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A COMPARATIVE STUDY ON SCANNABILITY, DIMENSIONAL STABILITY OF CAD BITE MATERIAL WITH TWO OTHER IPS CONTRAST SPRAYED ELASTOMERIC BITE REGISTRATION MATERIALS.

Dental Science

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ABSTRACT

This in vitro study was aimed to compare the scannability, dimensional stability of CAD bite material with two other IPS contrast sprayed elastomeric bite registration materials and to evaluate and obtain the most accurate and stable bite registration material among the three elastomers.

Methods: Samples were made in CA Dbite, polyether and polyvinysiloxane bite registration materials and scannability and dimensional stability were compared. These samples were scanned using 3 Shape dental scanner. The images were imported into the software using the Raster image tool.

Results: CAD bite had the highest value for scannability than polyether and vinyl polysiloxanes which was found to be highly significant. Among IPS contrast sprayed elastomeric bite registration materials polyether was better than VPS. The polyether showed least dimensional stability compared to polyvinylsiloxanes and CAD bite though the results were insignificant.

KEYWORDS

Introduction

Interocclusal records are an everyday necessity in routine prosthodontic practice.[5]Successful rehabilitation dentistry is a composite of many accurate steps coming together in synergy. An often-overlooked and yet critical piece to a successful rehabilitation is the interocclusal registration. When restoring any of the occluding surfaces with a procedure that requires the use of a laboratory, the transfer of the correct maxillomandibular relationship is critically important in order to reduce occlusal adjustments on the new restoration.The fabrication of an immaculate prosthesis requires that the articulator should simulate the patient's mandibular movements as closely as possible [3,4]These articulators require interocclusal records for mounting casts and programming articulators. Correct interocclusal records give the clinician the opportunity to make minimal adjustments to the restorations that were delivered from the laboratory and avoid unnecessary use of chair time or repetition of some clinical and technical stages.[1] Many factors influence the accuracy of an interocclusal record, e.g. the materials used, the position of condyles, intercuspal position(IP) or retruded contact position(RCP), and other clinical variations which are involved in the recording procedure. According to Millstein and Hsu[6] the interocclusal record should be an accurate and dimensionally stable representation of an interocclusal space that is subsequently transferred to an articulator. There is no material that has all the properties of the ideal inter occlusal recording medium like limited resistance to closure, dimensional stability, and resistance to compression after polymerization, ease of manipulation, absence of adverse effects to tissues, accuracy and ease of verification. A wide range of materials have been used for interocclusal recordings; This include plaster, modelling compound ,waxes, acrylic resins, zinc oxide eugenol pastes and elastomers [5] All these materials except elastomers are inelastic and show increased initial resistance, dimensional stability, difficulty in manipulation and difficulty in verification due to their brittle nature. Polyether and addition silicones have been used for many years as impression material and have gained popularity because of their excellent accuracy, dimensional stability, and quick recovery .These impression materials have been modified with the addition of plasticizers and fillers in order to be used as interocclusal recording media [10].According to Warren and Capp the basic principal approach should be to make the interocclusal record at the correct occlusal vertical dimension, choosing an accurate, dimensionally stable recording material, and selecting an appropriate method of mandibular guidance. They must also have solid like hardness to retain the shape and strength when dental casts are articulated.[3]

Apart from conventional methods, there are bite registrations which are employed in conjunction with the computer aided design/ computer aided manufacturing (CAD/CAM).Being able to directly capture images of this bite record with a scanning device or camera saves dentists considerable time and eliminates a possible source of errors. The conventional bite registration material, if scanned could not produce any utilizable optical records. Only after powdering them with IPS Contrast Spray, a satisfactory image could be captured. With the new CAD bite materials the same scanning result can be obtained in one step. This is a bite registration material with a vinyl polysiloxane base. The filler and the pigments it contains make the polymer more opaque. Based on this image data, the computer can calculate the occlusion of the restoration being fabricated. But regarding the scannability of bite registration material there have been no studies in literature and also the influence of opacifiers on physical property such as dimensional stability has not been fully investigated.

Hence the purpose of this study was to comparescannability, dimensional stability of CADbite material with two other IPS contrast sprayed elastomeric impression materials.

Materials and Methods

The materials used in the study were Virtual CADbite (IVOCLAR VIVADENT) -Reflective vinyl polysiloxane bite registration material,VinylPolysiloxane(RECORD/BOSWORTH)-Vinyl polysiloxane bite registration material,Polyether (RAMITEC 3M ESPE)-Polyether bite registration material and IPS Contrast Spray(IVOCLAR VIVADENT) (suspension of Tio_2, Sio2 and ethanol) Two parameters (scannability and dimensional stability) were checked using a scanner. The samples were grouped into Group I- Samples for scannability in CAD bite, polyether and vinylpolysiloxane elastomeric impression materials and GroupII- Samples for dimensional stability in CAD bite, polyether and vinyl polysiloxane elastomeric impression materials.

For preparing specimens forscannability test, an ideal dentulous maxillary and mandibular casts made in die stone, were used. The casts were arbitrarily articulated in a mean value articulator. Twelve bite registration samples with each material were recorded. This was done by injecting bite material on the occlusal surface of the molar region and approximating the casts till the incisal pin touches the incisal table. 36 samples were thus obtained. Vinylpolysiloxane and polyether samples need to be powdered with IPS Contrast Spray before the scanning procedure. With the CAD bite the same scanning result can be obtained in one step. The samples were scanned using 3 Shape dentalscanner. The images were imported into the software using the Raster image tool and checked for resolution of each image.

For preparation of specimens for dimensional stability, a cylindrical

mould, 30mm in diameter and 3mm in thickness were used. To prepare samples the materials (CAD bite and VPS) were injected in to the mould from auto mixing gun. The material expelled from the gun was uniformly spread over the surface of the mould. For polyether bite required amount of equal length of pastes were dispensed on the mixing pad provided by the manufacturer. These two pastes were mixed together with stainless steel mixing spatula to get a homogenous streak free mix and then loaded into the mould.In order to standardize the measurement, a metallic block

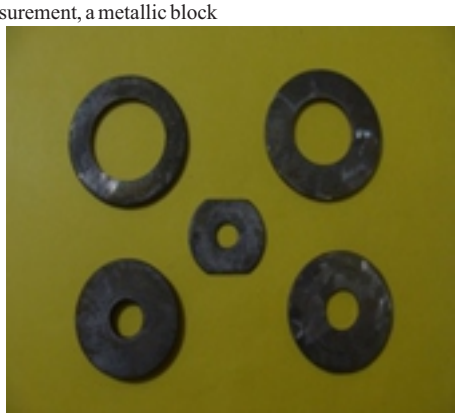

Fig 1: Metal moulds used for obtaining samples for dimensional stability

with two vertical lines (C, D) 25mm apart was embedded in to the material. Samples were carefully removed from mould once it was set, to avoid distortions and were digitalized using scanner. The images thus obtained were imported into the software using the Raster image tool. The vertical lines of the block were used as a 25mm dimensional reference (C-D). Vertical lines inscribed on the samples (C'-D') were compared against this reference. Each sample was measured thrice to compensate for any errors.1The following formula was applied to determine dimensional changes.

$$\text{Dimensional change \%} = \frac{(B-A)}{A} \times 100$$

A= Original distance of the block between edges,
C and D = 25mm,

B = distance between edges C' and D' in the samples

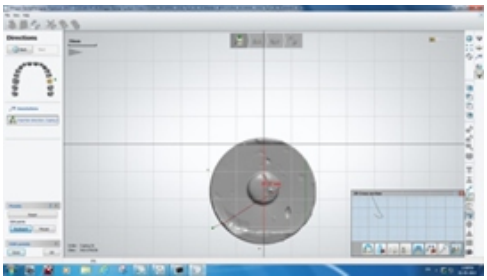

Fig.2: Measurement using AutoCAD software.

Measurement of the distance between edges C' and D'

Results

Statistical analysis was carried out using contingency coefficient test for scannability and ANOVA for dimensional stability.
CAD bite had the highest value for scannability than polyether and vinyl polysiloxanes which was found to be highly significant. Among IPS contrast sprayed elastomeric bite registration materials polyether was better than VPS.The polyether showed least dimensional stability compared to polyvinylsiloxanes and CAD bite though the results were insignificant.

The table1 shows the values of scannability for CADbite, pvs and polyether amongst which CAD bite proved to be the best material which was found to be statistically significant (p = 0.000)

Scanability * MATERIAL Crosstabulation				
			MATERIAL	Total

			VPS	POLY ETHER	CADBITE	
Scanability	630x 660	Count	1	0	0	1
		% of MATERIAL	8.3%	.0%	.0%	2.8%
	630x 661	Count	6	0	0	6
		% of MATERIAL	50.0%	.0%	.0%	16.7%
	631x 660	Count	2	0	0	2
		% of MATERIAL	16.7%	.0%	.0%	5.6%
	631x 662	Count	3	0	0	3
		% of MATERIAL	25.0%	.0%	.0%	8.3%
	757x 671	Count	0	1	0	1
		% of MATERIAL	.0%	w8.3%	.0%	2.8%
	757x 672	Count	0	7	0	7
		% of MATERIAL	.0%	58.3%	.0%	19.4%
	757x 673	Count	0	4	0	4
		% of MATERIAL	.0%	33.3%	.0%	11.1%
	935x 677	Count	0	0	2	2
		% of MATERIAL	.0%	.0%	16.7%	5.6%
	936x 677	Count	0	0	2	2
		% of MATERIAL	.0%	.0%	16.7%	5.6%
	937x 677	Count	0	0	3	3
		% of MATERIAL	.0%	.0%	25.0%	8.3%
	937x 678	Count	0	0	5	5
		% of MATERIAL	.0%	.0%	41.7%	13.9%
Total	Count	12	12	12	36	
	%Of Material	100.0%	100.0%	100.0%	100.0%	

Symmetric Measures			
		Value	Approximate Significance
Nominal by Nominal	Contingency Coefficient	.816	.000
N of Valid Cases	36		

The graph 1 showing the values for dimensional stability for CAD bite, polyether and pvs

The above table and graph shows the mean dimensional stability of VPS, Polyether and CADbite bite registration materials, which shows Polyether has the highest value of 0.3833 followed by VPS (0.1300) and CADbite (0.1267). oneway ANOVA was used for statistical analysis and was found to be non significant.

Discussion

The basic objectives for occlusal rehabilitation are optimal health, functional efficiency,oral comfort and esthetics. An accurate transfer of the maxillo-mandibular relationship to the articulator is essential for the fabrication of a prosthetic restoration. Bite registration help achieve successful restoration with harmonized occlusion and articulation.[4] Restorations made on incorrectly mounted casts might require considerable intraoral adjustments to correct the occlusion or even necessitate remaking of the restoration[19]. The most common errors found due to improper bite registration are improper vertical dimension, lacking stability in centric occlusion, and occlusal interferences in eccentric movement.

The different interocclusal recording materials have put clinicians in dilemma that which material should be used in routine clinical practice.Tejo et al compared the dimensional stability Dixon et al[4] compared and measured the accuracy of thermoplastic resins, acrylic resins and addition silicone interocclusal recording material. The addition silicon group generated significantly less mounting errors than those generated by the acrylic resins and thermoplastic resins. Saha et al[5] evaluated the accuracies of zinc oxide eugenol impression paste, wax, impression plaster and vinyl polysiloxane impression material and found VPS was found to be the most accurate.

The introduction of CAD bite registration material employed in conjunction with CAD/CAM aids to directly capture images of this bite record with scanning device or camera saves dentist time and eliminates errors. Based on this image data, the computer can calculate the occlusion of the restoration being fabricated.In this in vitro study scannable interocclusal elastomeric bite registration materials were used. The physical properties (scannability dimensional stability and

shore hardness) of CAD bite registration material with two other scannable elastomeric interocclusal recording materials were compared.

The scannability of CAD bite were compared to opacifier sprayed(IPS contrast) two other elastomeric interocclusal bite materials. The images of the material with highest resolution values had better scannable property.CAD bite had the highest value followed by polyether and vinyl polysiloxanes which was found to be highly significant. The highest scannability for CAD bite is because of the pigments used, the laser beam is not scattered, which results in an image with sharp and crisp detail.[23]Thescannability of polyether was higher to VPS. Further studies to evaluate this property would provide invaluable insight in the development of superior interocclusal recording material.

An ideal material for interocclusal record allows the intraoral placement of restorations without extensive adjustments. In order to achieve this goal the use of interocclusal recording materials which are dimensionally stable is of paramount importance.Several methods to evaluate dimensional stabilityhave been described in the literature. Traditional measurement methods such as compasses, calipers, and linear microscopes are common, but recently computational methods can offer high precision. The AutoCAD software was developed to create graphics in engineering and physics and is currently applied in medicine and dentistry both in clinical and laboratory procedures. This software can provide quick and accurate measurements of digitally scanned samples.[1]

The dimensional stability of CAD bite interocclusal material and two other scannable elastomeric bite registration materials was the second parameter compared in this study.The polyether showed least dimensional stability compared to polyvinylsiloxanes and CAD bite though the results were insignificant. According to dua etal. polyvinylsiloxanes were better than polyether. The excellent dimensional stability was attributed to the fact that it set by addition reaction. Hence there is no by products and loss of volatiles[3]The dimensional stability was significantly lower for polyether than that of the polyvinyl siloxane material according to Chai etal[22]. A study by dua et al. also showed lesser dimensional stability for polyether compared to vinyl polysiloxane impression material[4].A study by Tejo et al[23]evaluated dimensional stability of three types of interocclusal recording materials polyether was found to be more dimensionally stable interocclusal recording material

Conclusion

Within the limitations of this in vitro study the following conclusions were drawn.

1. CAD bite had the highest value for scannability than polyether and vinyl polysiloxanes which was found to be highly significant. Among IPS contrast sprayed elastomeric bite registration materials polyether was better thanVPS.
2. The polyether showed least dimensional stability compared to polyvinylsiloxanes and CAD bite though the results were insignificant.

Summary

Regardless of what type of prosthetic treatment is being performed, it is essential to provide the laboratory with an accurate occlusal registration to fabricate restorations that require minimal adjustment. This study was designed with the aim to obtain the most stable and accurate bite registration material.

In this study CAD bite material was compared with two other elastomeric bite registration materials such as vinyl polysiloxane and polyether for scannability, dimensional stability and shore hardness.To determine the scannability the samples were scanned using 3 Shape dental scanner. VPS and polyether were made scannable by powdering or coating it with IPS contrast spray.The dimensional stability of each material was calculated according to its amount of linear dimensional change.

The CAD bite material showed highest scannability and excellent dimensional stability. Among IPS contrast sprayed elastomeric bite materials polyether showed better scannability compared to VPS. All the three materials exhibited relatively high surface hardness.

Conventional system currently offers the flexibility, with regard to restoration types and material choices. However, new and emerging CAD/CAM technologies will continue to push the boundaries we face today.Therefore an emphasis on CADbite registration material is likely to hold good in the future. It is likely that future CADbite registration materials will be more robust, facilitating accurate data capture, which will result in high precision production restoration.

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