(RESEARCH ARTICLE)

Difference in Incisal sum analysis in STL models and DICOM files of University of Cuenca students

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Abstract

A cross-sectional study was carried out among the students of the 7th cycle of the State University of Cuenca where the incisal sum of each student was analyzed by using STL models with the Nemocast program and by using tomographies with the Sidexis 4 program. It was possible to use a wide universe previously obtained from a database of 40 students, provided by the University of Cuenca, of which 19 were randomly chosen to be able to analyze the data without the aim of distorting and manipulating the data released.

Through a meticulous evaluation of the analyzed data of the incisal sum of the 19 people, we proceeded to order the values and standardize them, however, for a greater impact and veracity in the study, we proceeded to analyze the data and propose an alternative hypothesis: which would be corroborated through the "T Student" method. Finally, it was possible to find the values of the mean and variance of each data grouping (format and incisal sum).

Theoretical framework: To carry out this study, it is important to know that different orthodontic measurement parameters and different software used were used. These elements will be disclosed below.

Mayoral analysis: This method can be used in permanent occlusion and allows estimation of the relative distances between the grooves that separate the buccal cusps from the lingual cusps of maxillary first and second premolars, and between the midline grooves where the mandibular cusps meet, the first molars of the maxilla. converge and normal patients should have dimensions of 35, 41, and 47 mm, respectively. When the value obtained is lower than the norm, a diagnosis of transverse micrognathism is obtained, and when a higher value is obtained, a diagnosis of transverse micrognathism is. [1]

The disadvantage of this method is that the cross-sectional assessment is only performed in the maxilla and not in the mandible. [1]

Nemoceph: NemoCast is an orthodontic software that allows you to perform digital cast analysis, digital diagnosis and planning, and export and print products.

Keywords: STL; T Student; Nemocast; Mayoral Analysis

1. Introduction

The dental size is expressed as the mesiodistal dimension of each piece, which is determined from childhood, this may be influenced by various factors such as race, ethnicity, and heredity. This measurement will not change after eruption

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unless affected by other factors such as interproximal caries, hence dimension is a stable factor in the tooth size/arch size relationship. The Incisive Index proposed by Mayoral determines whether the patient presents microdontia or macrodontia. To obtain this index, the mesiodistal diameter of the four upper incisors is considered, considering as normal the result of the sum of the maxillary incisors that were between 28 to 32mm. [3]

The concept of an ideal occlusion assumes a strict relationship between the maxillary dental size with its mandibular antagonists. Orthodontic treatment with optimal occlusal results, with an adequate overjet and overbite, is compromised by their dental size or anatomy. Macrodontia and microdontia are tooth size anomalies, which can affect a dental structure or its entirety. Referring macrodontia to the size of the tooth or teeth larger than normal. And microdontia refers to the size of teeth smaller than the normal limits of their variation. Localized macrodontia is observed more frequently in the upper central incisors, while microdontia is more frequently in the upper lateral incisor, generally bilateral. [3]

In the same way, the relationship of this type of anomaly with malocclusions is of Orthodontic interest, few investigations have been reported in this regard and of those that are found, there is a relationship with the 7 dental malocclusions. The present study has the purpose of determining if the measure proposed by Mayoral is applicable in the study population of the University of Cuenca, evaluating at the same time the behavior of this anomaly according to sex. [3]

1.1. Incisal addition in digital models

In this study, the measurement of the mayoral index was carried out to determine the calibration between the DICOM software and an STL file for the calibration of the mayoral index, in the students of the Faculty of Dentistry of the University of Cuenca who are in the 7th cycle of the career

1.2. The incisal addition to digital models can help create more accurate forecasts

Therefore, when comparing with this study, taking the Mayoral results as a reference, the Mayoral values for women can be used, and values greater than 30 mm and less than 34 mm can be considered normal. In the male sex, there is a statistical difference in the Mayoral value, with an average of 33 mm for the sum of the incisors, values greater than 31 and less than 35 can be considered normal. If the values proposed by the mayoral were used, this would lead us to diagnose macrodontia for most of the values in the general population.

The variation in size depending on the race found can be a determining factor in the orientation and planning of the treatment.

African American population in North America, 32.76 mm for men and 31.6 mm for women. 16 In the Indian population 31.54 mm in males and 31.02 mm in females 17 and the Mexican population 30.4 mm in males and 29.98 mm in females 18, so it is a reference to take into account for each population when making decisions and/or gnostic criteria. This justifies validating this approach in a study population and determining its applicability.

See Table 1 for descriptive statistics. In the general population, the mean was 32.5 mm with a standard deviation of 2 mm. Statistically significant differences (p.000) were found when comparing the general population with the values presented by the Mayoral. (3)

1.3. Incisal addition to digital models can improve accuracy and consistency

This article: Sensitivity and Specificity of Radiographic, Topographic, and Digital Model Analysis for Lateral Differences compares different methods for performing lateral differential analysis using AP radiography, tomography, and digital models as diagnostic tools. The study showed that 100 patients were measured differently using the following three methods

The materials used were: orthodontic pretreatment research models, Mitutoyo brand digital calipers, and a computer. The data was tabulated and the descriptive statistics were calculated in the Microsoft Office Excel 2007 program.

It is important to emphasize the clinical value of object size appreciation, as the reported margin of error for untrained people can exceed 2 mm compared to 1 mm and 0.5 mm for general dentists 25,26 Therefore, states Mayoral The proposed numerical parameters for the diagnostic criteria of tooth size abnormalities may be useful for orthodontists so that mesial-distal diameters without incisors or asymmetry can be considered in treatment planning as long as the patient not present. (3)

1.4. Length of the incisor arch of mayoral

The incisal arch length is taken by measuring the mesiodistal width of each maxillary incisor. Considering a normal size of the total sum to a value between 28 to 32mm. If that value were less than 28mm, we would be facing a microdontia. If, on the contrary, the value obtained were greater than 32mm, there would be a macrodontia.

2. Material and methods

To carry out this study, students from the dental school of the University of Cuenca were selected, who are in the seventh cycle and are studying the subject of orthodontics.

The students were referred to the different departments of the faculty to obtain the data, to the radiology department, to obtain the tomographies and panoramic radiographs respectively, and to the orthodontics postgraduate course to obtain the STL files of the scans of the dental arches of each student respectively.

The inclusion criteria in the study were

- Data from patients of legal age
- That all DICOM files were made with the same tomographic equipment

The exclusion criteria were:

- Data from a pregnant patient
- Data from patients with systemic diseases

2.1. Sample

During the 2022-2023 academic year, 40 patients were reviewed, of which 38 met the inclusion criteria.

From this database of 38 patients, 23 are women and 15 are men, ranging in age from 21 to 27 years.

2.2. Clinical procedure

The same protocol was carried out, which was comprised of two steps of obtaining data, for the first step, the mayoral index was performed on each tomography and the second step was the obtaining of the mayoral index in the STL files obtained.

2.3. Type of study

- **Descriptive:** It is considered descriptive because it observes and describes the values found in the population without modifying them since data is obtained and after being processed results are given to the investigation.
- **Cross:** It is considered cross-sectional because the study was carried out at a certain time and space as a cut-off in time.
- **Randomized:** Random selection of the study group

2.4. Tabulation and analysis plan

To obtain the results through the data recorded in the data collection form, the Excel program was used, which is represented by graphs and tables with the proper interpretation and discussion of the results obtained. The tabulation of the data was carried out with the application of the incisal index formula proposed by the Mayoral for the sum of the four upper and lower incisors.

2.5. Incisive sum according to mayoral

- Normodontia: 28 to 32 mm
- Increased macrodontia
- Decreased microdontia

3. Results

Descriptive statistics are found in table 1. data obtained from the NEMOCAST program using the STL models from the randomly selected student database; in table 2. data obtained from the SIDEXIS program using the DICOM models of the randomly selected students, in Table 3 the analyzed data was separated with only the incisal sum in columns separating upper and lower, also separating CBCT and STL (NEMOCAST) to be able to determine differences in both programs, both analysis of mean, variance and T statistic, thus establishing two null and acceptable hypotheses.

3.1. Analysis of the mean

Analyzing the mean in the CBCT study of the lower incisal sum, a value of 22.098 was obtained while in the STL study (NEMOCAST) the value was 21.36 with a difference between the two of 0.738.

Analyzing the mean in the CBCT study of the upper incisal sum, a value of 30.108 was obtained while in the STL study (NEMOCAST) the value was 28.430 with a difference between the two of 1.678.

3.2. Analysis of variance

Analyzing the variance in the CBCT study of the lower incisal sum, a value of 3.062 was obtained while in the STL study (NEMOCAST) the value was 1.911 with a difference between the two of 1.151.

Analyzing the variance in the CBCT study of the upper incisal sum, a value of 3.917 was obtained while in the STL study (NEMOCAST) the value was 2.104 with a difference between the two of 1.813.

3.3. Analysis of the t-statistic

Null hypothesis: The incisal sum in both programs does not vary

Alternative hypothesis: The incisal addition is different because its uses are specific to each program.

Using the T Student, the t statistical value was obtained, resulting in 2.980 in the upper incisal sum while in the lower incisal sum it is 1.444.

These results refute the null hypothesis that shows that by performing the incisal sum in both STL (NEMOCAST) and CBCT (SIDEXIS) we find the existence of a differential value, thus taking the alternative hypothesis as a feasible result to determine the accuracy and specificity of each format and program to use.

Table 1 Measurements made in Nemocast program in STL models

Table 2 Measurements carried out in the Sidexis program in CBCT models

NAME	UPPER ARCH				LOWER ARCH				UPPER INCISAL SUM	LOWER INCISAL SUM
TOOTH PIECE	**1.2**	**1.1**	**2.1**	**2.2**	**4.2**	**4.1**	**3.1**	**3.2**	**1.2+1.1+2.1+2.2**	**4.2+4.1+3.1+3.2**
BERMEO CABRERA JENY MARICELA	6,14	7,92	8,48	6,42	4,99	4,54	4,24	5,25	28,96	19,02
AREVALO VINTIMILLA PAULA DANIELA	6,26	8,29	8,08	6,38	6	5,19	5,72	5,16	29,01	22,07
AYORA OCHOA KAREN ANDREA	6,71	9,22	8,98	6,77	6,32	5,93	5,88	6,26	31,68	24,39

NAME	UPPER ARCH				LOWER ARCH				UPPER INCISAL SUM	LOWER INCISAL SUM
TOOTH PIECE	1.2	1.1	2.1	2.2	4.2	4.1	3.1	3.2	1.2+1.1+2.1+2.2	4.2+4.1+3.1+3.2
BERMEO CABRERA JENY MARICELA	7,2	7,9	8,2	6,5	4,2	4,9	5	5,2	29,8	19,3
AREVALO VINTIMILLA PAULA DANIELA	7,69	7,93	8,38	6,74	5,81	4,94	4,82	6,15	30,49	21,72
AYORA OCHOA KAREN ANDREA	6	8	8	6	6	5	5	6	28	22
BRAVO ENCALADA MANOLO ESTEBAN	6,18	7,,49	7,83	6,31	4,96	5,29	5,02	5,43	27,81	20,7
CAJAMARCA FAREZ ADRIANA LUCIA	6,48	7,55	8,01	6,5	5,33	5,62	5,13	5,85	29,54	21,92
GONZALEZ RODAS ELIANA ELIZABETH	6,11	7,56	7,53	7,12	7,61	4,96	4,83	5,83	28,32	23,23
GUERRERO ANDRADE MICHELLE BRIDGET	6,21	8,17	8,24	6,87	5,58	5,07	5,01	5,35	29,49	21,01
HERAS OLALLA GEOVANNA SOFIA	5,66	7,7	7,94	5,69	5,46	5,17	5,97	5,68	26,99	22,8
JUELA BRAVO VALERIA ALEXANDRA	6,63	7,14	7,26	6,66	5,81	5,47	5,4	6,01	27,69	22,69
PEÑA BENAVIDEZ PATRICIO GEOVANNY	6.39	7.46	7.57	6.19	5.4	5.64	4.65	5.64	27.61	22.84

PESANTEZ OCAMPO FABIANA VALENTINA	6.24	7.89	8.2	7.09	5,43	4.79	5.08	5.52	29,42	20.82
PARRA HIDALGO WENDY PAOLA	5.88	7.49	7.44	5.78	4.99	4.87	4.51	5.28	26.59	19.6
PINEDA PAREDES JOHNNY RENATO	6.9	8.4	8.3	7.2	6.3	5.1	4.9	5.2	31,08	21,63
RODRIGUEZ ROBLES CARLA JESSENIA	6.8	7.3	8.1	5	4.8	5.42	4.5	4.79	28.01	19.51
SANMARTIN ZHUNIO BELEN ESTEFANIA	5,74	7,09	7,14	5,89	5,13	4,02	4,28	4,71	24,86	18,31
ULLOA GOMEZ ANDREA CAROLINA	6	8	8	6	6	5	5	6	28	22
VALDIVIESO NAGUA MARLON FERNANDO	7.13	7.99	7.45	6.81	5.97	5.06	5.3	5.37	29.38	22.37
VEGA NOVILLO MONICA SALOME	6,53	7.78	7.8	6.6	5,71	4,62	5,18	5,27	28,77	20.78
VILLA SIGCHI ELIAN MATEO	6,29	7,75	7,7	6,59	5.49	5.48	5.67	5.98	28.33	22.56
CAJAMARCA FAREZ ADRIANA LUCIA	7,51	8,39	8,74	7,04	6,17	5,86	4,95	5,54	31,68	22,52
GONZALEZ RODAS ELIANA ELIZABETH	6,55	8,09	8,31	6,23	5,03	5,59	5,14	5,76	29,18	21,52
GUERRERO ANDRADE MICHELLE BRIDGET	6,84	8,5	9,33	6,83	6,03	5,28	5,39	6,26	31,5	22,96
HERAS OLALLA GEOVANNA SOFIA	6,51	7,75	7,75	6,28	5,49	5,8	5,75	5,97	28,29	23,01
JUELA BRAVO VALERIA ALEXANDRA	7,13	8,22	8,33	6,96	5,91	5,85	5,53	6	30,64	23,29

PEÑA BENAVIDEZ PATRICIO GEOVANNY	6,19	7,85	8,43	7,14	5,81	5,18	5,36	6,02	29,61	22,37
PESANTEZ OCAMPO FABIANA VALENTINA	6,68	8,18	8,83	7,27	6,03	4,97	5,08	5,68	30,96	21,76
PARRA HIDALGO WENDY PAOLA	6,73	9,02	8,19	6,66	6	5,81	5,14	5,77	30,6	22,72
PINEDA PAREDES JOHNNY RENATO	7,25	9,28	9,29	7,73	6,53	6,02	4,83	5,72	33,55	23,1
DAVID ALEJANDRO LEÓN SANCHEZ	7,05	9,92	9,68	7,16	7,05	5,74	5,79	6,61	33,81	25,19
SANMARTIN ZHUNIO BELEN ESTEFANIA	5,63	7,25	6,92	5,29	4,94	4,95	4,22	4,84	25,09	18,95
ULLOA GOMEZ ANDREA CAROLINA	6,9	7,56	8,68	6,36	5,42	5,27	5,45	5,81	29,5	21,95
VALDIVIESO NAGUA MARLON FERNANDO	7,18	7,96	7,43	6,13	5,89	5,11	5,53	5,31	28,7	21,84
VEGA NOVILLO MONICA SALOME	7,17	8,56	7,98	6,11	5,55	4,73	4,53	5,31	29,82	20,12
VILLA SIGCHI ELIAN MATEO	6,15	8,28	8,62	7,69	5,71	5,95	6,15	6,11	30,74	23,92

Table 3 Upper and lower incisal addition in STL and CBCT models

CBCT		NEMOCAST	
UPPER INCISAL SUM	LOWER INCISAL SUM	UPPER INCISAL SUM	LOWER INCISAL SUM
28,96	19,02	29,8	19,3
29,01	22,07	30,49	21,72
31,68	24,39	28	22
28,74	19,18	27,81	20,7
31,68	22,52	29,54	21,92
29,18	21,52	28,32	41,75
31,5	22,96	29,49	21,01
28,29	23,01	26,99	22,8
30,64	23,29	27,69	22,69

29,61	22,37	27,61	22,84
30,96	21,76	29,42	20,82
30,6	22,72	26,59	19,65
33,55	23,1	31,08	21,63
33,81	25,19	28,01	19,51
25,09	18,95	24,86	18,31
29,5	21,95	28	22
28,7	21,84	29,38	22,37
29,82	20,12	28,77	20,78
30,74	23,92	28,33	22,56

Table 4 T student test and results

	CBCT	NEMOCAST
	LOWER INCISAL SUM	*LOWER INCISAL SUM*
Half	22,0989474	21,36
Variance	3,0622655	1,91133333
Observations	19	19
Hypothesized difference of means	0	
Degrees of freedom	34	
t-statistic	1,44429175	
P(T<=t) one tail	0,07890489	
Critical value of t (one-tailed)	1,69092426	
P(T<=t) two tails	0,15780978	

Critical value of t (two tails)	2,03224451	
	CBCT	NEMOCAST
	UPPER INCISAL SUM	UPPER INCISAL SUM
Half	30,1084211	28,4305263
Variance	3,91706959	2,10409415
Observations	19	19
Hypothesized difference of means	0	
Degrees of freedom	33	
t-statistic	2,9805835	
P(T<=t) one tail	0,00268404	

Critical value of t (one-tailed)	1,69236031	
P(T<=t) two tails	0,00536808	
Critical value of t (two tails)	2,0345153	

4. Discussion

Several studies show the percentage prevalence of dental size anomalies, but their results do not always agree. Discrepancies in their results are attributed to racial differences, methodology used, and diagnostic criteria, among others. Mayoral proposed an Incisive Index to determine size alterations such as macrodontia and microdontia, taking into consideration the diameter of the four upper incisors, at the level of the dental equator, taking as normal the result of the sum of the maxillary incisors that were between 28 at 32mm. However, for the dentition analyses in which the mesiodistal diameter of the teeth is considered, variations have also been found concerning what other authors have suggested, so the parameters to establish the size mesiodistally are not the same as what has been reported. Knowing the average mesiodistal diameter of the teeth in a database is essential to have a parameter of the presence of some size alteration, to reach a diagnosis and identify the present anomaly.
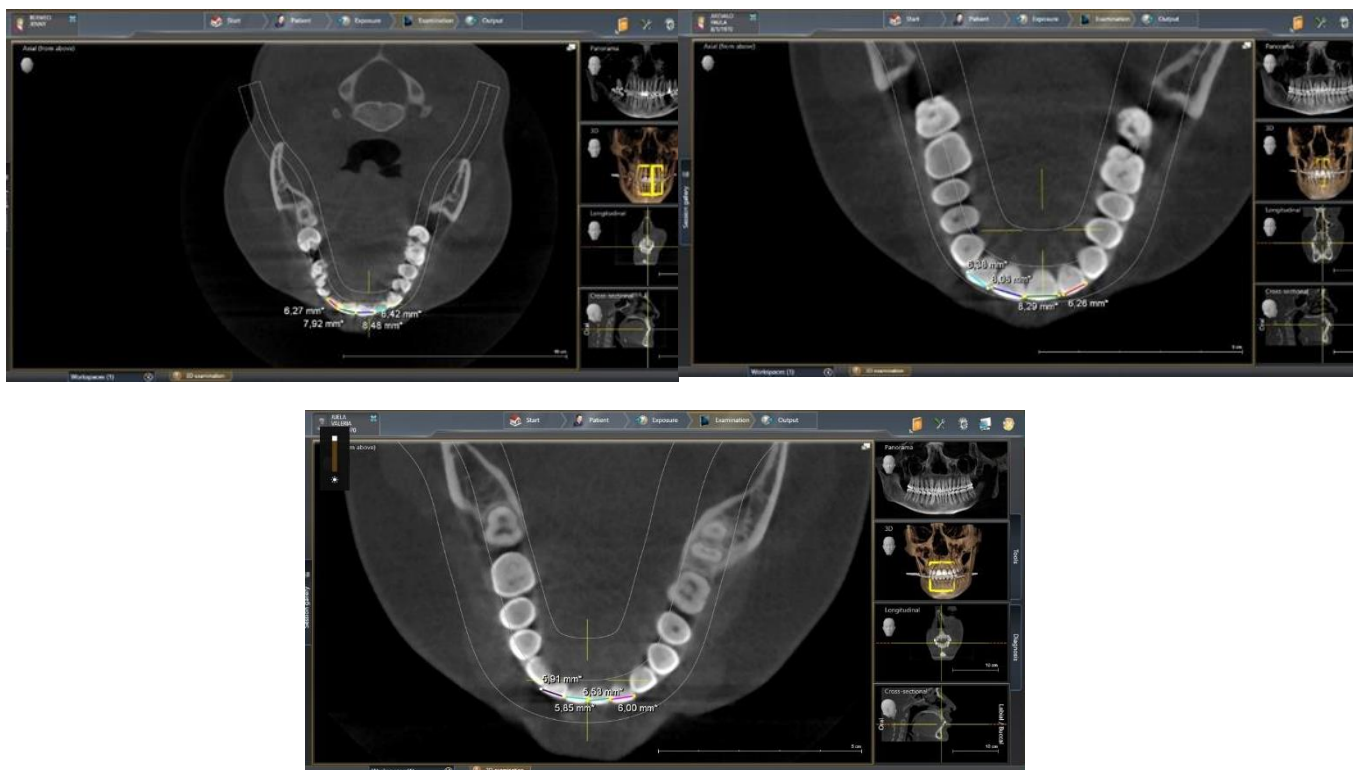
4.1. Annexes

Figure 1 Calculation of mesiodistal measurements of anterior pieces using the Sidexis 4 program in DICOM files
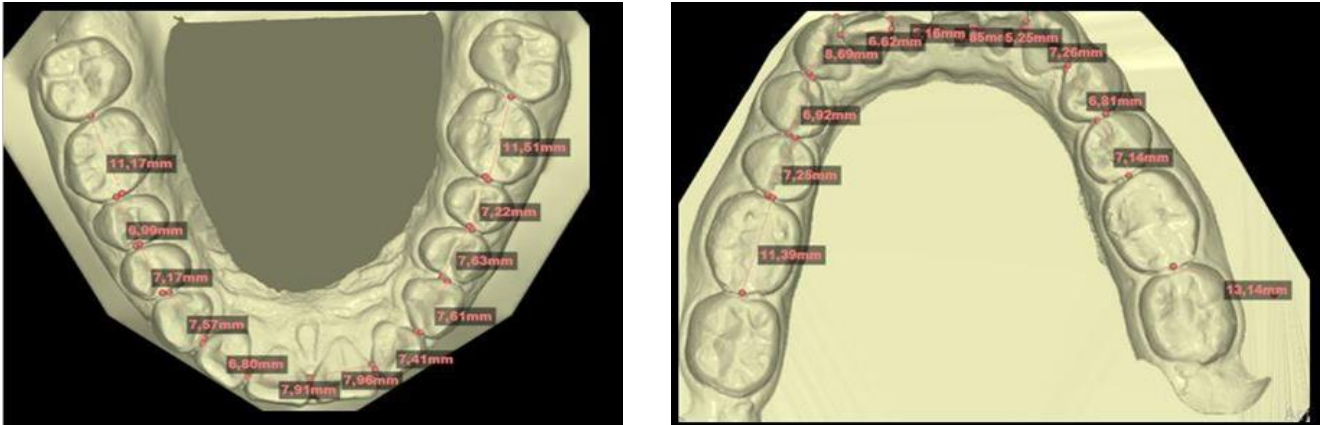
Figure 2 Calculation of mesiodistal measurements of anterior pieces using the Nemocast program in STL files

5. Conclusion

Through this cross-sectional study and thanks to its randomized selection from the database, it was possible to reach the result of a variance of less than 2mm in the taking of mesiodistal measurements of anterior pieces, thus being a minimum variance between the two programs and their different data collection methodologies. In addition to this, it was possible to observe a mean value in the lower incisal sum of 22.09 (DICOM) and 21.3 (STL), while the mean of the upper incisal sum was 30.10 (DICOM) and 28.43 (STL), thus being a mean regarding the established values of microdontia.

Finally, it was possible to verify and corroborate the alternative hypothesis by using the "T Student" method, which indicated that the variance between the two programs was minimal due to the precision and specificity of each program and each respective file.

Compliance with ethical standards

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Disclosure of conflict of interest

The conflict of interest in this manuscript is that the information used randomly from the database of the University of Cuenca consists of the data of the authors of the following article.

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