

# Centric relation registration with intraoral central bearing on curved vs. flat plates with rim trays in edentulous patients

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## ABSTRACT

The aim of this study was to compare jaw relation record in the completely edentulous patient using acrylic rim trays with curved or flat registration plates or using the manual guidance technique. The study included 17 patients – 11 female and 6 male, average age 70 years. Three jaw relation records were taken during one session, in the same vertical dimension, using acrylic rim trays: (1) with manual guidance (IM), (2) with self-guided recording system with acrylic rim tray and central support using a curved plate (BYC) and (3) with self-guided recording system with acrylic rim tray and central support using a flat plate (BYR). The models were mounted on a Whip Mix 2240 articulator to which a condyle position device (Orthodent) was added to register, at the level of the condyle box and incisal table, the differences among the positions recorded with the different setups (IM, BYC and BYR). The distances were measured on millimeter paper provided by the recording system manufacturer. For statistical analysis, confidence intervals

(95%) were calculated for the mean differences and Student's t-test for paired data (significance level: alpha<0.05). On both the mesiodistal plane and the vertical plane at the level of each condyle box and the incisal table, there were statistically significant differences among the three systems ( $p<0.001$ ). At the level of incisal table, BYC and BYR provided more retrusive records than IM [arithmetic means (standard deviations) in millimeters: 3.82 (2.10) and 4.53 (2.18), respectively]. The records obtained with BYR were significantly more retrusive with BYC [arithmetic mean (standard deviation) in millimeters: 1.41 (1.00)]. We reject the null hypothesis that proposes that all three registration systems described are clinically equivalent for establishing a jaw relation record in completely edentulous patients.

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**Keywords:** centric relation - complete denture - jaw relation record - edentulous mouth.

## Registro de relación céntrica con apoyo central intraoral en platinas curvas vs. rectas con cubetas rodete en edéntulos

## RESUMEN

El objetivo de este estudio fue comparar el registro de la posición intermaxilar en el paciente desdentado total obtenido con el uso de cubetas rodete de acrílico y platinas de registro curva o recta y con la técnica de inducción manual. Se incluyeron en el estudio 17 pacientes, 11 mujeres y 6 varones con edad promedio de 70 años. En cada uno de ellos se obtuvieron en la misma sesión y en la misma dimensión vertical tres registros intermaxilares con cubetas rodete de acrílico: uno con inducción manual (IM), otro autoinducido con el sistema de cubeta rodete de acrílico y apoyo central único utilizando una superficie palatina de registro curva (BYC) y un tercero con este mismo sistema pero con la superficie palatina recta (BYR). Los modelos correspondientes fueron montados en un articulador Whip Mix modelo 2240 al que se le adicionó un dispositivo de posición condilar (Orthodent) para registrar, a nivel de la caja condilea y la platina incisiva, las diferencias existentes entre las posiciones obtenidas con cada una de las variantes de las platinas en las cubetas rodete acrílicas y la posición registrada con inducción manual. Las distancias fueron medidas sobre papel milimetrado provisto por el fabricante del sistema

de registro. El análisis estadístico se llevó a cabo mediante el cálculo de intervalos de confianza (95%) para las diferencias medias y prueba de t de student para datos apareados (nivel de significancia: alfa<0,05). Tanto en el plano mesiodistal como en el vertical a nivel de cada caja condilea como en la platina incisiva, se encontró diferencia estadísticamente significativa entre las tres variables de registro ( $p<0,001$ ). A nivel de las platinas incisivas tanto BYC como BYR proporcionaron registros más retrusivos que IM [medias aritméticas (desviaciones estándar) en milímetros: 3,82 (2,1) y 4,53 (2,18), respectivamente]. Los obtenidos con BYR fueron significativamente más retrusivos que en el grupo BYC [media aritmética (desviación estándar) en milímetros: 1,41 (1,00)]. Rechazamos la hipótesis nula que propone que los tres sistemas de registro expuestos son clínicamente equivalentes para establecer una posición de registro intermaxilar en desdentados totales.

**Palabras clave:** relación céntrica - dentadura completa - registro de la relación maxilomandibular - boca edéntula.

## INTRODUCTION

Rehabilitation of completely edentulous patients involves techniques and skills requiring a combination of theoretical and practical knowledge to provide the best possible treatment.

For various reasons, which go beyond specific knowledge of dentistry, edentulism and the need for complete removable dentures are in constant demand for dental care. Demand for this type of treatment is expected to increase due to socioeconomic and demographic circumstances<sup>1</sup>, and there is currently a need to provide this kind of treatment to a growing universe of people.

Occlusion has always been one of the key aspects in these treatments<sup>2-7</sup>. In the 21<sup>st</sup> century, the International Academy of Prosthodontics<sup>8</sup> glossary of prosthodontic terms (GPT-8) recognizes seven meanings for the term Centric Relation, thereby indicating the range of concepts applied to occlusion, jaw relations and their records.

However, beyond the conceptual field, centric relation is used with the ultimate purpose providing treatment that will endow patients with the occlusal ability to perform all functions while maintaining the health of all components<sup>9</sup>.

In the clinical/practical field of centric relation, the search for simple, accurate, evidence-based techniques is challenging<sup>10,11</sup>. There is a need for studies on patients to provide clarity on the clinical efficacy of the many proposed variants, to support decision-making during prosthodontic treatments or when teaching prosthodontics<sup>12-18</sup>.

Within such a broad topic, the subject of jaw records is central<sup>19-21</sup>. In the search for more precise work protocols, since 2003, the Department of Prosthesis Clinic I at the Buenos Aires University School of Dentistry has proposed and begun to execute a work protocol which includes the use of acrylic rim trays for making definitive impressions and registrations in completely edentulous patients. This technique has been called BOPAYACU, for its initials in Spanish for Palatal Vault and Single Central Bearing Point.

BOPAYACU uses a standardized upper curved plane, onto which the patient performs anteroposterior and lateral mandibular movements as instructed by the clinician, while pressing against it the tracing screw attached to the lower rim tray. This upper curve prevents the mandibular propulsion typical of the fully edentulous patient, and this intraoral

upper vault acts as an anterior inclined plane or deprogrammer, enabling the condyles to center and return to their place<sup>9</sup>.

In contrast, the method which is most widely known and was formerly used by our department for teaching and for the treatment of completely edentulous patients, was the one proposed by G. Phillips<sup>9,19,21,22</sup>. It involves use of a flat plate connected to one jaw and a central screw attached to the opposite jaw, placed at the height of premolars on the registration rims prepared for such purpose. Both these techniques are self-guided, without direct operator intervention in the movements, and both use a central bearing which, by directing the interocclusal contact force in the center of both rims, press them against the supporting tissues, thereby contributing to stability.

They differ substantially in the curvature of the surface against which tracing is performed, which also gives direction to the anteroposterior movement performed by the patient while maintaining contact between the two devices.

This difference may or may not have implications in the final position of the intermaxillary record or in the position of the condyles when said registrations have been completed.

The aim of this study was to compare jaw relation records in the completely edentulous patient obtained: 1. with manual guidance technique, 2. with self-guided recording with acrylic rim tray and central support using a curved plate, and 3. the same, using a flat plate (BYR).

## MATERIALS AND METHODS

This study was conducted at the Department of Prosthesis Clinic I at the Buenos Aires University School of Dentistry. A detailed work protocol and checklists were prepared to ensure consistency in the clinical steps of the care provided to each patient included in the study. A dental laboratory was trained in the performance of the relevant laboratory steps: making the rim trays, making the plaster casts and trimming for mounting. An informed consent form was submitted to and approved by the Ethics Committee of Buenos Aires University School of Dentistry (# 0037828/2010).

The study included a group of completely edentulous patients who had undergone all the relevant steps up to the clinical instance of taking jaw relation records using acrylic rim trays. Patient inclusion criteria were:

- Having been completely edentulous for at least five years
- Wearing complete dentures installed in the past
- No motor or sensory disability which would prevent them from performing the mandibular movements required for intermaxillary record
- No lesions of the intraoral mucosa at the time the records were taken
- No joint pains or limitation in mouth opening
- Ability to accept and sign the informed consent.

Patient exclusion criteria were:

- Unclear or discordant tracing patterns at the time of registration,
- Not signing consent.

The study included 17 patients: 11 female and 6 male, aged 56 to 78 years, all completely edentulous, who met the inclusion criteria.

For each patient, during one session, in the same position and same vertical dimension, three jaw relation records were obtained with acrylic rim trays: one with manual guidance (MI), one self-guided with the BOPAYACU system using a curved plate (BYC), and one self-guided with the BOPAYACU system using a flat plate (BYR). Then the casts were mounted on an articulator (Whip Mix model 2240).

### **Impressions and records with rim trays**

After the clinical examination, primary impressions were made with rigid Schreinemaker trays for completely edentulous subjects, following the technique used regularly at the service.

Rim trays were designed following the guidelines by Alvarez Cantoni-Fassina<sup>9</sup> and made at a dental laboratory (Figs. 1,2). After clinically verifying the support and the size of bases and flanks, definitive impressions were taken, ensuring proper functional final size, seal and retention.

Rim trays made in this manner provide a unit for impressions and registrations: a rim tray is a single instrument made of a single material, which includes the distinctive parts of custom tray, shaped occlusal rims and both parts of the registration system by single central bearing. In this study, a modification was applied by changing the curved acrylic vault of the upper rim tray for a flat one, with the same inclination as the occlusion plane, without thereby modifying the vertical dimension established in the rims.

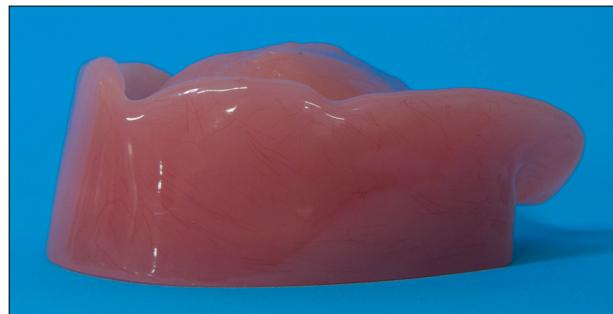


Figure 1: Acrylic upper rim tray



Figure 2: Acrylic lower rim tray

### **Taking intermaxillary records**

Having completed the steps described above in each patient, during the same session, in the same position and same vertical dimension, three jaw relation records were obtained with acrylic rim trays: one with manual guidance (MI), one self-guided with the BOPAYACU system using a curved plate (BYC), and one self-guided with the BOPAYACU system using a flat plate (BYR).

Based on these records, the casts were mounted on an articulator (Whip Mix model 2240), to which was added a condylar positioning device (Orthodont) to record variations at the level of the condyle box and incisal table. Distances were measured on millimeter paper provided by the manufacturer of the registration system.

Each patient's head position was standardized for taking the three records, so that any differences between records could not be attributed to differences in head position.

The patient was seated in a dental chair (Dabi Atlante, Brazil) with the backrest tilted at 45 degrees and patient head in a comfortable position, beyond cervical variations in each patient, ensuring that the clinical projection of the Frankfort plane was perpendicular to the backrest. Once a comfortable position was found for each patient, it was maintained throughout the record-taking session.

To ensure maintenance of the vertical dimension while centric relation was being recorded, care was

taken at intraoral level to ensure that the thickness of the registration material placed between the rims in manually guided closing did not exceed 2 mm.

Extra-orally, prior to taking the record and with the rims in the mouth and a 2 mm thick spacer placed in the anterior sector, two marks were made on the skin: one at the level of the wing of the nose and another 1 cm below the lip commissure. The distance between marks was measured with a millimeter ruler. After the registration silicone had hardened in each of the three techniques, it was checked that the distance had not varied by more than 1 mm.

First, the manual guidance technique was used. The patient was instructed to practice in order to find the repetitiveness in the arc of closure and, by applying slight pressure on the chin, the patient was guided to a more posterior position of the upper jaw, without causing pain and always seeking repetition of the arc of closure.

Occlusal registration silicone (Futar 2) was applied using an application gun and mix tips. After the record had hardened, it was removed and identified as number 1 for that patient. Then the patient was instructed to put on his/her usual denture and rest in the waiting room for at least 20 minutes.

Second, using the same rim trays, the lower tracing point of the BOPAYACU system, which consists of a screw with a rounded tip, was positioned. The single central support was positioned against the palatal vault preformed using the shaper designed for such purpose, with a minimum separation between rims to ensure that there was no interference by contact between them. The patient was instructed and trained to make the arrow point tracing. Once the graphic record was achieved, the patient was trained to move to the posterior position without manual guidance by the operator, to ensure it was self-guided, and this new position was recorded with the same registration silicone and identified as number 2. Then the patient was instructed to put on his/her usual denture and rest in the waiting room for at least 20 minutes.

Finally, the upper vault of the recording device was modified by adding self-curing acrylic to it and using a glass tile to shape a flat surface. Solid petroleum jelly was applied to the tile surface to facilitate separation of the acrylic once it polymerized. Then the lower screw was lowered to maintain the separation between rims, in order not to clinically modify the vertical dimension. The patient was again

trained to perform the movements that generate the self-guided arrow point tracing, to record the starting point of these movements, thereby obtaining on the registration silicone the third measurement for evaluation and comparison (Fig. 3).

### **Transfer of the recorded positions to an ARCON type articulator**

Once the silicone bite forks had been obtained for each clinical option, identified as I (manual guidance), II (record with BOPAYACU) and III (record with modified BOPAYACU), the definitive casts were made and mounted on a Whipp Mix 2240 articulator using the fork from record I.

For each clinical case and record, we used a single, new set of plates, which was kept until the end of the study. Thus, each of the recording techniques for all 17 clinical cases were mounted on the same articulator, by the same operator.

### **Graphic registration in the articulator**

An Orthodont brand condylar positioning device (CPI, according to the manufacturer) was added at the level of the condyle box on the Whipp Mix 2240 articulator. Once each clinical case was mounted on the articulator, it was labelled and placed in each condylar box of the corresponding CPI device. A set of millimeter graph paper stickers was added to each in order to record the marks at the level of each and of the incisal table (Figs. 4, 5, 6).

After obtaining the records by interposition of Bausch Arti-Fol metallic 12 µm articulating paper, each sticker was removed and placed on a registration card prepared for each case.

The measurements taken at the level of the condylar guidance boxes were recorded according to the plane of movement, mesiodistal and vertical,



Figure 3: Silicone jaw relations



Figure 4: Rim trays attached to casts and mounted on the articulator

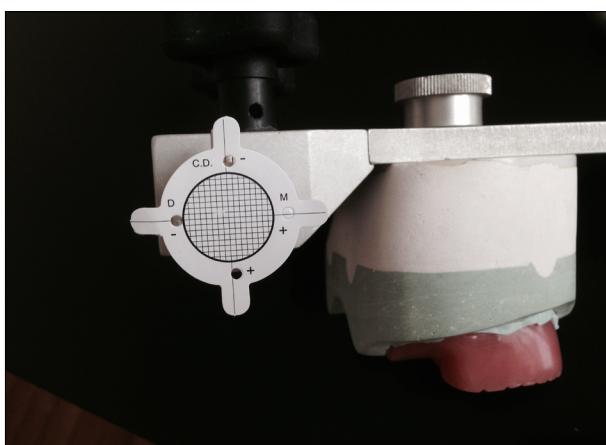


Figure 5: Device for measuring variations at condyle level, placed on the articulator

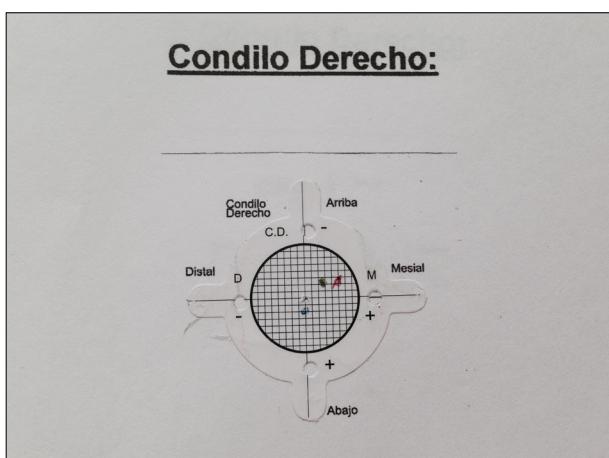


Figure 6: Record of variations in position on millimeter paper (Cóndilo derecho: Right condyle; Mesial: Mesial; Distal: Distal; Abajo: Under; Arriba: Above).

and the side. The records obtained at the level of the incisal table were recorded as anteroposterior and indicated following the same classification

criterion according to distance between marks and individualized according to color.

When all records were obtained, the differences in millimeters were measured using a 5x magnifying glass and observing the distance between each colored point recorded on the millimeter graph paper.

The recorded values were uploaded to an Excel spreadsheet, which served as a data matrix for subsequent sample analysis and statistical treatment, and for hypothesis testing.

Records were abbreviated according to the initial of the color of the point generated on the graph: B = Blue (1<sup>st</sup> record), manual guidance technique (MI); G = Green (2<sup>nd</sup> record), self-guided technique with curved or standard BOPAYACU (BYC); and R = Red (3<sup>rd</sup> record), self-guided technique with flat or modified BOPAYACU (BYR).

Values were recorded using the nomenclature provided in Table 1.

The data were grouped firstly according to condyle analyzed. Then, within each unit of analysis, the differences found between the mesiodistal and vertical planes were divided. At the level of the incisal table, the distances were measured in anteroposterior direction.

#### Data recording and statistical processing

For each patient and each condyle, we calculated the difference between the positions recorded with each BOPAYACU version, and between these and the position recorded with manual guidance.

For statistical analysis, confidence intervals (95%) were calculated for the mean differences between the values recorded with each BOPAYACU system and the manual technique. Student's t-test for paired data was used to compare the values of the two systems, as well as values per condyle in each patient. Pearson's correlation coefficient was calculated for the values for the two condyles in each patient. Significance level was set for alpha less than 0.05 for all cases.

#### RESULTS

Self-guided records with curved and flat plate BOPAYACU systems both differed significantly ( $p<0.05$ ) from the record obtained by manual guidance, in agreement with studies published on the subject to date. These differences were found at the level of condyle boxes on both mesiodistal and

**Table 1. Identification code for the variables included in the study.**

Plane	Condyle	Distance	Code
Mesiodistal plane	Right condyle	dist BI-Gr	MDDV
		dist BI-Red	MDDR
		dist Gr-Red	Dif_1
	Left condyle	dist BI-Gr	IDDV
		dist BI-Red	IDDR
		dist Gr-Red	Dif_2
Vertical plane	Right condyle	dist BI-Gr	VDV
		dist BI-Red	VDR
		dist Gr-Red	Dif_3
	Left condyle	dist BI-Gr	VIV
		dist BI-Red	VIR
		dist Gr-Red	Dif_4
Anteroposterior plane	Platina incisiva	dist BI-Gr	APIV
		dist BI-Red	APIVR
		dist Gr-Red	Dif_5
Surface	Right condyle	Reg BI-Gr	SUPDV
		Reg BI-Red	SUPDR
		Dif Gr-Red	Dif_6
	Left condyle	Reg BI-Gr	SUPIV
		Reg BI-Red	SUPIR
		Dif Gr-Red	Dif_7

vertical planes, and at the level of the incisal table (Table 2).

In the right condyle boxes, recorded via the condyle positioning devices, on the mesiodistal plane there was a mean difference among the three records of 1.24 mm to 1.82 mm, with mean standard deviation 1.2 mm. For the left side, the differences were 1.06 mm to 1.82 mm with mean standard deviation 1.1 mm.

On the vertical plane, mean difference was 0.71 mm to 2.18 mm, with mean standard deviation (SD) 1 mm.

In both condyle positioning devices and on both planes, maximum differences in the order of 5 mm and 6 mm were measured, and cases were found in which the differences were 0.0 mm to 0.5 mm.

On the incisal table, mean difference between the manual guidance record and the two BOPAYACU records was 3.82 mm (SD 2.10 mm) for curved plate and 4.53 mm (SD 2.18 mm) for flat plate. The mean difference between the two types of BOPAYACU was 1.41 mm (SD 1.00 mm).

The measurements at condyle level expressed in surfaces showed mean differences of 1.10 mm to

1.69 mm on the right side and 1.46 mm to 2.83 mm on the left side.

On both the mesiodistal plane and the vertical plane at the level of each condyle box and on the incisal table, there were statistically significant differences among the three variables recorded ( $p < 0.001$ ). At the level of the incisal tables, both BYC and BYR provided more retrusive records than did MI [arithmetic mean (standard deviation) in millimeters: 3.82 (2.10) and 4.53 (2.18), respectively]. BYR records were significantly more retrusive than BYC [arithmetic mean (standard deviation) in millimeters: 1.41 (1.00)].

## DISCUSSION

This study analyzed the data collected regarding the changes in position of jaw relation records associated to the use of flat and curved plates in the BOPAYACU device for jaw relation records in completely edentulous patients and comparing them to the manual guidance technique. The average values for anteroposterior variation of the jaw relation record at the level of the incisal table on the articulator suggest that the three systems tested are not equivalent. Mean distance was 3.82 mm (SD 2.1 mm) between manual guidance and BYC; 4.53 mm (SD 2.18 mm) between manual guidance and BYR; and 1.41 mm (SD 1.00 mm) between BYC and BYR.

Based on these observations, we reject the null hypothesis, which posits that registration using rim trays with manual guidance and registration using single central bearing and curved registration plate (BOPAYACU) are equivalent at the level of the incisal table; that registration using rim trays with manual guidance and registration using rim trays with modified BOPAYACU are equivalent at the level of the incisal table, and that registration using rim trays with BOPAYACU and registration using rim trays with modified BOPAYACU are equivalent at the level of the incisal table.

Upon determining the variation on the anteroposterior plane and the vertical plane of the jaw relation record at the level of the condyle box in the articulator, for completely edentulous patients, we found that the values were not equivalent in the three registration systems.

These findings are consistent with those obtained by comparing the condyle sliding surfaces calculated in the tables of the condyle positioning device.

**Table 2. Statistical data, confidence interval (in millimeters) for study variables, and significance (alpha) for the differences between the two ways of using BOPAYACU.**

Variable	Arithmetic mean	Standard deviation	Median	Maximum	Minimum	CI (95%)		P (alpha)
MDDV	1.53	1.27	2	4	0	0.88	2.18	
MDDR	1.82	1.22	1.5	5	0	1.19	2.45	
Dif_1	1.24	1.16	1	4	0	0.64	1.83	<0.001
IDDV	1.82	0.93	2	4	0.5	1.34	2.30	
IDDR	1.82	1.31	1	5	0.5	1.15	2.50	
Dif_2	1.06	1.09	1	4	0	0.50	1.62	0.001
VDV	2.18	1.24	2	4	0	1.54	2.81	
VDR	1.88	1.28	1.5	4	0	1.22	2.54	
Dif_3	0.71	0.75	0.5	2	0	0.32	1.09	0.001
VIV	2.12	1.52	2	5	0	1.34	2.90	
VIR	2.00	1.37	2	6	0	1.30	2.70	
Dif_4	0.82	0.90	0.5	3	0	0.36	1.29	0.002
APIV	3.82	2.10	3	8	1	2.74	4.90	
APIVR	4.53	2.18	4	8	1	3.41	5.65	
Dif_5	1.41	1.00	1	4	0	0.90	1.93	<0.001
SUPDV	1.69	1.89	1	6	0	0.72	2.67	
SUPDR	1.68	2.31	1	10	0	0.49	2.87	
Dif_abs6	1.10	1.10	1	4	0	0.54	1.67	0.001
SUPIV	1.83	1.64	2	6	0	0.99	2.67	
SUPIR	2.82	1.61	2.5	7	0.75	2.00	3.65	
Dif_abs7	1.46	1.26	1	4.5	0	0.82	2.11	<0.001

Considering these results, the clinician should consider in greater depth the importance of knowing about the intrinsic variations of the devices used for jaw relation records. Because they are not equivalent, the concept of self-guidance becomes an epistemological obstacle to understanding the clinical positions recorded. It is no longer the patient that induces a desired or ideal intermaxillary position, free from intervention by the operator, but the device is an inherent part of the outcome. The fact that the device may have either a curved tracing surface or a flat, slanting surface affixed to the slope of the occlusion plane, has been found to influence the record position measured at the level of the articulator's incisal tables or condyle boxes.

## CONCLUSION

Within the limitations of this study, we reject the null hypothesis, which posits that registration using rim trays with manual guidance and registration using rim trays with BOPAYACU are equivalent at the level of the articulator's condyle box; that registration using rim trays with manual guidance and registration using rim trays with modified BOPAYACU are equivalent at the level of the articulator's condyle box, and that registration using rim trays with BOPAYACU and registration using rim trays with modified BOPAYACU are equivalent at the level of the articulator's condyle box.

**DECLARATION OF CONFLICTING INTERESTS**

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**CORRESPONDENCE**

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