Investigation of complete dental arches of 23 patients aged at least 75 years

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Summary

Numerous factors help to conserve the dentition of elderly patients, such as healthy food habits, a strong physical constitution, and a good quality of life. The aim of this study was to define a model that takes into account the integration of both the structural and functional aspects of a healthy dentition. Twenty-three patients aged at least 75 years were recruited. The patients were required to possess all of their dentition and have no prosthetic rehabilitations and be asymptomatic for temporomandibular joint disorders. Occlusal characteristics were measured and recorded using the criteria adopted by the US National Health and Nutrition Examination Survey: presence or absence of rotation of the upper arches, trend of the occlusal table, and distribution of occlusal contacts during movements. We believe that the following parameters are predictive of a condition of the dental arches' equilibrium: crowding and disalignment of the teeth, derotated position of the upper arches, absence of the curve of Spee, an occlusal plane trend contrary to spherical theory, and presence of group function on the working side and malocclusion on the nonworking side. We consider that these factors are merely the consequence of correct functioning within the framework of favorable environmental factors.

Key words: occlusion, TMJ disorders, oral rehabilitation, mobile prostheses, dental geriatrics.

Introduction

Seldom in daily practice does a dentist have the opportunity to observe an elderly patient with conserved dentition. There is no doubt that several factors contribute to such a fortunate event, such as healthy food habits, a strong physical constitution, and a good quality of life (1-3). In addition to the general environmental and systemic factors that favor the conservation of complete dental arches, several local factors must also be taken into account (4). In such patients, adaptive processes, together with the patient's behavior, are structured in such a way as to shape the dental arches in a particular fashion, in accordance with certain principles that have yet to be fully elucidated.
This study focused on the structural characteristics of the mouths of elderly patients with conserved dentition in the light of current gnathologic, orthodontic, and periodontic thinking (5). The aim of this research was to formulate a hypothesis that would confirm the occlusal and structural requirements for maintaining the integrity of the dental arches into old age. To this end, we observed the morphological characteristics of the dental arches of patients aged at least 75 years (6,7) that remain complete and functionally efficient, and gathered data systematically whilst evaluating the contributing factors.

Materials and methods

Inclusion criteria
Twenty-three patients aged at least 75 years were recruited. These patients possessed all of their dentition (both anteriorly and posteriorly), no dental mobility, and mandibular mobility. In addition, they had no prosthetic rehabilitations and were asymptomatic for temporomandibular joint (TMJ) disorders and tonic masticatory muscles.
Data collection (Table 1).
The following data collection protocol was applied to each patient:
Anamnesis collection with special regard to the form–growth–function relationship and the classification of malocclusions.
Clinical orthognathodontic evaluation (8,9). Occlusal characteristics were measured and recorded using the criteria adopted by the US National Health and Nutrition Examination Survey (NHANES III)(10).
In more detail were examined:
B1. Presence/absence of labiolingual dysfunction;
B2. Application of the TMJ disorder (TMD) criteria: questionnaire on mandibular function and on the chronic pain scale in order to identify their presence and intensity (11);
B3. Angle classes;
B4. Alignment/disalignment of median lines;
B5. Dental crowding. The rating of dental crowding was based on the irregularity index (12), with a score of between 0 and 3 mm considered as anterior disalignment, while one exceeding 3 mm deemed to be crowding (13). The perfect alignment between the mesial face of the left canine and the mesial face of the right canine was scored

Table 1 - Data collection Protocol.

A	Anamnesi	Form-growth-function relationship and malocclusions classification
B	Clinical orthognathodontic evaluation	B1: Presence/Absence of labiolingual dysfunction
		B2: TMD (TMJ disorder)
		B3: Angle classes
		B4: Alignement/disalignement of median lines
		B5: Dental crowding
		B6: Dental anomalies and malposition
		B7: Overbite/Openbite
		B8: Overjet
		B9: Upper arches position
		B10: Presence/Absence Spee's and Monson's curve
		B11: Group function or canine guidance presence
		B12: Masticatory functional angle
C	Jarabak-Bondi's cephalometric	C1: S+Ar+Go angles
		C2: (PFH)-(S-Go)/(AFH)-(N-Me)
		C3: PFH (C-Go)/ AFH(N-Gn)
		C4: Base Angle
		C5: ANB Angle
D	Clinical examination	D1: Dental wear
		D2a: Gum inflammatory
		D2b: Receding gums

as zero (5,14);
B6. Dental anomalies and/or malpositioning;
B7. Overbite/openbite (15);
B8. Overjet (16);
B9. Position of the first upper molars. Evaluation of the parallelism between the median raphe of the palate and the mesiodistal diameter of the upper arches, taking the triangular fossettes into consideration;
B10. Occlusal plane state observed on the sagittal plane (absence/presence curve of Spee) and on the frontal plane (absence/presence of curve of Monson);
B11. Evaluation of the characteristics of the contacts between structures of antagonistic arches during lower-jaw movements. We evaluated whether a group function or a canine guidance was present during right and left lateral movements (15,17);
B12. Absence or presence of verticalization in lower jaw movements (masticatory functional angle) (18,19);
Radiographic assessment of facial typology. X-ray evaluation was performed on the basis of Jarabak-Bondi's cephalometric tracing; this was interpreted "dynamically" to obtain an understanding of the mutual relationships between the more important functional units of the face in the anteroposterior and vertical spatial planes. In particular, the following values were consider:
C1. Sum of S+ar+Go angles;
C2. Jarabak's ratio of posterior face height (PFH, S-Go) to anterior face height (AFH, N-Me);
C3. Bondi-Jarabak's ratio PFH (C-Go)/AFH (N-Gn);
C4. Base angle for divergence assessment;
C5. ANB angle for skeletal class assessment (this parameter was considered as a function of point B3 above;
Clinical examination of the masticatory apparatus of the soft tissues and hard tissues accompanied by photographic documentation (20,21);
D1. Presence of wear (20);
D2. Evaluation of the Prosthodontic Diagnostic Index (22).

Results

The cohort had a mean age of 79.6 years, and comprised 9 males and 14 females.
No one presented either hypertonus or pain on palpation of the masticatory muscles (temporal medial pterygoid and masseter) and labiolingual dysfunctions.
With reference to the possible presence of TMDs, on the Axis I and Axis II questionnaires the patients tested negative in all anamnestic and palpatory examinations of the masticatory muscles and TMJ [23-25].
In the examined subjects, 17 cases were found to be angle class I, 4 were class II, and 2 were class III.
Interincisive line symmetry was observed in 56.5% of cases and in all cases was present dental crowding with an irregularity index of >5.
The presence of rotations of different dentition was observed in 56,5% of cases.
Increased overbite was observed in 15 patient and was diminished in 4.
Increased overjet was observed in 7 cases, and reduced in 4 cases.
In all cases the position of the upper arches was distally derotated and there was absence of the curve of Spee and loss the curve of Monson.
During excentrum movements, such as during the movement of lower jaw protrusion, wherein the anterior contacts are also supported by posterior contacts, a group function relationship was observed in all cases.
Absence of verticalization of movements was observed in all patients, everyone exhibited a masticatory angle <25º.
Analysis of Jarabak tracings, modified Bondi, showed that in all cases the indexes present point to a brachyfacial typology.
Dental wear was found in 78.3% of cases. In 14 of these, the dental wear was observed on both arches, which is a sign of adaptation.
In 12 cases was present gum inflammation while in 6 cases receding gums.
To summarize the results of our study, the following characteristics were observed in all of the cases: dental crowding, brachyfacial typology, the absence of lingual dysfunctions, the presence of group function during lateral movements from the working side and malocclusion on the nonworking side, absence of the curve of Spee, loss of the curve of Monson, and derotation of the upper arches.

Discussion

We were able to observe 23 patients aged at least 75 years with dental arches that were complete in both the anterior and posterior sectors. This study focused on the structural characteristics of these patients' mouths; we asses-

sed them according to the existing diagnosis and data collection systems, as well as in the light of current gnathologic, orthodontic, and periodontic thinking.

To gain a better appreciation of how correct function affects the structure of the masticatory organ, we assessed the presence or absence of labiolingual dysfunctions, absence of any TMD and absence of pain on palpation of the craniomandibular muscles. In other words, if it is true that the function affects the structure of the organ, throughout their lives these patients have somehow maintained functioning that has allowed them in turn to maintain the structures of the masticatory organ in a good condition, since they all displayed the absence of the edentulous condition and prosthetic reconstructions in the posterior sectors. Even allowing for the existence of favorable genetic and environmental components, we investigated whether observing the characteristics of these mouths provides any useful information. Our aim was to define a preliminary theoretical model that takes into account the integration of the functional and structural aspects, which would allow us to predict more accurately the consequences of an altered function on the structure of the masticatory organ. For instance, by assessing the presence or absence of crowding of dentition, this factor may be considered as a physiological consequence of the normal development and adaptive processes involving the mouth. It is likewise possible to view the distinction into angle classes not as a functional classification, or indeed as a primary objective to be attained, but rather a certain kind of evolution that is not necessarily pathological or pathogenetic.

The mechanistic theories of occlusion suggest that the difference between ideal occlusion and malocclusion should be assessed on the basis of the morphological variations inferred from a comparison with the normal population. Once the predefined morphological objectives have been attained, a correct system functionality may be considered to have been reached. According to functionalist philosophy, occlusal rehabilitation is defined as the therapy aimed at achieving an excellent morphology integrated with the overall equilibrium of the masticatory apparatus. On the strength of these concepts, the requirements of an ideal occlusion are set out in Table 3 (26-28). Nevertheless, 95% of the population display significant morphological variations of occlusion (1,4,29). It is possible for even a serious malocclusion to exist without having any significant effect on the health of the stomatognathic apparatus (19,30). These reflections were made with reference to and considering all of the stomatognathic factors, and this leads us to believe that strictly speaking, not all of the results can be considered as predictive of a pathological condition of the masticatory organ, but rather as the consequence of an adaptive physiological process, at least in a general sense.

With reference to the principles of occlusion contained in Table 4, the alignment of teeth in the arches is related to the mutual relationship between the teeth within the dental arch, and the resulting imaginary plane is referred to as the occlusal plane. This plane is curved, as the teeth are situated in the dental arch according to different inclinations: the curves of Spee and Monson.

With reference to the occlusal plane, we found that all of the patients had a flat, straight occlusion plane (anti-Spee and anti-Monson), mesial inclination of the anterior and posterior teeth, and vestibular dental cusps, the upper ones of which were conserved and the lower ones worn (Figure 1).

Table 2 - Results.

A	Hypertonus or pain of the masticatory muscles		0
B	B1: Labiolingual dysfunction	Presence	0
		Absence	23 (100%)
	B2: TMD	Presence	0
		Absence	23 (100%)
	B3: Angle classes	I class	17 (73,9%)
		II class	4 (17,4%)
		III class	2 (8,7%)
	B4: Median lines	Allignement	13 (56,5%)
		Disallignement	10 (43,5%)
	B5: Dental crowding	Presence	23 (100%)
		Absence	0
	B6: Dental malposition	Presence	13 (56,5%)
		Absence	10 (43,5%)
	B7: Overbite	Normal	4 (17,4%)
		Increase	15 (65,2%)
		Reduction	4 (17,4%)
	B8: Overjet	Normal	12 (52,2%)
		Increase	7 (30,4%)
		Reduction	4 (17,4%)
	B9: Upper arches position	Normal	0
		Derotation	23 (100%)
	B10a: Spee's curve	Presence	0
		Absence	23 (100%)
	B10b: Monson's curve	Presence	0
		Absence	23 (100%)
	B11: Excentrum movements	Group Function	23 (100%)
		Canine guidance	0
	B12: Movements verticalization	Presence	0
		Absence	23 (100%)
C	Facial typology	Normofacial	0
		Brachyfacial	23 (100%)
		Dolicofacial	0
D	D1: Dental wear	Presence	18 (78,3%)
		Absence	5 (21,7%)
	D2a: Gum inflammation	Presence	12 (52,2%)
		Absence	11 (47,8%)
	D2b: Receding gums	Presence	6 (26,1%)
		Absence	17 (73,9%)

Table 3 - Ideal occlusion requirements (Okeson JP 1983)(27).

1. With the mouth closed the condyles are in their maximum superior position against the curve of the articular hemiarches
2. Dental contacts determine an axial loading of occlusal forces.
3. In laterality dental contacts are formed (canine guidance) on the working side and disclusion on the non working side.
4. In protrusion suitable contacts of the anterior teeth guide the disclusion of the posterior teeth.
5. In a position of food alert waking feeding the posterior contacts are stronger than the anterior contacts.

Table 4 - Occlusal evaluation criteria according to NHANES III (7).

1. Maximal opening capacity was measured as the distance between the incisal edges of the maxillary and mandibular right central incisors.
2. Relationship between RP and IP. The distance between the retruded contact position and the intercuspal position was measured as the horizontal, vertical, and lateral distance between the two positions to the nearest half-millimetre.
3. The side of the first contact on guided hinge closure.
4. Mediotrusion contacts were recorded during habitual lateral gliding from the intercuspal position up to 3 mm. The presence of contact was verified with thin strips for occlusal registration. Mediotrusion contacts inhibiting contact on the laterotrusion side were considered to be interferences.
5. Protrusion contact. The location of the protrusion contact was recorded and then verified with occlusal strips in cases of doubt. Contacts of posterior teeth during protrusive movement were considered to be interferences.
6. The muscles palpated were the insertion of the temporal muscle and the lateral pterigoid muscle. The palpation index was the sum of sites tender to palpation, the maximum thus being 4.
7. Pain on maximal active opening.
8. Pain and stiffness on guided hinge closure. In addition, the following variables were recorded at the age of 15:
9. TMJ-sounds. Clicking and crepitation during mandibular movements were recorded with a stethoscope.
10. Tenderness to palpation of the TMJs. The joints were palpated laterally and posteriorly.
11. Deviation of the mandible during the opening movement was recorded with the aid of a transparent acrylic sheet having parallel lines to facilitate recording of lower jaw deviation. Deviation of > 3 mm from the imaginary midline of the upper and middle face was recorded.
12. Occlusal interferences were used to calculate the interference score (horizontal and vertical distance RP-IP > 1.5 mm, lateral deviation >0.5 mm, and mediotrusion contact on one side were given 1 point each; horizontal and vertical distance RP -IP>2 mm, lateral deviation > 1.0 mm, and mediotrusion contact on both sides were given 2 points each).
13. The clinical CMD index was calculated for statistical testing at the age of 12 as follows: tenderness to palpation of the muscles of mastication was given 1 point, interincisal distance < 40 mm 1 point, and pain on maximal opening 1 point. At the age of 15 some additional variables were included in the index: pain on guided hinge closure 1 point, TMJ-sounds 1 point, tenderness to palpation of the TMJs 1 point, and deviation of the mandible during the opening movement >3 mm 1 point.

As far as the alignment of cusps and upper arch fossae are concerned, the following observations were made: non-linear alignment of cusps and lateroposterior maxillary teeth, intercuspal groove of the teeth parallel to the median axis of the palate, and staggered alignment of the vestibular surfaces between molars and premolars (Figure 2).

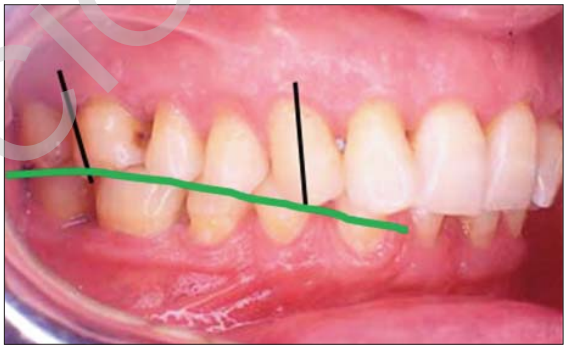

Figure 1 - A) Anti Spee and anti Monson; B) Vestibular cusps: superior kept and inferior worn.

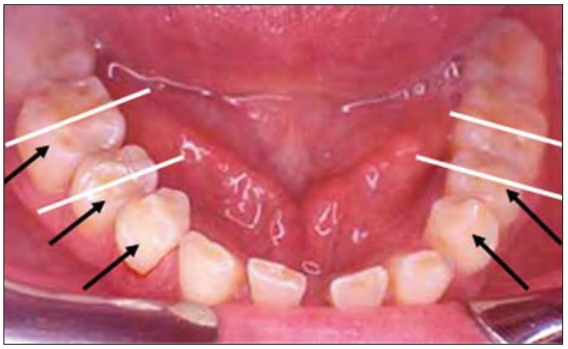

Figure 1 - B) Intercuspal groove of the teeth parallel to the median axis of the palate, staggered alignment of the vestibular surfaces between molars and premolars.

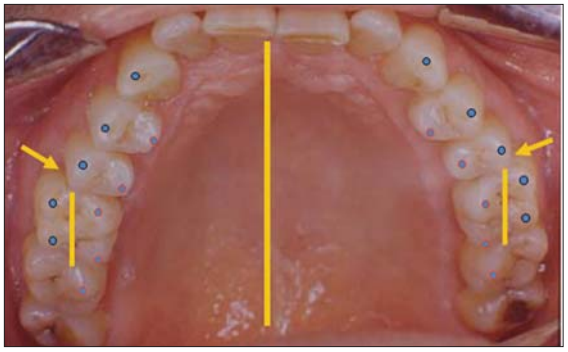

Figure 2 - Intercuspal groove of the teeth parallel to the median axis of the palate, staggered alignment of the vestibular surfaces between molars and premolars.

Figure 3 - Important role in stabilizing a group function on the working side is the disto-vestibular cusp of the first upper molar, which was found to be mesio-inclined (case studies).

Figure 4 - Extensive group contacts in the course of mandibular protrusion (A: right side; B: left side).

The maxillary and mandibular canines are the teeth best suited to absorbing and distributing horizontal forces while the posterior teeth are in malocclusion. Patients with these conditions are said to have a canine guidance. The most preferable alternative to canine guidance is the so-called group function (17,31). Any laterotrusive contact posterior to the mesial position of the first molar is counterproductive as a result of the increased force that leads to a closer approach to the fulcrum and the vector forces (32). In 96% of the patients in our study (22 out of 23), an important role in stabilizing a group function on the working side was the distovestibular cusp of the first upper molar, which was found to be mesioinclined (Figure 3). In order for this cusp to become involved in the group function, the upper molar must be perfectly positioned with its median axis parallel to the palatine raphe with respect to the median line of the palate, and the intercuspal groove must be parallel to the median line of the palate. To achieve extensive group contacts in the course of mandibular protrusion (Figure 4), wear of the front teeth must allow posterior malocclusion (Figure 5).(33)

Angle classes, median line asymmetry, tooth rotation and/or malpositioning, overbite, overjet, tooth wear and inflamed and receding gums are all factors that contribute to the great variability in the results observed. Crowding and disalignment, derotated positioning of the upper arches, absence of the curve of Spee, occlusal plane trend contrary to spherical theory, presence of group function on the working side, and malocclusion on the nonworking side seem to suggest that these factors, which are always present in all mouths, decisively contribute to the health of the masticatory apparatus in ways and in terms that remain to be elucidated. Among the constant contributory factors, it was noted that all of our patients are of the brachyfacial type, which is a genetic rather than an adaptive factor. This factor ensures a certain stability as regards the health of the stomatognathic apparatus.

Figure 5 - Important role in stabilizing a group function on the working side is the disto-vestibular cusp of the first upper molar, which was found to be mesio-inclined (case studies).

It may be concluded that it is impossible to label the following models that were found to be non predictive as pathological in the strict sense: angle classes, median-line asymmetry, tooth rotation and/or malpositioning, overbite, overjet, tooth wear, and inflamed and receding gums. In other words, the results seem to indicate that these fac-

tors may more logically be interpreted as the result of an evolutionary and adaptive process that is not necessarily pathological or in any way predictive of a pathology.
We suggest that the ubiquitously observed factors such as crowding and disalignment, derotated position of the upper arches, absence of the curve of Spee, occlusal plane trend contrary to spherical theory, presence of group function on the working side, and malocclusion on the non-working side are, together with genetic factors that affect facial typology, predictive of a condition of equilibrium and health of the dental arches (there were no hyperdivergent patients). We consider that these factors are merely the consequence of correct functioning within the framework of favorable environmental factors.

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