

# NUMERYS HC

## WHITE PAPER



# 1- Material for dental CAD/CAM: State of the art

In 1985, was produced the first CAD/CAM glass-ceramic inlay using a ceramic block comprising fine grain feldspathic ceramic [1].

Since this date, several CAD/CAM ceramic materials have been developed for permanent restorations:

CAD/CAM materials for permanent restoration [2]	
<b>Glass ceramics</b>	Feldspathic
	Leucite-reinforced
	Lithium disilicate reinforced
	Zirconium oxide and lithium silicate reinforced
<b>Polycrystalline ceramics</b>	Zirconia
<b>Resin</b>	Resin composite
	Nanoceramics

According to dentists and patients, the requirements for CAD/CAM materials are:

- High strength and toughness depending on the required indication
- High durability as dental restorative material
- Excellent optical appearance (translucency, brightness, color and fluorescence like that of natural teeth)
- Easy handling (easy milling and no additional extensive treatment after the CAD/CAM process)
- Easy placement of the restoration on natural dentin

Feldspathic ceramics are easily machinable and show very good aesthetic results for small pieces [2]. However, the need for more mechanically resistant materials in order to extend the indications led to the development of reinforced ceramic. Some of them are sold at a pre-crystallized stage in order to remain easily machinable. Nevertheless, post-milling crystallization is necessary to access the final shade and mechanical strength, which makes the process longer for the practitioner.

Then, resin composite blocks, which are softer has been developed to combine the advantages of the two previous groups. Positive effects of ceramics and resin-based materials have been combined in hybrid ceramic materials consisting of ceramic and polymers materials. However, in order to significantly improve the properties of resin composite for CAD/CAM, resin-composite nano ceramics blocs have been introduced.

Nanoceramic resin-based CAD/CAM block is the best compromise in term of properties with high mechanical performance, good wear resistance, good aesthetic aspect and an easy milling behavior.

## 2- Product description

NUMERYS HC is a pre-cured hybrid ceramic block for CAD/CAM using the nano-ceramics technology.

The objective for ITENA CLINICAL was to develop new ceramic resin that would provide outstanding strength and wear properties for single unit restorations for CAD/CAM systems. NUMERYS HC is developed according to optimized manufacturing consisting in a heat cure process under pressure.

This mill block is designed for dental clinics (chair-side) and laboratory (lab-side) milling applications by CAD/CAM.

## 3- Indications

NUMERYS HC is a highly esthetic hybrid ceramic-based block for milling dental restoration using a dental CAD/CAM system.

NUMERYS HC is used as a dental restoration by CAD/CAM for carious lesions or structural defects in teeth including:

- Inlay
- Onlay
- Veneer (minimum thickness 0.4mm)
- Crown and partial crown
- Implant retained crowns



Figure 1 - NUMERYS HC milled onlay [3]

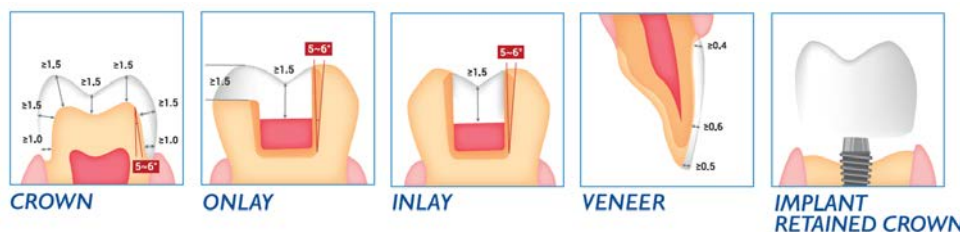


Figure 2 - Numerys HC indications guidelines

Nicolas Decerle et al. have shown that NUMERYS HC is also an excellent choice for endo-crowns due to its flexural behavior close to the one of dentin which decrease the risk of fracture. [3]

NUMERYS HC is suitable for temporary and long-term dental restoration made in lab or chair side solution.

NUMERYS HC attached pin is compatible with universal milling machines similar to CEREC<sup>1</sup>.

<sup>1</sup> SIRONA Dentsply brand

## 4- Product composition

NUMERYS HC blocks are based on REFLECTYS composite chemistry and consist in nano-hybrid ceramic fillers included in highly cured resin matrix.

<b>Composition</b>	
<b>Matrix</b>	Bis-GMA
	TEGDMA
<b>Fillers</b>	Barium aluminosilicate
	Zirconia
	Silicon dioxide

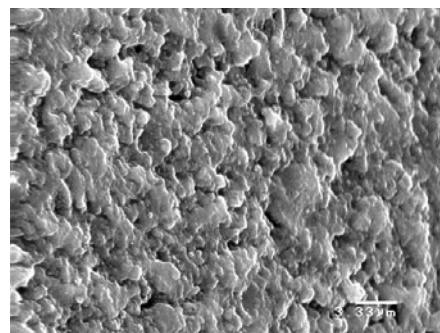


Figure 3 - Numerys HC microstructure: Nano ceramic particles embedded in a highly cross-linked resin matrix

The ratio is 25 %wt resin phase / 75 %wt mineral phase.

The quality of filler contents has been optimized to keep excellent machinable, mechanical and optical properties.

<b>Product</b>	<b>Resin matrix</b>	<b>Fillers</b>	<b>Filler contents (wt%)</b>
<i>NUMERYS HC (Itena Clinical)</i>	Bis-GMA, TEGDMA	Barium aluminosilicate, Zirconia, Silicon dioxide	75
<i>Lava Ultimate (3M)</i>	Bis-GMA, UDMA, Bis-EMA, TEGDMA	Silica, Zirconia	80
<i>Cerasmart (GC)</i>	Bis-MEPP, UDMA, DMA	Silica, Barium glass	71
<i>Block HC (Shofu)</i>	UDMA, TEGMA	Silica, Silicate, Zirconium silicate	61

Table 1 - Composition of different hybrid material CAD/CAM blocks on the market [3]

## 5- NUMERYS HC

### A- Main features of NUMERYS HC

- ▶ High flexural and compressive strength
- ▶ Strong material for wear resistant restorations
- ▶ Ideal for thin surfaces and implant retained crowns
- ▶ Respected anatomical shape and good marginal adaptation
- ▶ Fast and effortless polishing with brilliant and long-lasting performance
- ▶ Aesthetic, close to natural shades: requires little or no staining
- ▶ Easily reworkable: possibility of characterization in mouth



Figure 4 - Milled prosthesis. Result after polishing

- ▶ Compatibility with any dental cement
- ▶ Chemical bonding to TOTAL C-RAM™
- ▶ No firing and glazing: less time, less equipment, saves space
- ▶ Easy to mill
- ▶ Greater resistance to chipping than traditional glass ceramics: even for the smallest parts

## B- Shades and sizes

NUMERYS HC is available in two block sizes for excellent single tooth restoration.

NUMERYS HC shades has been developed according to the Vita shade guide in order to provide the best solution to each clinical case with a natural result.

NUMERYS HC offers single unique translucency to cover all the clinical cases.

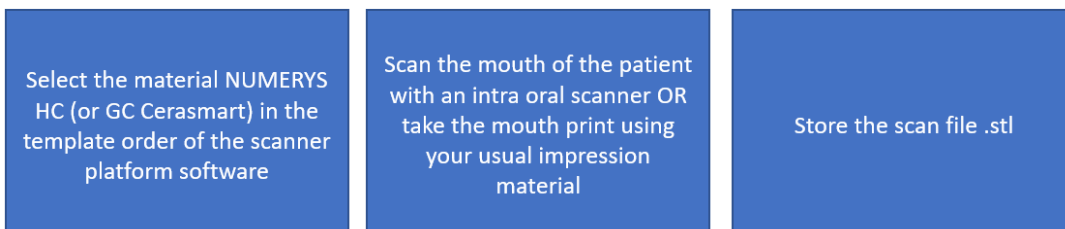
<b>Product</b>	<b>12</b>	<b>14L</b>
<b>Size</b> (WxLxH)	12.2x10.2x15	14.5x14.5x18
<b>Shade</b>	A1, A2, A3, A3.5, B3, E (Enamel)	
<b>Recommended application</b>	Inlay Onlay Veneer	Crown Endocrown

Table 2 - Numerys HC available sizes and shades

## C- Chairside CAD/CAM protocol

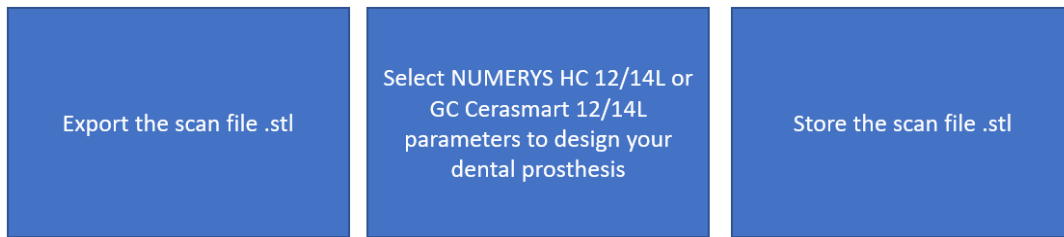
For scanning, designing and milling NUMERYS HC block, please select in your CAD/CAM workflow/software NUMERYS HC 12/14L. If not available, you can use GC Cerasmart 12/14L<sup>2</sup>.

### Scan:

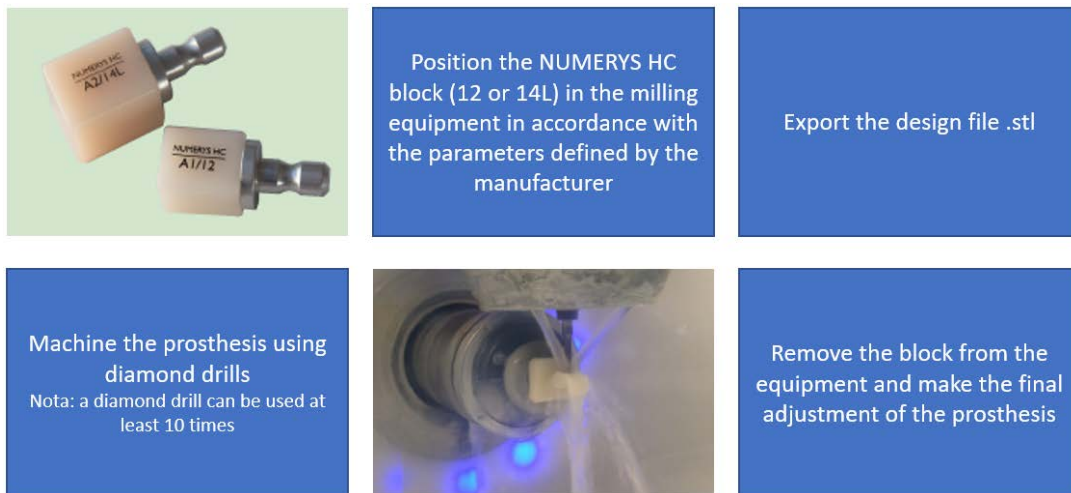


<sup>2</sup> Brand of GC

## Design:

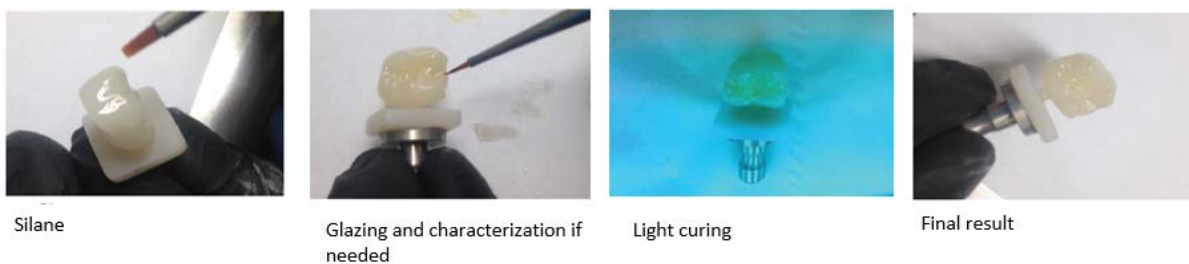


## Manufacturing:

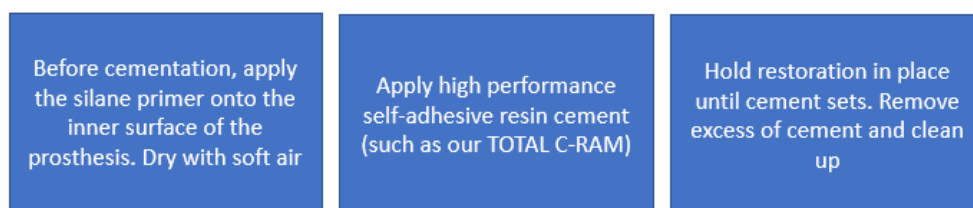


## Characterization:

This step is not mandatory because polishing would be enough for NUMERYS HC. Hence, only if you desire a higher aesthetics:



## Cementation:



## D- Technical Properties

### **Radiopacity:**

NUMERYS HC blocks have a radiopacity equals to 2.5mm Al equivalent.

### **Solubility:**

NUMERYS HC blocks have a good tightness due to their low water sorption and water solubility properties:

<b>Water sorption</b>	17.9 $\mu\text{g}/\text{mm}^3$
<b>Water solubility</b>	0.68 $\mu\text{g}/\text{mm}^3$

Table 3 - Properties with water [5]

### **Modulus of Elasticity:**

NUMERYS HC block has an elasticity modulus equal to 12 GPa.

## Product Performances / MARKET

Flexural strength is an important parameter to predict the fracture resistance of a material when used for stress-bearing posterior restorations.

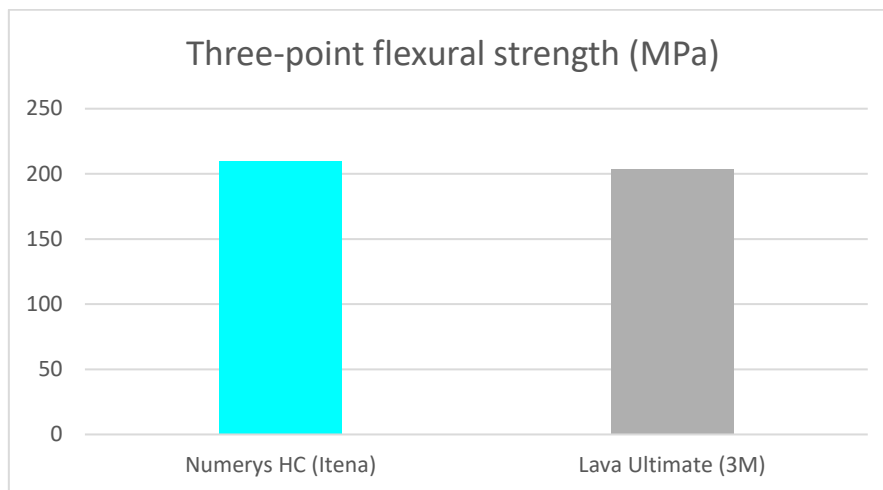


Figure 5 - NUMERYS HC three-point flexural strength compare to other products on the market [5]\_based on ISO 4049\_2009

NUMERYS HC has a better flexural strength than Lava Ultimate block.

Higher flexibility of composite resin nanoceramics is claimed to be due to the flexibility of the resin, which helps to reduce brittleness. [6]

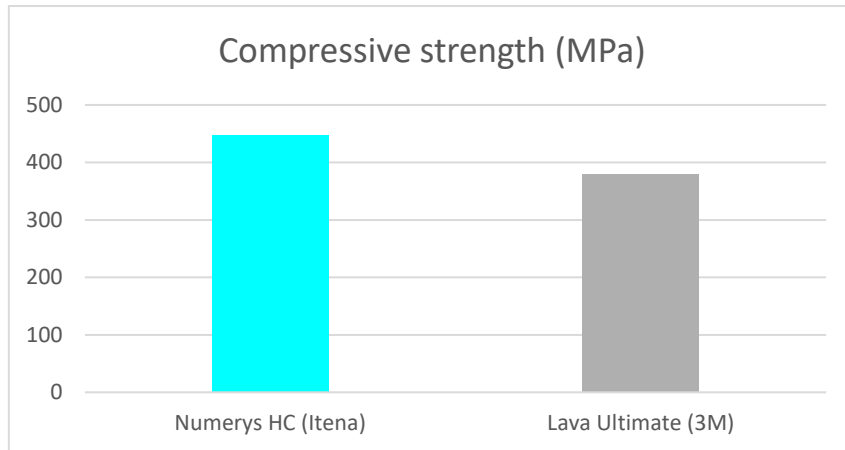


Figure 6 - NUMERYS HC compressive strength compared with other products on the market [5]\_based on ISO 9917

NUMERYS HC has a real better compressive strength than Lava Ultimate.

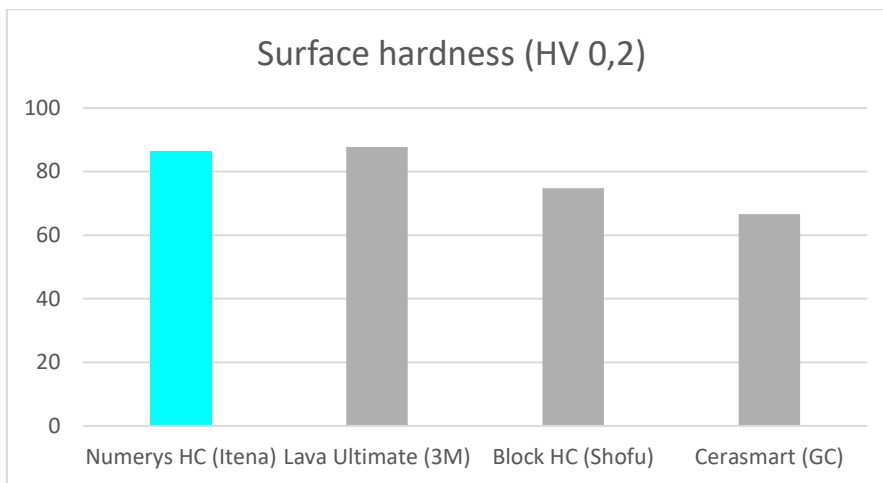


Figure 7 - NUMERYS HC surface hardness compared with other products on the market [5]

NUMERYS HC block presents a higher surface hardness than most of the hybrid ceramic blocks on the market. This good result is due to its optimizing high filler contents and their purity.

Wear is the result of a number of processes which act in various combinations, depending upon the properties of the materials. [7]

Attrition has been identified as one of the main clinical wear mechanisms for dental reconstructions. Abrasion of tooth occurs in three-body wear mode. It is generated by the sliding action of one tooth past another with force being transmitted through a layer of food that serves as a third-body medium. [6]



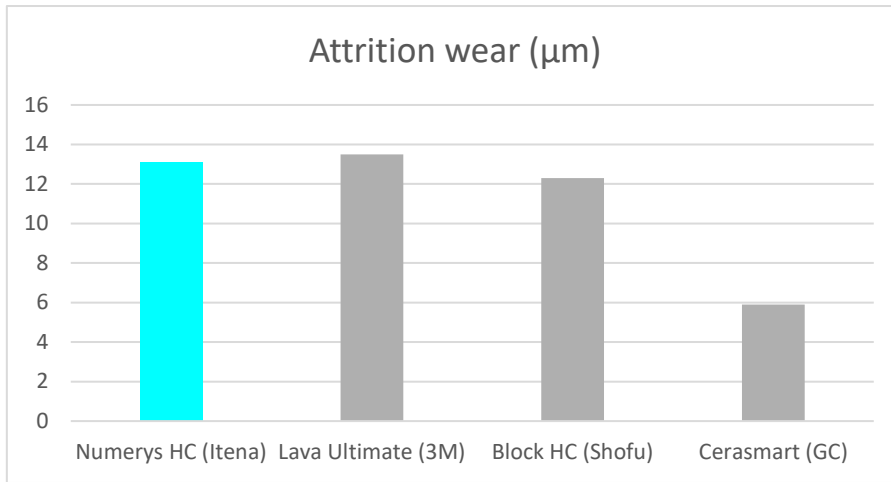


Figure 8 - NUMERYS HC attrition wear compared with other products on the market [5]

NUMERYS HC has the same attrition wear resistance than most of the competitive products on the market except Cerasmart that is poor.

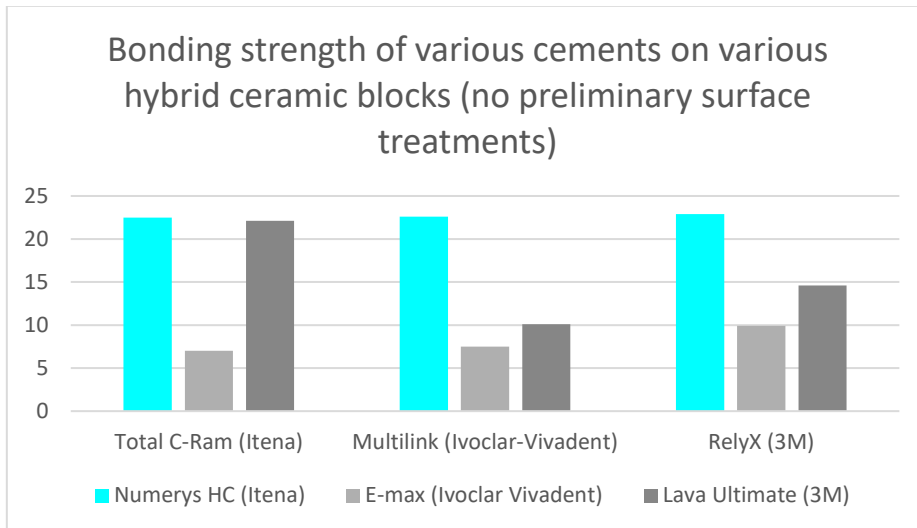


Figure 9 - Comparative bonding strength of various cements on various hybrid ceramic blocks (no preliminary surface treatment) [5]

As shown, NUMERYS HC presents the highest adhesion to the different cements tested compared to competitive blocks. This property enables a good retention of the restoration.

## Clinical study

A clinical study has been conducted by the Clermont Ferrand Odontological CHU over 18 months [3].

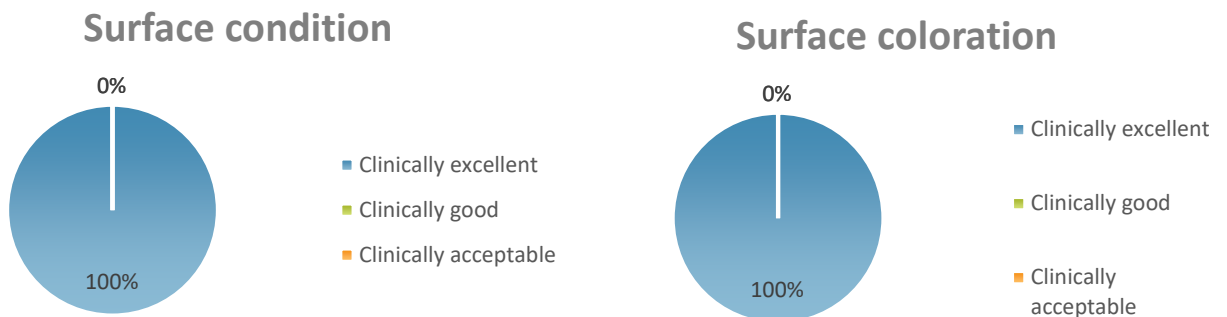
This study was carried on 48 restorations including:

- 11 endo-crowns
- 6 inlays/onlays
- 31 peripheral crowns.



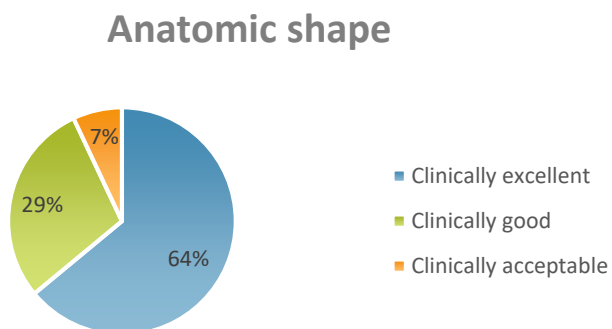
Figure 10 - Clinical case: endo-crown made with NUMERYS HC [3]

**Surface condition and surface coloration:**



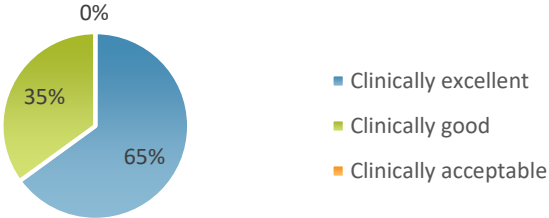
The excellent clinical results of surface condition and surface coloration show the exceptional capacity of NUMERYS HC material to be polish.

**Precision of restorations:**

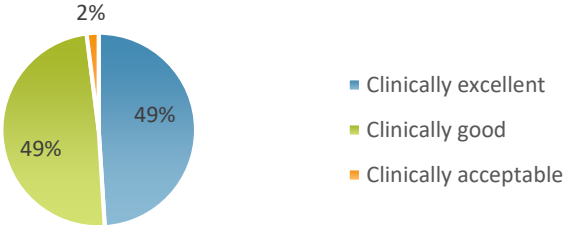


The very good machinability of NUMERYS HC blocs enables to obtain clinically excellent anatomic shape results.

**Labial surface marginal adaptation**



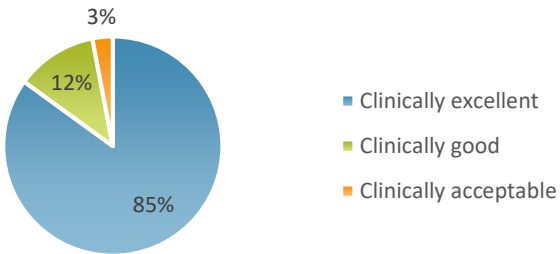
**Lingual surface marginal adaptation**



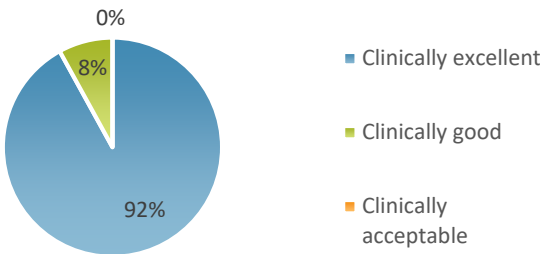
The very good marginal adaptation of NUMERYS HC shows again its excellent machinability and adaptation to CAD/CAM.

**Contact area quality:**

**Mesial surface contact area**



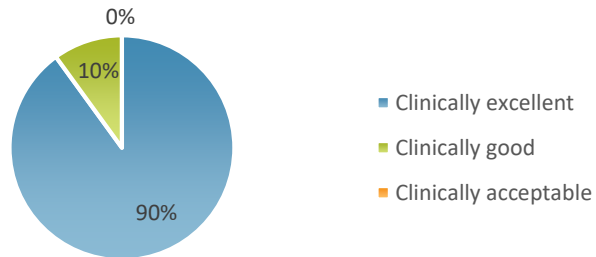
**Distal surface contact area**



These results show the excellent ability of the material to be adjusted in this delicate area to create a favorable anatomy.

**From a patient perspective:**

**Patient's perspective**



The patient's perspective was excellent for 90% of them and good for the others. The patients had the feeling of a natural tooth and spoke about the absence of heaviness compared to ceramo-metallic restorations.

## Scientific Literature data:

- [1] Dental composite properties evaluation: from experimental approaches to the prerequisite of a chewing bench – Hazem Abouelleil Sayed - 2017
- [2] Dental biomaterials for chairside CAD/CAM: State of the art – Hugo Lambert et al. – The Korean Academy of Prosthodontics – 2017
- [3] Evaluation d'un nouveau matériau composite pour CFAO – Nicolas Decerle et al. – Université Clermont Auvergne, Service d'Odontologie
- [4] Key parameters of hybrid materials for CAD/CAM-Based restorative dentistry – Sebastian D. Horvath, Dr. med.dent. – 2016
- [5] Itena's R&D internal test report
- [6] Mechanical properties and internal fit of 4 CAD-CAM block materials – Alexis Goujat et al. - 2017
- [7] Evaluation of wear resistance of dental resin composites with a 3D profilometer. Hyun-Suk Cha et al. – 2004