CHAPTER I
INTRODUCTION

1.1 Principles, Theory, Rationale and/or Hypotheses

The use of titanium orthodontic miniscrew implant (OMI) to obtain absolute anchorage has recently become very popular in orthodontic clinical approaches. The mode of skeletal anchorage facilitated by such an implant systems has a unique characteristic owing to their temporary use, which results in a transient absolute anchorage. The OMI offers several advantages such as sufficient anchorage in noncompliant patients, simplicity of insertion and removal, and relatively reasonable cost (Moon *et al.,* 2008). Complicated cases, for examples, severe tooth crowding (Figure 1), severe openbite (Figure 2), anterior crossbite (Figure 3), borderline surgical Class II or Class III malocclusion (Figure 4 and 5), and occlusal plane canting (Figure 6) can be solved by orthodontic mini-implant.

Figure 1. Severe tooth crowding: the lack of spaces on upper and lower jaws causing crowded or overlapped teeth.

Figure 2. Severe openbite: the space between the upper and lower front teeth caused by habits such as thumb sucking or tongue posturing.

Figure 3. Anterior crossbite: the wrong position of upper front teeth (stay behind the lower front teeth) may cause tooth stratification and misaligned jaw growth.

Figure 4. Class II malocclusion: the protrusion of upper front teeth causes the large horizontal gap between upper and lower front teeth.

Figure 5. Class III malocclusion: the protrusion of lower front teeth produces a negative overbite.

Figure 6. Occlusal plane canting: the occlusal plane rises toward the left side which make imbalance between the right and the left side.

In some cases, OMI is applied to be an alternative treatment instead of orthognathic surgery effectively (Papadopoulos and Tarawneh, 2007). Moreover, the OMI also creates simple force systems for orthodontic tooth movement compared to conservative mechanics such as molar uprighting, canine retraction, molar intrusion

and distalization (Park *et al*., 2002; Kim *et al.,* 2006). The foregoing properties together with the recently achieved simple application of these screws have increased their popularity, establishing them as a necessary treatment option in complex cases that would have otherwise been impossible to treat (Papadopoulos and Tarawneh, 2007).

Titanium has long been considered as an exotic metal. In recent years, there has been progressive change in its image from an expensive material much more familiar to consumers. Titanium was used in many commercial applications such as eyeglasses frame, sports equipment, accessories and arts. The natural selection of titanium for implantation is determined by a combination of most favorable characteristics including resistance to corrosion, biocompatibility, strength, low modulus and density as well as the capacity for joining with bone or osseointegration. Furthermore, the combination of mechanical and physical properties of titanium alloys provides implants to be highly damage tolerant. The lower modulus of titanium alloys compared to steel is a positive factor in reducing bone resorption. Several applications of titanium are including joint replacement parts for hip, knee, shoulder, spine, elbow and wrist. Eventually, dental implants, material for orthodontic surgery and OMI are common used (Long and Rack, 1998).

There are several products of OMI in clinical used. One of the most popular in Asian countries is Dual Top system, Jeil Medical Corporation from Korea. This system has dual head and has various head designs depending on clinical selection. Food and Drug Administration (FDA) approval confirms safely use, additional, each screw design has various lengths and diameter adapting itself in a lot of situations with different inter-radicular distances and soft tissue thickness (http://jeilmed.co.kr). The other type of OMI commonly used in Europe countries is Ortho Easy, Forestadent from Germany. This system was claimed for a special design having sharp cuts for easily insertion with low torsional moment and reduced bone pressure, resulting in better primary stability. Also, it has various diameters and lengths depending on screw position and mechanical used. International Organization for Standardization (ISO) verified the Ortho Easy system fulfilled the standard requirements in the year 2008 and 2009 (http://www.forestadent.com).

Both OMIs, the Dual Top system, Jeil Medical Corporation from Korea and Ortho Easy, Forestadent from Germany, made from titanium grade 5 (Ti-6Al-4V). This type of titanium is the most widely used because it is a biocompatible implant material that can be strengthened with a relatively simple heat treatment to offer very high mechanical properties. This kind of titanium may be heat treated to increase its strength. It can be used in welded construction at service temperatures of up to 600° F. This alloy offers its high strength at a light weight, useful formability and high corrosion resistance. Ti 6AI-4V's usability makes it the best alloy for use in several industries such as aerospace, medical, marine and chemical processing industries (www.supraalloys.com). So, the above material properties are also benefit for OMI to be an anchorage for the orthodontic treatment.

Recently, Thai OMI (Figure 7) was first introduced by Advance Dental Technology Center (ADTEC) which is a department of National Science and Technology Development Agency (NSTDA), Thailand. The ADTEC together with a professional research team invented a special design of Thai OMI to benefit for orthodontic treatment. Thai OMI was made from titanium grade 23 which is the higher purity version of Ti 6Al-4V. This material can be made into coils, strands, wires or flat wires. It is the top choice for any sort of situation where a combination of high strength, light weight, good corrosion resistance and high toughness are required. It has a superior damage tolerance to other alloys. These benefits make titanium grade 23 the ultimate dental and medical titanium grade. It can be used in biomedical applications such as implantable components due to its biocompatibility, good fatigue strength and low modulus. It can also be used in detailed surgical procedures such as orthopedic pins, screws, cables, ligature clips, surgical staples, springs, bone fixation devices, joint replacements and the orthodontic appliances (www.pmfirst.com). Thai OMI designed by using three dimensions software (3D) with a suitable proportion based on recommendations from professional dentists and orthodontists. At the present time, the research of Thai OMI are developing in a laboratory and preparing for clinical study to improve to being standardized quality. Thai OMI will be a great value for Thai patients to receive non-invasive alternative treatments (Figure 8) with security and less expense differed from the conventional orthodontic-surgery treatment.

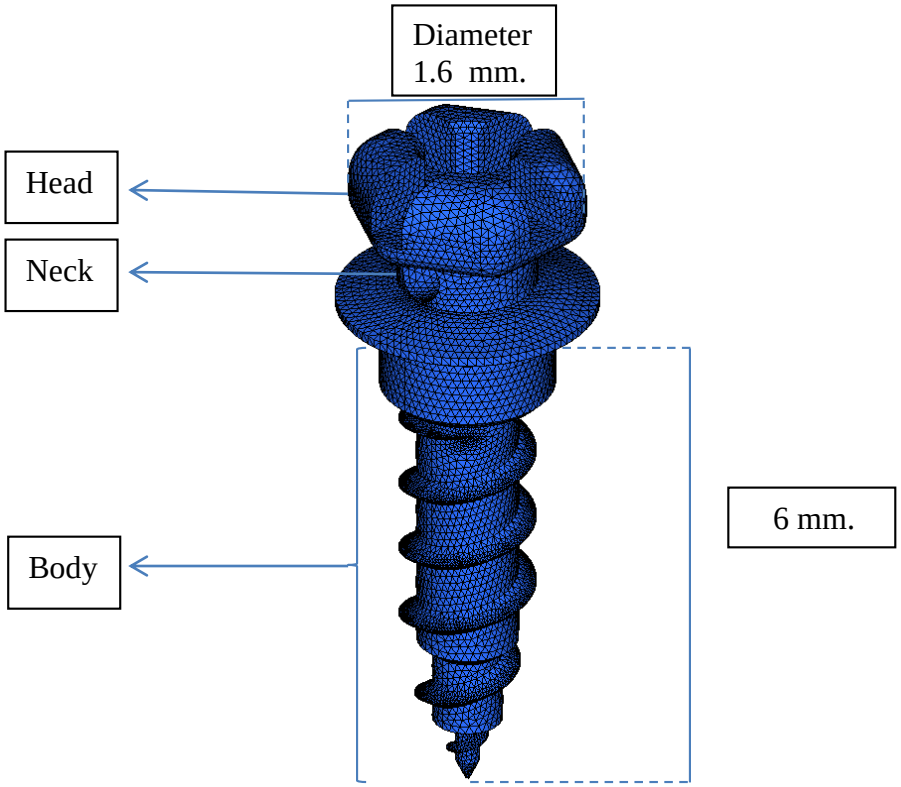

Figure 7. Thai orthodontic miniscrew implant (Thai OMI) and its components.

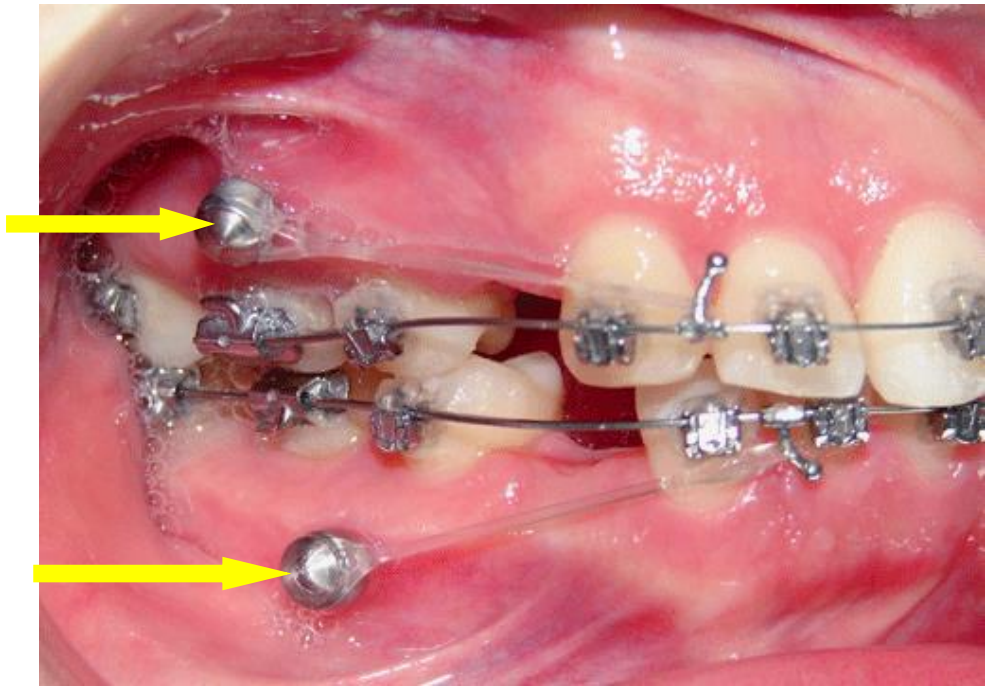

Figure 8. Orthodontic tooth movement treated by orthodontic miniscrew implant (yellow arrows).