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RAPID COMMUNICATION

Biological evaluation of a zirconia toughened apatitic composite implant†

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Abstract. A biological study is reported where implants of β-TCP/ t-ZrO_2 has been examined in rabbit mandibles. The composite is found to be fully biocompatible and evidence of good osteoconduction and tissue ingress has been noticed.

Keywords. Apatite; bioceramics; implantation studies.

Apatites and related phosphates are known to be very good prosthetic materials for bone repair and replacement (Jarcho *et al* 1976). There have been several reports of the use of apatites as implants in animal studies (Holmes 1978; Reznick *et al* 1989). It has generally been proven that they are highly biocompatible. Implant materials however require to have good mechanical strength besides biocompatibility (Landuyt *et al* 1995). It is also desirable that they encourage tissue growth around the implant and lead to good tissue bonding. In an earlier study we have demonstrated that a zirconia toughened apatitic composite exhibited higher fracture toughness and good *in vitro* biocompatibility (Nagarajan and Rao 1993). The sintered composite had a surface structure which was considered as suitable for tissue growth. But no animal implant studies were performed using these apatitic bodies.

In this communication we report implant studies conducted with this composite in rabbit mandibles. It is demonstrated that the implants are highly biocompatible with no adverse reactions in the surrounding tissue. There is evidence of tissue ingress and good bone bonding with the implant.

The zirconia toughened apatitic composite bodies (hereafter referred to as ZAP-30) were prepared by sintering commercial hydroxyapatite (HAp, 70 mol%) and monoclinic zirconia (m-ZrO_2, 30 mol%) at 1400°C for 2 h. Both HAp and m-ZrO_2 were initially ground together with alcohol and pressed into circular discs. Neither any sintering aid nor external pressure was used during sintering process. It has been established earlier (Nagarajan and Rao 1993) that this process leads to formation of a fine distribution of calcia stabilized tetragonal zirconia (t-ZrO_2) particles in a matrix of β-tricalcium phosphate (β-TCP). The resulting ZAP-30 discs exhibit a remarkable fracture toughness (in the range of 2–3 MPa $\sqrt{m}$). Square pieces (5 mm^2) were cut from the disc. The thicknesses of the pellets were uniformly 2 mm. These pieces were used in implant studies. In figure 1a ZAP-30 blocks used in this

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