CHAPTER 2

MATERIALS AND METHODS

Specimens preparation

Seven porcine mandibles were stripped of all soft tissues. The specimens were kept in saline and refrigerated until all test was completed. Mandibles of similar size were used and sectioned at the midline (left and right side) (Fig. 4).

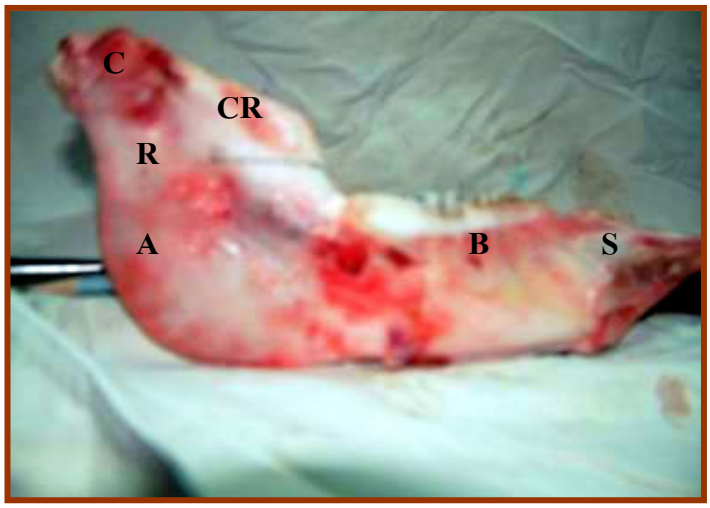


Fig. 4 Gross specimen of bovine hemimandible;
C= head of condyle, R= ramus , A=angle,
B= body, CR= coronoid process, S= symphysis

Fig. 5 The titanium plate, self- tapping screws

The 4 hole titanium plate with 2.5 mm thickening and 7 mm in length screws (Fig. 5)

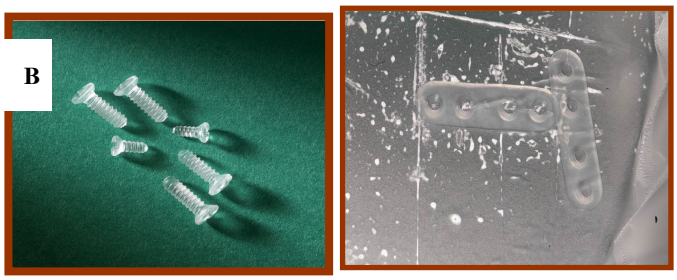


Fig. 6 The resorbable plate, non- self tapping screws.

The 4 hole resorbable plate (Inion®,Tampere, Finland) with 2.5 mm thickening and 8 mm non self-tapping screw (PLA/PGA) were used for fixation (Fig. 6))that plate preparation was shown in Fig. 7 and the screw insertion method was shown in Fig. 10.

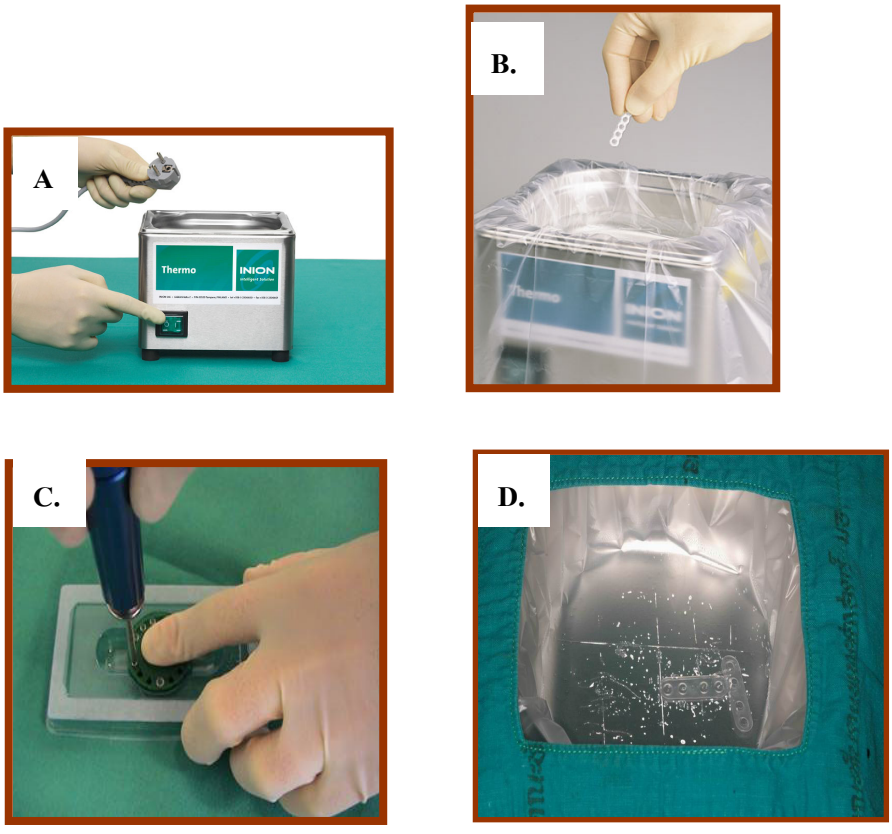


Fig. 7 Resorbable plate and screw preparation;

A. the water bath, B. the sterile thermodrape will cover the bath, C. Screws are mounted in a convenient screw-ring, D. Plates are activated by heating in the Thermo-bath.

Thermo-bath set up and resorbable plate and screw preparation .

Although the Thermo-bath cannot be sterilized, place it on a sterile draped cart so it can be located close to the surgeon. The sterile Thermodrape will cover the bath. Place the sterile Thermodrape over the Thermo-bath. Make a depression in the drape into which the sterile water can be poured. Fill bath just over ½ full (about 0.4 litters) with sterile water or saline. Once the water is in the bath it can be switched on/plugged in. It takes about 20 minutes for the water to reach the required temperature of 57^{o} Centigrade.

Plates are activated by heating in the Thermo-bath. It takes 1-2 minutes for them to be most malleable. Plate adaptation is carried out after activation (Fig. 6).

The plates are most malleable for 15 seconds after removal from the water bath and can easily be adapted by hand.(Fig.7). As the plate cools it becomes more rigid. It can still be bent for 15 minutes but bending pliers may be needed. The plate can be re-heated in the water bath at any time. Briefly dipping part of all of the plate into the water softens the plate for minor adjustments to be made. If fully immersed for several seconds the plate softens and loses all existing contours for total re-adaptation. Plates retail sufficient malleability to allow minor post-operative modifications. The screws are mounted in a convenient screw-ring that were inserted by manual tapping (Fig. 8,9).

Fig. 8 The resorbable plate are activated by heating and bended for adaptation.

Screws are mounted in a convenient screw-ring.

Fig. 9 The universal screwdriver is used for all screw sizes.

Manual Tap

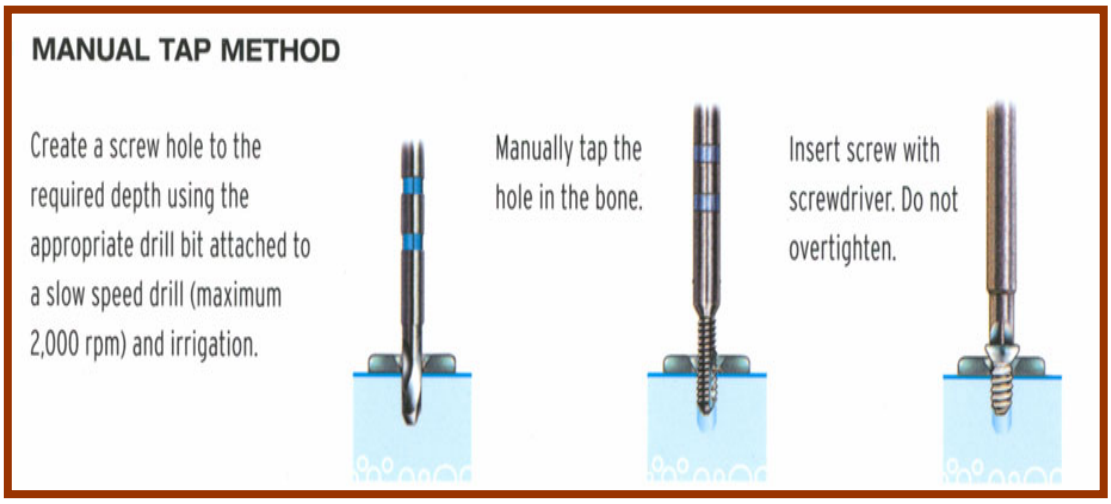


Fig. 10 Screw Insertion Methods.

14 hemimandibular segments were cut in bilateral sagittal split osteotomies procedure that used the methods of Trauner and Obwegeser (Fig. 11) and the coronoid process of each right and left mandible were removed because they caused problems in placement on the biomechanical test model .

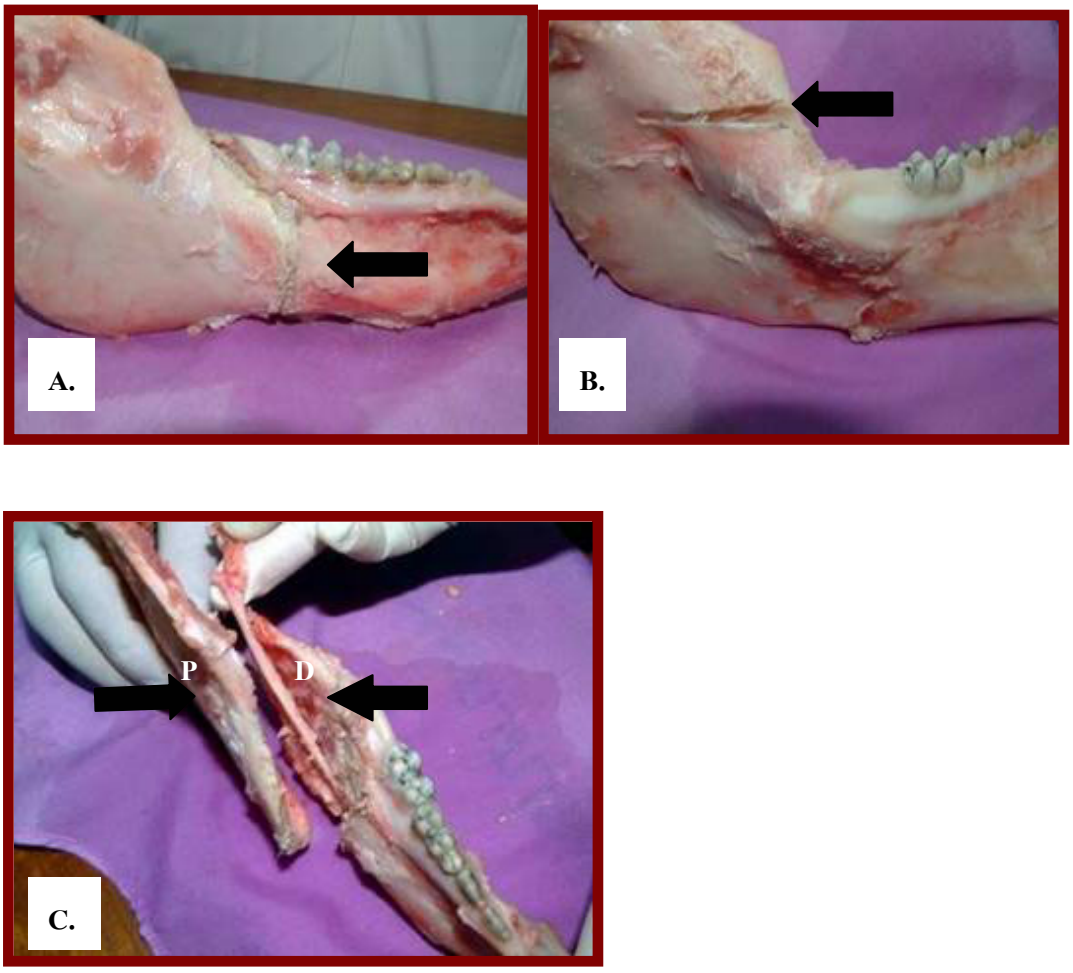


Fig. 11 Bilateral sagittal split osteotomies procedure;

A. the vertical cut posterior to molar teeth. (arrow)

B. the horizontal cut above lingual. (arrow)

C. the distal segment(arrow ; D) and the proximal segment. (arrow; P)

The 1st, 2nd and 3rd specimens the mandible were set back 5 mm by removed a part of bone 5 mm in length of the proximal segment, the 4th, 5th and 6th mandible were set back 10 mm by removed a part of bone 10 mm in length of the proximal segment (Fig.12).

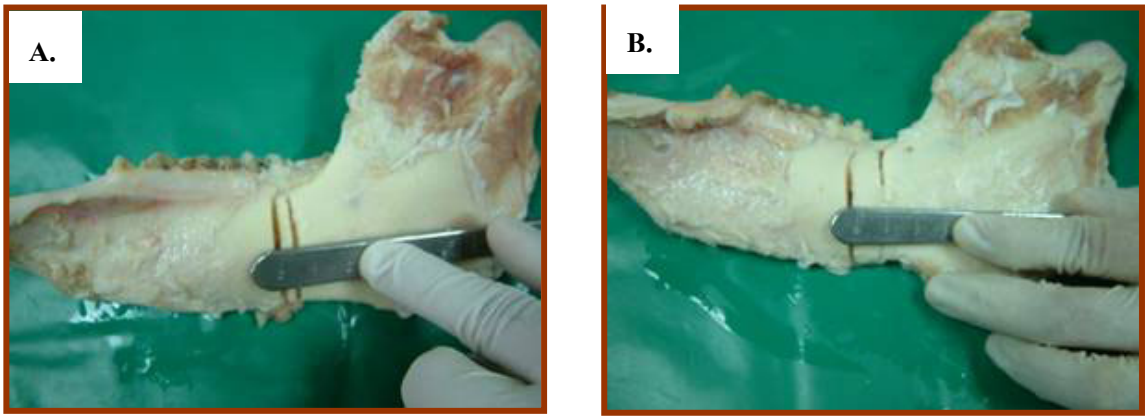


Fig. 12 The hemimandibulars were set back in the experimental groups;

A. the 1st, 2nd, 3rd mandible were set back 5 mm.

B. the 4th, 5th, 6th mandible were set back 10 mm.

The left side was fixed by 4 hole titanium plate 2.5 mm thickening, screw 7 mm in length /specimen as group I(Fig.12).

The right side was fixed by 4 hole non self- tapping resorbable plate 2.5 mm thickening , screw 8 mm in length (PLA/PGA)/specimen as groupII(Fig.13).

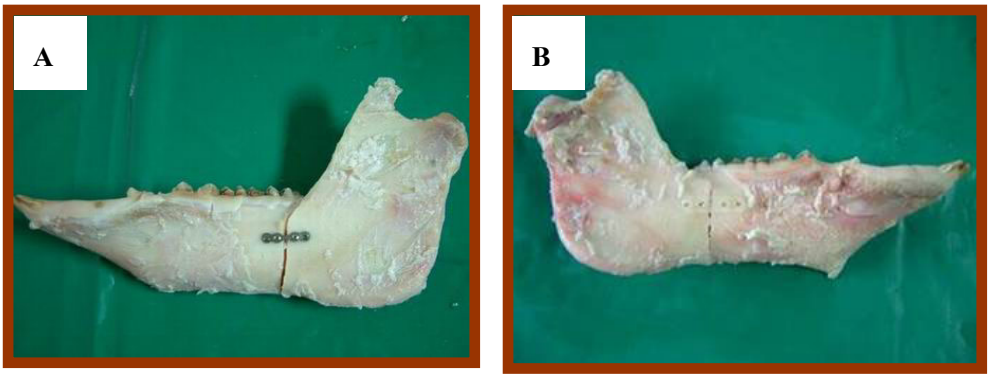


Fig. 13 The specimens were fixed by the rigid fixation;

A. The specimen in the left side was fixed by titanium plate and screws.

B. The specimen in the right side was fixed by resorbable plate and screws.

The left side of all specimens were fixed by titanium plate and screws and the

right side of all specimens were fixed with resorbable plate and screws (table 1) .

Table 1 Distribution of animal into experimental group.

Plate and screw type	Setback distance (mm)		
	0 mm	5 mm	10 mm
Titanium(Ti)	n=1	n=3	n=3
Resorbable(Re)	n=1	n=3	n=3

The custom made cradle was made by stainless steel, size 10cm X 25 cm X 30 cm that shown in Fig.14 .

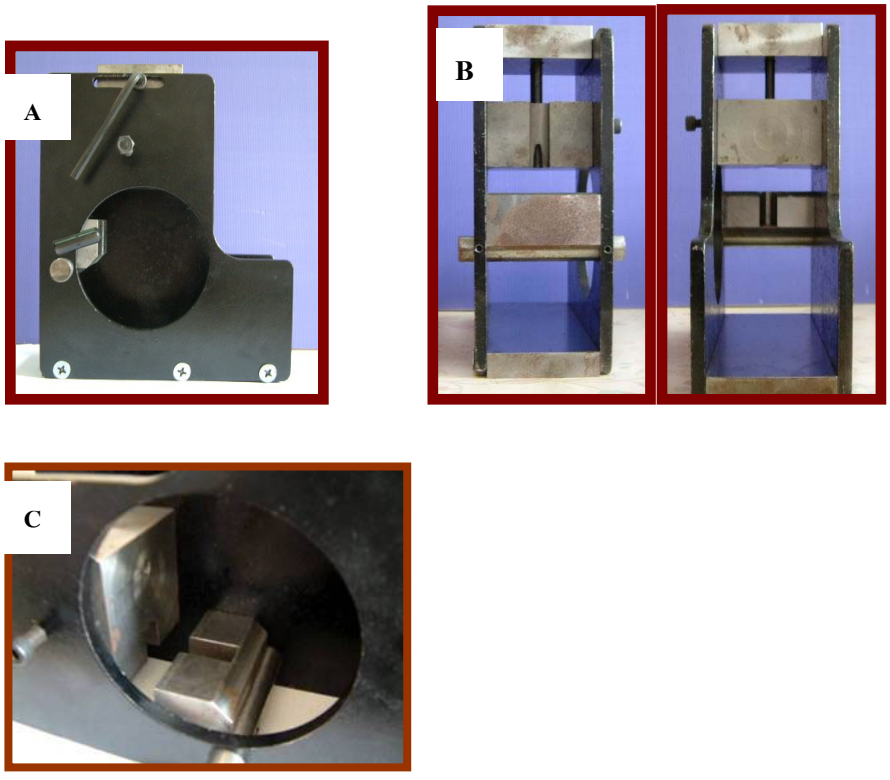


Fig. 14 The custom made cradle; A. lateral view, B. front and back view,C. inside view.

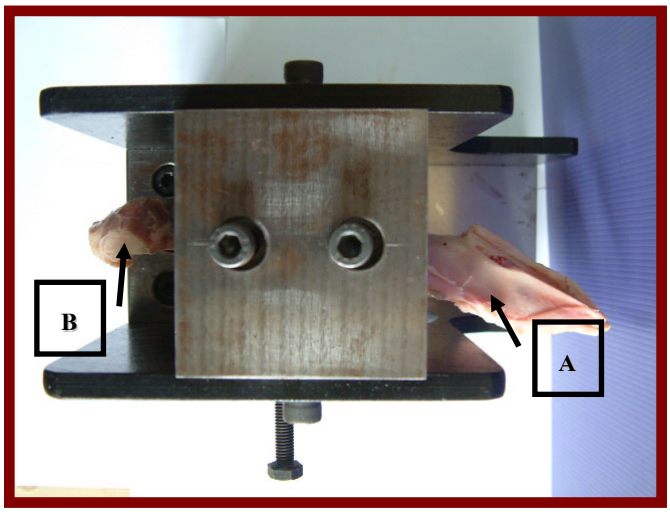
Biomechanical testing

Each fixed specimen was mounted in custom made cradle(Fig.16). Then the

vertical loading was performed by using an universal testing machine (Lloyd; LRX-Plus, Fareham Hant, UK) in Fig.15 was started from 0 kN at a rate of 20 mm/min to the failure point and the universal testing machine recorded and shown the load –displacement curve like Fig 16.

The biomechanical data are the maximum load (N), the stiffness (N/mm), the deflection at maximum load (mm), the load at rupture (N), the deflection at rupture (mm) of each specimen were explored and recorded .

Fig. 15 The universal testing machine.



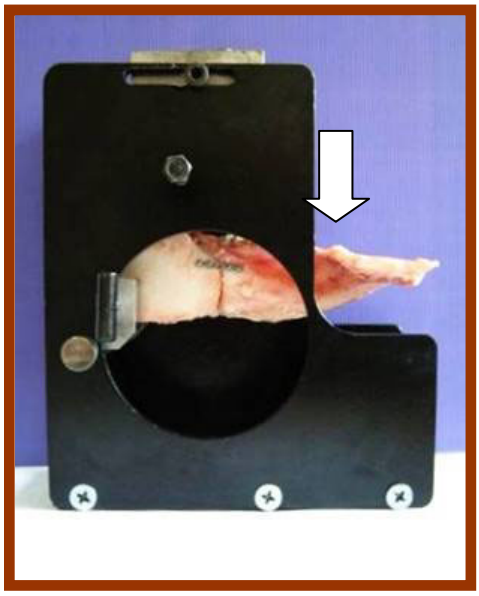


Fig. 16 The specimen in the custom made cradle (A= anterior part, B=posterior part (open arrow= vertical loading force).

Testing screw engagement

The prepared specimens were recorded the screw engage of the screws that were fixed in these specimens before and after the biomechanical testing by the Perio –test (Fig17,18).

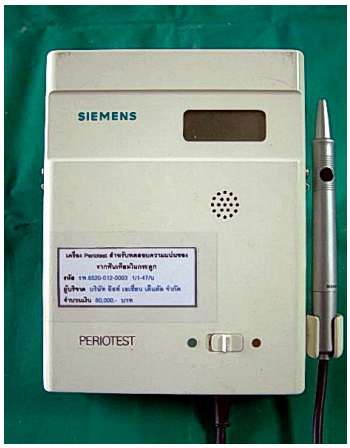


Fig. 17 The Perio-test.

The Perio-test recorded the screw engagement at before and after testing at -08 to +50 (Fig.16) that record in 4 level;

- Level 0 : (-08) to (+09)*
- Level I : (+10) to (+19)*
-Level II: (+20) to (+29)
-Level III: (+30) to (+50)

999 : broken plate and /or screw or loss of intact from cortex of specimen. And the screw must engage at least 1 cortex of each specimen.

Before the biomechanical testing, the screw engagement be at level 0 to level I.

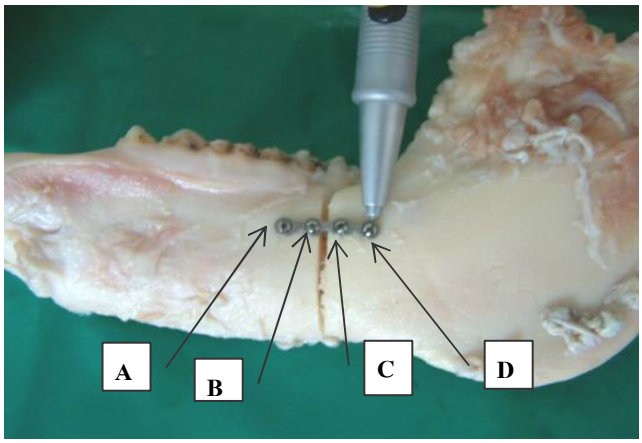


Fig. 18 The prepared specimen after fixed by plate and screws; A: screw 1, B: screw 2, C: screw 3, D: screw 4.

Data analysis

Data were reported as mean ±SD of the maximum load (N), the stiffness (N/mm), the deflection at maximum load (mm), the load at rupture (N), the deflection at rupture (mm) of each specimen and the Mann-Whitney U-test compared difference between the titanium group(Ti 1-Ti6) and the resorbable group (Re 1- Re6). Significant level of $p<0.05$. The analyses were performed on a personal computer using Commercial SPSS software (Version 11.0, Standard Software Package Inc., USA) for data analysis.