Patients with dental implants enjoy significant improvements in function and esthetics compared with those more traditionally using crowns, bridges and dentures. Implants also have the long-term advantage of maintaining bone mass in the maxilla and mandible that is otherwise rapidly lost due to disuse atrophy.

**TO THREAD OR NOT TO THREAD**

Two designs dominate the dental implant market: screws and cylinders. Screws form an immediate mechanical interlock with surrounding bone tissue, as they are threaded into the bone, thus securing the implant. With the longest clinical history, titanium and Ti-6Al-4V alloy screws are the most widely used dental implants. All screws, however, suffer the drawback of relatively complex surgical implant procedures, as the bone must often be pre-tapped. Nonetheless, the intuitive concept of mechanical fixation is still preferred by many clinicians.

Since cylinder implants do not offer immediate mechanical attachment, they typically feature coatings, such as plasma-sprayed titanium or hydroxylapatite (HA) ceramic. These coatings enhance bone attachment, and implants establish a solid, stable interface with the surrounding bone within months after implantation. HA coatings have proven to be the fastest integrating dental implant surface to-date. Additionally, cylinders are easier to implant than screws, as they are simply pushed into a pre-drilled site. The high success rate of HA-coated cylin-
ders has been well-documented over the past decade.

INCORPORATING BENEFITS INTO ONE

Sulzer Calcitek has developed the CSTi porous coated dental implant (Fig. 1), which combines the advantages of both screw and cylinder configurations. The porous surface is quickly integrated by the growth of bone into the coating, forming a stable interlock. Thanks to its cylindrical shape, the CSTi implant is easily placed, using the instruments and techniques familiar to most users of Sulzer Calcitek products. The implant system was recently introduced in diameters of 3.25, 4.0 and 5.0 mm, responding to the needs and anatomical limitations of almost every dental implant patient.

APPLIED ORTHOPEDIC KNOW-HOW

The CSTi (Cancellous Structured Titanium) surface was adapted from the coating widely used on a number of articulated joint prostheses of Sulzer Orthopedics Inc. The coating is a three-dimensional network of interconnecting pores in a matrix of sintered titanium powder. The name CSTi reflects the physical similarity of the porous coating to human cancellous bone.

Figures 2 and 3 show the CSTi coating in cross-section and from the surface. The porous coating provides a substantial volume of void space to accommodate healthy bone. The average porosity of the CSTi coating is 57%. Pores are random in shape, with dimensions ranging from 69 to 662 µm. Figure 4 shows a cross-section of the CSTi coating of a dental implant retrieved from a canine specimen. The void spaces are almost entirely filled with new bone.
August 1997 marked the first implantation of the new CSTi porous coated dental implant into a human patient. Growth after only two weeks. Although this is a best-case example, over 50% of the pore volume is filled with bone after only three months on average. With this extensive bone ingrowth, the goal of mechanical interlocking between implant and bone is achieved. The ingrowth process leads to a very strong connection between implant and bone. Albeit not immediate, mechanical fixation is established in less than one month. Animal studies have shown that CSTi-coated dental implants integrate at an equal or faster rate than HA-coated cylinder implants. (Note: Results from animal studies cannot be directly correlated with human clinical results.)

Extensive Adaptation to Dental Needs

The CSTi dental implant is the result of a four-year collaboration between Sulzer Calcitek and Sulzer Orthopedics Inc. The latter has used CSTi coatings for more than ten years on hip, knee and shoulder implants. The orthopedic and dental coatings are both made of sintered titanium powder, but are quite dissimilar in other respects. The dental implant coating is significantly thinner than the orthopedic coating, requiring new formulations and manufacturing techniques. The two companies continue to work together closely in the areas of manufacturing, testing, and quality assurance.

FDA Approval Granted

In February 1997, Sulzer Calcitek gained permission by the U.S. Food and Drug Administration to market the CSTi implant. The initial introduction of the CSTi implant is being limited to a select number of sites as part of a program to document its performance. Clinicians participating in the limited market release are Dr. Joseph P. Fiorellini (Harvard University), Dr. Dennis P. Tarnow (New York University) and Dr. Michael A. Pikos (Coastal Jaw Surgery, Palm Harbor, Florida). The first human CSTi implantation was performed by Dr. Pikos in August 1997 (Fig. 5). Figure 6 shows an X-ray of the patient after placement of a second implant. Broader availability of the enhanced coating is anticipated upon completion of this introductory phase.

For More Details

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6 X-ray of the first human CSTi patient showing two 3.25-mm CSTi implants in the mandible.