



## MAIN REASONS FOR TOOTH LOSS IN AN ADULT POPULATION SAMPLE

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### ABSTRACT

Oral health has a great impact on individual's quality of life and it can be significantly reduced with the loss of teeth. The aim of this study was to analyze the etiology of dental extraction in an adult population and the therapeutic choices of rehabilitation. Methodology consisted in recording tooth extractions during an eight-month time gap, as well as age, gender, reasons for extraction and prosthetic rehabilitation. A total of 241 patients were assessed, from which 609 dental extractions were performed. The most affected patients were men over 45 years old and the main reasons for tooth extraction were dental caries and periodontal disease affecting the upper maxilla. The preferred prosthetic rehabilitation were partial removable dentures followed by implant-supported rehabilitation.

**KEYWORDS:** Tooth extraction; Tooth loss; Adult; Epidemiology.

### INTRODUCTION

Oral health care plays an essential role in general health, being essential for the achievement of an adequate quality of life.<sup>[1]</sup> Tooth loss, depending on the number and location of the missing teeth, produces esthetic and functional alterations in many situations, worsening the patient's quality of life and leading to both biological, psychological and social implications.<sup>[2,3]</sup>

During the last years, Dentistry has leaned towards more conservative approaches based on the avoidance of tooth extractions and the maintenance of the natural dentition. However, tooth extraction, in certain cases, is the only viable therapeutic option.<sup>[4,5]</sup>

Tooth extraction is the endpoint of a variety of diseases and conditions affecting the dentition and among the most frequent causes, dental caries and periodontal diseases are found to be the leaders.<sup>[4,6]</sup> Cahen et al.<sup>[7]</sup> reports dental caries as the main cause of tooth extraction while other authors such as Phipps et al.<sup>[8]</sup>, establish periodontal diseases as the main reason. Others, like Ong et al.<sup>[9]</sup>, give equivalent weight to these two factors in the etiology of tooth loss. Additionally, Nuvvula et al.<sup>[10]</sup>, suggest that there exist several situations in which tooth extraction is a necessary therapeutic option, including

failed treatments, traumatism, tooth fractures, prosthodontics indications or patients' decision among some of them.

Thus, we think it is necessary to assess the most frequent causes of tooth loss, helping to establish a suitable preventive protocol for our patients, avoiding the extraction as the only reliable treatment plan. In the same way, it is important to determine which prosthetic rehabilitation best fits the individual treatment plan and restores the quality of life for each patient.

The aim of this observational study is to describe the epidemiological aspects of adult patients who attended the Dental Hospital at the Complutense University School of Dentistry (Spain) needing dental extractions, to determine the most frequent etiology for tooth loss in these patients and to identify the first-election treatment chosen by the patients for the replacement of the missing teeth.

### METHODOLOGY

This study is reported according to the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidelines.

### Study design

An observational, cross-sectional study was carried out according to the following methodology. This study was approved by the Ethical Committee (n° 19/357-E) and stands by the ethical principles of the Declaration of Helsinki.<sup>[11]</sup>

### Sample selection and setting

All patients who needed tooth extractions and attended the Dental Hospital at the Complutense University School of Dentistry (Madrid, Spain) seeking dental care during the study period were included in the selection process. The recruitment period was from September 2018 to May 2019.

### Data collection

Data for this study were obtained through survey forms filled by the clinician attending each patient. All the patients signed an Informed Consent form previous to their inclusion in this study and the data were processed according to the Organic Law 3/2018 for the Protection of Personal Data and Guarantee of Digital Rights.

### Eligibility criteria

The following inclusion criteria were considered: (1) patients over the age of 18, (2) patients in need for tooth extractions and (3) availability of the full medical history of the patient.

### Study variables

All the data obtained through the survey forms were gathered using an Excel sheet (Microsoft Corporation, Redmond, WA, USA).

### Independent variables

Gender was recorded as male or female. Patients were grouped by age to simplify data processing in the following manner: group 1 (G1) 18 to 24 years old; group 2 (G2) 25 to 34 years old; group 3 (G3) 35 to 44 years old; group 4 (G4) 45 to 54 years old; group 5 (G5) 55 to 64 years old; and group 6 (G6) 65 years old or more. Grouping by country of origin was also performed: Spain, Latin America, remainder of Europe and other countries. The extracted teeth were recorded according to the FDI World Dental Federation nomenclature and categorized in two manners, first as: central incisors, lateral incisors, canines, first premolars, second premolars, first molars, second molars and third molars. Secondly, according to their location in the maxilla or the mandible.

### Dependent variables

Reasons for tooth extraction, at tooth level, were categorized as: caries, periodontal diseases, absence of space, crown fracture, root fracture, infectious reasons or absence of antagonist. Data on whether each of the extracted teeth had received previous endodontic treatment was also recorded and dichotomized: yes or no.

Rehabilitation treatment, at patient level, was categorized as: implant-supported rehabilitation, complete removable denture, partial removable denture, fixed prosthodontics and no rehabilitation (either due to patient choice or the lost tooth being a third molar). The choice of treatment was selected in mutual agreement between the patient and the clinician.

### Statistical analyses

All statistical analyses were carried out with SPSS 21.0 software (IBM Corp., Armonk, NY, USA). Categorical variables were reported as number (%). A descriptive analysis was carried out and associations between variables were assessed through Chi Square test, setting the significance level at  $p < 0.05$ .

## RESULTS

### Sample analysis

1520 adult patients that attended the Dental Hospital at the Complutense University School of Dentistry during the recruitment period were included in this study. 241 patients (10.5%) needed dental extractions as a part of their treatment, amounting a total of 609 extractions.

This 241-patient sample was composed of 115 females (47.7%) and 126 males (52.3%). Their mean age was  $56.87 \pm 15.56$  years old, ranging from 19 to 90 years old. According to the groups established previously, the age distribution within the study sample was: G1 3.7%; G2 5.0%, G3 10.8%, G4 26.6%, G5 18.3%, G6 35.7%.

Regarding the country of origin of the patients, 85.5% came from Spain, 8.7% from South America, 3.7% from the rest of Europe and 2.1% from other countries (Table 1).

In relation to the gender of the patients, extractions were more frequent in males compared to females, with 392 (64.4%) and 217 (35.6%) extractions respectively, yielding a male-female ratio of 1.8: 1 ( $p < 0.05$ ).

The age group amounting for the most dental extractions was G6 receiving a total of 201 extractions (33%), followed by G4 with 160 extractions (26.3%). G1 and G2 were the groups that needed the least number of extractions (15 each). However, no statistically significant differences ( $p > 0.05$ ) could be found in the number of teeth extracted.

According to country of origin, 539 extractions were performed in Spanish patients (88.5%), 27 in patients from Latin America (4.4%) and 18 in patients from other European countries (2.9%). The remaining 25 extractions correspond to patients from regions other than those previously mentioned (4.1%). Statistically significant differences were found ( $p < 0.05$ ) (Table 2).

Regarding the location of the extractions, 345 were performed in the maxilla (56.7%) and 264 in the mandible (43.4%), no differences could be found

between different age groups, gender or origin of the patient.

When analyzing the extractions performed according to the dental group, we observed that third molars were the most frequently extracted teeth (21.2%), followed by second molars and first molars (15.8% and 14% respectively). The least frequently extracted teeth were canines (7.2%) followed by lateral incisors (10.8%) (Fig.1).

When studying the relationship between extractions and different age groups, we observed a higher frequency of third molar extraction in younger patients (G1: 66.7% and G2: 60%) compared with elderly patients (G5: 17% and G6: 13.4%), being this difference statistically significant ( $p < 0.001$ ). However, no statistically significant differences were found between gender or origin of the patients and the extraction of a certain dental group.

### Extraction reasons (Table 3)

The most frequent reasons for tooth extraction were caries (61.1%) and periodontal diseases (16.1%). Other less frequent extraction reasons were: lack of antagonist (9.4%), lack of space (5.7%), coronary fracture (3.9%), root fracture (3.0%) and infectious cause (0.8%), being this last the least frequent (Figure 2).

From the overall extracted teeth, 106 were received a root canal treatment previously (17.4%), of which 59.4% had performed more than 5 years ago. Although caries is the most common reason for tooth extraction of endodontically treated teeth (61.5%), there exists a higher percentage of coronal and radicular fractures (17.3% and 14.4% respectively) compared to non-treated teeth ( $p < 0.001$ ).

Regarding the relationship between the extraction reason and the age of the patients, the highest number of extractions due to dental caries was performed in groups G3, G4 and G5 (71.1%, 63.8% and 60% respectively), while extractions associated with periodontal diseases were more frequent in groups G4, G5 and G6 (13.8%, 24.4% and 21.4% respectively). The lack of space associated with the eruption of the third molar led to a greater number of extractions in groups G1, G2 and G3 (46.7%, 20% and 13.3% respectively). Finally, the G6 was the group in which the most dental fractures associated extractions were performed (12%). All these differences were statistically significant.

In relation to gender, caries led more frequently to tooth extraction in males (65.8%) compared to females (52.5%). However, females received more extractions due to periodontal causes (17.5%) and root fractures (5.1%) than males (15.3% and 1.8% respectively), these differences were statistically significant ( $p < 0.05$ ).

### Prosthetic Rehabilitation (Table 4)

The most frequent prosthetic rehabilitation were partial removable dentures (PRD: 41.7%), followed by implant-supported rehabilitations (17.1%) and complete dentures (CD: 15.1%).

When comparing age groups in relation to rehabilitation methods, significant differences were found ( $p < 0.05$ ). The elder (G5 and G6) are more frequently rehabilitated with PRD (51.1% and 57.7% respectively), followed by rehabilitation with dental implants in G6 (15.9%) and CD in G5 (16.3%). In contrast, younger groups (G1 and G2) tend to lean towards implant-supported rehabilitations (33.3% and 26.7% respectively).

Regarding gender, there is a higher frequency of rehabilitation through PRD (42.3%) and CD (19.6%) in the male population in comparison to females (40.6% and 6.9%). While females tend to choose implant-supported rehabilitations (22.1%), being less frequent in males (14.3%).

**Table 1: Sample characteristics: gender, sex and origin.**

| Sample characteristics |                | Patients |      |
|------------------------|----------------|----------|------|
|                        |                | n        | %    |
| Gender                 | Male (M)       | 126      | 52.3 |
|                        | Female (F)     | 115      | 47.7 |
| Age                    | G1 (18-24)     | 9        | 3.7  |
|                        | G2 (25-34)     | 12       | 5    |
|                        | G3 (35-44)     | 26       | 10.8 |
|                        | G4 (45-54)     | 64       | 26.6 |
|                        | G5 (55-64)     | 44       | 18.3 |
|                        | G6 (>65)       | 86       | 35.7 |
| Origin                 | Spain          | 206      | 85.5 |
|                        | Latin America  | 21       | 8.7  |
|                        | Rest of Europe | 9        | 3.7  |
|                        | Others         | 5        | 2.1  |

n: number of patients; % of patients

**Table 2. Extracted teeth: gender, sex and origin.**

| Sample characteristics |                | Teeth |      |     | p-value   |
|------------------------|----------------|-------|------|-----|-----------|
|                        |                | n     | %    | □   |           |
| Gender                 | Male (M)       | 392   | 64.4 | 3.1 | $p=0.013$ |
|                        | Female (F)     | 217   | 35.6 | 1.9 |           |
| Age                    | G1 (18-24)     | 15    | 2.5  | 1.7 | $p=0.205$ |
|                        | G2 (25-34)     | 15    | 2.5  | 1.3 |           |
|                        | G3 (35-44)     | 83    | 13.6 | 3.2 |           |
|                        | G4 (45-54)     | 160   | 26.3 | 2.5 |           |
|                        | G5 (55-64)     | 135   | 22.2 | 3.1 |           |
|                        | G6 (>65)       | 201   | 33   | 2.3 |           |
| Origin                 | Spain          | 539   | 88.5 | 2.6 | $p=0.034$ |
|                        | Latin America  | 27    | 4.4  | 1.3 |           |
|                        | Rest of Europe | 18    | 2.9  | 2   |           |
|                        | Others         | 25    | 4.1  | 5   |           |

n: number of teeth; % of teeth; □: mean number of teeth extracted.

**Table 3: Relationship between the reason of tooth extraction and the age, gender and origin of the patients.**

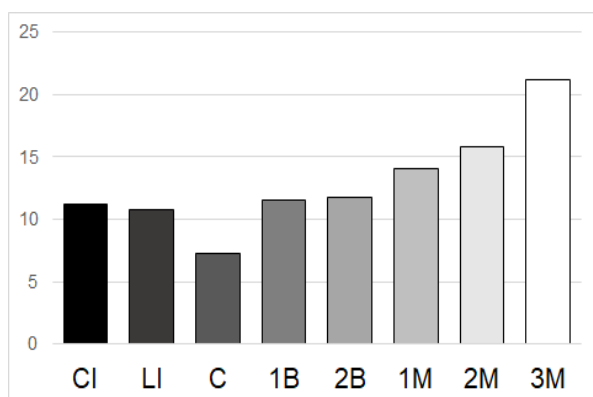
| Sample characteristics |            | Reasons for tooth extraction |      |                     |      |               |      |                |     |               |     |           |     |                    |      | p-value |
|------------------------|------------|------------------------------|------|---------------------|------|---------------|------|----------------|-----|---------------|-----|-----------|-----|--------------------|------|---------|
|                        |            | Caries                       |      | Periodontal disease |      | Lack of space |      | Crown fracture |     | Root fracture |     | Infection |     | Lack of antagonist |      |         |
|                        |            | n                            | %    | n                   | %    | n             | %    | n              | %   | n             | %   | n         | %   | n                  | %    |         |
| Gender                 | Male (M)   | 258                          | 65.8 | 60                  | 15.3 | 20            | 5.1  | 16             | 4,1 | 7             | 1,8 | 3         | 0,8 | 28                 | 7,1  | p=0.013 |
|                        | Female (F) | 114                          | 52.5 | 38                  | 17.5 | 15            | 6.9  | 8              | 3,7 | 11            | 5,1 | 2         | 0,9 | 29                 | 13,4 |         |
| Age                    | G1 (18-24) | 5                            | 33.3 | 0                   | 0    | 7             | 46.7 | 0              | 0   | 0             | 0   | 0         | 0   | 3                  | 20   | p=0.000 |
|                        | G2 (25-34) | 8                            | 53.3 | 0                   | 0    | 3             | 20   | 0              | 0   | 0             | 0   | 0         | 0   | 4                  | 26.7 |         |
|                        | G3 (35-44) | 59                           | 71.1 | 0                   | 0    | 11            | 13.3 | 1              | 1.2 | 1             | 1.2 | 0         | 0   | 11                 | 13.3 |         |
|                        | G4 (45-54) | 102                          | 63.8 | 22                  | 13.8 | 13            | 8.1  | 6              | 3.8 | 2             | 1.3 | 2         | 1.3 | 13                 | 8.1  |         |
|                        | G5 (55-64) | 81                           | 60   | 33                  | 24.4 | 1             | 0.7  | 2              | 1.5 | 6             | 4.4 | 0         | 0   | 12                 | 8.9  |         |
|                        | G6 (>65)   | 117                          | 58.2 | 43                  | 21.4 | 0             | 0    | 15             | 7.5 | 9             | 4.5 | 3         | 1.5 | 14                 | 7    |         |

n: number of patients; % of teeth

**Table 4: Relationship between prosthetic rehabilitation and the age, gender and origin of the patients.**

| Sample characteristics |            | Prosthetic rehabilitation |      |                 |      |               |      |    |      |    |     |     |      | p-value |
|------------------------|------------|---------------------------|------|-----------------|------|---------------|------|----|------|----|-----|-----|------|---------|
|                        |            | Implant                   |      | No, third molar |      | No reposition |      | CD |      | FD |     | PRD |      |         |
|                        |            | n                         | %    | n               | %    | n             | %    | n  | %    | n  | %   | n   | %    |         |
| Gender                 | Male (M)   | 56                        | 14.3 | 60              | 15.3 | 27            | 6.9  | 77 | 19.6 | 6  | 1.5 | 166 | 42.3 | p=0.000 |
|                        | Female (F) | 48                        | 22.1 | 40              | 18.4 | 22            | 10.1 | 15 | 6.9  | 4  | 1.8 | 88  | 40.6 |         |
| Age                    | G1 (18-24) | 5                         | 33.3 | 10              | 66.7 | 0             | 0    | 0  | 0    | 0  | 0   | 0   | 0    | p=0.000 |
|                        | G2 (25-34) | 4                         | 26.7 | 8               | 53.3 | 3             | 20   | 0  | 0    | 0  | 0   | 0   | 0    |         |
|                        | G3 (35-44) | 10                        | 12   | 22              | 26.5 | 4             | 4.8  | 23 | 27.7 | 0  | 0   | 24  | 28.9 |         |
|                        | G4 (45-54) | 36                        | 22.5 | 26              | 16.3 | 15            | 9.4  | 34 | 21.3 | 4  | 2.5 | 45  | 28.1 |         |
|                        | G5 (55-64) | 17                        | 12.6 | 16              | 11.9 | 7             | 5.2  | 22 | 16.3 | 4  | 3   | 69  | 51.1 |         |
|                        | G6 (>65)   | 32                        | 15.9 | 18              | 9    | 20            | 10   | 13 | 6.5  | 2  | 1   | 116 | 57.7 |         |

n: number of teeth; % of teeth; CD: Complete Denture; FD: Fixed Denture; PRD: Partial Removable Denture



**Figure 1: Number of teeth extracted per tooth type.** CI: central Incisor; LI: lateral Incisor; C: canine, 1B: 1st bicuspid; 2B: 2nd bicuspid; 1M: 1st molar; 2M: 2nd molar, 3M: 3rd molar.

## DISCUSSION

The results of this study indicate that, during the 2018/19 academic year at the Complutense University Dental Hospital, dental caries and its complications were the main reasons of dental extraction (61.1%), followed by periodontal diseases (16.1%). Exodontia were most frequently performed on third (21.2%), second (15.8%) and first molars (14%) and least frequently in canines (7.2%) and lateral incisors (10.8%). The extracted teeth were primarily rehabilitated through PRD (41.7%), implant-supported rehabilitations (17.1%) and CD (15.1%).

The finding that third molars were the most frequently extracted teeth matches with that of previous studies such as Lee et al.<sup>[6]</sup>, Aida et al.<sup>[12]</sup>, Angelillo et al.<sup>[13]</sup>, Alesia et al.<sup>[14]</sup>, Medina-Solis et al.<sup>[15]</sup>, mainly due to the presence of caries, absence of antagonistic tooth and lack of space.<sup>[6, 12-15]</sup>

Dental caries and periodontal diseases resulted as the primary reasons for exodontia. These results are in agreement with most of the studies available in the literature.<sup>[5, 10, 16, 17]</sup> However, they differ from those obtained by Alesia et al.<sup>[14]</sup>, who reported orthodontic and dental eruption problems as the second most prevalent causes of exodontia. The authors justify this as the result of a decrease in the prevalence of periodontal diseases due to the implementation of preventive programmes and the increase in orthodontic treatments due to the rising aesthetic demand by patients.

As in other studies, the most affected patients were those between 45 - 54 years (G4) and over 65 years (G6). This may be due to the fact that, in the past, the population had limited access to dental services, and only a minority of the population could afford them. In addition, there was less awareness on the importance of oral hygiene, increasing the risk and incidence of oral pathology.<sup>[4, 6, 12, 15, 18]</sup>

Males had a higher frequency of tooth loss coinciding with other studies described in the literature. This result

can be related to a higher demand for health care by women, along with dietary or behavioral differences between genders, such as smoking.<sup>[19,20]</sup> Unlike our study, which shows a higher number of caries-related exodontia in males, and periodontal-disease-related extractions in the females, others studies show a higher percentage of extractions associated with both caries and periodontal diseases in women.<sup>[14,15]</sup>

In relation to the rehabilitation treatment, the results indicate that the most frequently chosen therapeutic option was partial or complete removable prostheses, perhaps due to their lower cost compared to implant-supported prostheses,<sup>[21]</sup> despite the fact that the latter provide a better quality of life.<sup>[22]</sup>

Older patients opted for different treatment options than younger patients. As a first therapeutic option, patients over 55 years old choose PRD; while individuals under 25 years old opt for implant-supported rehabilitations. Although advanced age is not a contraindication for implant treatment, geriatric patients often entail more complex medical cases usually involving multiple systemic diseases and poly medication that must be taken into account before implant placement and that increase the risk of side effects associated with surgery, as in those cases of prolonged treatment with oral bisphosphonates.<sup>[23,24]</sup> Moreover, it is important to assess the cognitive and motor capacity of these patients to ensure the maintenance of peri-implant health and attendance to regular check-ups.<sup>[23]</sup> On the other hand, implant rehabilitations have shown high long-term survival rates allowing to improve the quality of life of the patients by enhancing aesthetics, phonation ability, comfort and chewing capacity due to a better retention.<sup>[24-28]</sup>

One of the limitations of this study was that the sample was only formed by patients attending the University Dental Hospital, most of them of Spanish origin. In addition, due to the lower cost of dental treatments offered by the center, patients who request dental care tend to have a lower socioeconomic status, thus often resorting to cheaper therapeutic options. The sample size is relatively small compared to the population of the Community of Madrid, preventing the extrapolation of the results to the general population.

## CONCLUSION

The present study reveals a greater frequency of dental extraction in male patients over 45 years of age, affecting primarily the upper maxilla. Particularly, third molars were the most affected teeth and dental caries and periodontal diseases the main reasons for exodontia. The most common rehabilitation methods were removable dentures and implant-supported prostheses.

The importance of preventive treatments and early diagnosis of the most common dental diseases needs to be emphasized to avoid their progression to advanced

stages, where tooth extraction is the only possible therapeutic option. However, it is important to increase the sample size of this study to obtain more conclusive results.

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