Introduction

Lithium disilicate is one of the most popular and most prescribed materials for dental restorations. IPS e.max by Ivoclar is a common type of lithium disilicate and will be the main focus of this white paper. This high strength, glass ceramic offers some of the strongest and most esthetic restorations available today. The majority of dental lab technicians believe that wet grinding this material is the best way to produce e.max restorations. Thus, labs looking to enter the digital dental market often look for dental mills that provide a wet option. As we will point out in this whitepaper, the belief that e.max restorations must be wet milled is a false and costly one.
Opportunity For Labs With Dry Mills Only

Roland’s current product offering includes two dry mills. The DWX series offers a flexible and open architecture solution which allows dental laboratories to choose from a variety of materials, including wax, zirconia, PMMA, VITA ENAMIC® hybrid ceramic and 3M™ ESPE™ Lava™ Ultimate CAD/CAM Restorative nano ceramic resin. Laboratories researching mills sometime believe that wet grinding and dry milling are an interchangeable option with little or no preparation needed. It is true that there are machines that can be used as both a wet and dry solution; however the changeover between the two does not come easily or quickly.

![Graph showing material usage trends](image)

Europe, US, China and Japan iData Research 2012

Most labs do not have an unlimited equipment budget and may only be able to afford one type of mill. Although wet milling is an option that many would like to have, sometimes the amount of actual business that would require the use of a wet mill on a regular basis will not outweigh the cost. With materials like zirconia, and PFM’s (porcelain fused on metals) still being so popular in the dental lab business, dry milling of zirconia and wax is still responsible for the majority of restorations being done in dental labs today. With the price of precious metals going up over the last few years, zirconia has begun to take some of the PFM market away and is now the most popular material being milled on Roland mills today. The use of hybrid ceramics is growing rapidly. Nevertheless, some dentists may continue to prescribe e.max restorations, causing labs without an e.max solution to worry that they will lose a customer.
Historical Background

Even before digital workflows began to surface in the dental laboratory market, hand waxing and pressing with e.max was a significant and profitable method of producing dental restorations. With the ever-growing popularity of e.max both in the ingot form for pressing and the block form for grinding/milling, the question as to which method is best remains the same. One of the most common requirements mill owners look for when searching for new CNC systems is the ability to incorporate wet capabilities. This allows the mill to grind materials normally too hard for traditional milling like glass ceramics and lithium disilicates. Lab owners may feel as though they limit themselves by not offering e.max restorations to their customer base.

Two Methods of Manufacturing e.max Restorations

There are actually two different solutions when it comes to manufacturing e.max restorations. The first is e.max CAD, which is a pin-type lithium disilicate that requires grinding in a wet environment. The second and slightly more labor-intensive restoration solution is e.max Press. e.max Press uses the same manufacturing process as a PFM if produced on a Roland mill. The lost wax cast method is a process that has been around for thousands of years and is still very popular in many industries outside of the dental lab business. Producing an e.max crown can be done using either technique, but the big question labs need answered is: Are the restorations really the same? The following information supports the actual benefits one would see when using the e.max pressing technique over the more popular e.max CAD.

Comparative Analysis

The number one option for manufacturing the highest quality e.max restorations is the lost cast wax process. With a Roland DWX series dental mill, labs are able to quickly mill 20 to 30 wax crowns in a disc of wax. Not only are users able to produce superior anatomic details using end mills as small as 0.3mm, but also the margin integrity of a wax process-produced full-contour crown provides users with a smooth, clean margin that requires less adjustment prior to cementation. Although grinding an e.max crown will produce a long-term esthetic appearance, e.max Press is scientifically a better solution. When looking at strength, both e.max processes offer some of the strongest restorations available. However e.max Press is 11% stronger than e.max CAD. According to Ivoclar’s Scientific Report 2011 on e.max CAD and Press, a flexural strength rating of over 400 makes e.max Press the absolute strongest of all ceramic restorations available on the market today.
e.max CAD versus e.max Press – A Comparison

e.max Press has an extended micro crystal structure that is longer than the crystal structure in the e.max CAD version. These longer crystal structures produce a stronger final restoration. Since the process of crystallization takes place in a different stage, with the CAD version, the longer crystal structures cannot be achieved due to the need to grind prior to final crystallization. Along with the strength of e.max, there are some other factors to consider as well. Surface quality with e.max Press produces superior results compared to the much rougher e.max CAD.

Source: Ivoclar Scientific Report 2011
Key Findings

When looking at the scientific and clinical data provided by several independent sources, it appears initially that choosing e.max CAD or e.max Press will provide similar benefits of a strong, long lasting and esthetic restoration. When scrutinizing these two options side by side however, e.max Press is the clearly superior choice. When looking at some of the main properties of what makes for a good restoration, the results demonstrate that choosing to produce restorations with the pressing method provides the following benefits over the CAD version of e.max:

1. Superior flexural strength of over 400.
2. Cleaner and more precise margin integrity. Less chipping and a much smoother margin line is found in pressed restorations with little or no post processing work required to achieve this characteristic.

![e.max CAD](image1)

![e.max Press](image2)
3. Less wear on the opposing teeth due to the smoothness of restorative surface (CAD version smoothness is still not achieved even with post-processing polishing with diamond tools).

Source: IPS e.max CAD Scientific Report 2011

Surface quality
4. A higher level of detail is possible when milling the initial restoration in wax. Since many strategies utilize a 0.3mm tool to attain superior anatomical detail, the CAD grinding method does not allow for the same quality.
Conclusion

Industry-wide, e.max remains one of the most prescribed materials for dental restorations. While wet milling can automate the production of e.max restorations, it is not the only production platform well suited for this material. An investment in dry milling technology enables the production of superior e.max restorations while also simplifying the production process for a host of other popular materials, including wax, PMMA, zirconia, VITA ENAMIC hybrid ceramic and 3M ESPE Lava Ultimate CAD/CAM Restorative nano ceramic resin.

Roland Dental Milling Machines

Ultimately, an investment in Roland’s dry milling technology can provide labs with all the performance and versatility they need to serve dentists and patients well. The DWX series’ lower price tag and operational costs, as well as their simplified workflow and unmatched reliability, translate into greater efficiency and cost savings for labs involved in digital dentistry.