Report SER21-07

DETERMINATION OF THE MAXIMUM COMPRESION STRENGTH OF 7 DENTAL IMPLANTS (MPI)

UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

BIOMATERIALS, BIOMECHANICS & TISSUE ENGINEERING

1 OBJETIVES

The objective of this study is to determine the compression curve of 7 endogenous dental implants manufactured by MPI Medical Precision Implants according to ISO-14801:2017 standard [1].

2 MATERIALS

The MPI company provided 7 implant assemblies to be tested at compression. They were assembled according to the fixing torque specifications described in the surgical protocol of this implant model (30 N.m).

The implant assemblies tested consisted of 7 dental implants, provided with a solid top component made of grade V titanium alloy (Ti6Al4V) in a single monoblock. This component has an internal hole where the screw is inserted. The tightening screw is made of titanium grade 5 (Ti6Al4V).

3 METHODS

3.1 DETERMINATION OF THE MAXIMUM COMPRESSION STRENGTH

A universal BIONIX-370 mechanical testing machine (MTS, USA) (Figure 3-1) have been used for the determination of the maximum compression strength. A total of 7 uniaxial static compression tests have been performed. The tests were carried out using a 2,5 kN load cell and under conditions of constant test speed of 1mm/min.

Figure 3-1.-Bionix-370 mechanical testing machine (MTS, USA) used for compression testing.

All samples were prepared following the ISO-14801:2017 [1]. According to the standard, the bone anchoring part of the sample must be fixed in a fixed anchoring device that must hold the sample at a distance of 3.0 ± 0.1 mm apically from the nominal bone level determined by the manufacturer; in this case the company MPI. This distance is internationally accepted as the average level of bone resorption after dental implants implantation.

The hemispherical components manufactured simulate the real pillar. (Figure 3-2).

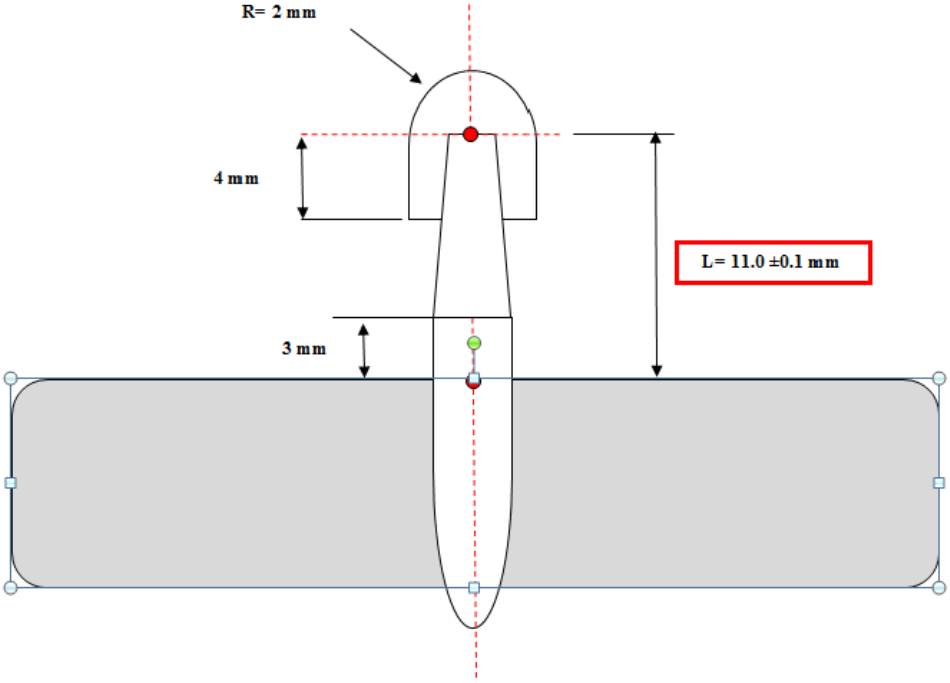
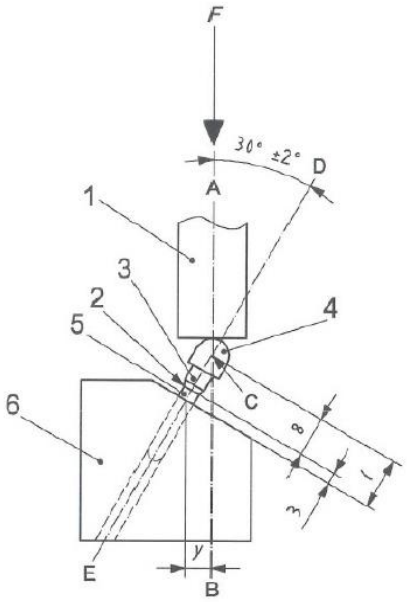


Figure 3-2.- Front diagram of the distances described by ISO 14801 for implant testing

The ISO-14801:2017 standard [1] specifies the existence of a constant distance of 11.0 ± 0.1 mm from the implant support level to the center of the hemispherical free end. This distance must be measured parallel to the central longitudinal axis of the implant body and it is counted from the surface of the resin to the center of the hemispherical dome.

All the analysis has been carried out under the same test conditions. The implants were hold with the same and unique clamping device, consisting of a clamping jaw made of stainless steel, which supports the resin block in which each implant has previously been encased (figure 3-3).



Leyenda

1 Dispositivo de carga [debe permitir el libre movimiento transversal a la dirección de la carga (véase el apartado 5.2.6)]
2 Nivel nominal del hueso (véase el apartado 5.3.2)
3 Pieza de conexión
4 Miembro de carga hemisférico
5 Cuerpo del implante dental
6 Soporte de la muestra

Figure 3-3.-Test installation scheme

According to the standard, the resin used to embed the implant as a fixed anchoring method must have an elastic modulus greater than 3 GPa.

Finally, the piece obtained for the test consists of the endogenous dental implant embedded in a resin block (Figure 3-4) that is placed inside the clamping jaw to proceed to its mechanical fatigue application (Figure 3 -5).

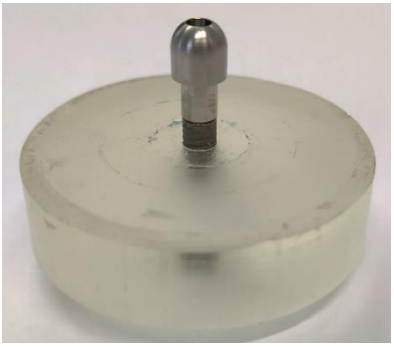


Figure 3-4.- Image of the dental implant embedded in the resin ready for testing

Figure 3-5.-Image of the final assembly of the implant tested inside the fatigue jaws.

4 RESULTS

The results of the study are presented below in Table 4-1 and Table 4-2, where X correspond to the average value and SD to the standard deviation.

4.1 DETERMINATION OF THE MAXIMUM COMPRESSION STRENGTH VALUE

The results of the compression tests are:

Sample	F_{max} (N)
C1	404,04
C2	393,66
C3	358,88
C4	425,41
C5	363,89
C6	385,54
C7	398,37

Table 4-1.-Results obtained from the maximum compression strength tests.

Fmax (N)	
X	389,97
SD	23,11

Table 4-2.-Calculated average of the maximum compression strength and standard deviation.

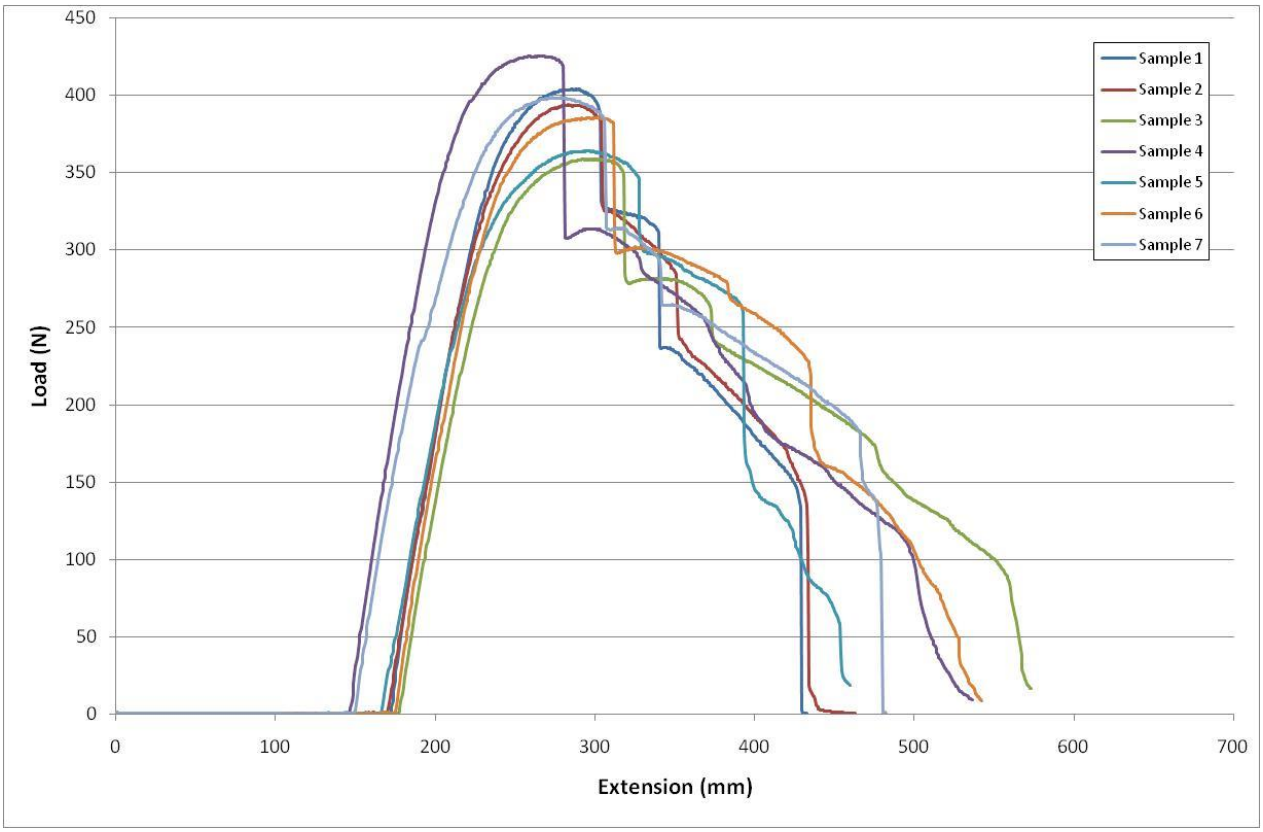


Figure 4-1.- Comparison chart of compression tests of samples.

5 CONCLUSIONS

From the results obtained in the compression to fracture characterization study of the dental implant model of the manufacturer MPI it can be concluded that, for the conditions evaluated, the average maximum compression strength value obtained corresponded to 390±23 N.

6 BIBLIOGRAPHIC REFERENCES

[1] AENOR, "UNE-EN ISO 14801-2017," Dentistry - Implants - Dynamic loading test for endosseous dental implants" (ISO 14801:2017).

This report has been carried out by researchers from the Biomaterials, Biomechanics and Tissue Engineering Group of the Universitat Politècnica de Catalunya.

Dr. José María Manero

Full Professor

Dr. Miquel Punset

Head of engineering services

Meritxell. Molmeneu Trias

Laboratory Manager

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The received test samples will be kept for 3 months, after the delivery date of this report. They will be destroyed afterwards. Any complaints must be filed within the mentioned period.