



Sociodemographic and clinical factors associated to survival of endodontically treated teeth conducted by undergraduate dentistry students. Medellin (Colombia)

Factores sociodemográficos y clínicos asociados a la supervivencia de dientes tratados endodónticamente por estudiantes de pregrado. Medellín (Colombia)

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ABSTRACT

Objective: To determine clinical and sociodemographic factors associated to survival of endodontically treated teeth. The present study was conducted by undergraduate students of the Faculty of Dentistry (Medellin, Colombia) during the period 2007-2011. **Material and methods:** Retrospective, longitudinal study with survival analysis through consultation with clinical histories according to inclusion criteria, and, further ahead, patient examination. Global survival was calculated with the use of Kaplan-Meier analysis, and curves were compared with log rank test. Cox proportional risk model was used for multivariate analysis, adjusted HR association was obtained with a 95% confidence interval. **Results:** Sociodemographic and clinical variables with statistically significant association were: education level, type of health affiliation, initial diagnosis and restoration type. Teeth remaining for three years after endodontic treatment were 78%, whereas 57% survived for over six years. Tooth survival mean in treated patients was 1,959 days (standard error: 66.9 days). Multivariate model showed that tooth loss speed was greater in multi-rooted teeth (HR 2.38, CI 95% 1.23-4.60) as well as in teeth with initial diagnosis of acute apical abscess (HR 27.96, CI 95%, 1.84-423.09). **Conclusion:** Clinical and sociodemographic factors were identified, associated to survival of endodontically treated teeth, this allowed to establish epidemiological monitoring systems in order to assess dental care quality.

Key words: Endodontics, tooth extraction, follow-up studies, survival analysis.

Palabras clave: Endodoncia, extracción dental, estudios de seguimiento, análisis de supervivencia.

RESUMEN

Objetivo: Determinar los factores sociodemográficos y clínicos asociados con la supervivencia de dientes tratados endodónticamente por estudiantes de pregrado de la Facultad de Odontología-Universidad de Antioquia (Medellín, Colombia), durante el periodo 2007-2011. **Material y métodos:** Estudio longitudinal retrospectivo con análisis de supervivencia por medio de las historias clínicas según los criterios de inclusión y posteriormente se examinaron a los pacientes. La supervivencia global se calculó utilizando el análisis de Kaplan-Meier, y las curvas se compararon a través del *log rank test*. Para el análisis multivariado se realizó el modelo de riesgos proporcionales de Cox, obteniendo la medida de asociación HR ajustada, con su intervalo de confianza al 95%. **Resultados:** Las variables sociodemográficas y clínicas con asociación estadísticamente significativa fueron nivel de educación, tipo de afiliación a salud, diagnóstico inicial y tipo de restauración. Los dientes que permanecen después de un tratamiento endodóntico durante los primeros tres años es del 78% y los que sobreviven por más de seis años es del 57%. La media de supervivencia de los dientes en los pacientes atendidos es de 1,959 días (error estándar de 66.9 días). El modelo multivariado mostró que la velocidad de pérdida del diente fue mayor en multirradiculares (HR 2.38; IC 95% 1.23-4.60) y en aquellos con diagnóstico inicial de absceso apical agudo (HR 27.96; IC 95% 1.84-423.09). **Conclusión:** Se identificaron factores sociodemográficos y clínicos asociados con la supervivencia de los dientes tratados endodónticamente, lo que permite establecer sistemas de vigilancia epidemiológica para evaluar la calidad de la atención odontológica.

INTRODUCTION

In any endodontic treatment, one of the main targets is to restore health to tissue surrounding the root, allowing tooth preservation, esthetics and function.¹ To this, one can add the need to rehabilitate, performing crown seal and favoring recuperation of tissue surrounding the root.^{2,3} In this respect, epidemiological

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studies in endodontics represent a great scientific challenge in order to understand prevalence, distribution and determining factors in main pulp conditions.⁴ Review of three influential international scientific publications in endodontics: *Journal of Endodontic*, *Endodontic Dental Traumatology* and *International Endodontic Journal* showed that in the last decade, over 2000 reports are clinical and experimental studies, while only 25 epidemiologic studies were found.⁴

A significant proportion of studies inform on results of endodontic treatment reporting a 53-95% success rate during several observation periods.⁵⁻⁷ Upon reviewing these studies it becomes evident that definitions of results and classification have been variable, giving rise to a considerable diversity of reported «success» rates. This situation suggests to conduct a search for a more objective quantification of first-time endodontic treatment results, as would be the case for tooth survival analysis.⁸

It is important to point out that most survival studies have been targeted to implant restoration instead of permanence of endodontically treated teeth. Results of initial survival studies of endodontically treated teeth began to draw the attention of endodontic researchers as a way to compare with the high survival of implant studies.⁸⁻¹⁰ Therefore, survival analysis is considered an important epidemiological approach to assess results of primary endodontic treatment.⁸ After performing an endodontic procedure, within the scope of tooth survival, a range of 96-98% has been reported with a mean follow-up time of 34-75 months,¹¹ a range of 97% up to eight years after performing non-surgical endodontic treatment has likewise been reported.¹²

The Faculty of Dentistry of the University of Antioquia is an institution forming human resources in oral health, operating within a teaching-service scheme.¹³ This means that many patients of growing complexity are treated according to students' level of experience and always supervised by a teacher. Subjects of different social and economic levels attend these clinics, bearing in mind these clinics are strategically located in the center of Medellín.¹⁴ Most endodontic treatments conducted by undergraduate students require several appointments for completion. The fact of requiring multiple appointments and the non-performance of final restorative treatment might directly influence prognosis and in turn survival of these teeth. In this respect, literature mentions increases in the risk of bacterial contamination in root canals, which would reflect in endodontic prognosis turning it into a main failure factor.¹⁵ Studies focusing on evaluation of clinical and demographic factors in

institutions forming health-related human resources are scarce.

Bearing in mind all the aforementioned, the purpose of the present study was to determine clinical and sociodemographic factors associated to survival of endodontically treated teeth in patients treated at the Faculty of Dentistry of the Antioquia University during the period 2007-2011.

MATERIAL AND METHODS

A follow-up study with survival analysis was performed on a retrospective cohort. Treated patient population was described and was related to tooth survival, based on systematic collection of information provided by our clinical histories as well as patient evaluation (clinical and radiographic assessment). Studied population was composed of patients treated for the first time by undergraduate students of the School of Dentistry, University of Antioquia, during the period 2007-2011. The following exclusion criteria were applied: endodontic re-treatments, underage patients, teeth with unfinished endodontic treatment and patients with uncontrolled systemic compromise.

In order to assess survival, first of all, it was taken into consideration whether the tooth was present at the time of the examination, and in the cases when it was not, a mean of days in which the tooth was present in the mouth was calculated as well as probable extraction date, according to patient's information. Additionally, the following factors were considered sociodemographic variables: gender, age, socioeconomic status (according to financial classification established by municipal planning office), occupation, General Health social security system affiliation (contributive, or with payment capacity, subsidized or with no payment capacity, and with no affiliation) and education level. The following factors were taken into consideration as clinical variables: type of tooth, initial endodontic diagnosis, number of appointments for endodontic treatment, type of restoration, total isolation with rubber dam.

Clinical and sociodemographic variables associated to tooth loss were assessed with respect to follow-up time. Absolute and relative frequencies as well as summary measures were used in the descriptive analysis. Global survival was calculated using Kaplan-Meier analysis, curves were compared with log rank test. Cox's proportional risk model was used for the multivariate analysis for explanatory purposes, an adjusted hazard ratio (HR) association measure was obtained with 95% confidence intervals. Rejection was considered for patients who did not present the event

of interest (tooth extraction) upon study completion. Systematization, processing and data analysis was conducted with SPSS program, version 20 Program.

The present study was in compliance with the international norm for research in human beings^{16,17} and met with general ethics principles. Bearing in mind Resolution 8430 (1993) of the Health Ministry, title II article 11, this research project is considered of minimum risk for the patient, since it deals with data recording based on clinical history, clinical and radiological examination and is not interfering with physical or psychological variables of the patient.¹⁸ Moreover, Resolution 1995 (1999) was taken into account, this resolution establishes norms for handling of clinical history and confidentiality of obtained information.¹⁹ Once radiological and clinical examinations were completed, the need for conducting remission for possible dental treatments was determined. The present research project was approved by the Bioethics Committee of the

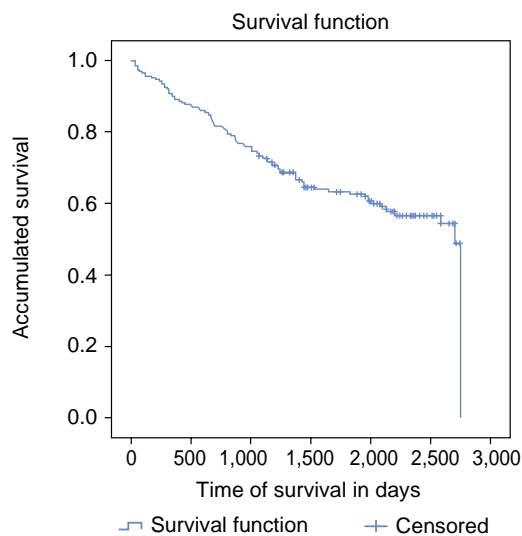
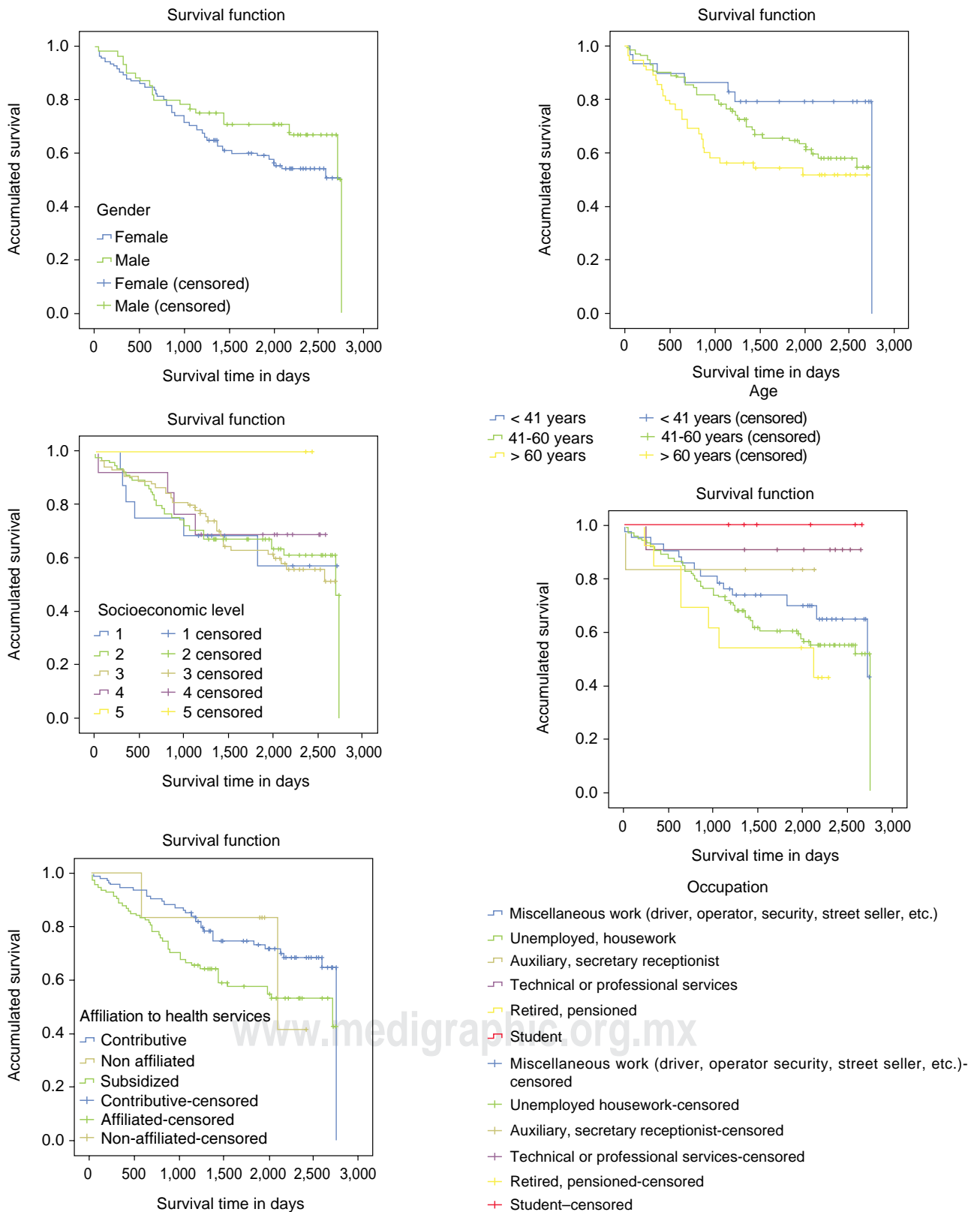


Figure 1. Global survival function in teeth of patients treated at the school of dentistry, University of Antioquia, Medellin, 2007-2011.

Table I. Survival means (days) according to sociodemographic variables in teeth of patients treated at the School of Dentistry, Antioquia University, Medellin, Colombia, 2007-2011.*

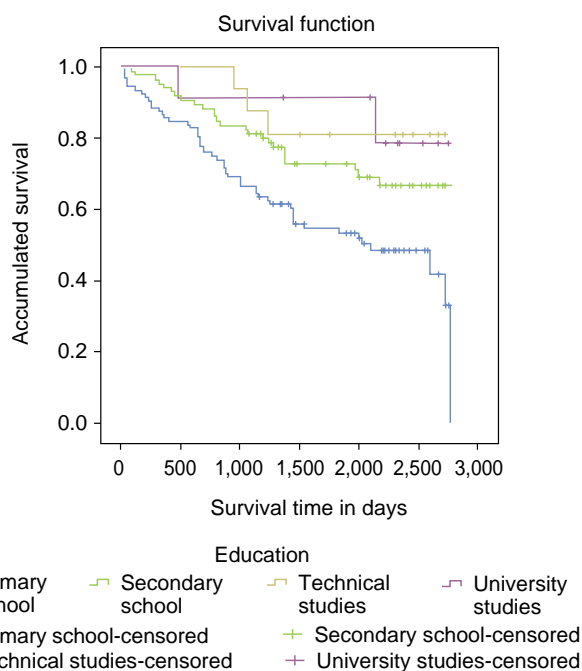
Sociodemographic characteristics	Estimation	Error	LL	UL	Log rank	p value
Gender						
Male	1,892.679	80.663	1,734.580	2,050.777	2.084	0.149
Female	2,116.452	129.105	1,863.406	2,369.498		
Age						
≤ 40 years	2,300.618	181.262	1,945.345	2,655.891	5.340	7.340
41-60 years	2,020.384	83.463	1,856.796	2,183.972		
≥ 61 years	1,736.808	148.042	1,446.646	2,026.969		
Socioeconomic stratum						
1					1.272	0.866
2						
3	Und	Und	Und	Und		
4						
5						
Occupation						
Miscellaneous work (conductor, handyman, surveillance, street salesman, etc.)					9.612	0.087
Unemployed, housework						
Auxiliary, secretary, receptionist	Und	Und	Und	Und		
Technical or professional studies						
Retired with pension						
Student						
Affiliation to General System of Health Social Security						
Contributive	2,221.247	89.951	2,044.943	2,397.550	6.562	0.038
Subsidized	1,845.732	98.402	1,652.864	2,038.600		
Not affiliated	1,968.750	271.676	1,436.266	2,501.234		
Educational level						
Primary school	1,769.547	103.958	1,565.789	1,973.305	14.186	0.003
Secondary school	2,173.042	98.567	1,979.850	2,366.234		
Technician	2,405.938	159.754	2,092.819	2,719.056		
University studies	2,471.857	187.380	2,104.593	2,839.121		

* Und = Undetermined; LL = Lower limit; UL = Upper limit.



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Figure 2. Survival function according to sociodemographic variables in teeth of patients treated at the School of Dentistry, University of Antioquia, Medellín, 2007-2011.



Continue from Figure 2. Survival function according to sociodemographic variables in teeth of patients treated at the School of Dentistry, University of Antioquia, Medellin, 2007-2011.

School of Dentistry of the Antioquia University (deed number 4, 2014).

RESULTS

Total study population was 228 teeth of 188 patients. General survival analysis (*Figure 1*) reveals that the possibility of not losing the tooth until day 900 is 80%; survival mean of teeth in treated patients was 1,959 days (standard error: 66.9 days). Percentage of teeth surviving three years after an endodontic treatment was 78%, this figure decreased to 66% at 4-5 follow-up years; proportion of teeth surviving over six years was 57%.

When comparing free loss time (tooth extraction) with sociodemographic variables (*Table I and Figure 2*) it can be observed that teeth of male patients exhibited greater survival average than teeth of female patients (2,117 days). On the other hand, an age-related important gradient was observed, revealing that to greater age, lesser survival time was elicited, this proportion was greater in patients under 40 years of age (2,301 days). With respect to variables affiliation to Health Social Security General System, it could be observed that teeth of patients in the contributive regime exhibited higher survival rates

(2,221 days) this figure was lesser in non-affiliated patients (1,969 days). With respect to the education variable, an important social gradient was observed showing that to lesser educational level, lesser survival rate; survival mean was lesser in patients with primary school level/(1,770 days) and greater in patients with university educational level (2,472 days). The only variables that exhibited statistical significance were affiliation to Health Services and education ($p < 0.05$).

Bearing in mind free extraction time or loss according top clinical variables considered in the present study, (*Table II and Figure 3*) survival mean was greater in multi-rooted teeth (1,966 days). With respect to initial diagnosis, teeth with pulp necrosis exhibited greater survival mean (2,056 days), and lesser survival mean was found in teeth of patients with chronic apical abscess (744 days). With respect to number of appointments for endodontic treatment, to a greater the number of appointments, lesser the survival mean was observed, being lesser in teeth of patients who attended more than seven appointments (1,934 days). With respect to the type of restoration, it did not reach survival average since too much censorship based on the presence of absolute isolation (rubber dam) survival mean was greater in teeth that had presented it (2,018 days). The only variables that exhibited statistical significance were initial diagnosis and type of restoration ($p < 0.05$).

Multivariate analysis conducted through Cox multiple regression model is shown in *table III*. Speed of tooth loss (time) was greater in teeth belonging to females, in teeth of patients older than 60 years, patients not affiliated to a Health Social Service, with primary school education level, multi-rooted teeth, teeth with acute apical abscess, and in teeth of patients who attended two or three appointments for endodontic treatment. Statistically significant association was only found in multi-rooted teeth (HR 2.38; CI 95% 1.23-4.60) and in those teeth with initial diagnosis of acute apical abscess (HR 27.96, CI 95% 1.84-423.09).

DISCUSSION

In the present study, it was found that clinical and sociodemographic factors intervene in survival of endodontically treated teeth. Important social gradients were found inasmuch as survival of these teeth is lesser in teeth of subjects in a state of social vulnerability, with lower educational level, belonging to lower socioeconomic levels, or lacking affiliation to health social security services. Likewise age and some clinical factors bearing influence in treatment's

Table II. Survival mean (days) according to clinical variables in patients treated at the School of Dentistry, University of Antioquia, Medellín, Colombia, 2007-2011.*

Clinical characteristics	Estimation	Error	LL	UL	Log rank	p value
Type of tooth						
Single rooted	1,954.168	92.781	1,772.318	2,136.019	0.097	0.953
Bi-rooted	1,911.266	207.660	1,504.252	2,318.280		
Multi-rooted	1,965.681	107.296	1,755.381	2,175.982		
Initial endodontic diagnosis						
Pulp necrosis	2,056.268	106.925	1,846.694	2,265.842	21.050	0.007
Symptomatic apical periodontitis	1,999.833	510.984	998.305	3,001.362		
Acute apical abscesses	976.000	27.000	923.08	1,028.920		
Chronic apical abscess	744.000	313.656	129.234	1,358.766		
Asymptomatic apical periodontitis	1,695.654	158.28	1,385.425	2,005.883		
Symptomatic irreversible pulpitis	1,969.827	145.913	1,683.838	2,255.816		
Asymptomatic irreversible pulpitis	2,011.575	308.643	1,406.634	2,616.516		
Previously initiated therapy	2,090.82	137.768	1,820.795	2,360.845		
Number of endodontic treatment appointments						
1	2,084.943	204.704	1,683.723	2,486.164	1.761	0.623
2 to 3	1,868.397	99.788	1,672.812	2,063.981		
4 to 6	2,026.231	103.611	1,823.153	2,229.310		
More than 7	1,933.684	313.345	1,319.527	2,547.841		
Type of restoration						
Amalgam					16.133	0.024
Full crown						
Ionomer						
Post and crown	Und	Und	Und	Und		
Temporary restoration						
Provisional						
Resin						
Other						
Total isolation (rubber dam)						
Yes	2,018.023	87.621	1,846.286	2,189.760	1.368	0.241
No	1,873.489	102.861	1,671.881	2,075.096		

*Und = Undetermined; LL = Lower limit; UL = Upper limit.

prognosis were determinant factors in the survival of these teeth, with differences in magnitude and intensity, as, for example, initial diagnosis, type of tooth, number of appointments, type of restoration and isolation of operative field. To the best of our knowledge, this is one of the first studies targeting determination of factors associated tooth survival in teaching-service institutions in Colombia.

Many of the studies which assess endodontic treatment results have used the concepts of success and/or failure as main prognosis criterion,²⁰ nevertheless, it is important to consider other methodologies as, for instance, tooth survival (considered as the time the tooth remains in place once the endodontic treatment is completed). This can be considered an objective indicator of the clinical result.

In the present study, percentage of teeth surviving after a root canal treatment during the first three years was 78%, whereas survival at 4-5 years was 66%, and proportion of teeth surviving more than six years was 57%. These survival percentages for each time interval were lower than those reported by a meta-analysis.⁸ Survival of 2-3 years was 86.4%, survival of 4-5 years was 93.3% and survival of 5-8 years was 86.7%. In general terms, survival reported in high quality studies varies from 86 and 93%,⁸ nevertheless, figures of up to 98% survival in five years have been reported in other studies.²¹

With respect to sociodemographic factors related to tooth survival, the only variables exhibiting statistical significance were affiliation to health programs and education. National and international result comparability is limited due to scarcity of

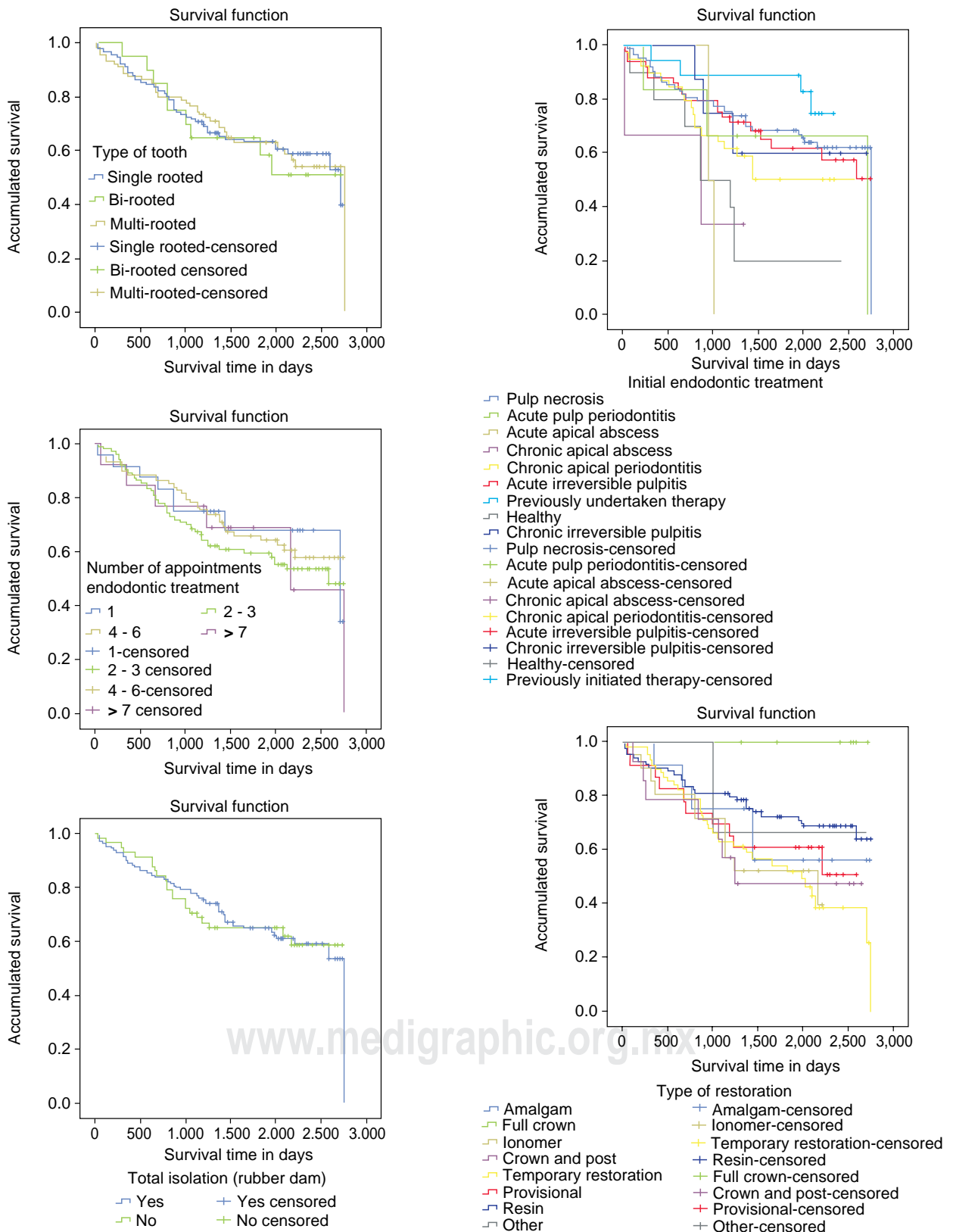


Figure 3. Survival function according to clinical variables in teeth of patients treated at the School of Dentistry, University of Antioquia, Medellin 2007-2011.

Table III. Multiple Cox regression model in teeth of patients treated at the School of Dentistry, University of Antioquia, Medellín, 2007-2011.

Independent variables	HR	CI 95%	
		LL	UL
Gender			
Female	1.302	0.691	2.453
Male	1.000	---	---
Age			
≤ 40 years	1.000	---	---
41-60 years	1.651	0.634	4.300
≥ 61 years	2.450	0.861	6.975
Health program affiliation			
Contributive	1.105	0.229	5.336
Subsidized	2.093	0.456	9.608
Not affiliated	1.000	---	---
Education			
Primary School	4.029	0.526	30.858
Secondary School	2.820	0.361	22.060
Technician	0.848	0.069	10.386
University level	1.000	---	---
Type of tooth			
Single rooted	1.000	---	---
Bi-rooted	1.902	0.809	4.471
Multi-rooted	2.385	1.236	4.605
Initial endodontic diagnosis			
Pulp necrosis	1.312	0.446	3.861
Symptomatic apical periodontitis	2.069	0.218	19.648
Acute apical abscess	27.967	1.846	423.791
Chronic apical abscess	5.028	0.846	29.882
Asymptomatic apical periodontitis	2.007	0.628	6.418
Symptomatic irreversible pulpitis	1.206	0.378	3.846
Asymptomatic irreversible pulpitis	2.252	0.486	10.44
Previously initiated therapy	1.000	---	---
Number of endodontic treatment appointments			
1	0.547	0.121	2.467
From 2 to 3	1.545	0.429	5.566
From 4 to 6	0.728	0.217	2.437
More than 7	1.000	---	---
Total isolation (rubber dam)			
Yes	0.969	0.571	1.647
No	1.000	---	---

* HR = Hazard ration; CI 95% = Confidence interval 95%; LL = Lower limit; UL = Upper limit.

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epidemiological studies in a subject that might include these variables in teaching-assistance institutions. It is important to mention that there are barriers to gaining access to health services, especially in the case of subjects affiliated to linked and subsidized regimes and this affects continuity and timeliness of endodontic treatment.^{14,22} In other cases, there are sociocultural factors specific to individual subjects, who decide in favor of extraction as a solution to the problem

ailing them, as well as determining factors related to knowledge and exercises of self-care practices with respect to oral health.²³

When clinical factors related to endodontically treated teeth's survival are analyzed, the only variables that exhibited statistical significance were initial diagnosis and type of restoration. Periapical and pulp diagnosis of the tooth before first-time endodontic treatment bears influence on tooth survival. Teeth

with pulp vitality²⁴ and lacking periapical lesions^{24,25} experience longer survival when compared to teeth with pulp necrosis and/or periapical lesions.⁸ Likewise, whether restoration be temporary or definitive, bears influence in the survival of teeth after endodontic treatment, as is mentioned in literature.⁸ In this process, influencing factors are related to suitable crown sealing which prevents bacterial colonization and hence favors preservation of tooth tissues.

Multivariate analysis according to Cox's proportional risks model showed that several sociodemographic and clinical factors intervene in the speed of tooth loss, nevertheless, variations exist in severity and magnitude. In patients with multi-rooted teeth speed of tooth loss was 2.4 times greater when compared to patients with single-rooted teeth, this association proved to be statistically significant. This situation concurs with findings reported in other studies where it is mentioned that survival decreases in relation to how posterior is the first-time endodontically treated tooth.^{8,12,21,26-28} On the other hand, it was found that speed of tooth loss was 28 times higher in teeth with acute periapical abscess with respect to teeth with previously initiated therapy; this association was statistically significant. Results concur with previous studies⁸ where diagnosis is a relevant factor which bears influence in the prognosis and intervenes as a determining factor for success or failure of endodontic treatment.

As a strong point in the present study, it is worth mentioning that several sociodemographic and clinical variables were included, which allowed to approach the research phenomenon from the social epidemiology standpoint. Likewise, survival analysis allowed an approach to the reality lived in the clinics of the Faculty, and this is relevant if one bears in mind its assistance-teaching nature. Limitations of the present study were the non-attendance of patients to revisions, which can be related to different causes such as wrong telephone number, change of address, demise of some of them, unwillingness to attend the appointments, as well as those patients who, having a programmed appointment, decided not to attend.

To conclude, we might mention that clinical and sociodemographic factors associated to endodontically treated teeth were identified. With respect to the profile of subjects who performed endodontic treatments, we can mention they were students of the Faculty of Dentistry of the Antioquia University, working under the supervision of professors who were endodontic experts. All obtained results allowed to assess the ability of students in training to resolve problems and achieve favorable survival results through a first-time

endodontic treatment. Findings can be considered for other institutions sharing similar characteristics with the Medellín institution, and this should lead to generation of strategies to improve service according to problems and requirements detected in the present study, as well as to guarantee quality in the training of future dentists.

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