Original research

Kennedy Classification of Edentulous Arches in Patients Treated at a University Clinic in Cartagena

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ABSTRACT

Introduction: Edentulism is a public health problem caused by the accumulation of oral pathologies, affecting both the elderly population and the young population in unfavourable social conditions, causing negative effects on facial appearance, nutrition, and the abilities to eat, speak and socialise. Partial edentulism implies the absence of one or more teeth; this is classified according to the Kennedy method which is the most accepted among the dental community. **Objective:** To characterise partially edentulous dental arches in patients treated at a university dental clinic in Cartagena from 2015 to 2018. **Material and Methods:** A descriptive cross-sectional study was carried out using medical records. The sample was obtained using selection criteria. The current regulations for Colombia and the Declaration of Helsinki were considered; requests were made

for ethics approval and for permission to access the clinical archives. To collect the information, a registration form was designed and validated, used by four previously trained students. The descriptive analysis and the chi–square test, were developed using IBM® SPSS® Statistics software, version 11. **Results:** A total of 130 medical records were reviewed, of which 111 met the selection criteria. The female sex predominated with almost 75% of the clinical histories included. The most frequent reason for consultation was aesthetics, approaching 80%. Edentulism occurred in 47% in the mandible (95% CI: 37.31-56.55), followed by Bimaxillary edentulism. A statistically significant relationship was found with age, for the group of 46 to 63 years old with mandibular Class I according to Kennedy classification. **Conclusion:** The predominant type of partially edentulous dental arch was Class III in the maxilla and Class I in the mandible, according to Kennedy classification. There was no association between gender, the type of partial edentulism and the classification of the dental arches.

Keywords: Edentulous dental arch, Partially Edentulous dental arch, Dentistry.

INTRODUCTION

The World Health Organization (WHO) defines edentulism as the result of the accumulation of oral pathologies, representing a public health problem, in addition to being the reflection of the success or failure of preventive modalities established by a health system[1]. A prevalence greater than 10% has been reported in adults over 50 years of age, however, it is also a phenomenon that affects the younger population in unfavourable social conditions, with important effects on facial appearance, nutrition, as well as the abilities to eat, speak and socialise[2]. The main reported causes are the presence of dental caries, periodontal disease, systemic diseases because of trauma or sociodemographic level and questionable oral hygiene[3-5]. In the case of partial edentulism, where one or some natural teeth are absent, causes such as traumatic injuries, impactions, supernumerary teeth, neoplastic and cystic lesions have also been reported. In this type of edentulism, some intraoral consequences are generated, such as the inclination of adjacent teeth, overeruption of opposing teeth, negatively affecting dental occlusion, the temporomandibular joint, chewing, swallowing, phonation, aesthetics and socio-emotional factors[6].

Various methods are available to classify partial edentulism, such as those of Kennedy, Applegates, Avant, Neurohar, Eichner, American College of Prosthodontics; yet the Kennedy classification is the most studied and is widely accepted among the dental community for its simplicity, immediate visualization, prosthesis recognition, dental or tissue support and evaluation of the design features of removable partial denture. In the classification there are four classes of partially edentulous dental arches with probable modifications that can occur in one class[7]. Specifically, the following classes are found in Kennedy classification: Class I, where there are edentulous posterior areas bilaterally, Class II, where there is a unilateral posterior edentulous area, Class III, where there is a unilateral edentulous area with teeth located in front and behind it, Class IV where there is a unilateral anterior edentulous area that includes the midline. In addition to the classes previously described, modifications may be presented which indicate that in one case multiple edentulous areas are manifested and

that these modifications apply only to Classes I, II, III and never to Class IV, since the existence of another additional edentulous area to the one located in the anterior sector automatically changes the class[8,9].

In Colombia, it has been reported that about 71% of people have lost one or more teeth, where there is an association with age, in age groups of 15 years-old they have loss of up to one tooth while in the group of older adults the highest number of missing teeth is found[10]. Given this situation, the need arises to promote oral health care through good hygiene, control visits to the dentist and promote strategies aimed at reducing the rates of partial edentulism in the population to prevent the complete loss of teeth, as well as achieving the corresponding rehabilitation in current cases. For this reason, it is essential to have information concerning the dental arches in which the dental losses occur, the affected sector, the missing tooth or teeth, which can even help carry out prognostic activities for the same patients and prepare prosthetic designs in accordance with the need for the dental arch.

Although the pattern of tooth loss has been evaluated in many populations from different countries, in Colombia, especially in the city of Cartagena, according to the authors, there are no studies that assess partial edentulism and its classification. For this reason, the objective of this study is to characterise partially edentulous dental arches in patients treated at a private university dental clinic in Cartagena during the period from 2015 to 2018.

MATERIAL AND METHOD

A descriptive cross-sectional study was carried out in the Integral Clinic of the School of Dentistry of the *Universidad del Sinú*, Cartagena campus, from 2015 to 2018. The sample was built from the medical records completed in this period and were selected based on compliance with criteria. Medical records were included with the rehabilitation area component completed and with the authorization of the scientific research tutor. Medical records that reported the presence of total edentulism in the patient, medical records that lacked identification data and the patient's signature of informed consent, and records with illegible wording that did not allow their interpretation were excluded. To collect the information, the following were considered as dichotomous nominal qualitative variable: sex (female, male), as polytomous nominal qualitative variables: origin, year of assessment (2015, 2016, 2017, 2018), reason for consultation (control, pain, aesthetics, preventive/control, rehabilitation), partial edentulism location (bimaxilla, mandible, maxilla), Kennedy classification (I, II, III, IV, without edentulism), and modification of the classification[1-4,9].

A clinical assessment registration form was designed to capture data, which was previously subjected to a process of theoretical validation and review through the judgment of two experts, who determined the validity of the content, the sufficiency and relevance of the aspects valued and their categories.

For data collection and storage, four students from the dental area were previously trained in a standardised way to review the medical records and the respective registration in the file. Once the information was captured, it was tabulated into a Microsoft® Excel for Windows® matrix, which was then transferred to IBM® SPSS® Statistics software, v. 11. Subsequently, it was decided to apply descriptive statistics (frequencies, proportions and percentages) with 95% confidence intervals, and to establish an association between variables, the chi-squared statistical test was applied with a *p* value of 0.05.

The research protocol considered the national regulations in force in Colombia set out in resolution 008430 of 1993 and the Declaration of Helsinki, it was reviewed and approved by the Internal Ethics Committee of the dentistry program as recorded in folio 4022019. Similarly, the request for permission to access the institutional archive for academic and research purposes was requested, considering the modifications and waivers of informed consent included in the special conditions for using data from health records set out in the international ethical guidelines for health-related research with humans, from the Council for International Organizations of Medical Sciences (CIOMS).

RESULTS

A total of 130 medical records were reviewed, of which 111 met the selection criteria. The mean age of the registered patients was 50.28 years (SD=11.21), with a minimum age of 21 years and a maximum of 82 years. Female patients predominated with almost 75% of the medical records included, and 58% of the patients came from the city of Cartagena, while the remaining percentage comes from rural areas and other departments.

Concerning the distribution by year of assessment of the patients registered in the medical records, more than half were admitted and assessed in 2016, and only one record was included from 2018. The most frequent reason for consultation found was for aesthetic purposes in more than 79%, followed by rehabilitation in almost 12%, which reflects the high concern of patients for their physical and aesthetic appearance (Table 1) and the little interest or need to attend consultations for control or preventive purposes.

Table 1.
Distribution of patients registered in medical records from 2015 to 2018, by year of assessment and reason for consultation.

Variable	n=111	%
Year of assessment		
2015	18	16.2
2016	61	55.0
2017	31	27.9
2018	1	0.9
Reason for consultation		
Control	1	0.9
Pain	6	5.4
Aesthetics	88	79.3
Preventive/Control	3	2.7
Rehabilitation	13	11.7

Source: authors' own elaboration based on collected data.

Regarding the location of the partially edentulous dental arch, it was found that 47% of edentulism occurred in the mandible (95%CI=37.31-56.55) followed by bimaxillary edentulism. Meanwhile, in the classification of the edentulous dental arch for the maxilla, Class III

predominated in 20.7% (95%CI= 13.61-29.4), with modification 1 being the most frequent for all classifications with 18% (95% CI= 11.36- 26.44). The least frequent was modification 4, which occurred in less than 1%. In the case of the mandibular edentulous dental arch, Class I was the most frequent with 38.7% (95%CI = 29.6-48.4) followed by Class II at 26.1% (95%CI = 18.2-35.3), with modification 1 being the most reported with 32.4% (95%CI= 23.8-41.9) (Table 2).

Table 2.
Location of edentulism, classification of the edentulous dental arch according to Kennedy and modifications in patients registered in medical records from 2015 to 2018.

Variable	n	%	CI 95%
Location of edentulism			
Bimaxillary	48	43.2	33.87-52.98
Mandible	52	46.8	37.31-56.55
Maxillary	11	9.9	5.0-17.0
Kennedy classification for maxillary edentulous arch			
I	17	15.3	9.18-23.3
II	18	16.2	9.9-24.4
III	23	20.7	13.61-29.4
IV	1	0.9	0-4.9
Without edentulism	52	46.8	37.31-56.55
Maxillary arch modification			
1	20	18.0	11.36-26.44
2	15	13.5	7.7-21.3
3	4	3.6	0.9-8.9
4	1	0.9	0-4.9
Kennedy classification for mandibular edentulous arch			
I	43	38.7	29.6-48.4
II	29	26.1	18.2-35.3
III	27	24.3	16.6-33.3
Without edentulism	12	10.8	5.7-18.1
Mandibular arch modification			
1	36	32.4	23.8-41.9
2	21	18.9	12.1-27.45

Source: authors' own elaboration based on collected data.

When reviewing Kennedy classification with respect to sex, Class I predominated in the female maxilla, followed by Class III, while for men the most frequent class was Class III, followed by Class II. In the mandible, Class I predominated for women, followed by Class II, and for men Class III, followed by Class I (Table 3). Nevertheless, no statistically significant association was found when the sex variable was related to the classification of the dental arch according to the Kennedy classification for the maxilla and mandible (*p* value 0.09 and 0.49 respectively).

Table 3.
Distribution pattern of partial edentulism according to sex.

Maxillary		Re-count (%)	Class I	Class II	Class III	Class IV	Total
Female	n (%)	39(75)	16(94.1)	14(77.8)	13 (56.5)	1 (100)	83 (74.8)
Male	n (%)	13(25)	1(5.9)	4(22.2)	10 (43.5)	0 (0)	28 (25.2)
Total	n (%)	52(100)	17(100)	18(100)	23 (100)	1 (100)	111
Mandible							
Female	n (%)	8 (66.7)	35 (81.4)	22 (75.9)	18 (66.7)	0 (0)	83 (74.8)
Male	n (%)	4(33.3)	8 (18.6)	7 (24.1)	9 (33.3)	0 (0)	28 (25.2)
Total	n (%)	12 (100)	43 (100)	29 (100)	27 (100)	0 (0)	111

Regarding the presence of edentulism considering the age groups, the age group for which the most cases were identified was 46 to 63 years. When reviewing the distribution of the classification of the dental arch according to age groups, it was presented that for the maxilla in the group of 28 to 45 years the distribution for Classes I, II and III was similar. In the group from 46 to 63 years old, Class III predominated and for the group from 64 to 82 years old, the most frequent class was Class II. With reference to the mandible, Class II predominated in the 28-45 age group, while Class I was the most frequent class in the 46-63 and 64-82 age groups. A statistically significant association was found when relating the age variable, for the group of 46 to 63 years with Class I according to Kennedy classification for the mandible (Table 4).

Table 4.
Distribution pattern of partial edentulism according to age.

Maxillary								
Age		Class I	Class II	Class III	Class IV	Total	X^2	p value
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)		
28 a 45	14 (26.9)	8 (47.1)	8 (44.4)	7 (30.4)	1 (100)	38 (34.2)		
46 a 63	28 (53.8)	9 (52.9)	9 (50.0)	16 (69.6)	0 (0)	62 (55.9)	14.01	0.08
64 a 82	10 (19.2)	0 (0)	1 (5.6)	0 (0)	0 (0)	11 (9.9)		
Total	52 (100)	17 (100)	18 (100)	23 (100)	1 (100)	111 (100)		
Mandible								
28 a 45	6 (50.0)	8 (18.6)	13 (44.8)	11 (40.7)	0 (0)	38 (34.2)		
46 a 63	6 (50.0)	25 (58.1)	15 (51.7)	16 (59.3)	0 (0)	62 (55.9)	18.29	0.006*
64 a 82	0 (0)	10 (23.3)	1 (3.4)	0 (0)	0 (0)	11 (9.9)		
Total	12 (10.8)	43 (38.7)	29 (26.1)	27 (24.3)	0 (0)	111 (100)		

*p value <0.05

DISCUSSION

The present study allowed the review of dental medical records from 2015 to 2018, although there were limitations such as access to the archive due to the availability of the schedule and the intersection with activities of the collectors. It is considered satisfactory to achieve a compliance rate for inclusion of 85.3% of the reviewed records.

It is interesting that some of the patients recorded in the histories have origins other than the city of Cartagena, both from other departments and from rural areas. The latter allows us to have a baseline of orientation, to propose future studies focused on the behaviour of edentulism in rural areas combined with dental care. Given that the largest number of dentists, dental schools and hospitals are concentrated in cities, there is limited access to specialised dental services in rural areas, such as orthodontics, oral and aesthetic rehabilitation[11]. This may also force these patients to travel to the city of Cartagena to receive care.

In the literature, it has been established that edentulism is greater in older age groups and is due to multiple factors, including difficulty performing oral hygiene procedures due to systemic diseases or functional disability. This has been reported in some studies such as Fouda *et al.*, 2017 in Saudi Arabia[12], for the age group over 70 years (35.7%) and confirmed in the study by Almusallam *et al.*, 2020 in the same country[13]. The latter found a significant statistical association between age and edentulism, where 82% of the participants who became completely toothless belonged to the oldest group. Although in the present study the oldest age range was 64 to 82 years, the 46 to 63 age group (55.9%) was the one in which the most cases were reported. Perhaps this can be explained considering that older adults sometimes do not attend dental appointments because they perceive that appointments are difficult to get if they are not in a special program for systemic diseases such as hypertension or diabetes. Likewise, because they do not have the financial means to pay for expensive treatments that are not covered by the mandatory health plan, or because they have minimal access to goods and services during their older adulthood, their health status deteriorates in either case.

Regarding the distribution by sex found in the medical records, there was a predominance of women, which could be due to biological differences in the incidence and prevalence of health conditions between women and men, where women probably have a higher prevalence of dental caries and periodontal diseases. Also, it can be explained by the socially constructed characteristics of men and women, which end up influencing the relationship between gender and access to dental services[14], and this is an interesting topic to focus on in future research. At the same time, it could be assumed that there is a greater number of women with partial edentulism, but this phenomenon cannot be affirmed when the distribution in the sex variable was unequal since the study was based on medical records and does not necessarily reflect the real behaviour of edentulism. Therefore, it is recommended in future studies to consider a descriptive cross-sectional design that implies the possibility of calling patients to carry out a sampling among the population of clinic attendees and assess edentulism. In the study by Ghiță *et al.*, 2019[15], the distribution of partial edentulism was very close between women and men, although in men it was relatively lower even though it has traditionally been considered that men have poor oral hygiene habits and a lower need and willingness to seek dental care.

With reference to the location of partial edentulism, mandibular partial edentulism is more common than maxillary partial edentulism, which is similar to what was reported by Ghiță *et al.*, 2019[15]. The predominance of mandibular partial edentulism could indicate that the greatest loss of teeth is occurring in this dental arch and therefore there is a smaller number of natural teeth remaining in the mandible. For this reason, in future studies it would be important to consider the average number of remaining natural teeth, as shown in the results of Ribeiro *et al.* 2016[16], where the average for the mandible was 5.2 (± 5.4), exceeding the average for the maxilla with 3.5 (±5.2). These studies would make it possible to identify the teeth that remain in the mouth, and serve as a reference for the design and planning of treatments to be established in these patients in the future.

Regarding the Kennedy classification in the maxilla, the predominance of Class III coincides with what was reported by Ghiță *et al*.,[15] 2019 and Fayad *et al*., 2016[15,17]. Still, in the last study the reported figure almost triples the findings found in our research and it is also interesting that class II occupies second place for the maxilla. Nonetheless, for the edentulous dental arch in the mandible, Class I was the most frequent class in the present investigation, contrary to the findings of Ghiță *et al*.,[15] 2019 in Romania and Huamanciza *et al*.,[18] 2019 in Peru, where Class III was the most frequent for the mandible.

It is important to highlight that both in the present study and that of Huamanciza *et al*., 2019[18] no patient presented class IV in the mandible. This finding could be useful if it is considered as a reference regarding the conservation of natural remnant teeth in the ante-ro-mandibular sector, a very important aspect that can have a positive effect on the dental aesthetics and self-esteem of patients.

The differences reported between the studies could be due to cultural aspects, diet and oral hygiene habits among others, thus causing variations in the risk experienced by the studied populations to develop dental caries, periodontal disease or other reported causes for the loss of dental organs.

CONCLUSION

The predominant type of partially edentulous dental arch for the maxilla was Kennedy Class III and for the mandible it was Class I. At the same time, it was evident that Kennedy Class IV was the least common. There was no association between the gender variable and the type of partial edentulism and the classification of partially edentulous dental arches.

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