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Prevalence of maxillary collapse in elementary school students, making use of Pont's index and 3Shape® intraoral scanner

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Abstract
Introduction: Maxillary collapse is defined as an alteration of the maxillary complex due to an excessive vertical growth of it in patients. (1) Some of the clinical differences manifested by patients are unilateral and bilateral posterior crossbite, crowded teeth, narrow palate, and a V-shaped arch. The Pont's index, described by Dr. Pont in 1909 and developed in French population predicts the width necessary for the proper alignment of the teeth in the maxillary arch. (2, 3) The 3Shape® system and scanner collects information of the maxilla, denting or clay models. The 3D images it provides are a useful tool for estimating maxillary collapse since they allow us to carry out more accurate measuring at a lower difficulty. (4)
Objective: Classify and identify maxillary collapse in students aged between 9 and 12.
Results: A prevalence of 28 students was obtained who presented a transverse distance in the premolar and molar area that was less than that indicated by Pont's index, representing 53% of the sample.
Conclusions: The timely diagnosis of maxillary collapse in children provides us with a wide range of conservative treatments that would help in the correction of this condition.

Keywords: Maxillary collapse, Pont's index, intraoral scanner, 3Shape ®

Introduction

Maxillary collapse is defined as an alteration of the maxillary complex due to an excessive vertical growth of it in patients. Some of the clinical differences manifested by patients are: unilateral and bilateral posterior crossbite, crowded teeth, narrow palate, and a V-shaped arch. During the active growth period, it is possible to stimulate the maxilla growth through orthopedic appliances that exercise force on the dental organs and the maxillary bone. Once the active growth period has passed, it is managed in an interdisciplinary manner between orthodontics and maxillofacial surgery [1, 5, 6, 7].

The Pont's index, described by Dr. Pont in 1909 and developed in French population predicts the width necessary for the proper alignment of the teeth in the maxillary arch. This is calculated by adding the mesiodistal distance of the maxillary incisors and two constants are decreeted to obtain the transverse width of the first premolar area, with a constant of 80, and the first molar area, with a constant of 64. The sum of the mesiodistal distance of the upper incisors is calculated, then it is multiplied by 100 and divided by each constant to obtain the ideal transverse width of the area of first premolars and molars. Once the result has been obtained, it is compared with the distance present in patients and it is determined if there is a discrepancy [2, 3].

The intraoral scanner was implemented in odontology in 1973. The 3Shape® system and scanner collects information of the maxilla, denting or clay models. The 3D images it provides are a useful tool for estimating maxillary collapse since they allow us to carry out more accurate measuring at a lower difficulty. [4, 6, 8].

Skeletal alterations do not usually cause concern in the population because they do not usually cause painful symptoms. Once a skeletal disorder is detected, such as the maxillary collapse during the growth period, it may be corrected and treated through conservative orthodontic and/or orthopedic appliances.

Objective

The objective of this article is to classify and identify cases of maxillary collapse in students aged between 9 and 12. To distinguish the increase or decrease in the transverse maxillary growth, identifying and quantifying the number of cases where maxillary growth is present without a previous diagnosis.

Materials and methods

An intraoral clinical examination was performed in 391 students aged between 9 and 12, of whom 189 presented the adequate clinical characteristics; however, only 53 patients met all requirements necessary for the research with teeth 11, 12, 14, 16, 21, 22, 24, and 26 fully erupted. A clinical history and intraoral scan were performed using 3Shape® system and scanner to establish and determine the cases of maxillary collapse. The 3D images obtained by the 3Shape® scanner were exported and once the images were collected, measurements were taken using the 3Shape 3DViewer® program. Once the images were obtained, the results were concentrated in Microsoft Excel 2010 where the corresponding equations were performed to display the results, using tables and graphs.
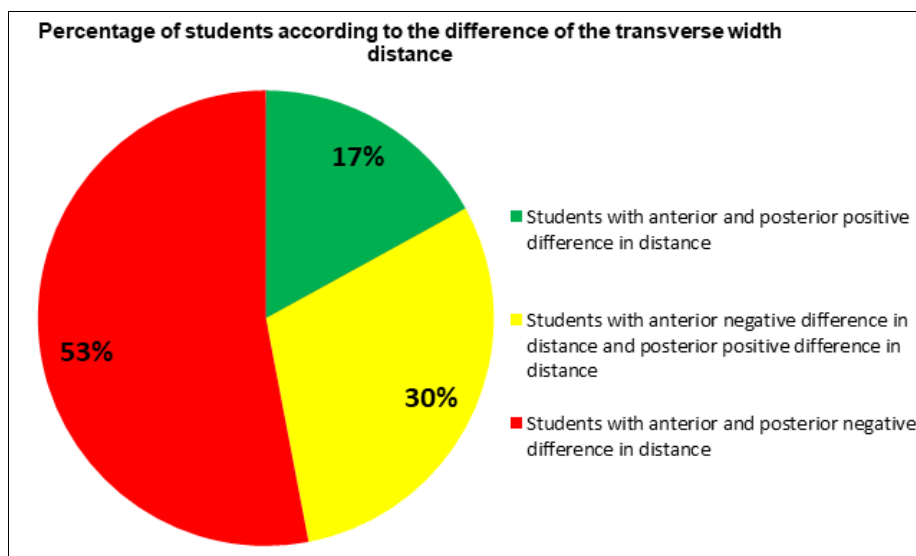
Results: The first chart shows the information collected, it includes the following: the number of the student according to the number assigned to their file, the gender of the student, the age, the mesiodistal width of teeth 12, 11, 21, and 22, the sum of the mesiodistal width of teeth 12, 11, 21, and 22, the anterior transverse width values which is the distance from the deepest transverse fissure point of teeth 14 to the deepest transverse fissure point of teeth 24, the ideal transverse width according to Pont's index; the value is obtained through the following formula: the result of the sum of the mesiodistal width of the 4 upper permanent incisors multiplied by 100 and divided by 80, the difference between the student's anterior transverse width the ideal anterior width according to Pont's index; the cells marked in red represent a negative difference between the distance, showing that the student's maxilla is narrower than indicated by Pont's index, if the cells are marked in green they represent a positive difference between the distance, showing that the student's maxilla is wider than indicated by Pont's index, the values of the posterior transverse width which is the distance from the major fossae of tooth 16 and the major fossae of tooth 26, Pot's index' ideal posterior transverse with is obtained through the following equation: the sum of the mesiodistal width of the 4 permanent upper incisors, multiplied by 100 and divided by 64, the difference between the student's transverse width and Pont's index ideal width, the students who use the maxillary expanders, the students who have orthodontic treatment, and the type of dentition, mixed or permanent. (Table 1)

The students who obtained positive results in the anterior and posterior distances were 6 females and 3 males, with a total of 9 students, representing 17% of the sample. The students who obtained a negative result in the anterior distance and a positive result in the posterior distance were 9 females and 7 males with a total of 16 and 30%. And the students who obtained negative results in the anterior and posterior distances were 11 females and 17 males with a total of 28 and 53% of the sample, with a higher prevalence of students with a narrower maxilla than what is indicated by Pont's index. (Table 1 and graph 1).

Table 1: Total of students according to the difference between the maxilla width distance of the patients and Pont's index.

Sex	Students with anterior and posterior positive difference in distance	Students with negative anterior difference in distance distance and positive posterior difference in distance	Students with anterior and posterior negative difference in distance	Total
Female	6	9	11	26
Male	3	7	17	27
Total	9	16	28	53

Graph 1: Percentage of students according to the difference of the transverse width distance of the patient and the distance of the ideal maxilla width distance by Pont's index.

The prevalence of students according to the anterior transverse width distance in comparison to Pont's index anterior transverse width distance was 18 students with a difference of >-2mm. <-4mm with 34% and the difference of the students' posterior transverse width in comparison to the posterior transverse with by Pont's index the highest prevalence was in difference of >0mm - <2mm with 14 students and 26% of the sample. (Table 2 and 3)

Table 2, 3: Prevalence of students according to the difference of the students' anterior transverse width and Pont's index anterior transverse width

2. Prevalence of students according to the difference of the student's anterior transverse width and Pont's index anterior transverse width		3. Prevalence of students according to the difference of the student's posterior transverse width and Pont's index posterior transverse width	
Resulting values of the difference	Number of students	Resulting values of the difference	Number of students
> -10mm - < -12mm	2	> -12mm - < -14mm	1
> -8mm - < -10mm	1	> -10mm - < -12mm	2
> -6mm - <-8mm	4	> -8mm - < -10mm	2
> -4mm - <-6mm	6	> -6mm - < -8mm	3
> -2mm - < -4mm	18	> -4mm - < -6mm	6
> -0.0mcm - <-2mm	13	> -2mm - < -4mm	5
> 0mm - < 2mm	6	> -0.01mm - < -2mm	9
> 2mm - < 4mm	1	> 0 mm - < 2mm	14
> 4mm - <6mm	2	> 2mm - < 4mm	9
Total of students	53	> 4mm - <6mm	2

In the anterior transverse difference according to the difference in patient's transverse width and the transverse distance according to Pont's index, a negative difference in 23 males with 88% and a positive difference in 3 males with 12% were obtained. In the case of the females, a negative difference in 21 students was obtained, representing 78%, and a positive difference was present in 6 females, representing 22%. (Table 4)

In the posterior transverse difference according to the patient's transverse width difference and Pont's index transverse distance, a negative difference in 16 males was obtained, representing 62% and a positive difference of 10 males was obtained, representing 38%. In the case of females, a negative difference in 12 students was obtained, representing 44% and a positive difference was present in 15 females, representing 56%. (Table 5)

Table 4: Anterior transverse distance difference.

Anterior transverse distance difference			
Male		Female	
Negative difference	23	Negative difference	21
Positive difference	3	Positive difference	6
	26		27

Table 5: Posterior transverse distance difference.

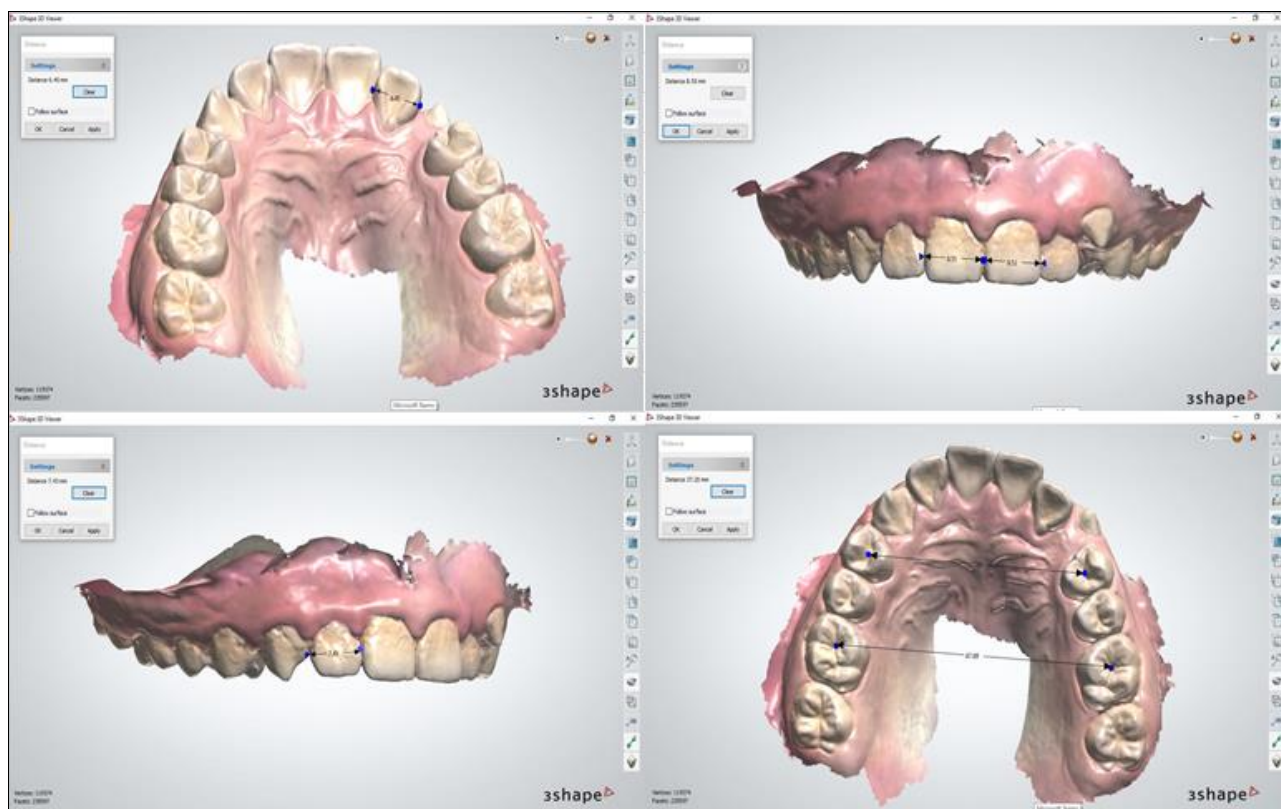| Posterior transverse distance difference			
Male		Female	
Negative difference	16	Negative difference	12
Positive difference	10	Positive difference	15
	26		27

Fig 1: Intraoral scanning measurements taken with 3shape® system.

Table 6: Data base

Student number	Gender	Age	Mesiodistal width 12	Mesiodistal width 11	Mesiodistal width 21	Mesiodistal width 22	Slo: Incisors mesiodistal Width	Anterior transverse distance	Anterior transverse distance Pont's ideal	Anterior transverse distance difference	Posterior transverse distance	Posterior transverse distance Pont's ideal	Posterior transverse distance difference	Expander	Orthodontic treatment	Type of dentition
1	M	10	7.43	8.55	8.52	6.45	30.95	37.2	38.69	-1.4875	47.89	48.359375	-0.469375	No	No	P
2	M	10	7.87	9.63	9.73	7.28	34.51	40.26	43.14	-2.8775	48.3	53.921875	-5.621875	No	No	P
3	M	12	6.95	8.42	8.38	6.76	30.51	37.43	38.14	-0.7075	49.22	47.671875	1.548125	No	No	P
4	M	10	7.34	8.64	8.68	7.06	31.72	36.56	39.65	-3.09	53.08	49.5625	3.5175	No	No	M
5	M	9	5.92	7.96	7.97	5.47	27.32	32.02	34.15	-2.13	44.71	42.6875	2.0225	No	No	M
6	F	11	6.66	7.93	7.97	6.66	29.22	34.25	36.53	-2.275	46.3	45.65625	0.64375	No	No	M
7	F	11	6.83	8.15	8.52	6.97	30.47	34.62	38.09	-3.4675	46.04	47.609375	-1.569375	No	No	P
8	F	12	6.77	8.45	8.3	6.69	30.21	34.56	37.76	-3.2025	45.78	47.203125	-1.423125	No	No	P
9	F	11	6.94	8.75	8.6	6.89	31.18	33.5	38.98	-5.475	41.17	48.71875	-7.54875	No	No	M
10	F	10	6.09	8.43	8.51	6.22	29.25	36.4	36.56	-0.1625	45.85	45.703125	0.146875	No	No	M
11	M	12	6.45	8.4	8.48	7.15	30.48	36.32	38.1	-1.78	46.95	47.625	-0.675	No	No	P
12	M	12	7.8	9.49	9.93	7.51	34.73	37.56	43.41	-5.8525	49.91	54.265625	-4.355625	No	No	P
13	M	12	8.36	10.4	10.1	7.83	36.66	39.96	45.83	-5.865	44.41	57.28125	-12.87125	No	Yes	P
14	M	12	7.03	8.92	8.45	7.7	32.1	37.65	40.13	-2.475	44.49	50.15625	-5.66625	No	No	P
15	F	11	7.56	8.83	8.66	7.46	32.51	32.18	40.64	-8.4575	45.45	50.796875	-5.346875	No	No	M
16	M	12	6.81	9.1	9.17	6.89	31.97	37.79	39.96	-2.1725	48.96	49.953125	-0.993125	No	No	P
17	F	10	6.33	7.88	8.05	5.94	28.2	37.46	35.25	2.21	48.89	44.0625	4.8275	No	No	M
18	F	10	7.05	8.81	8.9	7.09	31.85	37.71	39.81	-2.1025	49.33	49.765625	-0.435625	No	No	M
19	F	12	6.56	7.71	7.61	6.38	28.26	36.13	35.33	0.805	48.15	44.15625	3.99375	No	No	P
20	F	11	6.05	7.75	7.83	6.01	27.64	34.44	34.55	-0.11	45.85	43.1875	2.6625	No	No	M
21	F	11	6.98	8.58	8.62	6.99	31.17	37.86	38.96	-1.1025	47.96	48.703125	-0.743125	No	No	M
22	F	9	7.31	8.54	8.65	6.95	31.45	35.38	39.31	-3.9325	44.23	49.140625	-4.910625	No	No	P
23	F	11	7.05	8.78	8.73	6.7	31.26	43.23	39.08	4.155	49.23	48.84375	0.38625	No	No	P
24	M	11	5.68	9.41	9.09	5.87	30.05	34.34	37.56	-3.2225	49.96	46.953125	3.006875	No	No	M
25	M	10	6.7	9.12	9.13	6.77	31.72	38.65	39.65	-1	51.95	49.5625	2.3875	No	No	M
26	M	10	8.17	9.44	9.48	7.94	35.03	37.7	43.79	-6.0875	46.13	54.734375	-8.604375	No	No	M
27	F	11	6.46	7.94	8.14	6.66	29.2	40.57	36.5	4.07	48.76	45.625	3.135	No	No	P
28	F	10	7.34	9.04	8.99	7.37	32.74	33.69	40.93	-7.235	43.42	51.15625	-7.73625	No	No	M
29	M	9	7.05	8.62	8.64	7.01	31.32	36.58	39.15	-2.57	45.71	48.9375	-3.2275	No	No	M
30	M	10	7.8	9.69	9.89	7.7	35.08	37.66	43.85	-6.19	48.8	54.8125	-6.0125	No	No	M
31	F	10	6.17	8.31	8.33	6.75	29.56	38.3	36.95	1.35	49.73	46.1875	3.5425	No	No	P
32	F	11	6.83	8.64	8.77	7.03	31.27	38.15	39.09	-0.9375	45.53	48.859375	-3.329375	No	No	M
33	F	10	7.09	9.17	9.14	7.14	32.54	36.91	40.68	-3.765	50.97	50.84375	0.12625	No	No	M
34	F	9	6.48	8.02	7.95	6.43	28.88	33.89	36.1	-2.21	45.73	45.125	0.605	No	No	P
35	M	11	9.51	10.4	10	9.14	39.1	38.4	48.88	-10.475	50.5	61.09375	-10.59375	No	No	M
36	M	11	7.93	9.75	9.44	8.15	35.27	39	44.09	-5.0875	45.08	55.109375	-10.02938	Yes (previously)	Yes	P
37	M	10	8.76	10.3	9.9	8.25	37.18	34.77	46.48	-11.705	48.73	58.09375	-9.36375	No	No	M
38	M	11	6.97	8.28	8.45	6.75	30.45	36.98	38.06	-1.0825	47.04	47.578125	-0.538125	No	No	M
39	F	11	5.66	7.7	7.19	5.52	26.07	33.1	32.59	0.5125	46.36	40.734375	5.625625	No	No	P
40	F	10	6.71	8.48	8.19	6.45	29.83	36.88	37.29	-0.4075	48.5	46.609375	1.890625	No	No	M

41	F	9	7.12	9.1	9.25	6.78	32.25	37.58	40.31	-2.7325	47.95	50.390625	-2.440625	No	No	P
42	F	10	6.36	8.84	8.87	6.17	30.24	37.47	37.8	-0.33	48.67	47.25	1.42	No	No	M
43	F	9	7.12	8.46	8.36	7.24	31.18	33.83	38.98	-5.145	47.13	48.71875	-1.58875	No	No	M
44	M	10	6.53	8.4	8.84	6.59	30.36	38.54	37.95	0.59	48.56	47.4375	1.1225	No	No	M
45	F	10	6.88	8.1	8.19	6.67	29.84	37.17	37.3	-0.13	47.91	46.625	1.285	No	No	M
46	F	10	6.58	7.96	7.98	6.57	29.09	34.03	36.36	-2.3325	41.63	45.453125	-3.823125	No	No	M
47	M	10	6.89	9.21	9.53	6.74	32.37	36.1	40.46	-4.3625	45.67	50.578125	-4.908125	No	No	P
48	F	11	6.65	8.96	8.76	6.84	31.21	36.84	39.01	-2.1725	49.57	48.765625	0.804375	No	No	P
49	M	11	6.69	8.37	8.41	6.78	30.25	37.96	37.81	0.1475	50.45	47.265625	3.184375	No	No	M
50	M	9	7.47	8.46	8.41	7.44	31.78	39.1	39.73	-0.625	51	49.65625	1.34375	No	No	P
51	M	11	7.8	9.2	9.11	7.71	33.82	35.89	42.28	-6.385	50.14	52.84375	-2.70375	No	No	P
52	M	10	7.35	9.54	9.46	7.23	33.58	39.66	41.98	-2.315	53.85	52.46875	1.38125	No	No	M
53	M	11	6.67	8.59	8.68	6.56	30.5	38.82	38.13	0.695	49.39	47.65625	1.73375	No	No	P

Discussion

The Pont's index is a tool that allows us to determine the transverse distance of the arches based on the mesiodistal distance of the incisors and provides us an ideal distance for the correct alignment of the permanent teeth. [2, 3].

Several authors do not agree on the viability of the results obtained through Pont's index as a parameter to determine the transverse distance since Pont's study was based on French population with different clinical characteristics and features specific to this lineage [9].

Some studies such as Nava (2015) conclude that it is not viable to apply Pont's index since it represents significant discrepancies in the mandibular arch and maxillary arch [2].

Carrizosa (2003) determines that applying Pint Lider-Hart app is viable for predicting the transverse width and it is viable for applying to Mexican population when it comes to maxillary arch, in patients with no malocclusion [3].

Conclusions

Each patient's diagnosis must be considered unique and individual. The use of Pont's index could be useful or as a viable auxiliary diagnosis tool to determine distance parameters, both increase and decrease, of the transverse development of the maxillary arch.

A timely diagnosis with the help of tools such as intraoral scanners allows us to determine the distance of the maxillary collapse in children and provides us with a wide overview of conservative treatments that help correct and limit the condition.

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