Virtual® CADbite Registration

Scientific Documentation

ivoclar vivadent

Table of Contents

1. Impression materials

Obtaining a highly accurate impression of the oral situation is crucial to the success of indirect restorative procedures. The quality of impressions is dependent on both the experience and skill of the clinician and the characteristics of the impression material used. State-of-the-art impression materials have to fulfil high requirements as far as reproduction of detail, tensile strength and stability are concerned.

Various types of materials can be utilized for dental impression taking, e.g. hydrocolloids such as alginates, or polysulfides, polyether and silicones. Vinylpolysiloxanes belong to the family of addition-reaction silicones. When compared to the other materials mentioned, they feature a number of decisive advantages. These include:

- high precision
- good surface detail reproduction
- high tensile strength
- quick elastic recovery after deformation
- neutral taste and odour
- unaffected by liquid disinfectants
- different viscosities available
- adjustable setting times

Removal of the impression from the mouth should be possible without distortion or tearing, and the impression should preserve its dimensional stability while being sent to the dental lab. There, a plaster replica of the oral situation is poured from the negative mould. The plasters which are compatible with the impression material have to be listed in the instructions for use.

2. Bite registration

Bite registrations are made to record the positional relationship of the upper and lower jaws to each other. Bite registrations help achieve successful restorations with harmonized occlusion and articulation. To record the interocclusal jaw relationship, bite wax strips or plates have been and are still utilized. The wax used for this purpose should have a mouldable consistency in the oral environment, but maintain its shape outside the mouth at room temperature. Normally, the wax is softened by heating it prior to taking the wax bite.

Instead of bite waxes, which are not very dimensionally stable, addition silicones can be used to take bite registrations. These materials offer the benefits mentioned above.

3. Bite registrations for CAD/CAM procedures

Apart from conventional impression taking, which serves the purpose of fabricating a plaster model, there are digital impression taking procedures, which are employed in conjunction with the computer-aided design/computer-aided manufacturing (CAD/CAM) of tooth restorations. Digital impressions are taken either of the model in the dental lab, or directly in the mouth at chairside using an intraoral scanning device or camera. In order to determine the occlusal relationship, an antagonist bite registration is required. Being able to directly capture images of this bite record with a scanning device or camera (without having to apply a contrast medium) saves dentists considerable time and eliminates a possible source of error. Examples of scannable bite registration materials are e.g. StoneBite Scan from Dreve, Metal-Bite from R-Dental or Kanibite Scan from Kaniedenta. All of these materials are vinylpolysiloxanes.

4. Virtual CADbite Registration

Virtual CADbite is a bite registration material with an addition-reaction polysiloxane (vinylpolysiloxane) base. The fillers it contains make the polymer more opaque and prevent light scattering. Therefore, images of the bite registration can be captured directly with a laser scanner. Based on these image data, the computer can calculate the occlusion of the restoration being fabricated.

Virtual CADbite shows optimum readability when using a laser scanner from Sirona Dental Systems. Moreover, it features high strength and excellent reproduction of details.

Fig.1: Virtual CADbite Registration

5. Technical data

Standard Composition	**(in wt%)**
Vinylpolysiloxane	20 - 30
Methylhydrogensiloxane	5 - 10
Organoplatinic complex	0.01 - 0.05
Silicon dioxide	40 - 50
Pigment	10 - 20
Food dyes / aroma	0.1 - 0.5

Physical properties

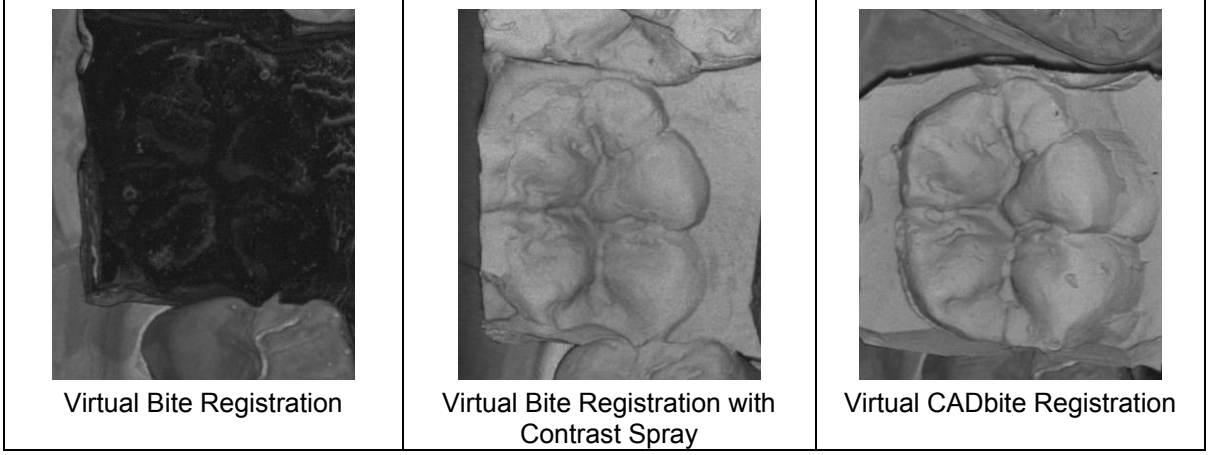
Working time after mixing at 23°C	max. 30 sec.
Minimum time in mouth	min. 45 sec.
Detail reproduction	2 µm
Shore D hardness (1h after setting)	32 ± 3

6. Properties of Virtual CADbite Registration

In order to assess the suitability of Virtual CADbite for bite registration procedures, the material was tested and the results were compared with those of other well-proven materials.

6.1 Scannability

No utilizable optical record could be obtained by scanning the conventional bite registration material. Only after powdering the bite registration with IPS Contrast Spray, a satisfactory image could be captured. With the new Virtual CADbite, the same scanning result can be obtained in one step (Fig.2). The result is extraordinary. Because of the pigments used, the laser beam is not scattered, which results in an image with sharp and crisp detail.



Virtual Bite Registration	Virtual Bite Registration with Contrast Spray	Virtual CADbite Registration

Fig.2: Scans of Virtual Bite Registration without and with Contrast Spray and of Virtual CADbite Registration.

6.2 Hardness

To measure the hardness of Virtual CADbite, the Shore hardness test based on the Shore D scale was used, which is the preferred method for more stiff rubbers/elastomers. The hardness value is determined by pressing an indenter foot into the polymerized material with a force of 50 N at a temperature of 23°C for 15 sec. The depth of the indentation is measured on a scale of 0 to 100. If the indenter completely penetrates the sample, a reading of 0 is obtained, and if no penetration occurs, a reading of 100 results.

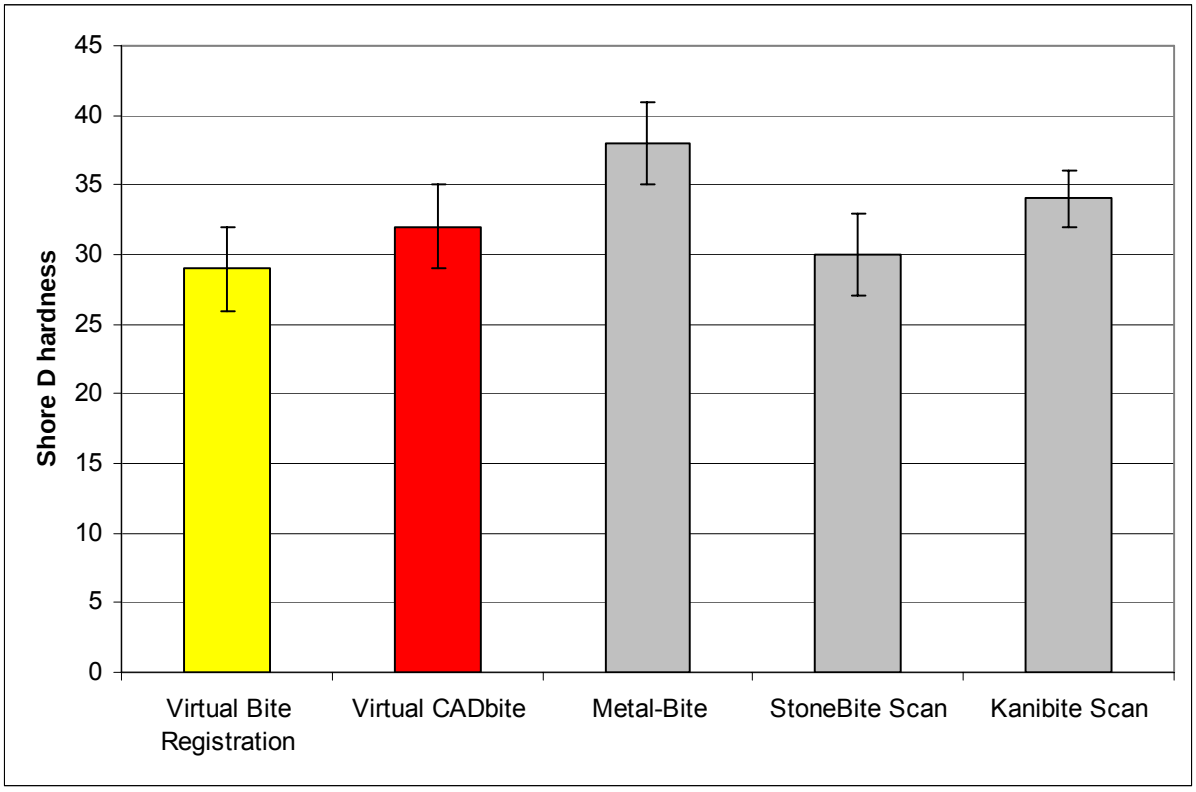


Fig.3: Shore D hardness of various bite registration materials (R&D, Ivoclar Vivadent, 2007)

Of the materials compared in this chart, Metal-Bite exhibits the highest hardness. All the other materials show more or less the same hardness values. Hardness is frequently used synonymously with the dimensional stability of a specimen under a load. Clinically, all the materials perform equally well.

6.3 Working and setting times

Working and setting times of impression materials are measured with the oscillating rheometer. Virtual CADbite is directly dispensed onto a measuring plate. The working time is measured at 23°C and 35°C, while the setting time is measured at 35°C. The procedure takes account of the average temperature in the mouth.

Product	Working time (@23°C, ±5”)	Setting time (@35°C, ±5”)	Setting time from start of mixing (@35°C, ±5”)
Virtual Bite Registration	50”	28”	86”
Virtual CADbite	36”	23”	76”

Table 1: Working and setting times of Virtual Bite Registration and Virtual CADbite (R&D, Ivoclar Vivadent, 2007)

Virtual CADbite has shorter working and setting times than the existing Virtual Bite Registration material (Table 1). Quicker setting affords the advantage of ensuring a higher precision of the impression. Moreover, it enhances patient comfort and thus patient compliance for this type of procedure. An even shorter setting time would mean, however, that the dentist has to work very quickly.

6.4 Tensile strength

For tensile strength measurements, test specimens with a bone-like shape are used (see Fig.4). The jaws of a Zwick tensile tester grip the specimens on both sides and exert a steady pulling force (10 mm/min). The tensile strength of a material is the maximum amount of tensile stress that it can be subjected to before failure. Additionally, elongation at break and the tensile modulus can be determined.

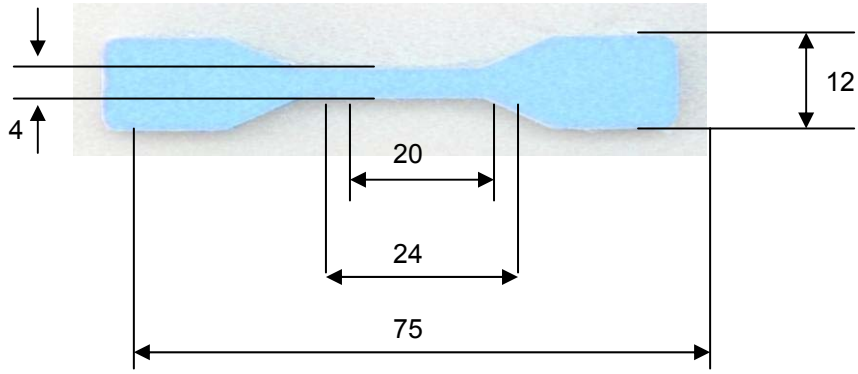


Fig. 4: Test specimen for tensile strength measurement

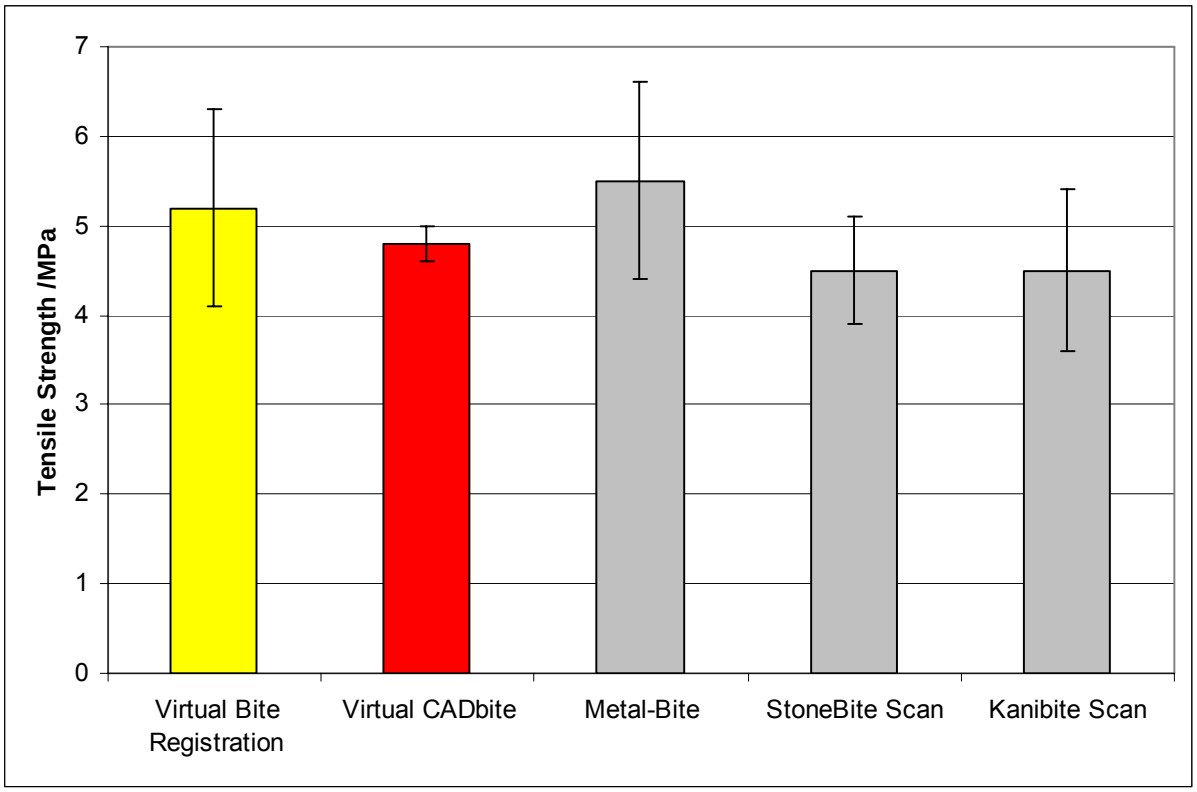


Fig. 5: Tensile strength values of different bite registration materials (R&D, Ivoclar Vivadent, 2007)

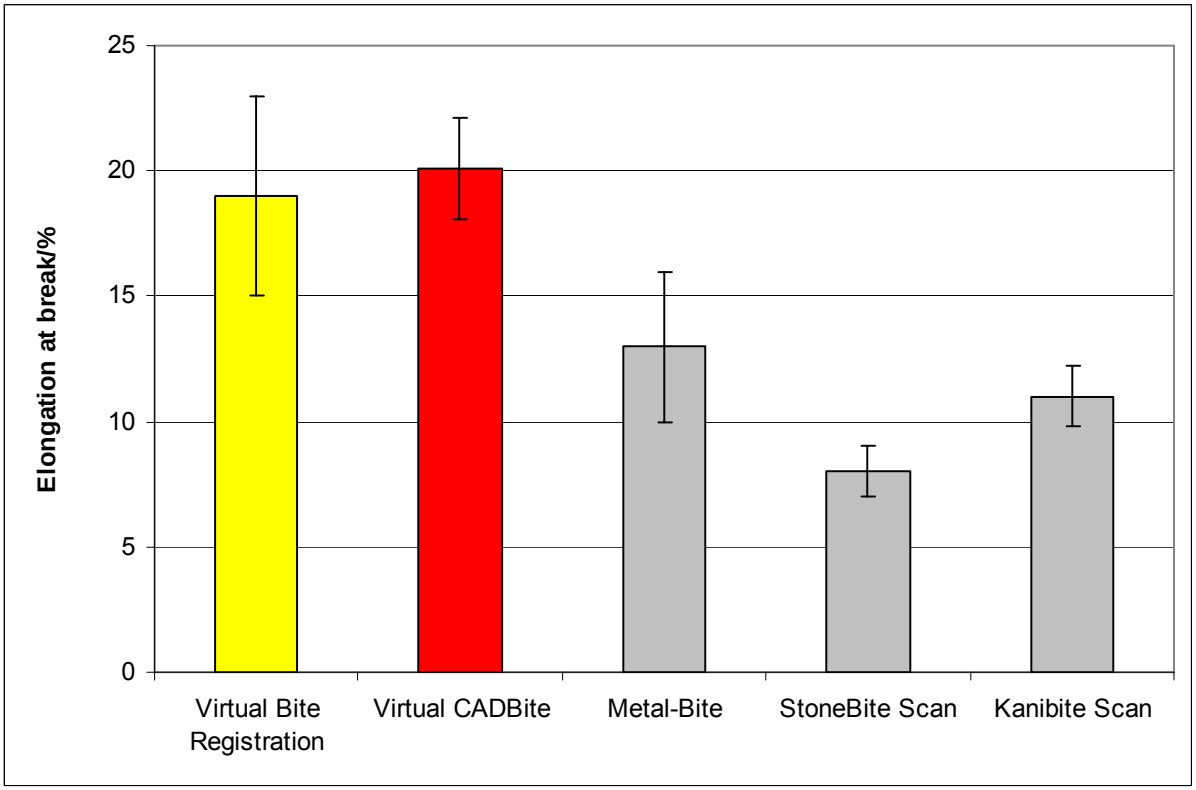


Fig. 6: Elongation at break of different bite registration materials (R&D, Ivoclar Vivadent, 2007)

It is interesting to note that all the measured materials demonstrate comparable tensile strength values of around 5 MPa. The difference between the elongation at break values is more pronounced. Elongation at break is closely related to fracture toughness. A high elongation at break value contributes to ensuring problem-free removal of a bite registration from the mouth without distortion or tearing.

Table 2 shows a comparison of tensile strength values. The tensile modulus correlates with the hardness of the material.

Product	Tensile strength (MPa)	Elongation at break (%)	Tensile modulus (MPa)
Virtual Bite Registration	5.2 ± 1.1	19 ± 4	31 ± 1
Virtual CADbite	4.8 ± 0.5	21 ± 2	24 ± 1
Metal-Bite	5.5 ± 1.1	13 ± 3	49 ± 4
StoneBite Scan	4.5 ± 0.6	8 ± 1	59 ± 2
Kanibite Scan	4.5 ± 0.9	11± 1	45 ± 3

Table 2: Comparison of values obtained in tensile tests.

7. Clinic

The handling of Virtual CADbite was tested in the internal clinic of Ivoclar Vivadent. Below, a clinical case is presented by means of the series of pictures (Fig.7). Teeth # 46 and 47 of the patient which had been restored with amalgam showed secondary caries. After removal of the defective fillings and preliminary preparation of the teeth, a bite record was taken with Virtual CADbite. Since the opposing dentition had an irregular appearance, an antagonist bite registration was particularly helpful in this case. The antagonist was displaced palatinally.

Prior to completing cavity preparation, a rubber dam was placed to ensure a completely dry operating field for the adhesive procedures planned. Now it was safe to fill the undercuts and line the dentinal areas in the centre of the cavity with flowable composite. For this purpose, the cavity was conditioned with AdheSE. Next, Tetric EvoFlow was applied to the undercuts and dentinal areas in the cavity centre. The composite increments were cured with the bluephase LED curing unit in the LOW power mode. This was followed by finishing of the cavity margins, removal of the remaining stains and finishing of the reconstructive lining. Subsequently, the prepared teeth were powdered with Contrast Spray for the optical impression taking procedure. Then images were captured with an intraoral scanning device. The completed bite registration was trimmed with a scalpel and seated on the preparations. The digital impression of the prepared teeth with the bite registration in place could be taken without having to apply an additional coat of powder.

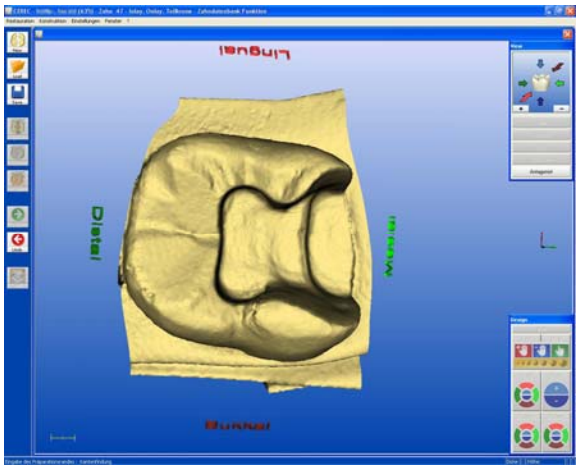
Based on the data obtained, the inlay was digitally constructed using Cerec software and subsequently milled from IPS Empress CAD ingots.

Pre-operative situation: Amalgam fillings in teeth # 46 and 47 showing secondary caries

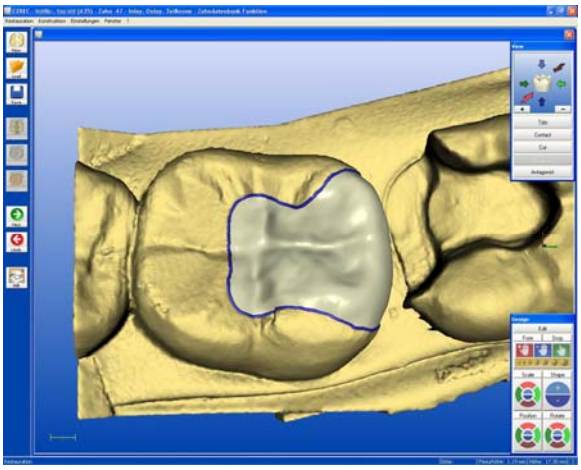
Bite registration with Virtual CADbite

Situation after preparation of the cavity and prior to filling the undercuts

Completed preparation with IPS Contrast Spray prior to optical impression taking



Virtual model of prepared tooth # 47



The completed inlay after virtual construction

Fig. 7: Photo documentation of a clinical case

8. Clinical experience with Virtual

Virtual was launched in 2002 and has in the meantime established itself in the marketplace as a high-precision impression material. It acts like a hydrophilic material which, at the same time, exhibits excellent moisture displacement capabilities (see Scientific Documentation of Virtual). As a result, highly accurate impressions are achieved. The fresh peppermint scent is perceived as pleasant and calming by patients.

9. Biocompatibility

Polysiloxanes are generally described as being chemically inert and biocompatible. Cell toxicity tests of the individual components were conducted. The results revealed that the materials used as ingredients in Virtual do not show any toxicity. Thus it can be confirmed that both Virtual and Virtual CADbite neither pose a health risk to patients nor to the employees in dental clinics and laboratories.

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Edited: September 2007