

was stated that TMD patients had an abnormally high level of postural activity in the elevator muscles²⁶ and lower maximum biting force.³⁴ It was proposed that a high PRI (Pantographic Reproducibility Index) score was pathognomonic for TMD.¹² However, there is no study so far using the mandibular movement velocity to evaluate the effects of occlusal splint on mandibular function in normal subjects and TMD patients.

There was a tendency for movement velocities to be slower in patients with TMD than those of the asymptomatic group.^{11,16} In preliminary studies, no difference in open-close velocities between TMD and non-TMD subjects was noted.⁴⁸ The possible reasons for the discrepancy might be resulted from differences in the methods of measurement and classification for the patient group.

Microtrauma was stated to be one of the major etiologic factors of TMD.^{22,33} If excessive occlusal force could be reduced by some methods such as occlusal splint therapy or biofeedback training, the trauma to the TMJ system could probably be minimized. Bite force analysis was usually measured by incorporation of a strain gauge into the crown or bridge as well as in the prosthetic appliance which would probably increase the vertical dimension and resulted in an unnatural measurement outcome.^{17,21,38} Another drawback of the strain gauge measurement was that it could only measure a specific area of the teeth where the strain gauge was incorporated. If we could measure the force impact to the masticatory system as a whole, the measurement would be more meaningful. According to the Newton's Second Law, $F = ma$,¹⁹ the physiological and clinical significance of the value of mandibular movement velocity would be a useful parameter to evaluate the impact force to the entire stomatognathic system. If we converted the velocity into the acceleration via the differential equation " $a = dv/dt$ ", we could probably estimate the force produced and its relative impact force on the stomatognathic system. Once we could find an appliance or other method that could reduce the velocity, it might reduce the impact force to the entire masticatory system. This could explain to some extent the therapeutic efficacy of the occlusal splint in the management of some sorts of TMD patients.^{2,9}

The purposes of this study are to evaluate the immediate effect of occlusal splint on mandibular move-

ment velocity, and to try to create a model for using velocity as a parameter to determine the relative impact force to the entire stomatognathic system.

MATERIALS AND METHODS

Subjects

Thirty-three dental students with a mean age of twenty-two years old (ranging from 21 years to 26 years) with no signs or symptoms of TMD participated in this study. The subjects consisted of 24 males and 9 females. Subjects were randomly selected from the dental students at Taipei Medical College. All participants were in good physical health, free from any acute dental diseases and had taken no medication recently. Each subject was given a comprehensive oral examination, which included an evaluation of the signs and symptoms of Temporomandibular Disorders. A consent form was signed after we carefully explained the experimental procedure and possible discomfort caused by the placement of an occlusal splint.

Apparatus

Myotronic K-6 system (Myotronics Co. Ltd. Seattle, WA. USA) was used to record the mandibular movement velocity and the trajectory. The mandibular movement velocity was analyzed in the photo 2 scheme of the K-6 system. The photo 2 scheme was a simultaneous vertical velocity record and the frontal view of lateral deviation during opening and closing movements. The opening-closing velocity was divided into five categories: (1) the maximal opening velocity from centric occlusion to maximal mouth opening, (2) the average opening velocity from centric occlusion to maximal mouth opening position, (3) the maximal closing velocity from the maximal mouth opening position to the centric occlusion, (4) the average closing velocity from the maximal mouth opening to centric occlusion and (5) the maximal velocity at 1 mm before tooth contact from the maximal mouth opening.

Photo 1 of the K-6 system depicted the trajectory of jaw movement in sagittal and frontal planes during opening and closing of the mouth. EM-2 mode of the K-6 system was used to monitor the electromyographic activities of the masseter muscle and the temporalis