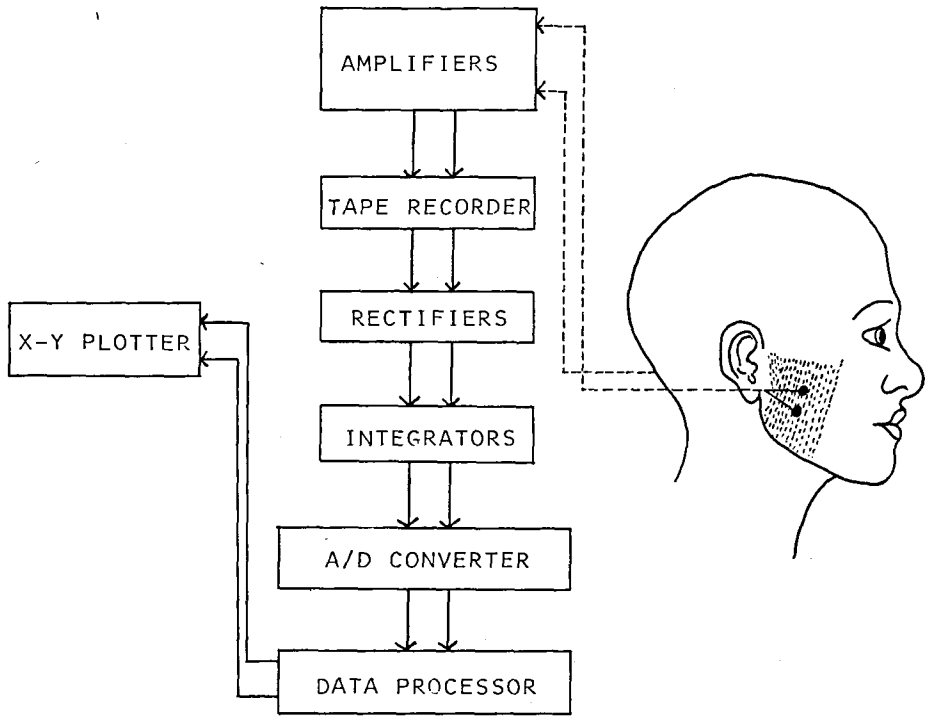

Fig. 2. The blockdiagram for Ressagous' figure

positioned. Six specially constructed fluxgate magnetometers were used to sense the magnetic field. The entire sensor array was mounted on an eyeglass frame and was lined up with the occlusal plane. The rest and occlusal vertical dimension were measured in the sweep mode and were recorded at

Table 2. Free-way space in existing dentures and the new denture

Type	New Denture				Existing Denture			
Instrument	M. K. G.			S. C.	M. K. G.			S. C.
sec	T_{10}	T_{20}	T_{30}		T_{10}	T_{20}	T_{30}	
1 : ○	2. 1	2. 4	2. 0	2. 5	0. 2	0. 4	0. 3	0. 6
2 : ●	2. 2	1. 5	1. 5	2. 2	0. 3	0. 4	0. 4	0. 4
3 : △	1. 6	1. 9	2. 1	2. 4	0. 4	0. 5	0. 4	0. 8
4 : ▲	2. 5	2. 8	2. 5	2. 4	0. 3	0. 4	0. 5	0. 2
5 : □	1. 9	2. 3	2. 4	2. 3	0. 2	0. 3	0. 6	0. 5
$\bar{x}$: x	2. 1	2. 2	2. 1	2. 3	0. 3	0. 4	0. 4	0. 5

mm

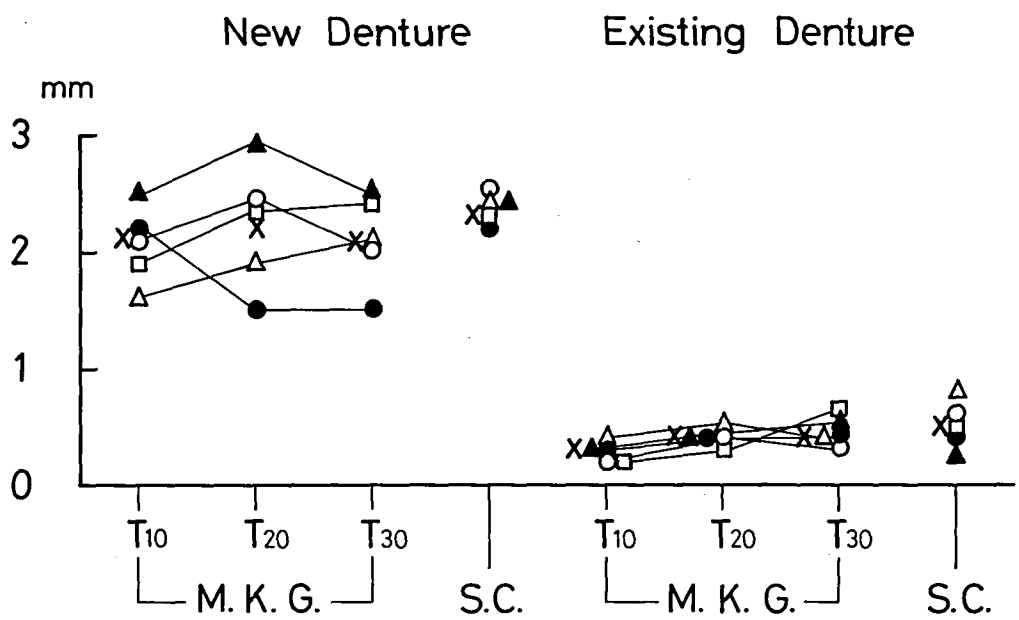

Fig. 3. The result of measurement in the occlusal vertical dimension in existing dentures and the new denture

10, 20, 30, sec. intervals, from the time when the physiologic rest position had been judged (Table 1). It was clear that the occlusal vertical dimension of existing dentures has increased greatly and that all of the values were less than 0.8mm in both method. The result of these examinations indicated that the largest cause of symptoms was practitioner error in determining the vertical complete denture construction. Accordingly, we have eased the patient's discomfort by means of the mandibular treatment denture which is lower than existing dentures.

Electromyographic examinations. In order to compare the effect of the occlusal vertical dimen-

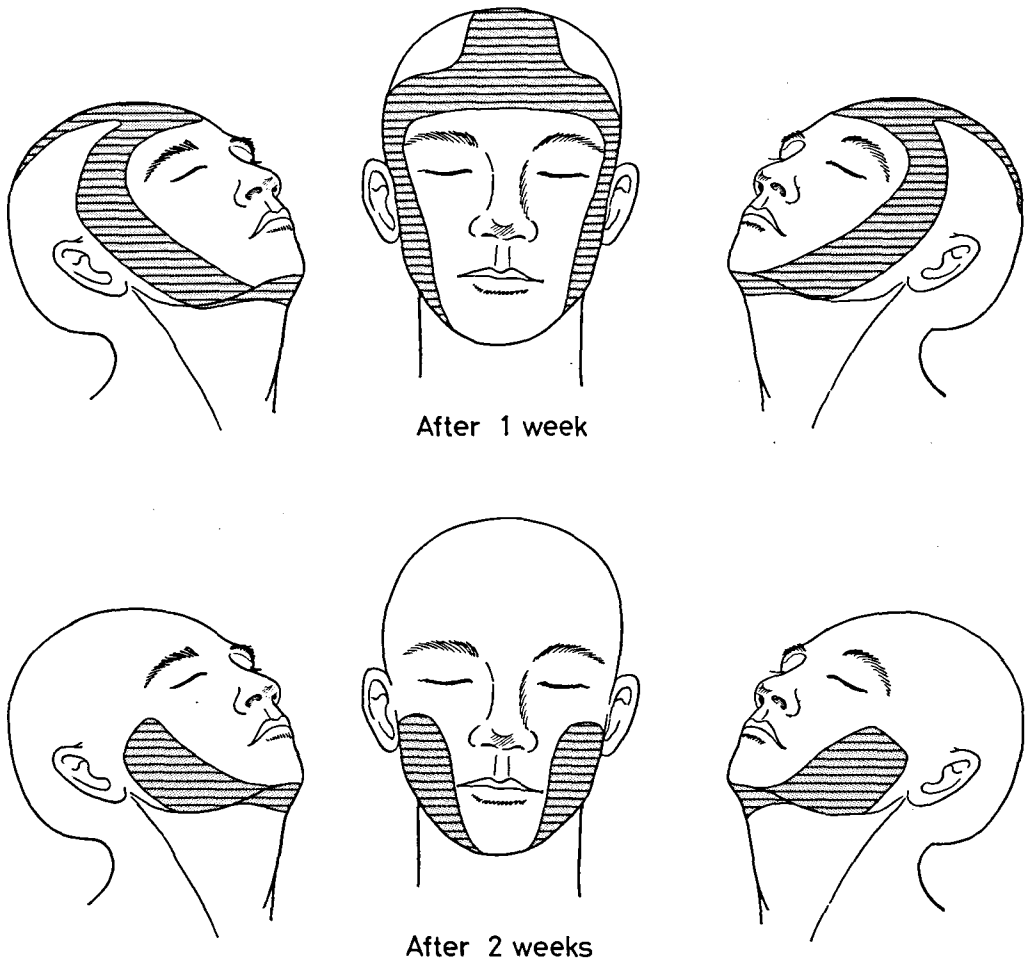

Fig. 4. The degrees and areas in patient with a new denture worn after 1, 2, 3 and 4 weeks

sion between existing dentures and the lower denture, EMG activity was recorded from the right and left masseter muscles (Fig. 2). The EMGs were recorded by bipolar surface electrodes placed over a reproducible point on these muscles. Care was taken that the orientation of these electrodes was approximately symmetrical on the two sides. After differential amplification, the EMGs from these electrodes were recorded using a FM cassette tape recorder, and subsequently it was replayed into an electronic integrator. This device sums the wave forms of an ingoing signal to produce a measure of its magnitude of the integral of an EMG is related linearly to the tension being developed by the muscle, provided that shortening of the muscles dose not occur. Variation in EMG integrals can reasonably be interpreted as an indication of variation in tension of the muscle concerned. Records were made on the mastication of chewing gum and a Japanese cracker "Senbei".

Results

As the result of these measurements, there was an apparent increase in the occlusal vertical

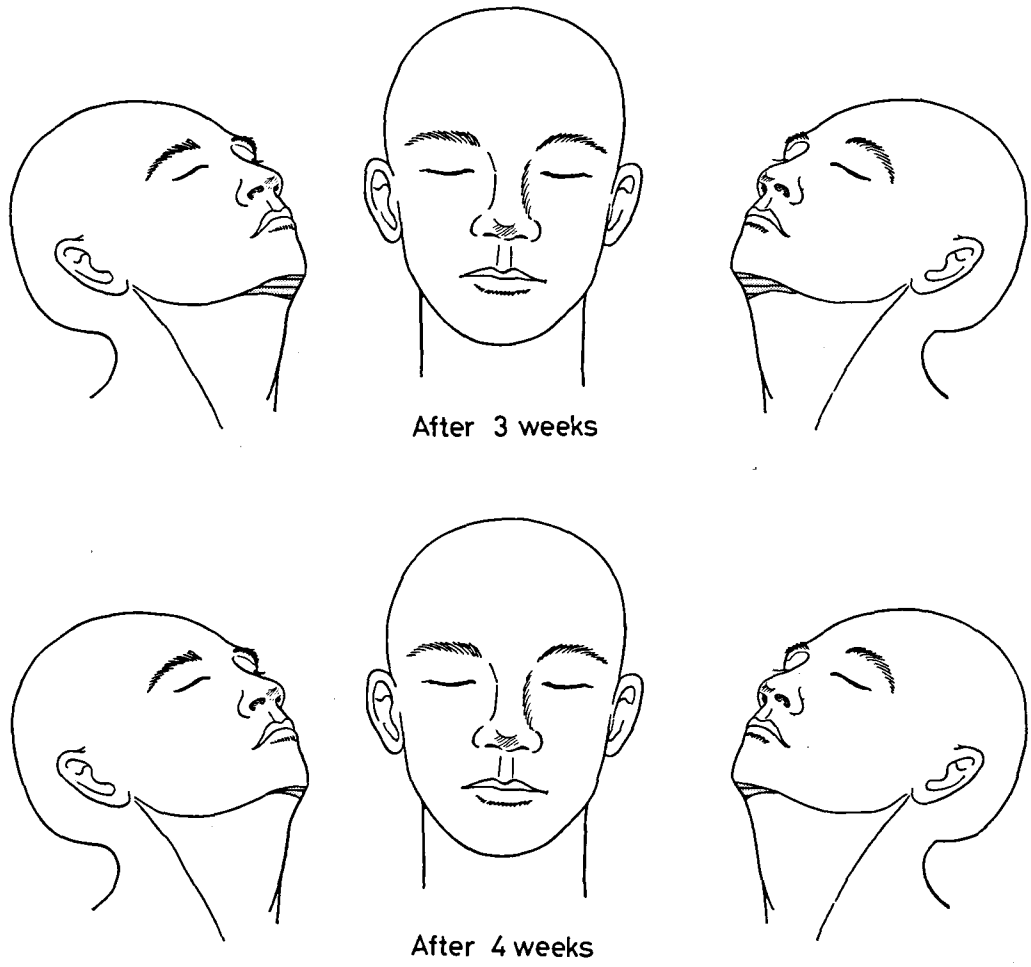

Fig. 4. cont'd. For legend see opposite page

dimension in existing dentures. The differences of free-way space between existing dentures and the new denture, which is about 2.0mm lower than existing dentures, were compared (Table 2 and Fig. 3). It was clear that the amount of free-way space between existing and new dentures were larger than the formers.

Fig. 4 shows the degrees and areas of the discomfort and/or numbness in patient with a new denture worn after 1, 2, 3 and 4 weeks, which were lowered by patient's complaints and by palpation. The symptoms disappeared gradually with the lapse of time and had completely disappeared about 6 weeks later.

The integration of electromyograms were performed in such a way that every 3.5sec. a value was obtained representing the activity in the range of 21 seconds from the onset of mastication. Obtaining the value of muscle electric discharge when the muscles contracted at one time, the maximum integration value was calculated by a value of one hundred and was normalized (Fig. 5). From the results, there were clear differences between existing and new dentures in mastication of chewing gum and "Senbei". The muscle activity indicated a lower activity, and this tendency was

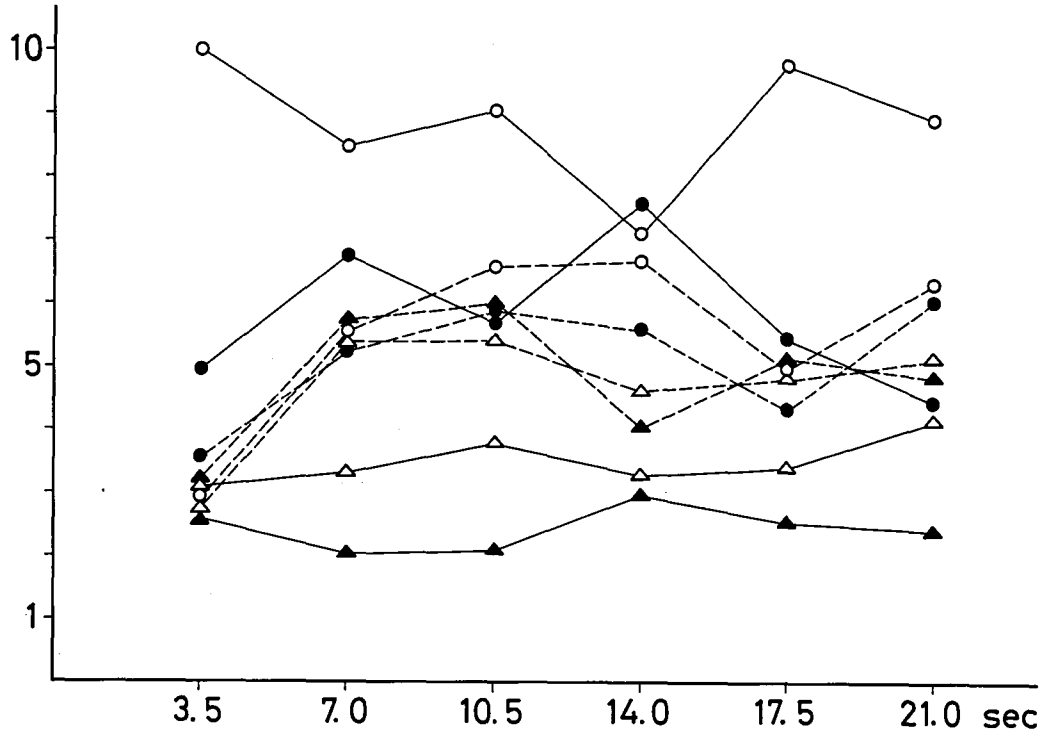

Fig. 5. Calculated and normalized the maximum integrated value

remarkable in gum chewing. Furthermore, there were clear differences in the comparative evaluation of the before and after prosthetic treatment with the Lissagous's figure (Fig. 6).

Discussion

Myofascial pain dysfunction syndrome. Edentulous patients with poorly occluding dentures or with incorrectly occlusal vertical dimension sometimes complain of facial pain, lateral headache, and, occasionally, neck pain. In the differential diagnosis dental, nasal, and neurological sources of pain must be excluded before submitting the patient to a detailed diagnosis of gnathic dysfunction. However, pain and dysfunction of the masticatory system can have a very heterogenous background.

As stated previously, numerous terms related to the dysfunction of the TMJ has been introduced in the literature since Costen (1934)[22] gave his name to these symptoms. The term "Costen-syndrome" has been most often replaced by TMJ disturbances, TMJ dysfunction syndrome,

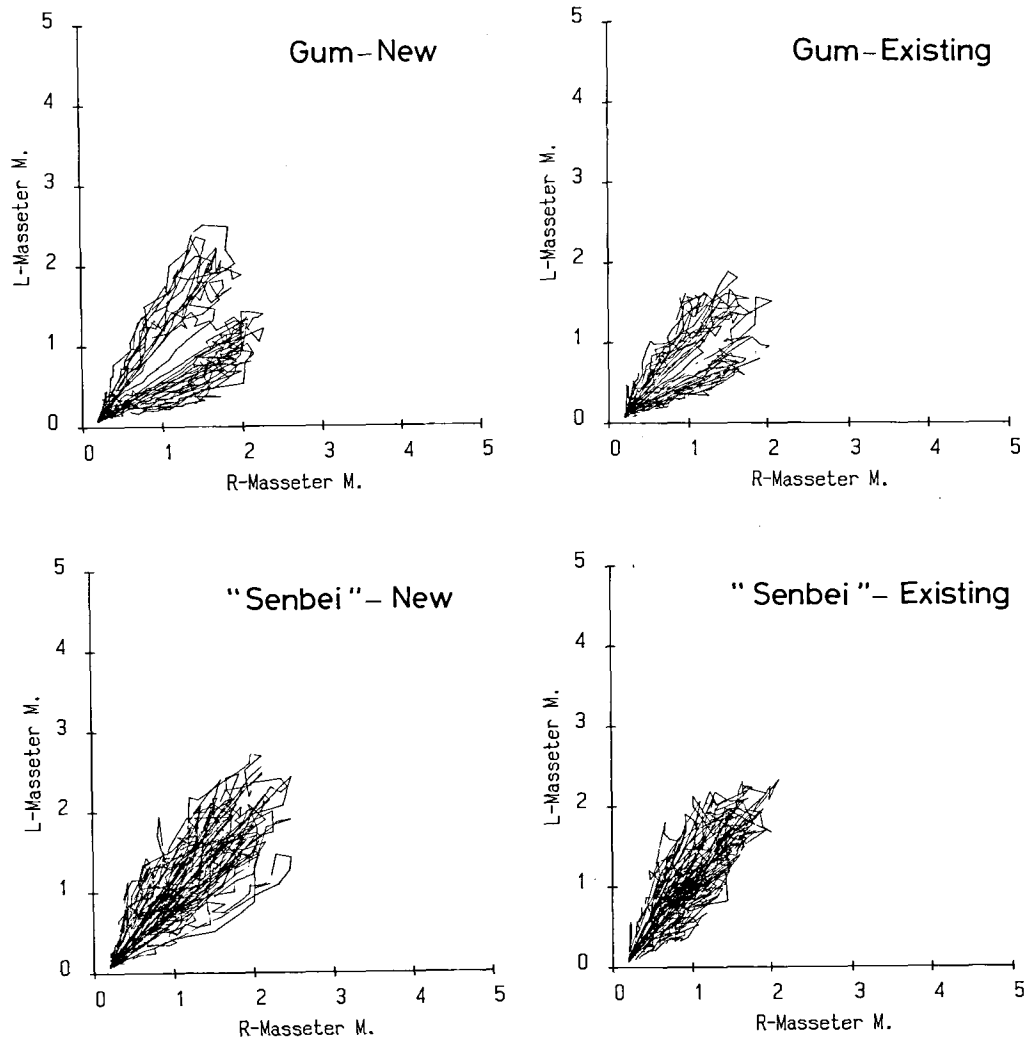

Fig. 6. The EMGs activity patterns of both masseter muscles in Ressagous' figure

and functional TMJ disturbances or disorders. In close accordance with the aetiologic concept, some talk about "occluso-mandibular disturbances", myoarthropathy of the TMJ. Others stress in their terminology the factor "pain" among the symptoms and propose "Pain-dysfunction syndrome", "myofascial pain dysfunction", or the combination of the two important symptoms, pain and dysfunction; "temporomandibular joint pain-dysfunction syndrome". The overabundance of terms is still confusing and contributes to the controversy about the aetiology.

Although the myofascial pain dysfunction syndrome has a multiple aetiology, faulty vertical dimension is a frequent cause of muscular pain among wearers of complete dentrues. Furthermore, it has been found that the restoration of a physiological free-way space in such cases, using a few methods which are based upon measurement of such things as face height, esthetics, and phonetics, can often lead to a dramatic remission of pain and/or dull pain.

Causes of "pain-dysfunction syndrome" associated with complete dentures. Loss of intermaxillary

space, especially in the posterior segment, resulted in temporomandibular joint pain or muscular pain[23]. Muscle tension was probably the most frequent contributing cause of muscular derangement of the temporomandibular joint. If the muscles involved with the temporomandibular joints were the target area of tension, the added emotional complications acted as a feedback mechanism[24]. Temporomandibular joint disturbances and associated muscle pathosis arise from three main causes ; physical disturbances during closure of the mandible, physical disturbances during opening of the mandible, and systemic disturbances[25].

Basic concepts of neuromuscular physiology. The neuromuscular function of the masticatory system depends basically on the integration of sensory feedback and motor neuron response at the reflex level. The motor responses are programmed and monitored by the sensory processes of proprioception on the subconscious level and by perception on the conscious level. As these processes relate to oral function, they involve the sensory innervation of the various components, such as the periodontal ligaments, salivary glands, the epithelial surface of the oral cavity, the muscles of the tongue and mouth, the muscles of mastication, and the temporomandibular joints[26]. A defect or nonintegration of the proprioceptive input can result in poor function or pathologic changes to the system[26]. A multiplicity of asynchronous sensory inputs can cause disharmony in the function of the system, and can result in TMJ dysfunction[26].

Physiologic mandibular rest position. Postural rest position of the mandible is maintained by a balance between muscular tone, particularly of the elevator muscles, and the effect of gravitational forces[27]. Psychic tension is a very important consideration, since it has an effect on neuromuscular behavior[28]. It is known that postural rest position of the mandible is influenced by the myotatic (stretch) reflex, which is activated by stretch of the muscle spindles in the elevator muscles. When gravitational forces act to depress the mandible, this reflex causes the appropriate number of motor units to fire in these muscles, the jaw returning to its original position and further muscle spindle stimulation causes. This unconscious activity maintains the posture of the jaw. In addition, however, the response threshold of the muscle spindles is determined by the gamma efferent (fusimotor) system[28]. Since the fusimotor system is excited by the reticular stem activity, muscle spindle threshold levels, and muscle contraction or tone. An increase in the tone of the mandibular elevators will decrease rest vertical dimension and consequently reduce inter-occlusal distance. Thus, the psychologic status of the patient is a important consideration in which the postural rest position is used as a reference position of the mandible[28].

If the vertical dimension is abnormally increased——so-called "bite raising"—— thus eliminating the free-way space, the teeth will be constant contact. This eliminates the rest position and creates continuous tension on the muscles of mastication, and stress on the temporomandibular joint and the supporting tissues.

The importance of the rest position lies in the fact that it permits the tissues of the stomatognathic system to test, and thus, to repair themselves. It has been shown that even slight pressure, if it is constant, will cause pathological tissue changes. Intermittent pressure, on the other hand, provides a period of rest during which self-repair can take place. Another damaging result of muscular tension is that once tension has resulted in painful, some muscles, the individual will usually respond by tensing the same muscles again, resulting in further shortening of those muscles.

It seemed that the cause for the symptoms in this case was the errors of the vertical dimension which is abnormally increased.

Electromyographic considerations. The movement of mandible which is the principal function of

the gnathostomatic system take palce by tonus and/or contraction of the masticatory muscles. The electromyographic studies have been described in earlier reports, and the techniques were excellent method to evaluate the muscular function[10,29~39]. We obtained the very useful knowledge in comparative evaluation of the EMG activities of the masseter muscles before and after prosthetic treatment.

In the comparison of new dentures with existing dentures during gum chewing, the amount of EMG activities of the both masseter muscles were larger than existing dentures, and then the right masseter muscle showed higher activity. There was not a large difference between the right and left masseter muscles in existing dentures, and their EMG activities were not larger than the new denture. It seemed that these clear differences were due to a new denture which has a correct occlusal vertical dimension. The changes of the amount of EMG activities and ensuing the time proceeds of mastication did not appear in existing dentures. On the other hand, the amount of EMG activities in a new denture reversed at between 10.5sec. and 14.0sec. and showed a violent variation. This phenomenon may occur when gum chewing on the right side changes to the left side of the denture. There were not any differences in the amout of EMG activities from both masseter muscles in comparison with a new denture and existing dentures, although it would be difficult to compare with chewing gum, in which the conditions are not changing every moment. The amount of EMG activities at the 14sec. from beginning of mastication was the largest, however, after passing the peak, it dose not have a tendency to increase. When the observed facts are put together, a new denture with normal occlusal vertical dimension was more effective than the existing one in the electromyographic evaluations.

Ressagous' Figure. The study of mandibular movement have been well known through two methods. One is the analysis of EMG parameters of the masticatory muscles, and the other is the recording of the mandibular movement by way of mechanical displacement of mandible. In the former, however, the dynamic aspects of the mandibular movement were difficult for adequate expressions, and in the latter, the mandibular movement during the isometric contraction of the muscles could not be recorded. The EMGs are transformed into a Ressagous' figure in order to make up for one another's defects, and the balance of muscular strength in both masseter muscles can be understood objectively. In general, Ressagous' patten can be quiet complex and the variations of each masticatory stroke were large when chewing tough food. The EMGs activity patterns of the both masseter muscles in Ressagous' figure were separated distinctly, because the properties of the chewing gum could not change as time proceeds in mastication using dentures. Ressagous' patterns in the "Senbei" mastication, on the other hand, were not separated, because its properties could change with the lapse of time.

Conclusions

In this case, the patient has a discomfort and numbness in his head, inferior maxillo-facial part and both buccal regions, because the occlusal vertical dimension of his complete dentures has been abnormally increased. The symptoms disappeared gradually with the lapse of time and had completely disappeared about 6 weeks later. A new denture with a normal occlusal vertical dimension was more effective than the existing one in the electromyographic evaluations.

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