CHAPTER 1

INTRODUCTION

1.1 GENERAL INTRODUCTION

In medical practices, bone drilling process is one of the processes that need to be master by physicians especially by orthopedic surgeon. In orthopedic surgery always involved the musculoskeletal system and surgeon need to use both surgical and non-surgical means to treat musculoskeletal trauma, sports injuries, degenerative diseases, infections, tumors and congenital conditions. Besides, the need of bone drilling process is also important in treating the bone fracture.

Before this, bone drilling tools used in surgery do not include any means for the control of penetration and it totally depend on surgeon’s manual skills to stop the penetration when completing a hole and already known that human bone is consist of cancellous and cortical bone that are very differ in density and thickness. This soft and hard bone tissue could be estimated in order to assist the surgeon while drilling a bone. Many researcher and organizations are trying to build any devices or ways in order to improve the bone drilling technique which is relatively low cost and time saving.

Besides drilling, pedicle screw fixation process is also important in dealing with musculoskeletal system especially in vertebrae region such as cervical, lumbar and thoracic vertebrae. Laine et al, (2000) has proposed that transpedicular screw insertion is a demanding technique due to considerable variability in the human anatomy and to the fact that it is impossible to guide a screw exactly in three planes of space based on the two-dimensional image information of fluoroscopy. The pedicle screw fixation is almost same or related to drilling process because it need to produce a hole for fixed
screw and it is totally depend on the surgeon manual skill to complete a hole. The surgeon has to put enough pressure according to the bone tissue either hard or soft. Sometimes, it is hard for surgeon to complete a hole in cervical or thoracic region because the anatomy of the region itself are closed to spinal cord and major vein that could lead to other side effect to the patient if the process goes wrong. Pedicle screw misplacement rates of between 21.1 and 39.8% have been reported in clinical studies with conventional insertion techniques and an adequate postoperative CT assessment has been studied (Castro et al, 1996; Gertzbein et al, 1990; Jerosch et al, 1992 and Laine et al, 1997). So, realizing this shortage that could risk the patient, this study would enhance the process with the knowledge of acoustic emissions (AE) to unsure the safety of the patients and give courage and confident to the surgeon while doing this procedure.

In this project, the acoustic emissions (AE) technique was used to monitor the pedicle screw fixation process. The technique is one of non-destructive test (NDT) group and it application is still new in term of monitoring the drilling process. This technique was developed base on the theory of transient elastic waves that emit from rapid strain energy release inside a material that is subjected to stress. Acoustic emissions are a suitable method for recognizing the crossing of interfaces between hard and soft tissues and to discriminate among layers of different tissues. Acoustic emissions signal events will give different results when across these layers and these results will be investigated in order to study the trend and it characteristics.

During pedicle screw fixation procedure, elastic wave is produced by pedicle probe used by surgeon when perforating a hole. The AE sensor will be attached at the pedicle probe and will sense the transient elastic wave known as AE signal events. The AE signal events will further analyzed to indicate the component’s condition.

Practically, the AE signal events will further analyzed into the time and frequency domain. Time and frequency domain will justify some parameter such as peak amplitude, signal duration, detection threshold, time, period, velocity, acceleration and frequency.
1.2 OBJECTIVES

For this project two main objectives are listed:

- To investigate the Acoustic emissions (AE) signal events in cervical bone during pedicle screw fixation procedure when through two type of bone tissue; hard and soft bone’s tissue.
- To study the trend of the Acoustic emissions (AE) signal events for penetration level during the hole perforation in pedicle screw fixation procedure.

1.3 SCOPE OF THE STUDY

The definition of scope is important to make sure the research is done towards the right direction. For this research, the study will use the acoustic emissions technique to monitor the pedicle screw fixation procedure. A same device was used to perforate a bone that consists of hard and soft bone’s tissue.

1.4 IMPORTANT OF STUDY

This research is important in order to monitor the pedicle screw fixation procedure that vital in orthopedic surgery. It can assist the surgeon in the perforation process to be more precisely and accurately. This research also can help the surgeon from doing carelessly mistake in order to save life. The interests in monitoring bone drilling or perforation process using non destructive testing (NDT) become very essential since it is relatively low cost and the result could be save more life and pain.