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Editorial

First of all, I would like to extend my sincere thanks to the editorial board of this journal. Editors of the board worked very hard for inviting paper submission to the journal. As you know, the main problem of a new journal is the lack of sufficient and qualified paper submission. Besides, reviewers I invited to view the submitted papers have done good jobs and made valuable corrections and comments. I believe, with their continuous support, the journal will meet the expectation of our members and colleagues, and soon become a well recognized journal in Taiwan and then the world.

For most of prosthodontists and even those dealing with orofacial pain clinic, traditional Chinese medical approaches are not orthodox, mostly because of their lack of scientific data support. However, clinical evidences on muscle pain control through needle punctures can not be totally ignored. In Taiwan and even world-wide, acupuncture or dry needle puncture approaches are applied successfully in physical therapy field. A review paper on the use of needle puncture for temporomandibular disorders (TMD) is included in this issue. That review was written by a group of dentists and researchers with sufficient western medical training background. I hope discussions on this approach will be arisen, and more intensive research on traditional medicine for TMD or orofacial pain can be seen soon.

Furthermore, an original research paper on implantology is also included in this issue. In previous issues of this journal, only case reports were found. We understand why research papers are not easily obtained in journals like JPI. We have to ask graduate institutes of dental schools encourage their students and staff to submit research outcomes to our journal. Graduate dental institutes have better research environment and facilities and they have the responsibility to commit research paper writing and submit to either international or domestic journals. In addition, our specialist qualification procedures should set up JPI journal paper submission a prerequisite. By doing so, research on prosthodontics and implantology can be promoted, and our journal can have better paper source in the near future.

Yuh-Yuan Shiau, DDS, MS. FICD
Editor in Chief

Review Article

Application of Acupuncture in Temporomandibular Joint Disorders

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Abstract

The treatment of temporomandibular joint disorder (TMD) usually begins with conservative remedies such as medication, heat compression, patient education, and occlusal bite plates, among others. Normally, a combination of methods is needed to relieve patient symptoms because of the complexity of the disorder and its specific etiology for each patient. Because acupuncture has been proven to possess pain-reducing and anti-inflammatory effects, in this report, we reviewed the effectiveness of acupuncture in relieving the symptoms of TMD. The mechanism of acupuncture is very different between traditional and modern medicine, with the evidence showing that the analgesic effect of acupuncture comes from its ability to elevate the pain threshold, release neurotransmitters in local regions, and modulate pathways in the central nervous system. Within the limits of our review, the local acupoints around the TMJ, such as ST-6, ST-7, SI-18, GV- 20, GB-20, BL-10, and distant point LI-4 can be suggested for treating TMD. With 30-minute treatment sessions occurring once a week for 6 weeks, evidence showed that the effectiveness of acupuncture in minimizing patient discomfort is comparable to the effectiveness of other treatment options.

Keywords: acupuncture, temporomandibular joint disorder

Introduction

Temporomandibular joint disorder (TMD) is a condition that dentists frequently encounter. The condition often causes musculoskeletal problems, including pain and disability (just second to chronic low back pain), and it is the most common cause of facial pain. Signs and symptoms of TMD vary, but as epidemiological studies have shown, there is a high prevalence of certain conditions, such as pain and tenderness in the temporomandibular joints (TMJ) and masticatory muscles, sounds in the joints during function, and limitations or other disturbances in jaw movement. Approximately two-thirds of patients suffering from TMD seek medical help; nevertheless, approximately 15% of them develop chronic pain.[1] TMD includes a number of related diagnoses for temporomandibular joints, masticatory muscles, and associated structures. The classification provided by the Ameri-can Academy of Orofacial Pain (AAOP) divides

Table 1. Diagnostic Category from AAOP[1]

Masticatory muscle disorders
Myofascial pain
Myositis
Myospasm
Myofibrotic contracture
Centrally mediated/ Local myalgia
Temporomandibular joint disorders
Disc displacement disorders
Dislocation
Inflammatory Disorders
Osteoarthritis
Ankylosis
Fracture
Congenital or developmental disorder

the diagnoses into two categories, based on anatomical structure: "masticatory muscle disorder" and "temporomandibular joint (TMJ) disorders" (Table 1).[1]

Under most circumstances, the treatment of TMD-related pain, especially pain originating primarily from the muscle, begins with conservative, noninvasive methods. Conservative treatments often include medication, patient education, dietary modifications, and occlusal splints and/or occlusal therapy. When comparing the management of TMD using a stabilization splint worn at night and no treatment, short-term improvements can normally be expected from the splint treatment. However, comparisons of stabilization splint treatment with placebo treatment (via a non-occluding palatal splint) have been in-conclusive. There is thus a lack of evidence to either support or invalidate the treatment of TMD with occlusal splints and occlusal adjustments. In short-term follow-up studies, stabilization appliances were equally effective compared to other treatments such as physical therapy (e.g., acupuncture, TENS) and behavioral management. However, long-term effects are still limited.[5]

The etiology of TMD is complex and undetermined. Both central and peripheral mechanisms have been proposed. Systemic factors often have psychological origins, for ex-ample, mental stress, anxiety, and depression , and some systemic conditions such as rheumatoid arthritis are also often noted in TMD patients. Local factors should also be considered, such as trauma of the mandible and masticatory system, prolonged mouth opening, habits involving heightened or persistent pressure on the chewing system (e.g., gum chewing or betelnut chewing). Although many investigations based on self-reports or clinical diagnoses suggest a positive association between bruxism and TMD pain, some potential bias cannot be ruled out at the diagnostic level. Studies that were designed specifically to diagnose bruxism have shown less association between bruxism and TMD.

Because of the complex nature of this disorder, there is no gold standard for treating TMD. Approaches generally include a combination of methods and designs based on the specific etiology for each patient. Acupuncture originated in China thousands of years ago and has long been used by Chinese people to treat various diseases. Over the last few decades, it has been increasingly applied in western medicine to combine acupuncture with conventional treatments. In 2002, the World Health Organization reported chronic myofascial pain to have a good reaction to acupuncture treatment. This treatment method is characterized by comparatively low side effects. Therefore, acupuncture has been introduced as a treatment for TMD due to its function in pain reduction as well as its anti-inflammatory and neurohormonal effects.

In this review, we describe the mechanism of acupuncture based on various theories—from traditional Chinese medicine to modern western medicine, including studies on the molecular level. To introduce acupuncture as part of the treatment of TMD, we reviewed articles so as to understand the effectiveness of acupuncture and how it should be executed in treatments.

The Role of Acupuncture in Temporomandibular Joint Disorders

Mechanism of acupuncture

Acupuncture developed in China thousands of year ago. In the book Huangdi Neijing (黃帝內經), which is now considered by archeologists to be the most ancient literary record of acupuncture to date. The use of sharp stones and herbs to cure pain and disease is described to have existed since the Stone Age.

The mechanisms of pathophysiology in Chinese medicine are quite different from those of Western medicine. Acupoints can be located almost everywhere on the human body, as was discovered in prehistoric times, when people realized that diseases could be cured after certain points on the body were accidentally burnt or punched. The acupoint is the exit point of qi (氣) on the skin surface of the hu-

man body. When disease occurs in the internal organs, bad qi can travel through the meridians of the diseased organs and present on the corresponding acupoints as focal soreness. These sore acupoints can then be used as a diagnostic tool to locate the source of the disease.

The acupoint is also the entrance for introducing elements from the outside environment into the body because it is the opening of meridians on the skin surface. For example, the entrance of cold and bad qi from some acupoints can lead to headaches and perhaps symptoms of the common cold.

The view of traditional Chinese medicine

According to the earliest description in Lingshu Jing (靈樞經), which is a part of "Huangdi Neijing" (黃帝內經), a thin needle inserted into the Meridians regulates qi. In Su Wen (素問), which is another part of "Huangdi Neijing", the ability of acupuncture to balance yin (陰) and yang (陽) of the human body by engaging the meridians with needles is described. When too much yin has taken over yang, we bring more yang to the patient to balance the flow of qi by manipulating the acupuncture needle in a certain way. When too much qi jammed in one meridian or acupoint and causes disease, the excess qi can be led out by acupuncture needles to balance yin and yang.[7]

Lingshu Jing also stressed that if one cannot feel the qi while inserting the needle into the acupoint, the practitioner must keep trying until qi is reached (刺之而氣不至，無問其數). Biao You Fu (標幽賦) and Dou Han Qing (竇漢卿) (1295) described the feeling of locating qi as that of a fish taking a bite from a hook during the act of fishing, and when people fail to reach qi, it is like hanging in a deep and large room.(氣之至也，如魚吞鉤餌之沉浮；氣未至也，如閒處幽堂之深邃). In modern Chinese medicine, it has been described and emphasized as "de qi (得氣)". From the patients' point of view, the sensation of the needle puncturing the skin and reaching the acupoint does not feel like the pain of being punctured by a needle, but rather like soreness, dullness, and heaviness. Some patients say that it feels like a weak electric shock, which can sometimes travels with the meridian and spread to areas away from the inserted needle.

The view of western medicine

Modern researchers have used scientific methods to understand the mechanism behind the analgesic ability of acupuncture. According to classical literature on acupuncture and a study by Hui et al. using fMRI, failure to produce de qi also results in the failure to produce the analgesia effect of acupuncture. As in the case of treating paraplegic pa-tients, whose nerve conductions were interrupted, the practitioners were unable to produce de qi and therefore, acupuncture analgesia. The efficacy of acupuncture analgesia was shown by Chiang et al.[13] Acupuncture manipulation at the acupoint hegu (LI-4) gradually increased the pain threshold by 20-40 min after needle insertion, and the pain threshold increased by 100% at 40 min. However, after injection of 2% procaine to the acupoint, the effect of acupuncture analgesia and the local sensation were both inhibited. That same year, a research group of acupuncture anesthesia at Beijing medical college[14] modified some of Chiang's experiment. It was found that blocking the analgesic effect with local anesthesia was successful only when 2% procaine was injected into a deeper layer, such as the muscle or tendon layer, but not subcutaneously, highlighting the importance of nerve innervation in deeper structures of the acupoint. Lin measured the average depth to produce de qi in different acupoints on the backs of 107 patients. Patients were grouped by sex and body type (i.e., obese, regular, and thin). The result shows that although the depth to produce de qi differs case by case, it is located mostly in the muscle layer.[15] A further trace into the histology of acupoint using a rat model showed that the distribution of A and C nerve fibers is closely associated with the acupoint.[16] Taken together, the acupoint is the A and C nerve innervation at the muscle layer and act as a trigger in the mechanism of acupuncture. The local sensation is the foundation of acupuncture analgesia. Without the afferent signal from the local nerve fiber, there is no analgesic effect.

Regarding the central nervous system (CNS), the pathway of the endogenous descending pain inhibitory system has been thoroughly studied to understand pain.[17] The descending inhibitory system consists of various parts of brain regions in the cortical area, thalamus and spinal cord to control pain. The system has been proven by means of opiate analgesia and brain-stimulation-induced analgesia to be closely related to acupuncture analgesia.[8]

During an acupuncture treatment, stimulation at the acupoint ascends the CNS like a pain signal, but it also activates other brain regions and then the descending inhibitory system to modulate pain.

At the molecular level, a close look at the neurotransmitters shows that the opioid peptides play an important role in regulating acupuncture analgesia. First, Mayer et al. (1977)[18] discovered that naloxone, a specific opioid receptor antagonist, can partially re-verse the analgesic effect of acupuncture on electrically stimulated denta-pulp pain in a human model. Using a rat model, Sekido et al.[19] showed that injection of naloxone at the inflammatory site can eliminate the effects of acupuncture treatment, which suggests that the peripheral opioid released by acupuncture stimulation helps modulate pain at the in-flammatory site. Using both rat and human models, Han et al.[20] demonstrated that elec-trical acupuncture (EA) stimulation at a low-frequency (2 Hz) facilitates the secretion of enkephalin, whereas EA at a high frequency (100 Hz) releases dynorphin. Since different frequencies of EA stimulate the secretion of different types of opioid peptides, these mole-cules work on different zones. EA at 2 Hz sequentially activates the arcuate nucleus of the hypothalamus (beta-endorphinergic neurons), PAG, medulla (enkephalinergic neurons), and the dorsal horn to suppress nociceptive transmission. Hz at 100 Hz activates the par-abrachial nucleus-PAG-medulla-spinal dorsal horn pathway through the release of dy-norphin.[21,22] Comparing the efficacy of the two frequencies in a spinal nerve con-striction model using neuropathic rats showed that 2 Hz EA stimulation for 30 min sup-pressed cold hypersensitivity for more than 24 h, whereas 100 Hz EA stimulation showed no effect.[23] Although most reports showed better therapeutic effects for the lower fre-quency stimulation, some reports indicate 100 Hz EA stimulation to be more effective for relieving muscle spasms induced by spinal trauma. [24]

The effect of acupuncture in treating temporomandibular joint disorders

Noiman et al.[25] recruited 39 patients suffering from facial pain, of which 4 patients had trigeminal neuralgia (TN), 35 had TMD of a non-osseous source. Seventeen were diagnosed as having chronic conditions and 22 as having acute conditions (< 3 months). Local

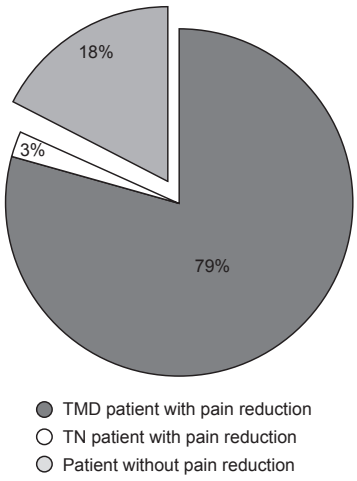

Fig. 1 The effects of acupuncture treatment on facial pain (reported by Noimat et al [27])

acupoints in the TMJ region and masticatory muscles, regional points around the head and neck, and distal points on the upper and lower limbs were chosen for therapy. Thirty-two (82%) of the 39 patients who received acupuncture treatment reported at least a 30% re-duction in visual analogue score (VAS). Of these 32 patients, [28] (71.7%) reported more than 80% pain alleviation, whereas the other 4 patients reported partial pain alleviation (30-80%), and none presented any side effects. In the 32 patients who considered acupuncture to be effective, 31 had TMD, and only 1 of the 4 TN patients reported a significant improvement. (Fig. 1) [25]

Mario Vincente-Barrero et al.[26] conducted a randomized trial on 20 patients who were diagnosed with TMD and compared the efficacy of acupuncture and decompression splints after a treatment session of 30 days. The result showed that patients treated with decompression splints experienced reduced subjective pain, pressure pain on the masticatory muscles, and an increased mouth opening range, but the difference did not reach statistical significance. However, patients treated with acupuncture reported improvements in all parameters (i.e., reduced subjective pain, stronger pressure to produce pain on masticatory muscles, increased mouth opening range), and the pain reduction is statistically significant. Taken together, these studies show that acupuncture has short-term analgesic effects that are comparable to those of decompression splints in TMD patients.

To compare the long-term treatment efficacy, List et al. conducted a one-year follow up in 1992.[28] In the beginning, they recruited 110 patients with symptoms of TMD for more

Table. 2 Summary of the individual studies on the selection of acupuncture points based on the fact that either all or at least two authors have used the point as a standard treatment[33]

Acupuncture	List et al (1992)	Johansson et al (1991)	Raustia et al (1985a)
Located on the face			
ST-6	+	+	+
ST-7	+	+	+
SI-18	+	+	+
Located on the neck			
GV-20	+		+
GB-20	+		+
BL-10	+		+
Distant points			
LI-4	+	+	+

than 6 months and randomly divided them into 3 separate treatment groups: acupuncture treatment, occlusal splint therapy, and a control group that received no treatment. Patients were evaluated by subjective and clinical assessments before and immediately after the treatment. During the short-term period of observation, the acupuncture and occlusal splint groups both reduced symptoms, compared to the control group. However, acupuncture produced better subjective results with statistical significance, compared to occlusal splint therapy. After 1 year, 80 participants returned for the follow up. The result showed that 57% of the patients who received acupuncture treatment and 68% who received occlusal splint therapy benefited subjectively and clinically ($p < 0.001$). Although the acupuncture group showed a smaller percentage of patients who benefited from treatment, there was no statistical significance between the two groups. Furthermore, this difference may be due to the fact that the occlusal splint was worn every night throughout the year, whereas there was no follow-up regimen for acupuncture treatment.

Despite such evidence, we should still address the possibility that acupuncture is only a placebo. Executing double-blind experiments in acupuncture treatments was difficult until Park et al. invented the Park Sham Device.[29] Subsequently, Smith et al. (2006)[30] published a report comparing the efficacy between acupuncture needles and Park Sham De-vices by measuring subjective values, VAS, joint and muscular pain, and other values in 27 TMD patients. The patients were randomly divided into real and sham acupuncture groups. After 5 weeks of treatment, the real acupuncture group showed statistically significant improvements for nearly all parameters, whereas the sham acupuncture group showed insignificant improvements.

Acupoints for treating patients with temporomandibular joint disorders

Because traditional Chinese medicine views the etiology of TMD differently compared to western medicine, the acupoints chosen for treatment are different, too. For example, some authors suggest scalp acupuncture for treating TMD and related headaches. Unfortunately, an evidence-based review or controlled trial from the perspective of traditional Chinese medicine or scalp acupuncture is still lacking. Some systematic reviews have suggested acupoints for TMD treatment, however, these acupoints are located mainly around the temporomandibular joint, or local tender spots, and echoed the concept that myofascial trigger points correlate anatomically with classical acupuncture points in 70% of the cases. The review of Rosted et al.[31] included reports treating pain dysfunction syndrome (PDS), which includes joint symptoms, masticatory muscle symptoms, limitations or deviations in mandibular movement, and headache by means of acupuncture. Only randomized and blind trials limited to needle acupuncture were included. Finally, three publications met the criteria of the author, and a total of 27 acupoints were evaluated in these reports. As summarized in Table 2, seven acupoints that at least two from the three authors used the point as a standard point in treatment were included. These acupoints will be discussed individually later. Of the 7 acupoints, 3 were located near the TMJ and 2 were located on the neck (many patients also complained of soreness in the neck). GV-20 (百會) and LI-4 (合谷) are located away from the region that TMD patients usually complain of, and the mechanism underlying these two acupoints is not as clear as the ones for the surrounding muscles.

Six treatments in average were sufficient to control the symptoms, and the treatment fre-

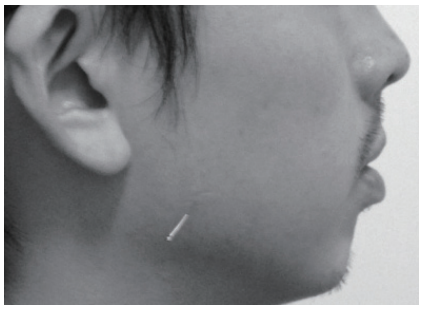

Fig. 2 Needle insertion of ST-6

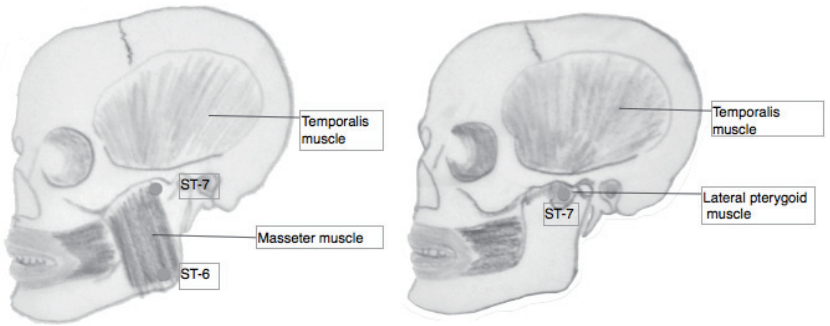

Fig. 3 Location of ST-6 and ST-7

quency was once a week.[31] In another review by Jung et al.[13], the mean treatment duration is 1.4 weeks, ranging from only 1 treatment to a session that lasted 6-12 visits.

After inserting the needles and achieving the de qi sensation, the needle should be left in the acupoints for 30 min in each treatment session. The patient should return for maintenance treatments once every 3 months, until the remission of symptoms.[31]

ST-6 (頰車穴，足陽明胃經)

ST-6 is on the stomach meridian, and it is located near the mandible angle and one middle-finger's breadth from the angle of the mandible. (Fig. 2) The original meaning of the acupoint in Chinese is the "axis" on the cheek that controls mouth opening, which is quite appropriate because the mandibular angle can be seen as the jaw's axis of centric movement when just looking from the face. When the mouth is wide open, a depression can be felt on the acupoint, and when teeth are clenched, a bounce from masseter muscle can be felt. The acupuncture needle should be inserted at a perpendicular angle to the skin surface until it reaches a depth of approximately 2 cm in the masseter muscle (Fig. 3). [32]

ST-7 (下關穴，足陽明胃經)

ST-7, like ST-6, is also located on the stomach meridian, under the zygomatic arch. Palpating from the targus toward the face, the practitioner first feels the condylar head and then there is a triangular depression between the mandibular notch and zygomatic arch, and the acupoint is located in the depression (Fig. 4). When the mouth is wide open, the condylar head will bounce up from the depression, and when the mouth is closed, the depression can again be felt. This acupoint was considered to be the "machine"(機關) to control jaw movement because of this "bouncing" effect, and it is the lower as opposed to the upper one (GB-3). For treatment, the needle should be inserted perpendicularly to the skin surface for approximately 1.5 to 2.5 cm, and a de qi feeling should be reached by that level. We can imagine when needle is inserted at the acupoint, we will penetrate through masseter muscle and reach the fascia of lateral pterygoid muscle or even the muscle, and the stimulation of these muscles brings relief of tenderness. [33]

Fig. 4 Needle insertion of ST-7

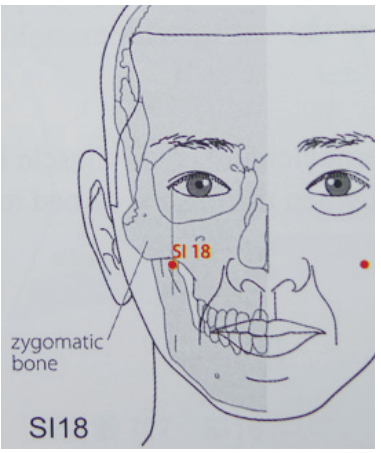

Fig. 5 Location of SI-18 [34]

Fig. 6 Needle insertion of SI-18

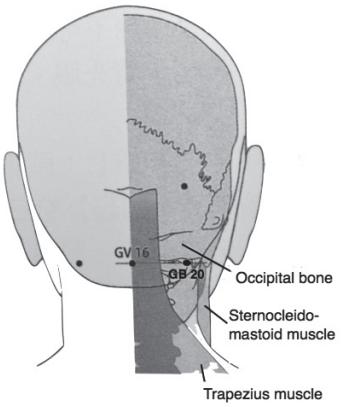

Fig. 7 Location of GB-20 [35]

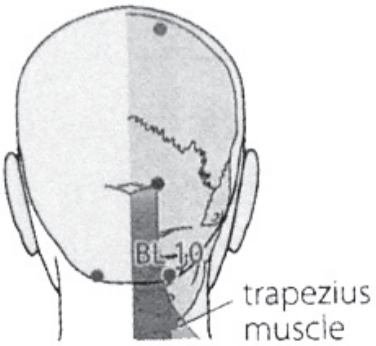

Fig. 8 Location of BL-10 [38]

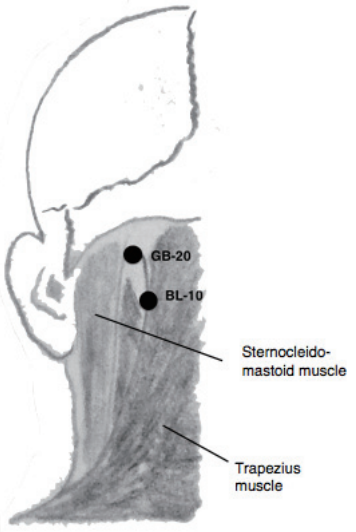

Fig. 9 Comparison of the positions of BL-10 and GB-20

SI-18 (顴 ，手太陽小腸經)

SI-18 is on the small-intestine meridian and is located below the zygomatic process from the frontal view. It is on the perpendicular line made from the lateral canthus, on the same horizontal level of the crosspoint of the nostril and nasolabial fold (Fig. 5).[34] The needle should be inserted perpendicularly to the facial plane and can achieve the de qi feeling at a depth of approximately 1.5 cm. Insertion of the needle at the acupoint penetrates buccinator muscle and then reaches the fascia of the masseter muscle to stimulate the analgesic effect to the fatigued muscle (Fig. 6).

GB-20 (風池，足少陽膽經)

Many TMD patients also complain of neck pain or headache of muscular origins. The following two acupoints are located on the neck muscles, and they can be used to relief these symptoms. GB-20 is on the meridian of the gall bladder and is located posterior to the mastoid process and inferior to the occipital bone in the depression between the sternocleidomastoid muscle and the trapezius muscle. The acupuncture needle should be inserted at a depth of approximately 2.5 to 4.0 cm. We can understand the function of the acupoint by the anatomic structure that it is to relief the muscle pain of the posterior triangle of the neck. From the perspective of Chinese medicine, GB-20 has long been used to cure headaches, migraines, and stiff necks because this acupoint is believed to be the location where bad qi often jammed (Fig. 7).

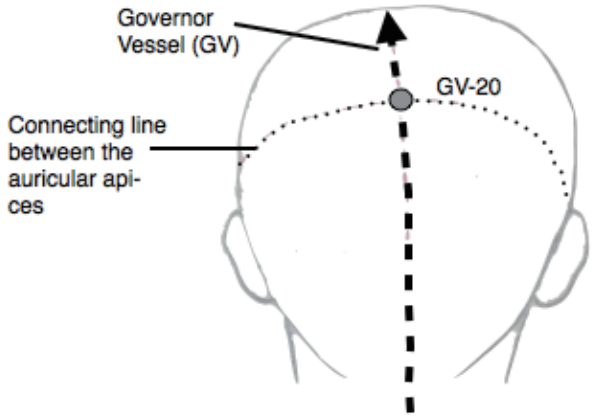

Fig. 10 Location of GV-20

BL-10 (天柱，足太陽膀胱經)

BL-10 is located on the meridian of the bladder. This acupoint is on the depression lateral to the trapezius muscle, at the same level of the spinous process of the second cer-vical vertebra (C2). The original name of the acupoint refers to the pillar on the neck and the support of the head, so the main purpose of the application of the BL-10 is to relieve neck and shoulder pain, as well as dizziness and headache. For the treatment effect, the acupuncture needle should be inserted at a depth of 2.5 cm to reach the trapezius muscle beneath the skin (Fig. 8, 9).[35-38]

GV-20 (百會，督脈)

The governor meridian (督脈) runs along the center of the human body and circles around it. GV-20 is on the topmost of the me-

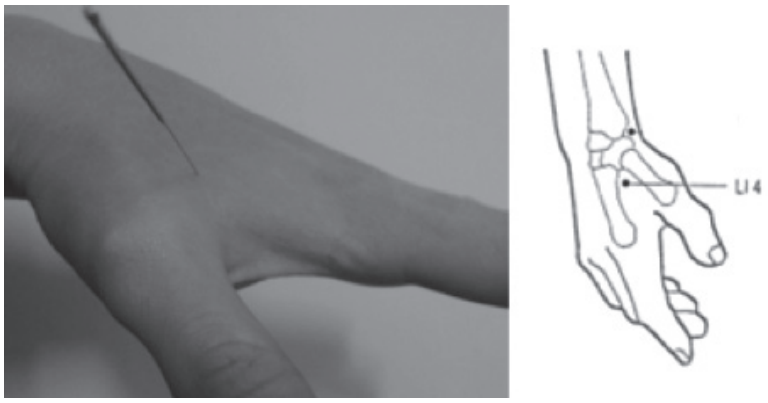

Fig. 11 Location and needle insertion of LI-4 [41]

ridian. It is located at the midpoint of the connecting line of two auricular apices. (Fig. 10) The needle should be inserted from the anterior to the posterior, at an angle approximately 30 degrees to the skin surface at a depth of approxi-mately 1.0 to 1.5 centimeters. The GV-20 was selected because it is considered to be effective in treating TMD symptoms through emotional relaxation. [33,39,40]

LI-4 (合谷，手陽明大腸經)

LI-4 can be used in various situations. From the perspective of Chinese medicine, LI-4 is effective for relieving all symptoms occurring in the head or face, including fevers, headache, and trismus. As mentioned, Chiang et al. reported acupunc-ture manipulation of LI-4 to be effective in elevating the pain threshold. LI-4 is located on the meridian of the large intestine on the dorsum of the hand, between the thumb and in-dex finger, radial to the midpoint of the second metacarpal bone. The original name of LI-4 in Chinese refers to a river valley, which describes the shape of the depression between the thumb and index finger. For the treatment effect, the acupuncture needle should be inserted at a depth of 2.5 cm into the muscle tissue to gain the de qi feeling (Fig. 11) .

Conclusion

Acupuncture in traditional Chinese medicine is described as the manipulation of qi using needles and a method of curing people by smoothing the flow of qi. As modern science progresses, we can understand that it involves not just yin and yang, but also the physiology and the work of neurotransmitters in the body and brain. The afferent signal from A and C sensory nerve fiber located in the muscle layer is the foundation of acupuncture analgesia. Needle stimulation at the acupoint ascends the CNS in a similar way as a pain signal, but it also activates the descending inhibitory system and thus, modulates pain.[8,25-27] Several neurotransmitters, such as the opioid peptides, coordinate to regulate the effect to reduce pain and modulate inflammation.[28,29] In studies on animals, it was shown that different patterns of stimulation can activate different opioid receptors and thus different pathways to produce varying treatment effects.[31,32]

Within the limitations of our review, the evidence shows the effectiveness of acupuncture in treating TMD[35], with comparable treatment effects as those of using occlusal splints in short-term observation.[36,37] For patients with pain dysfunction syndrome of TMD, we would suggest acupuncture as a treatment option. The treatment should be conducted once a week, 30 minutes each time, over six treatment sessions. Patients should then be followed up every 3 months until the symptoms are relieved. Local acupoints on the head and neck recommended for treatment are: ST-6, ST-7, SI-18, GV- 20, GB-20, and BL-10. Distant point LI-4 is also recommended. Although the efficacy of acupuncture is comparable to those of other treatments, identifying the etiology is still very important so that patients can seek help from other professions to treat their specific etiologies.

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Original Article

Effect of Anti-rotational Design and Counter-torque Device on Peri-implant Bone Stress During and After Preload – A Preliminary Results

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Abstract

Purpose: *Tightening an abutment screw (preload) may cause implant deformation and induce peri-implant bone strain. Preload may also transmit the torque to the peri-implant bone. This study's aims were to evaluate whether an anti-rotational design at abutment-implant interface and the application of a counter-torque device during preload would affect the transmission of torque and the development of peri-implant bone strain.* ***Materials and Methods:*** *A MirusCone abutment (MC) with an anti-rotational abutment-implant design and its configuration counterpart, without an anti-rotational design, Multiunit abutment (MU) were used for testing. The abutment screw of each type was tightened, with or without the counter-torque device application (wct and woct, respectively), by an electronic torque controller with 20 N-cm torque. During preload, the torque transmitted to implant-bone interface was measured by a torque gauge grasping the implant replicas (Nobel Biocare) for each group (MCwct, MCwoct, MUwct, MUwoct). The strain on the implant replica resulted from the clamping force of preload was measured from a snacked delta rosette strain gauge bonded on an implant replica embedded in an epoxy resin block. The outputs from the strain gauge were analyzed with Spike 2 software. The magnitude (μ) and direction of maximum principle strain (MPS) were calculated according to the formula provided by the manufacturer.* ***Results:*** *Application of a counter-torque device diminished about 90% of the torque transmitted to the torque gauge in both MC and MU abutments. There was no significant difference in the torque transmitted between MC and MU abutments. There is no significant difference in MPS magnitude among the groups after the preload, I.E. MCwoct: -242.48 $\mu\epsilon$, MCwct: -231.71 $\mu\epsilon$, MUwoct: -215.95 $\mu\epsilon$, MUwct: -221.00 $\mu\epsilon$. The direction of MPS was parallel to the long axis of the implant replica in all groups.*

Keywords: **anti-rotational design, counter-torque device, peri-implant bone stress, preload**

Introduction

The dental implants have been used widely in the treatment of edentulous area and the success/survival rate is more than 90%. In the presence of successful osseointegration, most complications after prosthesis insertion include screw loosening,[1-5] and loss of osseointegration etc. The factors attributing to the complications are very complex, such as misfit in the implant-abutment assembly,[6-8] screw's fatigue characteristics,[8] unfavorable stress distribution,[9] occlusal overload,[5] and occlusion scheme[10] etc.

The primary objective in tightening a screw joint is to generate an optimum preload that will maximize the fatigue life of the screw while offering a reasonable degree of protection against loosening.[3,11] Preload is what keeps the screw threads tightly secured to the mating counterpart of the screw and elongates the screw between threads and screw head.[3,8] The elastic recovery of the screw creates the clamping force that pulls the prosthesis and implant together. However, the torque applied to tighten the abutment screw may deform the implant and may be transmitted to the implant-bone interface. The consequences are peri-implant bone strain may be induced and the initially achieved osseointegration may be affected.[9]

For the Brånemark system (Nobel Biocare, Göteborg, Sweden), a counter-torque device (Nobel Biocare, Göteborg, Sweden) that limits contact and rotation between the hexagons during screw tightening was recommended to prevent the transmission of the tightening force.[5] The counter-torque device is designed to reduce the improper strain transmitting to the implant-bone interface. Lang et al[5] reported that less than 10% of the recommended tightening torque was transmitted through the implant stack when the counter-torque device was used. An average of 91% of the preload tightening torque passed through the implant stack to the implant-to-bone interface in the absence of a counter-torque device. However, the mechanism of a counter-torque device on the transmission of tightening force has not been clearly known. Recently, the original anti-rotational design at the abutment-implant interface has been neglected in most implant system for multiple implant retained prosthesis. However, it is not clear whether the anti-rotational design plays a role in transmitting the tightening torque to the implant and the bone surrounding the implant.

The number of immediate loaded implants has increased recently. Since it is critical to limit the stress transmitted to the bone during the procedure, understanding the transmission of the stress and strain during tightening the abutment screw may improve the success rate of immediate loading. Thus, this study's aims were to evaluate whether an anti-rotational design at implant-abutment interface and the application of a counter-torque device during the screw tightening procedure would affect the development of peri-implant bone strain during and after preloading the abutment screw.

Materials and Methods

Measurement of torque

To measure the torque transmitted to implant-bone interface during abutment screw tightening, a 5 mm diameter implant replica of Brånemark system (#31160, Nobel Biocare, Göteborg, Sweden) was grasped onto a torque gauge (6BTG, Tohnichi, Tokyo, Japan). A MirusCone abutment (MC) (SDCA425, Nobel Biocare, Göteborg, Sweden) with anti-rotational abutment-implant design and its configuration counterpart, without anti-rotational design, Multiunit abutment (MU) (#29186, Nobel Biocare, Göteborg, Sweden) were used for testing (Fig1). A 20 N-cm of torque force was applied, with or without counter-torque device, to the abutment screw of a torque controller (DEA028, Nobelpharma, Göteborg, Sweden). Therefore, four different groups were tested: MC with and without counter-torque device (MCwct, MCwoct), and MU with and without counter-torque device (MUwct, MUwoct). The tightening procedures were repeated five times for each group, and the resulting torque was recorded.

Fig. 1 Abutment-implant interface of Multiunit abutment (left) and MirusCone abutment (right); 5mm diameter implant replica (bottom).

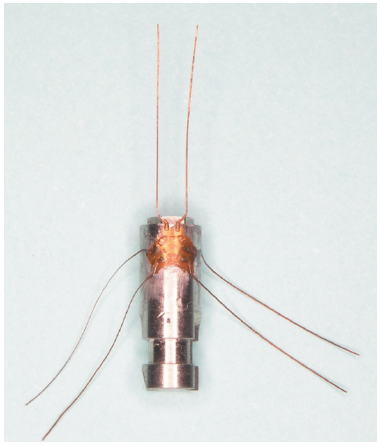


Fig. 2 A WA-06-030WY-120 strain gauge was bonded on a 5 mm diameter Brånemark implant replica.

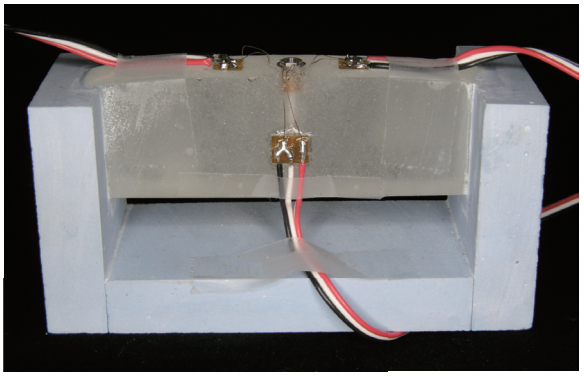


Fig. 3 The implant replica with strain gauges was embedded in a epoxy resin block.

Construction of strain-gauge models

A rosette type strain gauge (WA-06-030WY-120, Measurement Group, Raleigh, NC) was attached onto a 5 mm diameter implant replica with M-Bond 200 (Measurement Group, Raleigh, NC). The gauge has three electrical polarized coils, and the coils are superimposed onto each other. The angle of the long axis of each coil with respect to each other is 60°. The backing of the gauge was trimmed that the center point of the coil to the abutment-implant interface was about 1.5 mm (Fig2). One of the coils, defined as SG1, had the long axis parallel to the long axis of the implant replica. The remaining two coils were named SG2 and SG3 counterclockwisely.

The implant replica with attached strain gauge was wrapped within a 12x22x70 mm epoxy resin block. Silky-Rock die stone (Whip Mix, Louisville, KY; liquid/powder = 22 ml/100g) were used to secure the resin block and hanged it in the air. This completes the construction of the model (Fig3).

Data collection

The same dividing groups and tightening procedures as in torque measurement were followed, and the strains transmitted during and after tightening the abutment screw were recorded from the strain gauges. The signal from the strain gauges was amplified 1000 times with an amplifier (2310 Amplifier, Measurement Group, Raleigh, NC) and stored in a magnetic tape recorder (FM tape recorder, RD-145T, Teac, Japan). The signals were played back and converted (sampling rate: 1000Hz) using an analog to digital converter (A/D converter CED 1401, Cambridge Electronic Design, Cambridge, England), and then to a PC computer for analysis.

Five models were constructed and five sets of measurements from each group were obtained from each model.

Data analysis and statistics

The rosette type strain gauge (WA-06-030WY-120) is a 3-coil electrical polarized strain gauge with permeability factor of ϵ_1、ϵ_2、ϵ_3. According to the construction of the coil, the maximum and minimum principle strain ($\epsilon_{p,q}$) as well as the angle detween strain and SG1 ($\phi_{p,q}$) can be obtained with the following formula provided by the manufacturer:

$$\xi_{p,q}^{\epsilon} \quad \frac{SG1+SG2+SG3}{3} \pm \frac{\sqrt{2}}{3}\sqrt{(SG1-SG2)^2+(SG2-SG3)^2+(SG1-SG3)^2}$$

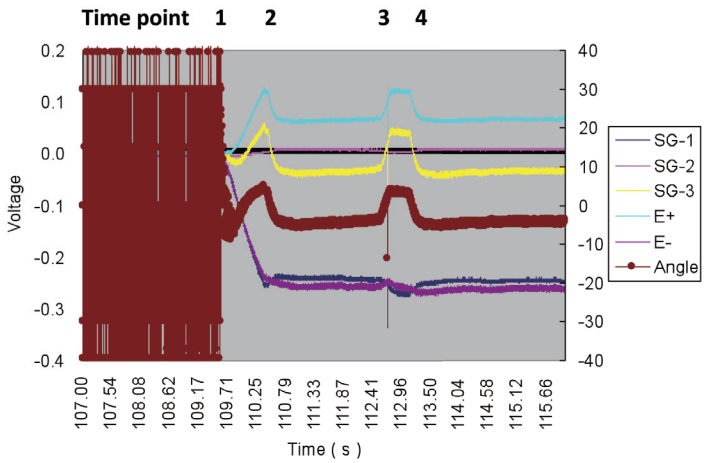
$$\phi_{p,q}^{\epsilon} \quad \frac{1}{2}\tan^{-1}\left(\frac{\sqrt{3}(SG2-SG3)}{(SG1-SG2)+(SG1-SG3)}\right)$$

The results were analyzed in steady state model known as two-way ANOVA analysis to observe statistical differences.

Results

In the first part of our study, the abutment screw was tightened with 20 N-cm torque and the data recorded from the torque gauge represented the torque transmitted to the implant-bone interface. The average torque values were: MCwoct: 22.79 N-cm, MCwct: 2.59 N-cm, MUwoct: 22.67 N-cm, MUwct: 1.92 N-cm (Table 1). The usage of counter-torque diminished the transmitted torque to 11.4% and 8.5% in the MC abutment and the MU abutment groups, respectively. There is no significant difference in torque transmitted between the MC and MU groups disregard the use of counter-torque device.

In the second part, the values of strain gauges were stable before and after the abutment screw tightening procedures. However,



Time point 1: 1st preload, beginning of screw tightening
Time point 2: 1st preload, end of screw tightening
Time point 3: beginning of screw re-tightening
Time point 4: end of screw-retightening.

Fig. 4 Preload of the MirusCone abutment screw without applying a counter-torque device (E+ : Minimum principle strain, E-: Maximum principle strain, Angle : between the long axis of implant replica and MPS)

Table. 1 Transmitted torque (N-cm) recorded by the torque gauge from five preload trials

	1st	2nd	3rd	4th	5th	Mean (SD)
MCwoct	22.26	24.32	22.56	22.26	22.56	22.79 (0.87)
MCwct	2.55	1.86	2.75	2.84	2.94	2.59 (0.43)
MUwoct	23.54	21.77	22.75	22.75	22.56	22.67 (0.63)
MUwct	1.96	1.77	1.77	2.16	1.96	1.92 (0.16)

Table. 2 The mean maximum principle strain (MPS, unit: μ) recorded after preload

	MCwoct	MCwct	MUwoct	MUwct
Model 1	-244.65	-208.57	-197.40	-234.95
Model 2	-230.93	-201.86	-232.19	-219.05
Model 3	-261.24	-273.60	-193.97	-211.86
Model 4	-221.38	-219.92	-218.22	-220.41
Model 5	-254.20	-254.58	-238.00	-218.72
Mean (SD)	-242.48 (16.38)	-231.71 (31.00)	-215.95 (19.89)	-221.00 (8.48)

Table. 3 Angle (Φ; unit: °) between the MPS and the long axis of the implant replica after preload

	MCwoct	MCwct	MUwoct	MUwct
Model 1	4.27	2.99	-10.43	0.55
Model 2	-5.14	-8.42	-10.28	-12.80
Model 3	0.07	0.08	-11.36	-9.49
Model 4	-5.76	-5.87	12.86	11.72
Model 5	6.21	6.51	15.38	13.65
Mean (SD)	-0.07 (5.39)	-0.94 (6.17)	-0.76 (13.62)	0.72 (11.99)

the strain signal revealed a dynamic wave form (Fig4). The highest absolute reading value was always detected from SG1 in all groups. The data suggested that, the direction of SG1 was most parallel to the direction of principle strain. In fact, the values of SG1 were almost identical to the maximum principle strain (MPS) calculated (Fig4).

From the results of these models, there was no significant difference in the peri-implant bone strain developed after preload of the abutment screw with or without applying a counter-torque device ($P > 0.05$) and the mean strain values of the four tested groups are MCwoct: -242.48 $\mu\epsilon$, MCwct: -231.71 $\mu\epsilon$, MUwoct: -215.95 $\mu\epsilon$, MUwct: -221.00 $\mu\epsilon$ (Table 2). The data showed that preload of the abutment screw may induce peri-implant bone strain with direction close to the long axis of the implant replica in all groups (Table 3).

Discussion

The purpose of preload is to generate an adequate clamping force which keeps two component parts together and attains stability across the screw joint. When the total external load experienced by the screw is greater than the yield strength of the screw, the protection afforded by the preload is lost and the potential for screw loosening and/or fracture occurs. Optimum preload will maximize the fatigue life of a screw and offer a reasonable degree of protection against loosening.[3,8,10]

During the process of preload, the torque may be transmitted and rotates the implant. The clamping force may also deform the implant and the excess strain could be transmitted to the implant-bone interface. Consequently, the initial osseointegration may be destroyed and the fabrication of prostheses will be delayed.[12]

Our results supported the observation of Lang et al,[5,13] when the counter-torque device was used, the magnitude of the torque transmitted to the bone was significantly reduced. Only 10 % of the tightening force was transmitted to the bone and the remainder may have been dissipated within the abutment and the counter-torque device.[5] With the application

of a counter-torque device, the torque values of the MC and MU abutments were reduced to 11.4% and 8.5 % in our study. Since excess torque may cause micro-crack in the peri-implant bone, our data suggest that a counter-torque device may be needed to limit the torque if the osseointegration is compromised or an implant will be immediately loaded.

It was proposed that engaging of anti-rotational configurations between the abutment and implant can prevent rotation at abutment-implant junction and screw loosening.[6,7] However, Lang et al.[13] examined the orientation of the abutment hexagon to the implant hexagon after tightening of the abutment screw with and without the use of a counter-torque device. Their results revealed and indicated that the hexagon-to-hexagon relationship was not a major influence on the transmission of torques to the implant/bone interface during abutment screw tightening. Their results were supported by our observations that there is no significant difference in the torque transmission between an abutment with anti-rotational design (MC) and without (MU). Thus, the torque may be transferred through the contact of the screw head to the abutment screw bore. The force then may be mechanically transferred to the abutment bearing surface and, through frictional contact with the implant-bearing surface, be transferred along the implant to the implant/bone interface.

Although there was a significant difference in torque transmission between the groups using a counter-torque device and without using the device during preload, there was no significant difference in the peri-implant bone strain developed after preload ($P > 0.05$). The discrepancy may be due to measurements made at different planes by the Tohnichi torque gauge and the strain gauge. Although implant analogs were used instead of implants in our study, our data suggest that the preload may deform the implant which may induce bone strain in the surrounding bone. More research is needed to clarify whether different amount of bone strain will be induced in implants of different designs and how the bone strain may affect the osseointegration.

Conclusions

A counter-torque device may diminish the torque transmitted to the peri-implant bone during preload. Preload may deform the implant and induce peri-implant bone strain parallel to the long axis of the implant after preload. Anti-rotational design at abutment-implant junction did not affect the torque transmission during preload and peri-implant bone strain after preload. Further studies are needed to clarity the static and dynamic changes of peri-implant bone strain during and after the abutment screw tightening procedure.

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Case Report

Socket Shield Technique for Ridge Preservation : A Case Report

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Abstract

The "socket shield technique" has demonstrated the potential in preventing buccal tissue from resorption in animal and clinical studies. It is assumed that retaining a root fragment attached to the buccal bone plate in this technique can avoid tissue alteration after tooth extraction. This article presents a 58-year-old healthy man with a failing upper right second premolar which would be replaced by an implant-supported single crown. Leaving a partial root fragment at buccal side in combination with immediate implant placement lingual to the retained fragment was performed. Four months after implant placement, clinical examination showed healthy peri-implant soft tissue and the ridge was well preserved. A definitive metal ceramic crown was fabricated and cemented on a titanium abutment. The prosthesis successfully restored the function of the patient. A maximum amount of horizontal resorption at the buccal side was 0.72mm. Applying socket shield technique and immediate implant placement may be a feasible treatment option in case with high esthetic concern.

Keywords: ridge preservation, immediate implant placement, extraction socket, socket shield, tooth retention

Introduction

Healing of extraction sockets are characterized by bone formation within the socket and loss of the alveolar ridge width and height externally.[1] The alteration of ridge contour may compromise the restoration-oriented three-dimensional positioning of the implant which requires optimal support and stability of surrounding hard and soft tissues.[2] In esthetic region, the height and thickness of facial and interproximal bone walls are the important factors for successful pink esthetic outcomes, which are made up by the color, shape, and character of the marginal peri-implant mucosa and the presence of interdental papilla.[3] Different techniques such as immediate implant placement[4] and ridge preservation procedure[5] have been proposed to maintain the ridge dimension to a certain amount. However, applying these methods to extraction sockets could not completely preserve the coronal part of facial bone walls which were comprised almost entirely of bundle bone.

Araújo and Lindhe suggested that following tooth extraction, the blood vessels in periodontium to the thin bone walls are severed, thereby causing facial bone plate resorption.[6] Thus it can be assumed that retaining a root may alter the occurrence of facial bone resorption.

Fig. 1 Complicated crown-root fracture at tooth 15 restored temporarily with composite resin.

Fig. 2 Tooth 16 and 17 were restored by implants which showed healthy peri-implant mucosa.

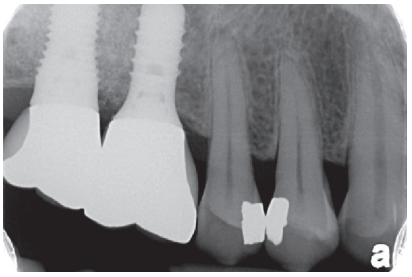

Fig. 3 Periapical radiograph taken before removing the tooth fragment showed moderate bone resorption and apical radiolucency at 15.

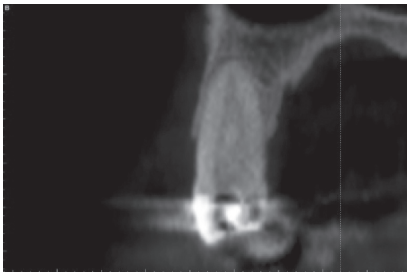

Fig. 4 Thin buccal plate and sufficient bone apico-palatal to the root on the CBCT image.

Retaining a root for alveolar ridge preservation has been tested in several clinical studies. In a case report, decoronation of an ankylosed tooth demonstrated complete maintaining of the height and width of the alveolar ridge prior to implant placement.[7] Salama et al. recommended a root submergence technique in which a natural tooth root was maintained and the surrounding tissue could be preserved at the pontic site.[8] Periodontal regeneration including new attachment apparatus, cementum, connective tissue, and bone could be formed around a submerged root whose surface was pathologically exposed.[9]

Davarpanah & Szmukler-Moncler reported a series of five cases that implant osteotomy preparation and placement were through the ankylosed roots.[10] The root fragments were deliberately left and did not seem to interfere with implant integration in the mid-term.

In 2010, Hürzeler et al. introduced a new method, the socket shield technique, in which a partial root fragment was retained around an immediately placed implant with the aim of avoiding tissue alterations after tooth extraction.[11] Histologic evaluation in a beagle dog showed no resorption of the root fragment and new cementum formed on the implant surface. Their clinical case demonstrated excellent buccal tissue preservation and clinically successful osseointegration of the implant. Joseph & Kitichai[12] reportrd an alternative approach in a case utilizing a retained proximal root fragment to maintain the inter-implant papilla.[12] Bäumer et al. conducted a pilot study concentrated on the histological, clinical, and volumetrical observation of the alveolar ridge and implant after applying this technique.[13] Healthy periodontal ligament of the tooth segment, minor volumetric change of the ridge contour, and direct bone-to-implant contact manifested that this technique is a feasible treatment option.

This article describes a patient whose alveolar ridge of a failing tooth is preserved by the "socket shield technique" and immediate implant placement.

Case Report

A 58-year-old, healthy, and non-smoking male patient presented with a complicated crown-root fracture on the upper right second premolar restored temporarily with composite resin. The fracture line extended 3mm apical to the palatal gingiva. The adjacent molars, tooth 16 and 17, were replaced by an implant-supported fixed partial denture after sinus elevation procedures. (Fig. 1,2) Clinical examination showed healthy periodontal and peri-implant tissues except 15 where bleeding on probing and plaque accumulation were found at its palatal side. Periapical radiograph of 15 taken before removing the fracture part of the tooth reveled moderate alveolar bone resorption and apical radiolucency. (Fig. 3)

Treatment options were discussed subsequently and implant-supported single crown was the choice for replacing the failing 15. Cone-beam computed tomography (CBCT) demonstrated thin buccal plate and sufficient residual bone apico-palatal to the root. (Fig. 4)

Fig. 5 Shield was prepared and conservative removal of the palatal root fragment.

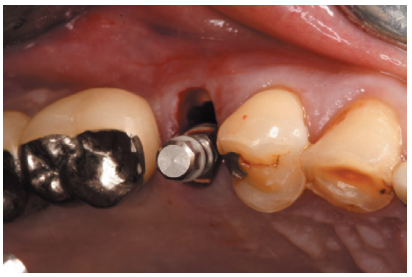

Fig. 6 The implant is placed at palatal position without contacting the shield.

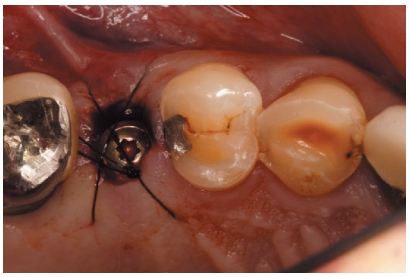

Fig. 7 Partial closure of the extraction socket by a minor pouch flap and stitch.

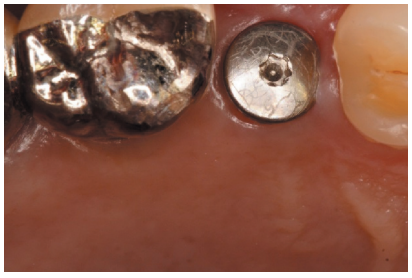

Fig. 8 Uneventfully healing of the peri-implant soft tissue after 4 months.

Fig. 9 Shallow probing depth around the implant.

Fig. 10 Titanium abutment was connected to the implant.

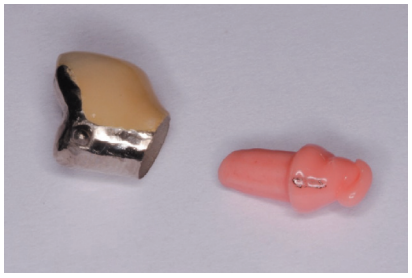

Fig. 11 A silicone index (pink) formed to the internal configuration of the implant restoration.

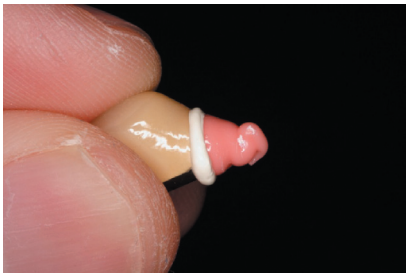

Fig. 12 Excess luting material could be wiped off after placing the implant crown onto the silicone index.

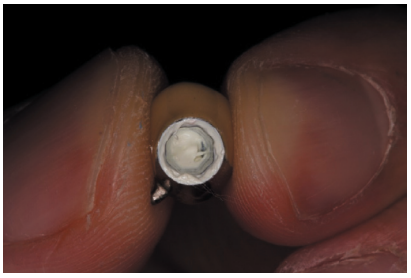

Fig. 13 A thin and evenly distributed layer of luting agent was provided for cementation.

The treatment plan implicated an immediate implant placement within the meaning of the socket shield technique and flapless implant placement at tooth 15 without damaging the adjacent implants.

Prophylactic procedures including taking 2g of antibiotic (Curam®, Sandoz GmbH, Kundl, Austria) one hour before surgery and rinsing his mouth with 0.2% chlorhexidine solution were performed. Tooth 15 was decoronated with coarsed-grained diamond bur and the shield was segmented and prepared by osteotomy drills. Conservative extraction of the palatal root fragment was done with periotome and forceps. (Fig. 5) The socket was debrided gently and irrigated with normal saline. Implant bed preparation at the palatal wall of the socket was performed and a root-form implant (Tapered Effect implant 4.1 X 12mm, Straumann®, Basel, Switzerland) was placed according to the manufacturer's recommendations without contact to the shield. The apico-coronal position of the implant platform was situated 1mm apical to the palatal marginal gingiva. The gap between the shield and implant surface was left to enable blood clot formation.(Fig. 6) The socket was partially closed by a minor partial-thickness pouch flap elevated at the buccal side and a Fig.ure-of–eight stitch. (Fig. 7) After 4 months, the soft tissue around the implant healed uneventfully, and represented shallow depth on probing. (Fig. 8,9) The final impression was taken and a porcelain-fused-to-metal crown was fabricated. A titanium abutment (RN synOcta cementable abutment, Straumann®, Basel, Switzerland) was torqued into the implant at 35N-cm. (Fig. 10) In order to reduce the cement extrusion into

Fig. 14 Final metal ceramic crown in situ. The gingiva height of 15 was maintained.

Fig. 15 The buccal ridge contour of 15 was preserved.

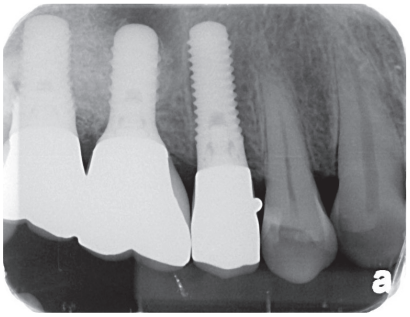

Fig. 16 Periapical radiograph taken after temporary cementation of the crown.

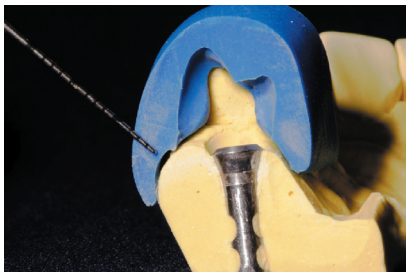

Fig. 17 Comparison of pre-operative (blue putty) and post-operative (yellow stone) ridge shapes. Only minor resorption of the buccal and palatal surfaces could be observed.

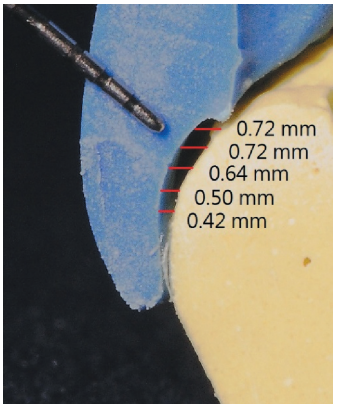

Fig. 18 The amount of horizontal resorption of the buccal surface was measured.

Fig. 19 One-year follow-up manifested constant morphology of the alveolar ridge.

Fig. 20 Peri-implant tissue showed an absence of inflammation after one year.

the peri-implant sulcus area, a silicone index made by filling it into the internal conFig.uration of the definitive restoration (Fig. 11) was used to prepare a uniform layer of luting agent. Lining the intaglio of the restoration with cement (TempBond; Kerr, Orange, Canada), seating the crown onto the silicone index, and wiping off the excess material eventually produced an evenly distributed layer of luting agent. (Fig. 12,13) The crown was then placed on the abutment intraorally and only a minor amount of excess cement could be detected and removed. The height and width of the ridge was preserved. (Fig. 14,15) Radiograph showed that the implant was well integrated. (Fig. 16)

Pre- and post-operative stone models were matched for comparing the ridge alteration after this intervention. A silicon putty impression was taken from the pre-operative stone model to record the baseline ridge morphology. The impression was cut in bucco-palatal direction at tooth 15 and placed on the post-operative model for comparison by using adjacent teeth as references. (Fig. 17)

The long axis of the implant dictated the vertical orientation of the measurements. The amount of horizontal resorption of the buccal surface are measured in pixels and calibrated by a periodontal probe at different points apical to the bottom of gingival sulcus in an interval of 0.5mm. The area showed the highest amount of resorption measured 0.72mm in palatal direction was the most coronal part of the ridge. (Fig.18)

The crown was definitively cemented with reinforced glass ionomer cement (FujiCEM®, GC Corporation, Tokyo, Japan) after two weeks. One-year follow-up fulfilled the criteria for implant success. (Fig. 19,20)[14]

Discussion

This case report confirmed that retaining a root fragment adjacent to the buccal crestal bone and placing an implant engaged to the palatal socket wall immediately are able to maintain the contour of the ridge. The implant can achieve osseointegration without any inflammation at peri-implant tissue. While histological examination is needed to verify the preservation of buccal bone plate and tissue regenerated between the shield and implant, the clinical outcome demonstrated the potential of socket shield technique to avoid noticeable alteration of ridge shape after tooth extraction.

In scientific literatures, immediate implant placement is a predictable procedure to accomplish osseointegration.[15] However, the biological response to tooth extraction, such as marked resorption of the buccal bone plate, is not altered when an implant is installed into the socket.[16-18] Simultaneously grafting the void between the implant and socket walls with bone substitutes in conjunction with a barrier membrane does not preserve the buccal bony wall either.[19] Applying guided bone regeneration (GBR) and/or soft tissue augmentation at the external buccal surface of the ridge can only partly compensate but not prevent the resorption process.[20] In GBR, flap elevation and overbuilding the buccal contour are necessary for predictable results. Scar formation, insufficient soft tissue for coverage, additional surgical wound for hard/soft tissue harvest, and high cost of biomaterials are main drawbacks of GBR technique used in immediate implant placement.

Socket shield technique meets the demands of minimal invasion, tissue preservation, and no need of bone substitute materials. Baumer et al. proved that the remaining tooth segments showed healthy periodontal ligament at buccal side and no osteoclastic remodeling of the coronal part of the buccal plate.[13] They also analyzed the clinical volumetric change of the alveolar ridge in a case and showed a mean loss of 0.88mm in labial direction with a maximum of 1.67mm and a minimum of 0.15mm. In our case, the maximal horizontal loss is 0.72mm, less than that report. Different subject, measurement method and tooth position may cause the dissimilarity.

Socket shield technique for ridge preservation can be applied not only for maintaining buccal contour of an edentulous ridge but also for keeping the inter-implant soft and hard tissue.[7] Kan and Rungcharassaeng[12] used proximal socket shield procedure in conjunction with immediate implant placement and provisionalization on a failing tooth adjacent to an implant restoration. The well-preserved inter-implant papilla and satisfactory esthetic results after 1-year follow up were shown in their case report. Diversification of this technique used for tissue preservation such as socket preservation for future implantation in adolescence may be practical. Howerer, more studies are needed to prove the feasibility.

Excess residual cement around the margin of cement-retained implant restoration has been proved to cause peri-implant inflammation.[21] Wadhwani and Piñeyro introduced a method of controlling cement flow using a duplicated silicone abutment with smaller dimensions.[22] Chee et al. compared different cement application methods and manifested that this technique produced the least amount of excess cement than other conventional methods such as applying the cement on the internal margin or axial wall only.[23] As the crown margin is located below the marginal peri-implant mucosa in our case, we employ this technique in the process of cementation in order to reduce the amount of residual cement.

In this case report, the application of socket shield technique combined with immediate implant placement for replacing a failing tooth obviously maintains the ridge shape. The implant-supported prosthesis functions well and healthy peri-implant soft tissue is observed. Further studies with larger scale of evidence and long-term follow up are needed to substantiate the validity of this technique.

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Case Report

An Interdisciplinary Approach for Diastema Closure In the Anterior Maxilla: A Clinical Report

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Abstract

Achieving a satisfactory anterior esthetic outcome is a considerable challenge for most dentists. Multiple interdisciplinary approaches are necessary to resolve esthetic defects, especially in cases of improper tooth alignment and excessive space between anterior teeth. This case report describes an interdisciplinary approach used for a 66-year-old male with diastema and peg-shaped lateral incisors. The interdisciplinary treatments included orthodontic and prosthodotic treatments. All ceramic crowns and porcelain laminate veneers were successfully applied to correct esthetic problems and achieve improved esthetic and functional outcomes.

Keywords: diastema, all ceramic crowns, porcelain laminate veneer

Introduction

The increasing demand for esthetic restorations has been met around the world in recent years. However, the esthetic appearances of cosmetic restorations are usually compromised by many potential problems, such as a diastema in the midline region, asymmetry of tooth arrangement and proportion, asymmetry of the gingival level and tooth discoloration. In such instances, an interdisciplinary approach including periodontic, endodontic, orthodontic, and prosthodontic treatments is necessary to evaluate and solve esthetic problems.[1-3]

The presence of a midline diastema usually distorts a pleasing smile. A lot of treatment options have been proposed to close the space between maxillary anterior teeth.[3-5] A careful diagnosis of the causal element is important in determining the appropriate treatment plan. However, the etiology of diastema is complex and multifactorial. Several etiological factors have been proposed as the causes of diastema, including periodontal attachment loss, pressure from the inflamed tissue, occlusal factors such as trauma from occlusion, oral habits (such as bruxism, mouth breathing, tongue thrusting, sucking habits, pipe smoking, and playing of wind instruments), abnormal labial frenum, non-replacement of missing teeth, gingival overgrowth, and iatrogenic factors.[4-6] In addition, a peg-shaped lateral incisor has also been regarded as a potential cause of diastema due to the distal movement of the central incisor.[7]

Fig. 1 Intra-oral frontal view showed large diastema between maxillary central incisors and peg-shaped maxillary lateral incisors.

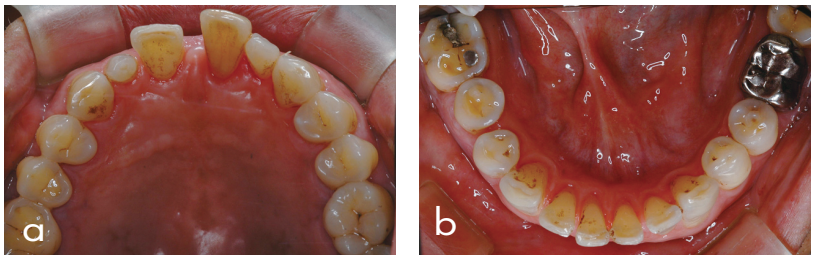

Fig. 2 Pretreatment maxillary (a) and mandibular (b) occlusal view.

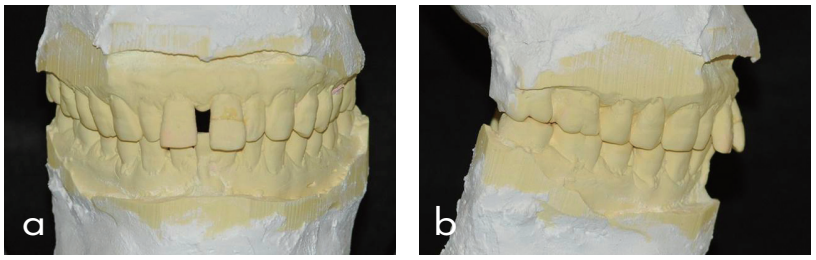

Fig. 3 Frontal view (a) and lateral view (b) of pretreatment mounted casts.

In some instances, orthodontic treatment can improve esthetic problems and the patient's satisfaction by correcting anterior open bite and closing the diastema. However, when dentoalveolar and Bolton discrepancies are detected, orthodontic treatment alone is not sufficient to obtain ideal proximal contacts with satisfactory vertical and horizontal overlaps.[8,9] In such instances, the orthodontic treatment can be used to redistribute the adequate spaces between the maxillary anterior teeth prior to the restorative treatment. The literature has demonstrated that direct composite resin restorations, porcelain laminate veneers and crowns are good treatment options for correcting anterior diastema.[5,9] Therefore, the purpose of this clinical case report was to present the interdisciplinary management (including orthodontic and prosthodontic treatment) of a patient who exhibits maxillary anterior diastema and peg laterals.

Case Report

A 66-year-old male came to Fung Chai Dental Clinic (Taichung, Taiwan) for restorative treatment. His chief complaint was tooth spacing and improper appearance of the maxillary anterior teeth. No major systemic diseases or drug allergies were noted. Extra-oral examination indicated the 3 mm of tooth display and diastema between maxillary central incisors at rest. Intraoral examination revealed normal dentition with mild gingival recession and cervical abrasion on the buccal side of teeth. There was approximately 2.5 mm spacing between the maxillary central incisors (Fig. 1). The labial flaring of maxillary central incisors, small peg-shaped maxillary lateral incisors, and occlusal enamel erosion over posterior teeth were all presented (Fig. 2). During the protrusive movement, the maxillary central incisors contacted evenly with the mandibular incisors. However, in the edge-to-edge position, only the left maxillary central incisor contacted the mandibular incisors. Tooth 21 showed discoloration and negative pulp vitality. The regular gingival zenith and thick gingival biotype were noted. In addition, the vertical overlap and horizontal overlap were 3 mm and 7 mm respectively according to the measurement on the study cast (Fig. 3). The mesio-distal widths of four maxillary incisors from tooth 12 to 22 were 5.9, 9.2, 9.0, and 5.8 mm respectively. The diagnosis of this case included diastema, peg-shaped maxillary lateral incisor, and labial flaring of maxillary central incisors.

After communication and discussion with this patient, the definitive treatment plan included closing the space between maxillary central incisors and aligning maxillary incisors to proper position with orthodontic treatment. Furthermore, full ceramic crowns were recommended to restore the maxillary central incisors and laminates for lateral incisors. The preliminary treatment included oral hygiene instructions, caries control, non-surgical periodontal therapy, root canal treatment of tooth 21, and orthodontic treatment for 6 months. Orthodontic treatment included alignment of the maxillary and mandibular dental arch; correction of excessive horizontal overlap; and creation of adequate space for further prosthodontic restorations (Fig. 4). Before removal of brackets, tooth proportion and space distribu-

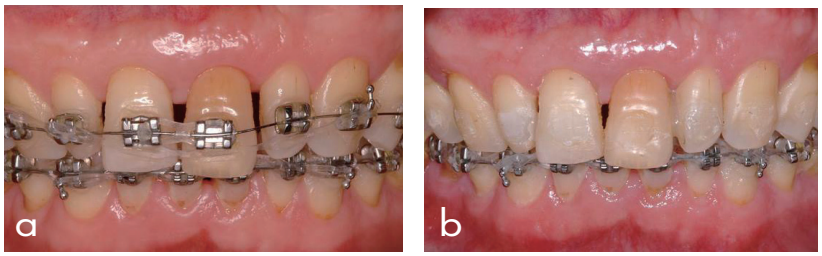

Fig 4. (a) Frontal view before the completion of orthodontic treatment. Diastema between maxillary central incisors was closed and space was re-distributed. (b) Frontal view after the completion of orthodontic treatment at the maxillary arch.

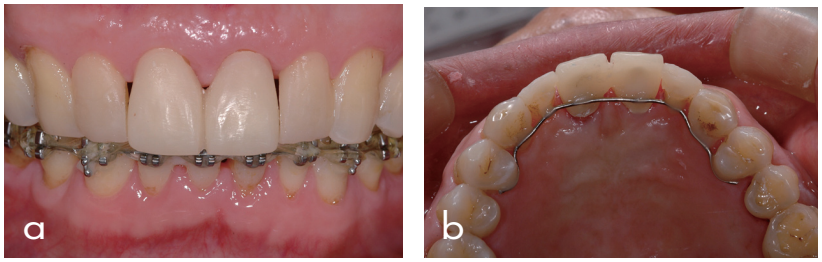

Fig 5. (a) Provisional crowns and veneers in place. (b) The palatal splinting wire in place.

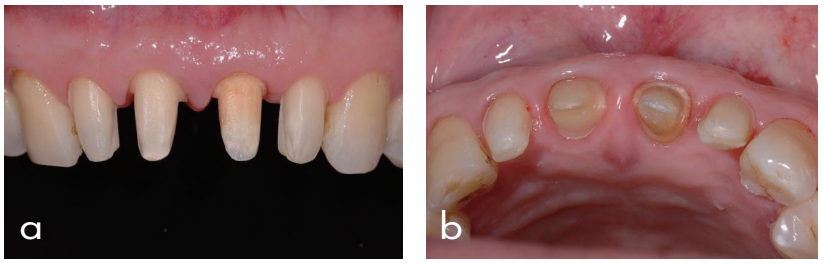

Fig 6. (a) Frontal view of tooth preparation for all-ceramic crowns and porcelain laminate veneers. (b) Occlusal view of tooth preparation and soft tissue architecture.

tion were reevaluated using recurring esthetic dental (RED) proportion analysis. The calculated RED proportion was approximately 70%. Maxillary and mandibular study cast were then taken with alginate impression for provisional restorations and palatal splinting wire. The provisional restorations were fabricated according to the diagnostic wax up. The provisional restorations were modified and adjusted until the phonetic, esthetic, and functional results were accepted by the patient (Fig. 5).

A circumferential 1 mm width of shoulder margin was prepared for full ceramic crowns of maxillary central incisors and a 0.3 mm width of chamfer margin was designed for laminate veneers of maxillary lateral incisors. Furthermore, a 1 mm subgingival margin on the mesial finishing line of centrals was prepared to eliminate the occurrence of black triangles (Fig. 6). To verify the adequate tooth length and appearance, a phonetic test (including F and S sounds) and an esthetic test (including tooth proportion, alignment, and color) were evaluated. After 3 months of wearing provisional restorations, the definitive impression was made using vinyl polysiloxane impression material (Aquasil, Dentsply/ Caulk, Milford, DE). The impression was poured with type III dental stone and a master cast was fabricated. The master cast was mounted on a semi-adjustable articulator (Artex, Girrbach, Germany). Pressed ceramic crowns and veneers (IPS e.max, Ivoclar-Vivadent, Schaan, Liechtenstein) were fabricated for the maxillary central incisors and lateral incisors.

The definitive restorations were checked and adjusted in order to obtain optimal proximal contact, ideal gingival contour, and occlusal contact (Fig. 7). The definitive restorations were cemented with dual-cure resin cement (Variolink II, Ivoclar Vivadent, Schaan, Liechtenstein). Even contacts at maximum intercuspation and proper anterior guidance of the maxillary central and lateral incisors were made. A maintenance plan, which included oral hygiene instruction and prosthesis home care, was established. The patient and the interdisciplinary team were satisfied with the esthetic and functional outcomes of these definitive restorations.

Discussion

The arrangement and proportion of maxillary anterior teeth are the major determinants for a pleasing appearance. To evaluate and describe the ideal tooth-to-tooth proportion, Levin applied the golden proportion (proportion of 1.618:1.0) to relate the successive

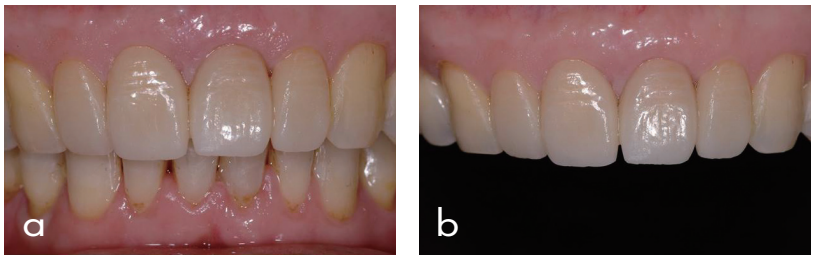

Fig 7. (a) Post-treatment intraoral view of definitive restorations. (b) Frontal view of the anterior maxillary restorations. Note the harmonious appearance between the restoration and the soft tissue.

widths of the anterior teeth as viewed from the front.[10] The golden proportion implies that the maxillary central incisor should be 62% wider than the lateral incisor, which is consistent between the widths of the maxillary lateral incisor and canines. However, Preston reported that only 17% of the patients had the golden proportion in terms of the relationship between the maxillary central and lateral incisors.[11] In addition, when using the golden proportion, the lateral incisors and canines appeared too narrow. Therefore, Ward indicated that the recurring esthetic dental (RED) proportion was more appropriate to individually fit the face, gender, and body type of each patient.[12] The average range of RED proportion from 62% to 80% was considered acceptable. In this case, the RED proportion was calculated prior to removal of orthodontic brackets to confirm the ideal space distribution and the tooth-to-tooth proportion. The calculated RED proportion was 70%, which is also preferred by most of dentists in a study.[13]

In addition to presenting the importance of space management and tooth-to-tooth proportion, incisal edge position is one of major determinants for a pleasing smile. The adequate incisal edge position can be evaluated according to the phonetics and the display length both dynamically and at rest. Some studies demonstrated that the amount of maxillary anterior teeth at rest decreased in visibility with increasing age and longer upper lips.[14,15] The exposure of maxillary central incisors at rest ranged from -0.04 to 1.37 mm in the patients over 50 years of age. Furthermore, smile displaying teeth including 2 to 4 mm gingiva were considered as the most esthetically pleasing.[16]

This clinical report presented an interdisciplinary approach to resolve esthetic defects, including diastema and peg-shaped lateral incisors. To design the definitive restorations, the RED proportion and incisal edge position were applied to evaluate the distribution of the spaces and the ideal tooth position before the completion of orthodontic treatment. All-ceramic crowns and porcelain laminate veneers on the maxillary central incisors and lateral incisors were completed. The combination of orthodontic and prosthodontic treatments with careful diagnosis and planning were critical for improved esthetic and functional outcomes.

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Case Report

Implant Retained Overdenture Improves the Retention and Stability by Using a Locator® System in a Mandibular Edentulous patient: A Case Report

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Abstract

Complete maxillary and mandibular dentures have been used as a conventional treatment of edentulous patients for longer than a century. Suitable complete maxillary dentures are usually well tolerated but many patients struggle to chew and swallow with the complete mandibular denture because it is too unstable. Previous studies have shown that a mandibular two-implant retained overdenture is superior to the conventional denture in terms of retention and stability. Thereby, the two-implant assisted mandibular overdenture should be the first treatment option for mandibular edentulous patients. In this report, a mandibular two-implant retained overdenture with Locator® attachments by using direct intraoral pick-up technique was discussed.

Keywords: Implant-retained, Overdenture, Retention, Stability, Locator System

Introduction

Complete maxillary and mandibular dentures have been served as a conventional treatment of edentulous patients for longer than a century. Suitable complete maxillary dentures are usually well tolerated but many wearers struggle to eat with the complete mandibular denture because it is relatively unstable. Previous studies have shown that a mandibular two-implant retained overdenture is superior to the conventional denture[1]. Thereby, the two-implant assisted mandibular overdenture is the first treatment option for mandibular edentulous patients[2] .

A successful mandibular complete denture relies on sufficient retention and stability. Redford et al demonstrated that more than 50% of conventional mandibular complete dentures have problems with retention and stability[3]. Mandibular two-implant overdentures have been shown to be superior to conventional dentures in randomized and non-randomized clinical trials with the observation time from six months to nine years[4]. According to consensus statements of Feine et al[5], the two-implant retained overdenture should be the first treatment choice for mandibular edentulous patients.

When dentists make the treatment plan and selection of the attaching mechanism for an implant-retained overdenture, they should consider the following factors: [1] cost effectiveness, [2] amount of retention needed, [3] pain caused

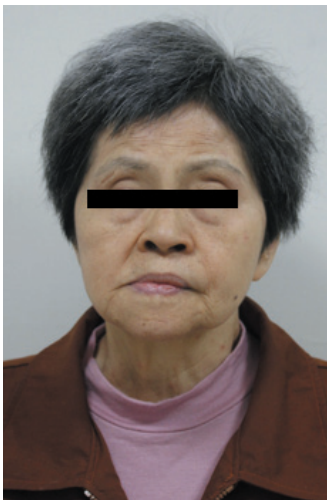

Fig. 1-a The patient's lower jaw was shifted to the right side when she wore the old dentures.

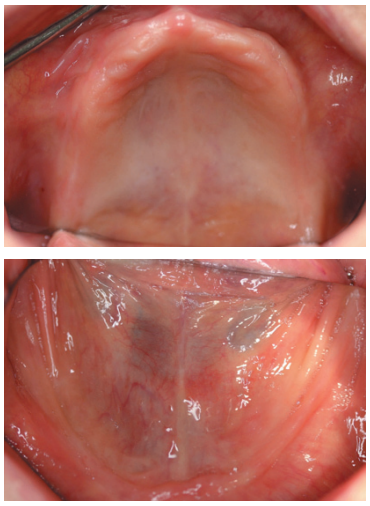

Fig. 1-b Severe ridge resorption, especially in the lower jaw.

Fig. 1-c Plaque deposition and unilateral crossbite were shown on patient's old dentures.

on the soft tissue, [4] amount of available bone, [5] expected level of oral hygiene, [6] patient's social economic status, [7] patient's expectation, [8]maxillomandibular relationship, [9] status of the antagonistic jaw, and [10] inter-implant distance.

In this report, we applied a mandibular implant-retained overdenture with Locator® attachments by using intraoral pick-up technique.

Case report

A 70 year-old female patient visited Taipei Medical University Hospital prosthodontic department with chief complaint of poor retention of old dentures, and wanted to renew her maxillary and mandibular complete dentures.

The patient was generally healthy, independent, and with medically controlled hepatitis. The existing prostheses, which were fabricated 2 years ago, include maxillary and mandibular complete dentures. The patient was not satisfied with the existing prostheses. Her major complaint with the prostheses was the rocking of dentures during speaking and chewing. She had to take off her dentures in order to swallow the food.

Extraoral examination revealed that the lower third of the patient's face was shifted to the right side when she wore the old dentures(Fig.1-a). The jaw relationship was prognathic according to Angle's classification. Otherwise, the extraoral physical examination was within normal limit. Intraoral examination revealed that alveolar ridges of maxilla and mandible were severely resorbed, especially in the mandible(Fig.1-b). Border and frenum attachments were relatively low and located too close to the crest of the residual ridges. Maxillary edentulous ridge was noticed as a round to taper shape but mandibular ridge appeared to be a short inverted "V" and "W" shape covered by firm soft tissue. An excessive interarch space was noticed due to severe ridge resorption. The complete maxillary and madibular dentures showed poor retention, stability, and border extension. Moreover, unilateral crossbite of right side teeth and poor oral hygiene with plaque accumulation were noticed.(Fig. 1-c)

Chair-side tissue conditioner (Lynal®, Dentsply Caulk, U.S.A.) and Unifast® self-cured resin occlusal reline were performed to improve the tissue adaptation and the occlusion of the old dentures. After panoramic X-ray and dental CT scan evaluation with oral surgeon's consultation, the treatment plan with maxillary conventional complete denture and mandibular two-implant retained overdenture was suggested and accepted by the patient.

Thus, the relined mandibular denture was duplicated to make a surgical stent for one stage Astra® (Astra Tech AB, Sweden) implant placement over the right and left canine sites. During healing period, multiple chair side relines with tissue conditioner were performed. After 3 months of healing time for osseointegration, the healing abutments of mandibular implants were replaced with Locator® (Zest Anchors, U.S.A.) abutments. (Fig. 2-a~c)

Alginate preliminary impression for both arches were obtained and followed by fabrication of individual trays(Ostron®, GC

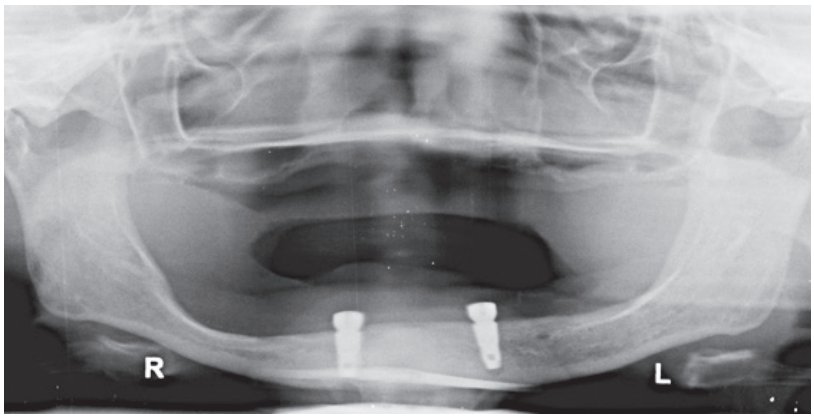

Fig. 2-a Panoramic radiograph was taken three months after implant placement.

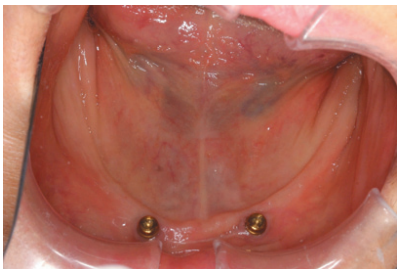

Fig. 2-b Intraoral veiw of Locator® abutments connected to the implants.

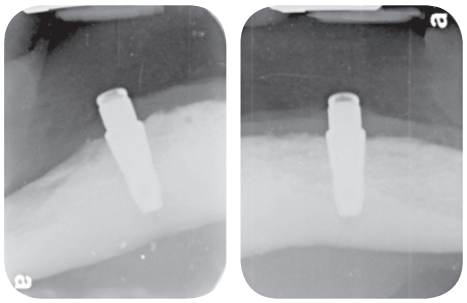

Fig. 2-c Periapical X-ray film of implants with Locator® abutments.

Corporation, Japan), which refined borders with molding compound(Peri Compound®, GC Corporation, Japan). Final impressions were made with vinyl polysiloxane impression materials(Virtual®, Ivoclar Vivadent, Italy), with Locator® impression copings (Zest Anchors, U.S.A.) for mandibular arch(Fig. 3-a~d). The master casts were poured to fabricate record bases and occlusal rims with metal housing in the mandibular record base. Vertical dimension, occlusal plane and lip support were evaluated and duplicated with record bases and occlusal rims. Face bow transfer with the interocclusal record were obtained by using vinyl polysiloxane bite registration material (StoneBite®, Dreve Dentamid GmbH, Germany). The master casts were then mounted on a semi-adjustable articulator.

Vertical dimension, lip support, and phonetics were re-evaluated with wax dentures after denture teeth (Ivoclar Vivadent AG, Liechtenstein) were arranged. Concomitantly, eccentric records were obtained to refine denture teeth setting. The refractory casts were duplicated to fabricate maxillary and mandibular denture metal frameworks. Before packing (Lucitone 199®, Densply, U.S.A.), Locator® metal housing was removed from mandibular wax denture. Selective grinding was performed to gain a fully balanced occlusion after denture processing and laboratory remounting. Dentures were then delivered and tissue adaptation was first assessed in the oral cavity. After adjustment of tissue and polishing surfaces, interocclusal record was obtained using Aluwax® (Aluwax Dental Products Co., U.S.A.) for clinical remounting and occlusal adjustment. Finally, maxillary and mandibular dentures were delivered to patient without metal housing and plastic male part(Fig. 4).

The metal housings with processing male parts were picked up with auto polymerizing resin (Unifast Trad®, GC Corporation, Japan) after two appointments of denture adjustment to get rid of sore spots and occlusal interferenc-

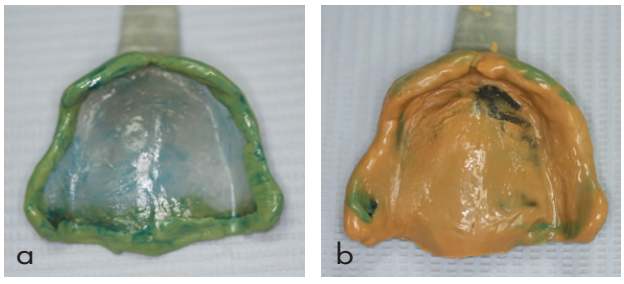

Fig. 3-a & b Refined individual tray and final impression of maxillary arch

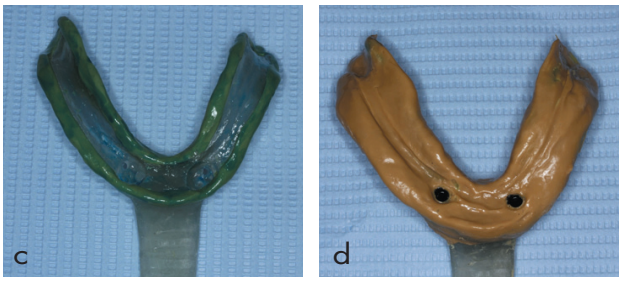

Fig. 3-c & d Refined individual tray and final impression of mandibular arch

Fig. 4 Funaliyed maxillary and mandibular complete dentures

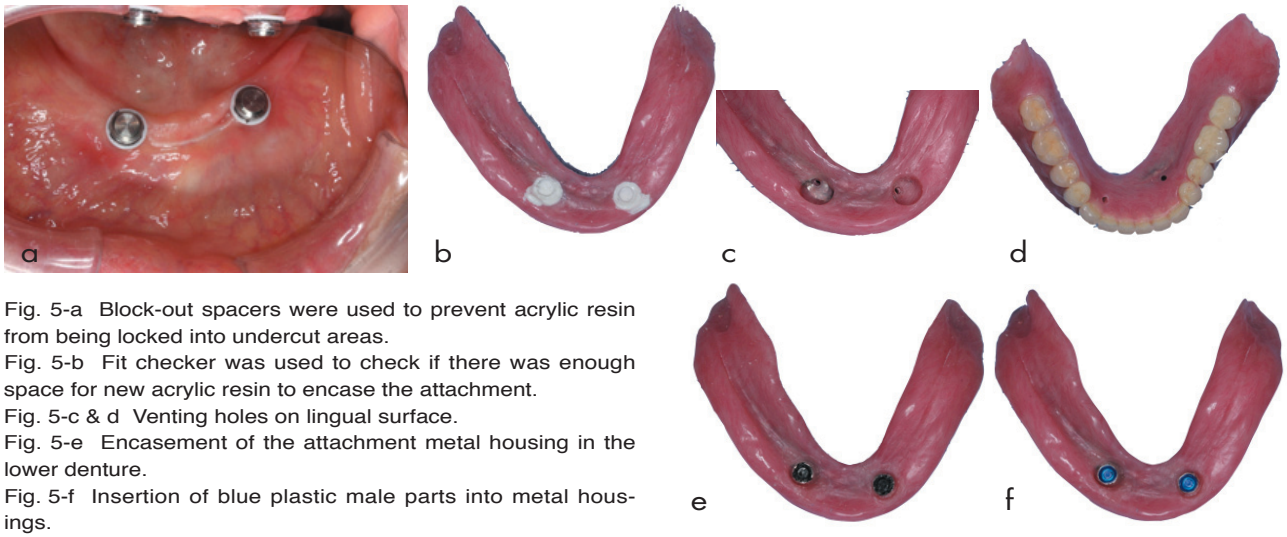

Fig. 5-a Block-out spacers were used to prevent acrylic resin from being locked into undercut areas.
Fig. 5-b Fit checker was used to check if there was enough space for new acrylic resin to encase the attachment.
Fig. 5-c & d Venting holes on lingual surface.
Fig. 5-e Encasement of the attachment metal housing in the lower denture.
Fig. 5-f Insertion of blue plastic male parts into metal housings.

es. The relief area was provided inside the mandibular denture to create space for new acrylic resin to encase the attachment. The relief holes were drilled on the relief space to ensure passive seating over abutments and attachments. Simultaneously, the white block-out spacers were used to prevent acrylic resin from being locked into undercut areas(Fig. 5-a~c).

Manual stabilization of the mandibular denture preceded patient's closure into centric occlusion during polymerization of acrylic resin. After resin polymerization, the denture was removed from oral cavity and was confirmed that stability and adequate encasement of the attachment housing in the acrylic resin. The definitive attachments were then inserted into the metal housing with adequate engagement of the Locator® abutments intraorally (Fig. 5-d~f). The patient was instructed with the insertion and maintenance of the dentures after occlusal adjustment and the verification of soft tissue adaptation. The patient was well trained to use the new dentures, and was satisfied with the good stability and better retention of the mandibular denture.

Discussion

In this case report, patient noticed that her facial midline off when wearing the old dentures. She also complained about difficulty in chewing and swallowing food as she wore the old dentures. After the implant-assisted mandibular overdenture and new maxillary complete denture treatment, we found her facial

Fig. 6 Extraoral view of the patient with new dentures.

midline shift was corrected to normal range, indicating that the old dentures occluded in an inappropriate horizontal position instead of CR position(Fig. 6). These drawbacks resulted in the shift of the mandible to the right side and chewing difficulty as well as swallow problems during eating.

We used the direct procedure to connect a mandibular implant-retained overdenture with Locator® attachments. This procedure could significantly reduces the rate of error from clinical impression and laboratory processing. Nissan et al[6] stated that the direct technique for attachment incorporation in mandibular implant-supported overdentures by using ball attachments is superior to the indirect technique in terms of aftercare over a long-term evaluation period. Nevertheless, we still found pressure spots after delivering the mandibular implant-assisted overdenture. To remove the pressured spots, the adaptation of soft tissue surface of the mandibular denture should be re-assessed with pressure indicating paste after connecting the attachment introrally.

Previous series studies conducted by McGill University revealed that the implant-retained mandibular overdenture group is superior to conventional denture not only in overall satisfaction[7], chewing satisfaction[8,9], nutritional status[10], eating and social activity[11], but also easier to fabrication[12]. Moreover, the implant retained mandibular overdenture is a cost-effective intervention[13]. In consistent with McGill group, we have the similar improvements in patient outcomes and easier task in the fabrication procedures.

Conclusion

The patient benefited tremendously from the mandibular implant-retained overdenture as presented in this clinical report. The fabrication procedure is relatively easier as compared with that for conventional denture. Therefore, the two implant-retained overdenture should be considered as the first treatment option for mandibular edentulous patients.

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3. 全文總頁數 (包括摘要、圖、表、參考文獻) 以八頁為限，必要時可增至十二頁。
4. 請以電子文件投稿，文書處理程式建議以IBM-Microsoft Word為主。須標示使用程式、投稿題目、第一作者姓名，將電子文件e-mail至: prosthor@ms48.hinet.net。
5. 請同時附上致本誌主編簡短信函，表明投稿本誌之意願，並說明所有著者均曾過目並簽名同意。若為人體試驗須附人體試驗委員會之同意函。

三、 稿件內容詳細規格如下:

1. 首頁 (title page)：包括題目、作者姓名、服務單位、學歷；英文簡題(running title)長度在四十個字以內；稿件主要負責者(corresponding author)之中英文姓名與地址、電話、傳真、e-mail。
2. 摘要 (abstract)：以400字為限，簡潔說明並標示研究目的、方法、結果、主要結論或新發現。若為原始著作則須說明並標示，並需附關鍵詞(key words) 5個以內。以中文投稿須有中文摘要外，另須附英文摘要。
3. 本文 (text)：
   A.學術綜論(review article)—無一定格式。
   B.原始著作(original article)—分前言、材料與方法、結果、討論、結論。
   (1) 前言 (introduction)：簡要說明研究由來。
   (2) 材料與方法 (material and methods)：敘述研究設計、對象、步驟。
   (3) 結果 (results)：研究結果以文字、表格或插圖表示之。
   (4) 討論 (discussion)：強調重要結果與論點，與前人論述作比較等。
   (5) 結論 (conclusion)：結論要簡要明確。
   C.技術報告(technical report)—分前言、方法描述、討論。
   D.病例報告(case report)—分前言、病例描述、討論。

4. 參考文獻 (references)：以出現於本文中之先後順序用阿拉伯數字(上標)排列之，書寫方式請參考Cumulated Index Medicus，內容含作者姓名(全部列出)、篇名、期刊名、年代、頁數。例如：(1)期刊之書寫：Lin YT, Chang LC. Space changes after premature loss of

the mandibular primary first molar: a longitudinal study. J Clin Pediatr Dent 1998; 22: 311-6. (2)書籍之書寫：McDonald RE, Avery DR. Dentistry for child and adolescent. 6th ed., Mosby Co, St Louis, 1994; pp339-41. (3)有編輯者之書籍章節書寫：Moore BK, Avery DR. Dental materials. In: McDonald RE, Avery DR. Dentistry for child and adolescent. 6th ed., Mosby Co., St. Louis, 1994; pp349-72. (4)電子期刊之書寫：Yavuz MS, Aras MH, üyükkurt MC, Tozoglu S. Impacted mandibular canines. J Contemp Dent Pract 2007; 8:78-85. Available at: http://www.thejedp.com/issue036/index.htm. Accessed November 20, 2007.

5. 插圖與表格 (figures and tables)：
(1) 插圖請勿放置於本文中，圖與表之數量盡量少，也不要編排，應儲存於另外的檔案夾。影像圖檔應以JPG、EPS或TIF 形式存檔。插圖以電子檔e-mail傳送投稿。
(2) 插圖之標題及詳細說明，須另頁複行繕打。顯微照像須以比例尺(internal scale marker)標明放大倍數。
(3) 病人臉部照片須遮蓋眼睛至無法辨認是何人的程度，否則須附病人之書面同意書。
(4) 繪圖軟體應使用如Photoshop、Photoimpact、Illustrator等。彩色或灰階圖形須掃瞄至300 DPI，線條圖形則須至1200 DPI，並請標明圖檔名稱及所使用軟硬體名稱。
(5) 圖或表中出現之字母或符號，均需於註解中詳細解釋。

四、投稿清單

(1) 致主編簡短信函。
(2) 提供稿件主要負責者之姓名與地址(中英文)、電話、傳真、e-mail、所有作者之服務機構(中英文)。
(3) 附中英文摘要(400字以內)，研究論文的摘要應分研究目的、方法、結果、主要結論。
(4) 附中英文關鍵詞(5個以內)；附英文簡題(長度在40個字以內)。
(5) 確認所有參考文獻的格式、內容、引用順序皆完整無誤。
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(7) 確認所有圖表皆符合格式。圖表皆儲存於另外的檔案夾，而未放置於本文中。
(8) 若為人體試驗須附人體試驗委員會之同意函。
(9) 全部作者同意簽名之證明函。

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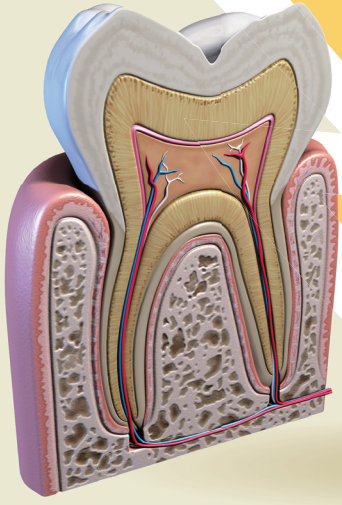
中華民國贋復牙科學會
第七十三次牙醫師繼續教育

牙髓與贋復
共治與合作



舉辦時間暨地點：

民國103年04／27（日）

新光吳火獅紀念醫院
地下一樓會議室
（台北市士林區文昌路95號）

民國103年05／04（日）

成大醫學中心 第四講堂
（台南市勝利路138號）

共同主辦：

中華民國贋復牙科學會
中華民國牙髓病學會
新光吳火獅紀念醫院牙科部


鈕憶華 醫師


郭恬君 醫師


劉閔結 醫師


陳益貞 醫師


陳冠良 醫師


莊富雄 醫師

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民國103年 04／27（日）
新光吳火獅紀念醫院 地下一樓會議室（台北市士林區文昌路95號）

民國103年 05／04（日）
成大醫學中心 第四講堂（台南市勝利路138號）

第七十三次牙醫師繼續教育　　牙髓與贋復、共治與合作

4月27日 台北新光醫院	5月4日 台南成大附設醫院
前牙贋復-贋復觀(9:00-10:20)	
鈕憶華	
前牙贋復-根管治療觀(10:40-12:00)	
郭恬君	陳冠良
聯合討論20分鐘	
午餐時間	
後牙贋復-贋復觀(13:30-14:50)	
劉閔結	
後牙贋復-根管治療觀(15:10-16:30)	
陳益貞	莊富雄
聯合討論20分鐘	

報名須知：

◎ 報名方式：請撕下隨附之劃撥單，逕自至各地郵局劃撥繳費即可，無須電話事先報名；收到款項後本會將於開課前五個工作天寄出報到通知單及收據。

◎ 費用：
台北場於04/17前逕至各地郵局劃撥繳費(以劃撥日期為準)
台南場於04/24前逕至各地郵局劃撥繳費(以劃撥日期為準)

附註：

1. 需繼續教育積分點數證明書者加收100元。
2. 會期間敬備茶點、午餐，午餐如需食素，請詳註於劃撥單中以便預備。
3. 以上課程費用經繳費後，未能到場時歉難退費或換場次，敬請見諒。
4. 請以劃撥方式報名，並請以正楷字體詳註需繼續教育積分點數證明書與否等…，以方便進行作業。
5. 本會郵局劃撥帳號13195250，戶名：中華民國贋復牙科學會。

本會會員	3000元
本會專科醫師訓練機構之住院醫師	3000元
本會專科醫師訓練機構之受訓醫師	2000元
非本會會員	4000元
學生註：1.學分班及在職專班學生除外。 2.以學生身份報名者須於報名前將學生証正反面影印後傳真至本會，以利驗證。 3.本會傳真號碼：02-25469157	1000元

@ 以上報名均含繼續教育積分點數認證費用，並依實際簽到紀錄予以認證登入點數，會後恕不接受補簽到及補申請認證登錄等情事之辦理。
@ 不需認證登錄者報名時得免填身份證字號。
@ 籲請尊重講員智慧著作權，出席課程時請勿私自做任何影像或聲音紀錄之行為。
@ 本次活動不克提供講員演講內容講義，敬請見諒。

※ 逾期報名者為免通知不及，請改現場報名，收費為5000元

Program of the 9th Biennial Congress of AAP
Date: November 21-23, 2014

The 9th Biennial Congress of Asian Academy of Prosthodontics (AAP)

in conjunction with

The 27th Annual Scientific Meeting & General Assembly of the Academy of Prosthetic Dentistry, R.O.C. Taiwan (APD-ROC Taiwan)

主題：From Expectation to Reality

- ***Keynote Speaker 1: Prof. Urs C. Belser***

Date: 11 月 21-23, 2014

Venue: Howard Civil Service International House, Taipei, Taiwan

Host Organization: The Academy of Prosthetic Dentistry, R.O.C. Taiwan

歡迎蒞臨參加

Venue: Howard Civil Service International House Taipei

Dr. Urs C. Belser

Conference Description

The organizing committee has the honor to invite Professor Urs C. Belser as one of the keynote speakers of the conference. Professor Belser is a world famous scholar on prosthodontics and implantology. He gave leactures in many continuing education courses and international conferences world wide, and had been in Taiwan several times. He won appreciation and respect on his lectures based on intensive research and clinical experiences. In this conference, he will give a whole day lecture and end with a panel discussion. In addition, invited speakers from each and every member country will give their recent achievements on clinical and basic studies. During the two meeting days, free paper presentation and industrial exhibiton will also be included. You can definitely expect a very fruitful and whorthwhile conference. Organizing committee members and colleagues in Taiwan are waiting for your visit.

Program Schedule

November 21, 2014 (Tentative)

Time	Event
8:30-9:00	Registration
9:00-12:00	Precongress meeting
13:30~16:30	Precongress meeting

November 22, 2014 (Tentative)

Time	Event
8:30-9:00	Registration
9:00-9:30	Opening ceremony
9:30-12:00	Keynote speaker's lecture
13:30-17:00	Invited speakers presentations
18:00-21:00	Welcome reception, Gala dinner

November 23, 2014 (Tentative)

Time	Event
8:30-9:00	Registration
9:00-12:00	Keynote speaker's lecture
13:30-16:00	Keynote speaker's lecture
16:00-17:00	Closing remarks

Location

Howard Civil Service International House

No. 30, Sec. 3, Shin-Sheng South Road. Taipei, 106, Taiwan, R.O.C.

Important Information

1.Registration

Registration Types	By 2014-09-01	After 2014-09-01
APP Member	USD250	USD280
None Member	USD320	USD350
Student**	USD100	USD150

*Registration Fee includes lunch, tea breaks and Gala dinner.

**ID required.

2. Abstract submission deadline: Jun. 30, 2014

強勢登場
預告

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New G-CEM LinkAce™ from GC

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黏合應用範圍：

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