Milling In Dentistry

**Historical Overview**

Milling technology has been standard practice in Europe and is increasingly being incorporated into U.S. laboratories. With the tremendous growth in implant reconstruction, telescopic restorations with milled substructures often provide solutions for difficult situations.

Unfortunately, there exists few written resources for milling instruction, especially in English. This newsletter is the first of a two part series that will focus exclusively on milling.

Milling is the precision machining of wax and cast surfaces at precisely controlled angles. Milling has proved to be the most effective way to stabilize and improve the stability and resistance forces in removable restorations (Fig. 1). Milling machines are also used for surveying (Fig. 2), setting attachments (Fig. 3), for drilling and tapping (Fig. 4), for creating customized screw blocks (Fig. 5), and setting dowel pins. A variety of good milling machines are available today, ranging from about $2500 to as high as $12,000.

The founders of milling technology are Dr. Alfred A. Steiger and Dr. Raoul H. Boitel, both of Zurich, Switzerland. In their book, *Precision Work for Partial Dentures*, (1959), they describe the “Channel Pin Shoulder System” (CPS) conceived by Dr. Steiger. This concept involves a milled primary unit, mated with a removable secondary casting with adjustable parallel sided pins (Fig. 6).

The adjustable pins engage the channels in the primary unit. The channels are open gingivally to act as a “sluice way” to prevent entrapment of debris. The CPS system owes its effectiveness to the large frictional surface area in intimate contact.

Dr. Steiger developed the CPS system to eliminate the problems associated with conventional clasps such as, food entrapment, lack of support, and stability, abrasion of enamel, and poor esthetics.

The CPS System does have some disadvantages. It demands the highest level of skill on the part of the dentist and technician. There is no margin for error, and the adjustable pins have a tendency to break if the patient ever adjusts the pins.

Dr. Steiger is also credited as the founder of modern attachment technology. His designs set the standard for premanufactured semi-precision and precision attachments (Fig. 7).

The cylinder design (Fig. 7A) is known as a “ring clasp” and is effective even in limited vertical space. The horseshoe design, also referred to as a “C” (Fig. 7B) provides excellent retention and stability. This design or attachment resists dislodging forces since it encompasses more than 180 degrees. Dr. Steiger’s “T” and “H” designs (Fig. 7C) are the forerunners for today’s intracoronal attachments. He patterned the “T” and “H” designs after the girders known for their incredible strength in building construction (Fig. 8).
Currently, most milled units are designed to work in conjunction with semi-precision or precision attachments. The most common example is a milled lingual arm for removable partial dentures (RPD). The lingual shoulder is milled parallel to the path of insertion of the attachment. The lingual arm increases the retentive surface area and in effect becomes part of the attachment (Figs. 9 & 10).

A milled lingual arm offers many advantages vs a conventional clasp, including comfort, increased stability and retention, rotational resistance and the elimination of food entrapment. Since a milled lingual arm is "intracoronal" no protruding reciprocal arm is felt with the tongue when the RPD is seated. Esthetics are also greatly improved since a buccal retentive arm is not required.

**Comfort and esthetics are the most important factors for most patients.**

*Fig. 10 is a conventional clasp.

**Milled Linguals**

To reduce wear on the milled primary casting, the secondary lingual arm is usually cast in type IV gold and soldered to the removable framework. The wide parallel walls of the primary unit are precisely milled at 0 degrees to maximize retention and stability. (Less taper creates more retention).

To maintain intimate contact between the fixed and removable sections, cylinder type attachments are milled in wax or preferably, plastic attachments, like an Omega-M etc., are incorporated into the wax-up (Fig. 11).

---

**Case History #1**

Six Bio-Vent* implants were placed in the maxilla of a woman with significant bone loss (Fig. 12).

It was determined that a fixed bridge type restoration would not provide adequate lip support. A decision was made to construct an implant supported overdenture incorporating a secondary framework designed to mate with a milled bar substructure (primary unit).

Universal Modification Abutments (UMA) were inserted as tissue extensions, impressions where taken and the models were mounted following the bite registration. The wax set-up was duplicated in stone so that a clear stent could be made to act as a guide for contouring the primary and secondary frameworks (Fig. 13).

To maximize retention, the wax-up was milled with 0 degree parallel walls (Fig. 14).

The primary wax pattern was then cast, sectioned, indexed intraorally, and soldered to achieve a passive fit. The soldered framework was then milled with 0 degrees carbide milling burs.* (*Available from Aii).

To provide additional mechanical retention, recesses and dimples were milled in the primary substructure to receive a plunger type attachments (Fig. 15).

Plunger attachments such as the Ipso Clip (left), Hannes Anchor (middle) or Mini Pressomatic (right) may be used (Fig. 16).

The Ipso Clip attachments were employed as back-ups in the event that the milled bar loses retention in the future. The housings for the Ipso clips were incorporated into the wax-up for the secondary framework (Fig. 17).

The plungers and springs can be screwed into the housings at a later date if needed.

The secondary framework was cast in sections, soldered, and seated over the milled substructure (Fig. 18).
Milling In Dentistry (cont.)

The denture teeth and acrylic were then processed over the secondary framework (Fig. 19).

**Final Result:**
The final milled restoration now has the comfort and function of a fixed bridge, provides the necessary lip support and is patient removable for hygiene maintenance. (Figs. 20 & 21).

A milled lingual in conjunction with an adjustable Biloc attachment was incorporated into the first bicuspid. The ring clasp was seated into the rest seat of the second molar (Fig. 24).

**Final Result:**
An extremely stable and patient removable bridge was created that allows for future alterations and conversions if necessary (Fig. 25).

**Summary:**
Milling technology provides the most effective way to stabilize patient removable restorations and makes solutions possible for difficult implant cases. The time, expense, and skill level required by milling technology results in high quality restorations in which everyone involved, including the patient, can take great pride.

**Acknowledgements:**
- Wieland Edelmetalle, Pforzheim, Germany
- Dental Labor Mecklenbeck, Duisburg, Germany
- Alloy used: Fortudur (Cooperfree)
- Case #1 (Figs. 12-23)
- Dennis Casselli DDS, San Francisco, CA
- Walter Haechler MDT, CDT San Francisco, CA
- Case #2 (Figs. 22-25)
- Noel Martin DMD, St. Louis, Mo.
- Gerard Jacobi CDT, Jacobi Dental Laboratory St. Louis, Mo.

(Questions & Answers)

**Question:**
I have been working with the UCLA system for the Branemark implant and have noticed on two occasions that the UCLA bridge seats perfectly on the model but will not seat or be out of occlusion intra-orally. What could be the problem?

**Answer:**
The problem usually occurs at chairside. When the UCLA hex impression coping is placed, the internal hex of the impression coping may not fully engage the external hex of the implant therefore, the analog becomes slightly malpositioned in the master model. There is no way to tell that this has occurred by looking at the model. A good example of this problem you are experiencing is illustrated in the following two radiographs. These were taken at 90 degrees to the junction of the impression coping and the implant. The first radiograph (Fig. 26) shows an Integral Omni-Loc implant with an obvious gap between itself and the impression coping. As you can see, the impression coping did not fully engage the internal octagon of the implant. The second radiograph (Fig. 27) shows the repositioned impression coping correctly engaging the implant.