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Implant geometry, micromotion (secondary stability) and bone to implant contact (%BIC). Are they correlated?

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Topic: Basic research

Abstract

Objectives: The aim of the present paper is to measure and compare in vivo osseointegration degree (%Bone to Implant Contact and %Bone Volume) and secondary stability of two different implant thread design in different bone densities (D1 versus D4). ***Materials and Methods:*** Eighty dental implants (Cortex, Shlomi, Israel) were inserted in sheep. Forty Dynamix® (large threads) and forty Classix® (classical threads design) 3,8 x 10 mm were used in both D4 (iliac crest) and D1 (mandible) bone density. Sheep were sacrificed after 2 months and biomechanical (implant micromotion) and histological (%BIC) data of every implant were recorded. ***Results:*** High insertion torque value were recorded, especially in cortical bone using larger thread design implants. The large and aggressive thread design implants showed a significant higher %BIC and %BV values than smaller thread design implant in low density bone (D4 quality). Implants characterized by larger threads design had secondary stability value statistically higher than classical design implants both in D4 and D1 bone densities. No correlation was found between %BIC value and implant secondary stability. ***Conclusions:***. Large and aggressive taper implant threads design are very useful in low density bone situations (upper jaw). The implant geometry and threads design and size could improve the implant osseointegration amount expressed as BIC percentage in D4 bone. The bone density is a key factor able to influence in a significant way the implant primary and secondary stability. A high insertion torque value (up to 130 N/cm) is not harmful for implant osseointegration.

Background and Aim

The osseointegration development requires an implant initial mechanical fixation into the bone at the time of the surgery (the primary stability). Torque-in value, implant geometry and bone density are factors involved in implants primary stability, but it is still unknown what influence they could have in the secondary stability. The bone to implant contact percentage (%BIC) is often used as a value of the osseointegration amount, but it was not clarified how much this value is correlated to secondary implant stability.The aim of the present study was to evaluate the correlation between implant geometry, secondary stability (micromotion, according to Trisi et al. 2009) and bone to implant contact percentage (%BIC) after implants osseointegration.

	%BIC ± SD	%BV ± SD	Secondary stability (µm)
Group 1: Dynamix© Implants in D4 bone	50,58± 8,65	36,64± 5,78	64 ± 27
Group 2: Classix© Implants in D4 bone	40,98±14,03	31,31 ± 7,78	177 ± 87
Group 3: Dynamix© Implants in D1 bone	36,10 ± 18,30	/	15 ± 5
Group 4: Classix© Implants in D1 bone	34,06 ± 18,18	/	22 ± 6

Table 1 - Average %BIC, %BV and secondary stability values of each group

Conclusions

The implant geometry and threads design and size could improve the implant osseointegration amount expressed as BIC percentage in D4 bone. Implant geometry and bone density are key factor able to modify in a significant way the secondary stability.

Methods and Materials

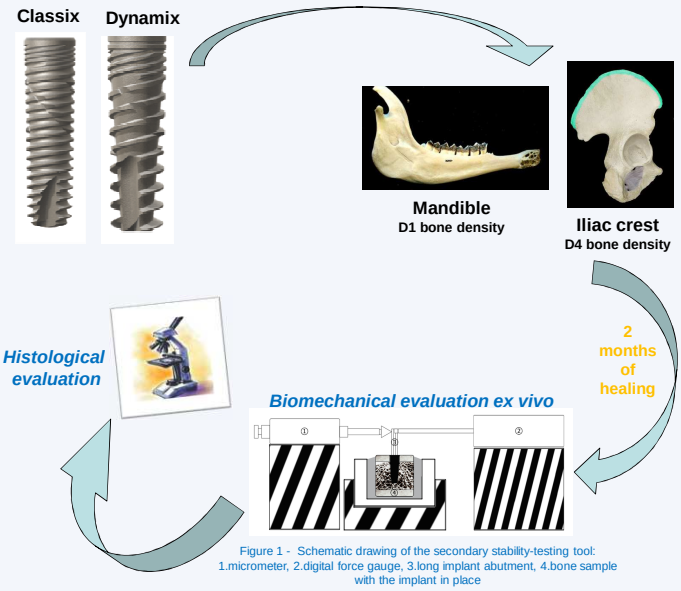

Figure 1 - Schematic drawing of the secondary stability-testing tool: 1.micrometer, 2.digital force gauge, 3.long implant abutment, 4.bone sample with the implant in place

Results

No significant histological differences were found between Classix® and Dynamix® implant geometries in D1 bone quality.

Figure 2 – Classix in D1 bone (Magnification x10 – Toluidine blue).

Figure 3 – Dynamix in D1 bone (Magnification x10 – Toluidine blue).

Condensing thread implants (Dynamix) demonstrated statistically higher %BV value than small thread implant geometry in D4 bone.

Figure 4 - Classix implant in D4 bone (Magnification x10 – Toluidine blue).

Figure 5 – Dynamix in D4 bone (Magnification x10 – Toluidine blue).

Dynamix Implants showed %BIC, %BV and secondary stability values statistically higher (P<0,05) that Classix implant in low density bone (D4). Implants inserted in D1 bone density showed significant better (P<0,05) secondary stability that implants inserted in D4 bone density.

References

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