Molecular assessment of osseointegration (angiogenesis-osteogenesis coupling) using three different bone graft materials (autogenic, xenogenic and synthetic) around dental implants; in vivo study

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Objective
To evaluate osteogenesis and angiogenesis coupling in different bone materials (Autograft, xenograft and synthetic) used around dental implants, we design this study to compare osteogenesis and angiogenesis coupling in 3 types of bone graft for dental implants. Implant restorations are an important every day treatment to evaluate osseointegration around dental implants. This bone material can produce appropriate osteoconductive quickly provoke osseointegration in implant place in compare with cerabone as xenogenic bone material. In this study we evaluated osseointegration process surrounding dental implant by osteogenesis and angiogenesis. As osseointegration composes of angiogenesis and osteogenesis processes, osteogenesis and angiogenesis expresses genes such as ALP, BMP7, RUNX, OCN and TIE1, Bfgf, ANG2, VEGFA, VEGFR, CD34 respectively, which these genes express in around of dental implant in 12 implants (4 implants from each group divided into 2, 4 and 6 months). This evaluation of gene expression and proteins have performed by Real time PCR and ELISA test, respectively.

Materials & Methods
Twelve healthy adult male dogs are randomly assigned into three Groups. Under general anesthesia the area corresponding to the 2nd to 6th sternera was created, using a 10 mm diameter trephine drill. After performing 2 mm further drilling at the end of the hole using ICG surgical kit, a 3.45 mm * 6.5 mm ICG dental implant (Medentis Medical GmbH) is inserted within each hole. The gap around the implants is filled with synthetic bone material (OSTEON™, South Korea) in Group I, xenogenic bone material (cerabone, GmbH, Germany) in Group II and autogenous bone particles in Group III.

To evaluate the effect of time on the bone healing and implant osseointegration every 2 months 4 dogs will be sacrificed (at 2, 4 and 6 months). We evaluated osseointegration process surrounding dental implant by osteogenesis and angiogenesis. As osseointegration composes of angiogenesis and osteogenesis processes, osteogenesis and angiogenesis expresses genes such as ALP, BMP7, RUNX, OCN and TIE1, Bfgf, ANG2, VEGFA, VEGFR, CD34 respectively, which these genes express in around of dental implant in 12 implants (4 implants from each group; divided into 2, 4, and 6 months). This evaluation of gene expression and proteins have performed by Real time PCR and ELISA test, respectively.

Results
Osteon as synthetic bone material revealed osteogenesis process by high gene expression ALP, RUNX2 and OCN during 2 months. While, cerabone as xenogen bone material showed these genes expression after 4 months. BMP-7 as a osteogenic gene has same level of expression by both of bone materials after 2 months. In angiogenesis process, two genes of ANG2 and VEGFA have expression by osteon in 4 months while these genes start expressing by cerabone after 6 months. Osteon can start TIE1 gene expression after 2 months and continue until 4 months while this gene has expression by cerabone after 6 months. CD34 and Bfgf genes have same levels of expression by both of bone materials in 2, 4 and 6 months. All of data are based on real time gene expression analysis and for RUNX2 as osteogenic gene and ANG2 as angiogenic gene also immunoassay.

Conclusion
Based on these preliminary in vivo results which related to osteogenesis and angiogenesis coupling, we can conclude that osteon as synthetic bone material which is osteoconducitively quick prove osseointegration in implant place in compare with cerabone as xenogenic bone material. This bone material can produce appropriate osseointegration around dental implant.

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