Acta Odontologica Scandinavica, 2014; 72: 179–186

informa
healthcare

ORIGINAL ARTICLE

Statistical analysis of teeth autotransplantation in Portugal's region of Chaves

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Abstract

Aim. The aim of this study was to evaluate the success rate of 33 transplanted teeth in a northern population of Portugal. ***Methods.*** The mean follow-up period was 7 years, ranging from 6 months to 20 years. ***Results.*** Six teeth (18%) were rated as unsuccessful, 52% of the donor teeth were transplanted to receptor alveolus after immediate exodontia and 24% were transplanted to receptor alveolus surgically prepared. From the total number of cases, 64% had open root apex at the time of the transplantation and, in the latest control, of all teeth root development was over in 55%. Teeth ankylosis was present in 38% of all cases and 58% of all 33 transplants presented pulpar vitality. Data shows that, in males, teeth transplanted into natural alveolus were non-ankylosed, with normal color and vital teeth with incomplete root development at the time of the surgery. All cumulative curves obtained showed no statistical significance, mainly due to the low number of unsuccessful teeth autotransplantations. Orthodontic treatment performed after tooth autotransplantation showed success in 15% of all cases. ***Conclusion.*** Data reconfirms that autotransplantation of teeth is, in selected patients, the best option to replace a missing tooth in young patients.

Key Words: *autotransplant, prognostic, single tooth, rehabilitation*

Introduction

Teeth autotransplantation is an alternative treatment for single tooth replacement. In patients aged under dental implant viability, it may become more frequent if the technique respects protocol and enlarges the success rate. It is important to select patients with a good prognosis that may provide a favorable condition for success [1]. The main reason for failure is poor selection of patients and this can be overcome by a means of careful treatment planning.

Our follow-up study lasted 3–14 years and showed that if the transplantation is located in a natural or artificial alveolus, teeth vitality is preserved in 90–96% of all cases [2,3]. The requirements for high success rates, according to the literature, are: donor tooth with 75% of root development and with open apex [2,4–7].

When planning an autotransplantation, it is important to consider the patient's age, the similarity between receptor alveolus and donor teeth and root development stage [1]. It is well defined in the literature that the young and co-operative patients, without any pathologic systemic disease, are the option of choice [1]. It is also shown that, in teeth with incomplete root development, vitality is preserved in 90–96% of all cases in 3–14 year follow-ups and that the preference is for natural alveolus [2,3]. The best case scenario seems to be when root formation is around 75%, with an open apex [1,2,4–7].

The success rate must be differentiated from the survival rate in tooth autotransplantation. The survival rate expresses the presence of the transplanted tooth, even if its function, esthetics or development are compromised [8]. On the other hand, to say that success has been achieved, there must be good esthetics, good positioning, the ability to chew without restrictions, pulp vitality and good dentofacial development [8]. This success rate is influenced by

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(Received 18 December 2011; revised 20 May 2011; accepted 11 June 2012)

ISSN 0001-6357 print/ISSN 1502-3850 online
DOI: 10.3109/00016357.2012.715190

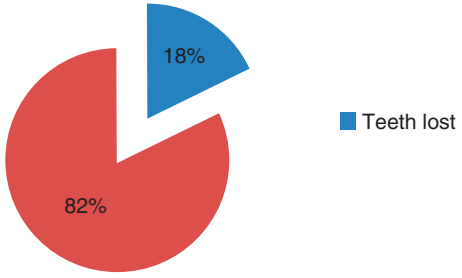

Figure 1. Survival rate of transplanted teeth.

the surgical technique, experience of the surgeon, the patient's age or the root development [8].

The aim of the present study was to evaluate a northern Portuguese population of patients submitted to 33 teeth autotransplantation and analyse some prognostic factors and some results.

Materials and methods

Thirty-three autotransplanted teeth were studied in 15 males and 18 females, aged from 8–50 years at the time of surgery, with a mean of 18 years old. None of the patients presented any systemic condition that contraindicated the surgical treatment. The mean follow-up period was 7 years, ranging from 6 months to 20 years.

Eleven third molars, eight premolars, six canines, seven incisors and one second molar were autotransplantated. All third molars were transplanted to the first molar sites.

Clinical procedures were based on the protocol described by Andreasen in 1990 [9–12].

During the latest follow-up, photographs were taken, occlusion was checked and periapical and panoramic radiographs were obtained to evaluate different variables. Clinical and radiographic information was registered regarding the following variables: the type of alveolus at the time of the surgery intervention, open apex and root development at the time of surgery, ankylosis at the time of follow-up, pulpar vitality, periapical state, replacement resorption, root development at the time of follow-up, pulpar obliteration, autotransplanted teeth lost and post-surgery orthodontic treatment.

For radiographic measurements of infrabony root percentage, the Schei rule was used. This specific technique, proposed by Schei in 1959, is a relative method that turns alveolar bone height into a fraction of the radiographic root length. The radiograph is amplified to visualize the transplanted tooth and, over this image, a Schei rule is used to measure the infrabony root percentage. The Schei rule is composed of a top horizontal line and several other lines with a common starting point, all equidistant, generating 20 regular intervals, each corresponding to 5%. The horizontal line is overlaid to the enamel–cement junction and the rule is horizontally moved until the lower line is placed over the root apex. Then an infrabony root proportion is obtained.

All transplanted teeth were considered as censored observations in statistical analysis. A survival time is considered censored when there is a follow-up time, but the event has not yet occurred or is not known to have occurred. All cases were considered censored at the time of the last clinical and radiographic examination. The survival rate was defined as the time from transplantation to the time of censoring or to the registered date judging the transplant as an unsuccessful case. All cases were included in the analysis, irrespective of the cause of failure.

Statistical analysis

Categorical variables are described through absolute and relative frequencies and continual variables are described through average, standard deviation, percentile, minimum and maximum.

The variables studied were gender, smoking, donor tooth, receiving site, alveolus, orthodontic treatment, apex closure at the time of surgery, age, ankylosis, pulp vitality, intrabony root percentage mesially and distally, root development at the time of the last control, pulp obliteration, general periodontal condition and present teeth on the last control.

The survival rate was determined as all transplanted teeth present at the time of the last control. The cumulative percentage was determined by the Kaplan-Meier method, in a multivariate analysis. The descriptive statistics and statistical analysis were performed with the computerized statistical package SPSS version 17 (SPSS, Inc.).

The cumulative curve was obtained for variables gender, alveolus, ankylosis, pulp vitality, root development and dental color.

Results

Out of the 33 transplants investigated, six (18%) were judged as unsuccessful during the observational period and the remaining 27 (82%) were registered as censored observations (Figure 1). Of all cases, 52% were re-implants or auto-transplantation for the donor tooth's site and 24% of all cases were performed in artificial alveolus (Figure 2). From all cases, 15% were submitted to posterior orthodontic treatment. Twenty-one cases (64%) had open apex at the time of the transplantation with an average of 75% of the root development at the time of the transplant (Figure 3). In the latest control, root development was completed in 55% of all teeth (Figure 4). Ankylosis was present in 39% of all cases and 58% of all 33 transplants presented pulpar vitality (Figure 5). Infrabony root percentage average was ~ 92% mesially

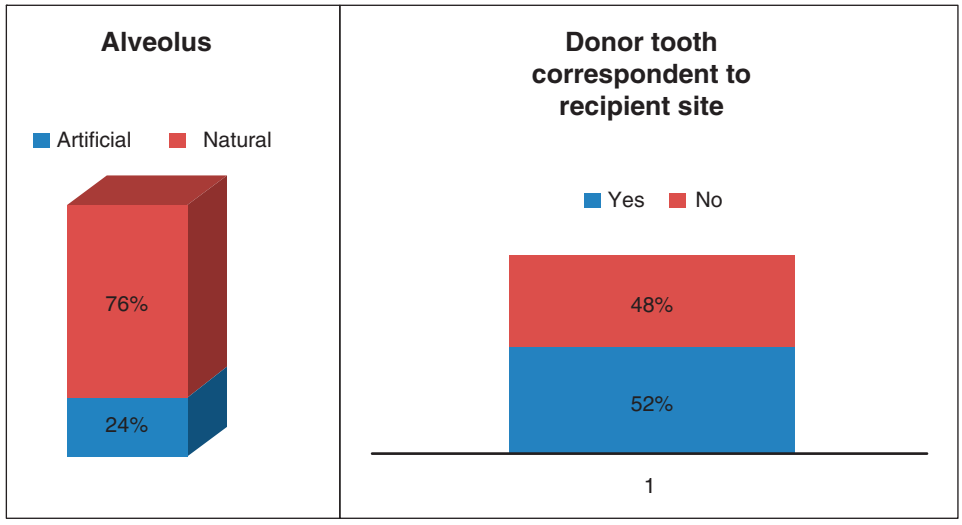

Figure 2. Alveolus and donor teeth correspondent to recipient site.

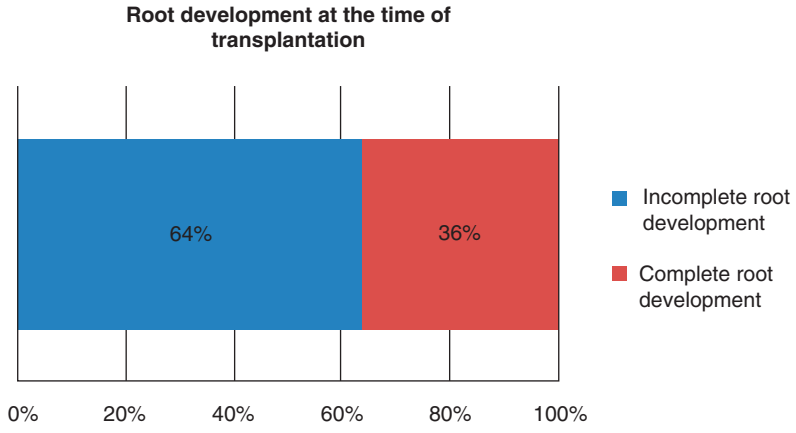

Figure 3. Root development at the time of transplantation.

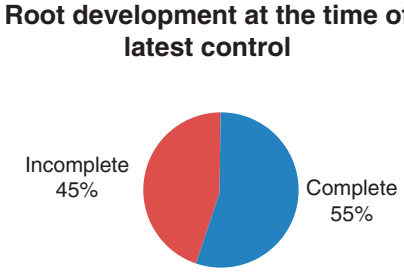

Figure 4. Root development at the time of latest control.

and 90% distally (Figure 6). Pulp obliteration was identified in 9% (Figure 7).

Results show that, over 20 years, males have a higher cumulative survival than females (Figure 8). Over 15 years, natural alveolus have a higher cumulative survival rate (Figure 9), anquilosed teeth have a lower cumulative survival rate after 20 years (Figure 10) and, after 12 years, more transplanted teeth with endodontic treatment are lost (Figure 11). Results also evidenciate, over 20 years, teeth with incomplete root development at the time of the surgery have a higher cumulative survival rate than teeth with complete root development (Figure 12) and that, after 12 years, teeth with normal color have a higher cumulative survival rate (Figure 13).

All cumulative curves obtained showed no statistical significance difference.

Discussion

The survival rate was 82%. According to Andreasen et al. [9] in 1990, survival rate of transplanted teeth after 13 years follow-up is 95–98%. In 1999, Josefsson et al. [4] found a 82% survival rate after 4 years follow-up, which is the same as in our study, but with a shorter follow-up time. The main reason for our 82% rate is the case selection. It is important to note that, in this investigation, the survival rate includes transplanted and re-implanted teeth, both with immature apex and complete root formation cases, in adults and adolescents. The literature shows a higher percentage of survival rate for immature teeth, in adolescents with natural alveolus [2,4–7].

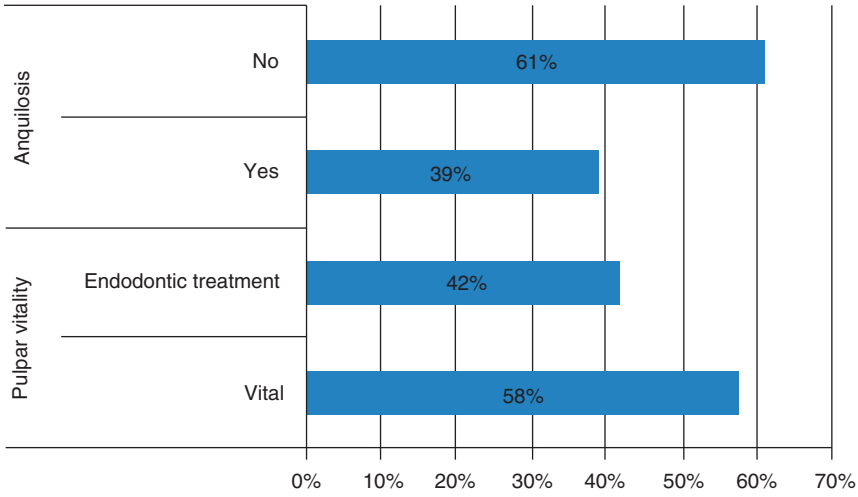

Figure 5. Ankylosis and pulpar vitality.

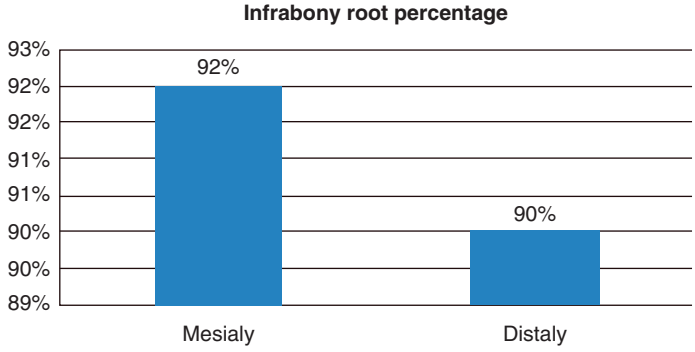

Figure 6. Infrabony root percentage.

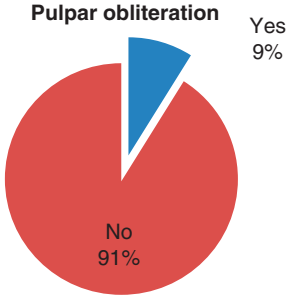

Figure 7. Radiographic pulpar obliteration.

About 24% of autotransplantations are performed on artificial alveolus. The literature tells us that artificial alveolus present lower survival rates than natural alveolus [2,4–7]. Therefore, these results may influence negatively our 82% survival rate. Even so, Ahlberg et al. [3] tell us that maxillary canines transplanted into artificial alveolus may have similar survival rates to those transplanted into natural alveolus.

From all cases, 15% were lately submitted to orthodontic treatment. This is an indicator that transplanted teeth may be a viable solution and the most natural one for replacing a missing tooth. These teeth can even be moved in orthodontic treatment and allow bone remodeling around them [12,13].

In 64% of the transplanted teeth the average root development at the time of the surgery was 3/4 and 55% of all studied teeth completed root formation. To achieve the complete root formation, it is important to, during the surgery, preserve the periodontal ligament and to be as minimally invasive as possible, because that may compromise root development, leeding to anquilose or root resorptions [8,14]. Ankylosis was present in only 38%, which may indicate that our case selection was good and the risk was lowered by that fact. Our results are supported by the literature, because the mean root development of all transplanted teeth was 3/4 and most authors conclude that immature teeth are preferable for better outcomes [9,13,15,16]. On the other hand, the fact that a considerable percentage of the teeth completed root formation indicates an important factor of the physiological process [16]. Root development can go on with no impediments, but even so it may present an unfavorable crown–root relation [8]. According to Andreasen et al. [9,10,12], if the root development is very low when the tooth is transplanted (lower than

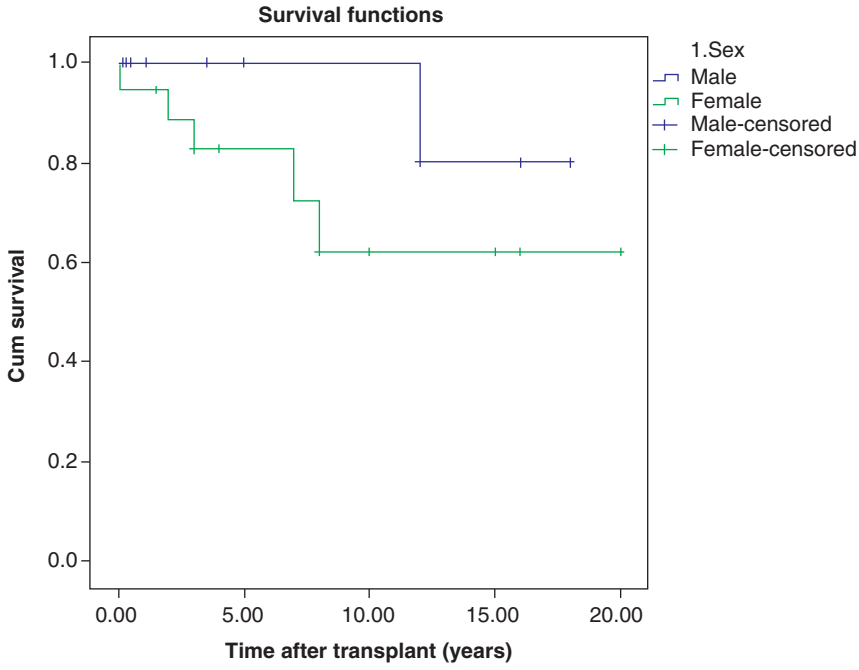

Figure 8. Cumulative survival rate according to gender.

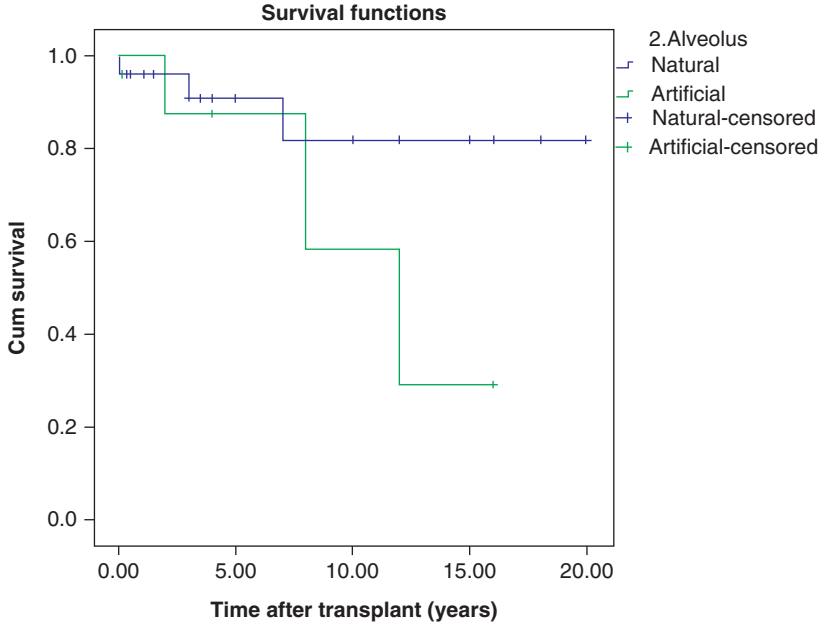

Figure 9. Cumulative survival rate according to the type of alveolus.

75%) the root growth is affected and may end-up with closed apexes, but with small length.

Andreasen et al. [9,10,12] also revealed a higher incidence of pulpar necrosis in teeth with completed root development at the time of the transplant, but with adequate root canal treatment, and survival rates may be assured and parcial pulpar obliteration may be present in teeth with pulpar regeneration and healing. This was found in only 9% of our studied cases.

In this study, 55% of the studied presented vitality teeth. This may be related to the high percentage of immature teeth transplanted. The other 45% presented adequate root canal treatment.

Infrabony root percentage was 92% mesialy and 90% distally. These measurements were achieved using the Schei technique described above and that allows determination of the infrabony proportion, without worrying on radiographic distortion, because

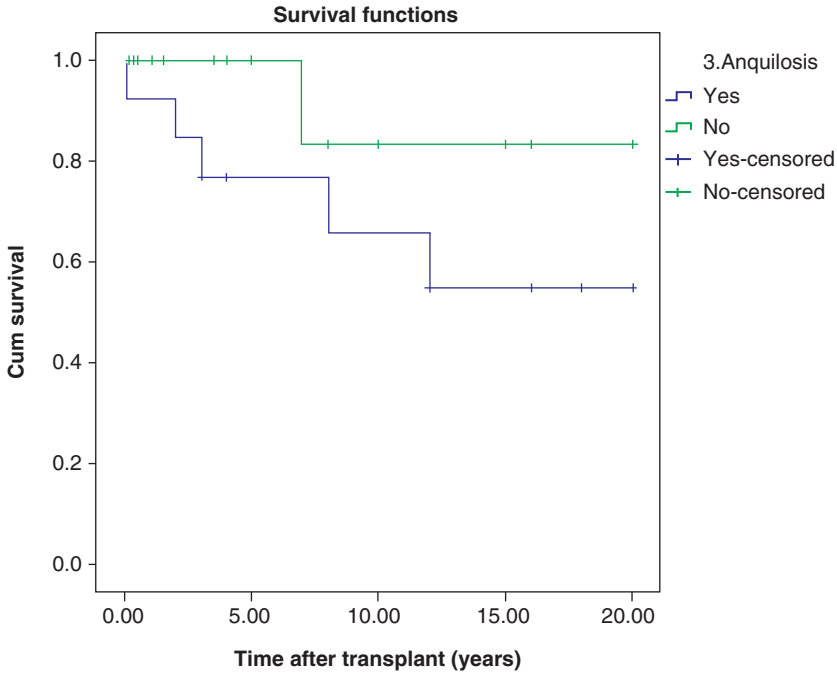

Figure 10. Cumulative survival rate according to anquilose.

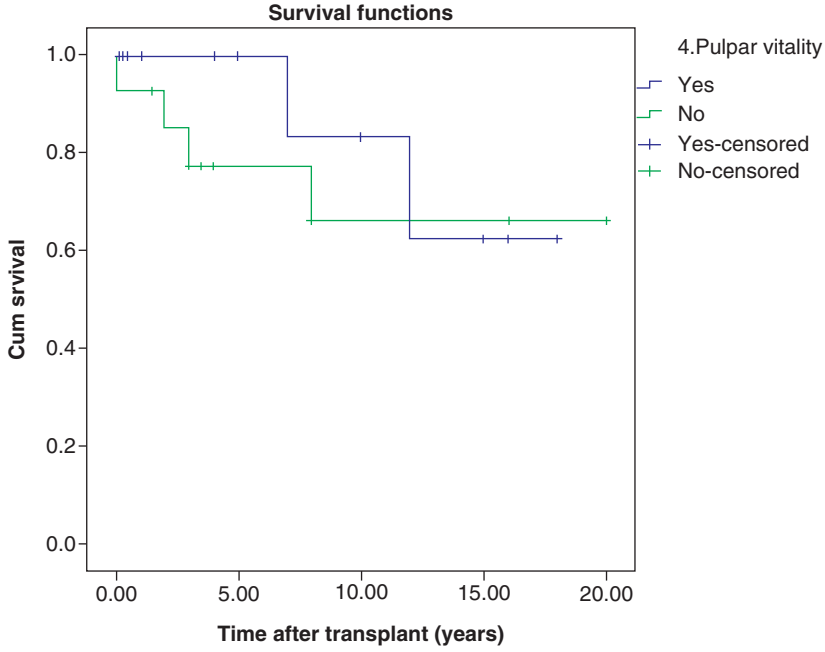

Figure 11. Cumulative survival rate according to pulpar vitality.

we deal with proportions and not real values. These results have to be interpreted with care, because we obtain a percentage of a root that can be a small root. One of the limitations of this study was the lack of information on the crown–root relation, but it is also true that over 90% of all roots were covered by alveolar bone, in some cases after 10 years follow-up, which indicates that the maintenance of these teeth is not difficult and, in absence of periodontitis, they can have a good prognosis.

Statistical cumulative survival graphics were also obtained for this work, but they are not statistically significant. This can be explained because of the very low number of negative results, that is the low number of transplanted teeth that were lost. For this reason, these graphics cannot be used for a general transplanted teeth population. However, they allow us to characterize and obtain an image through time of our results. Therefore, we cannot conclude on those cumulative survivals, but we can describe them.

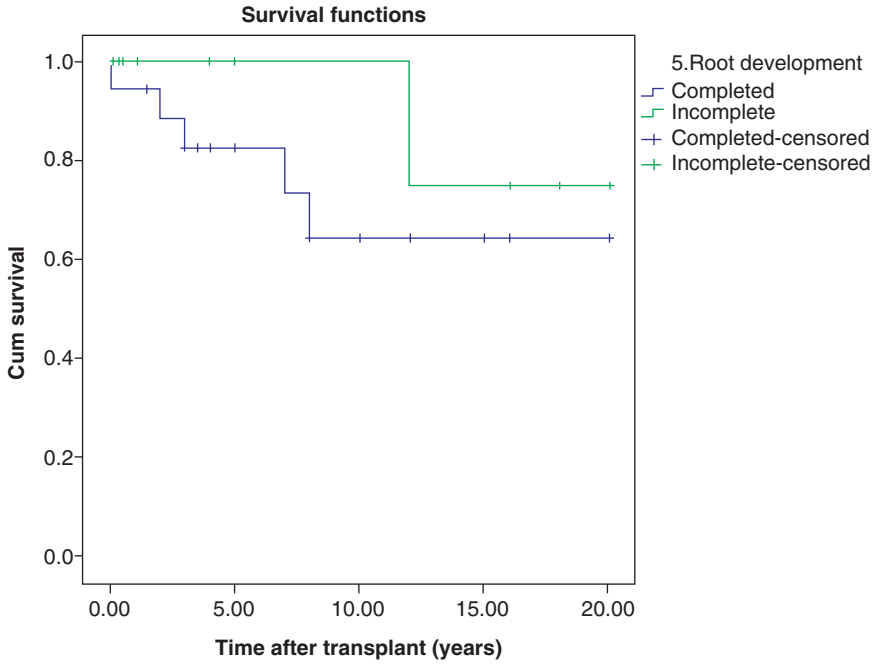

Figure 12. Cumulative survival rate according to root development.

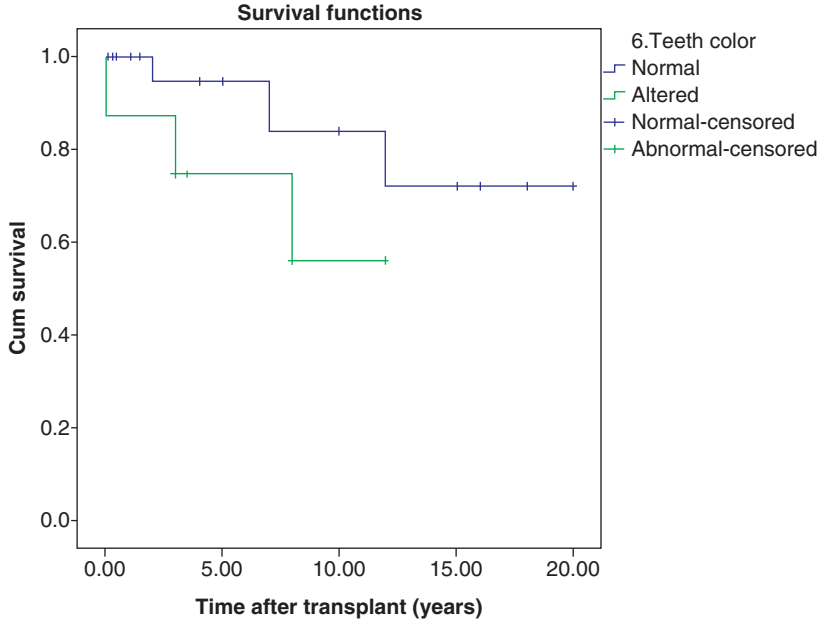

Figure 13. Cumulative survival rate according to tooth color.

According to gender, the graphic shows us that males have a higher cumulative survival rate than females. This could be relevant only with statistical significance. Natural alveolus show a higher survival rate than artificial ones, which is similar to results presented in the literature and discussed above [2,4–7]. Anquilose teeth show a lower cumulative survival rate than non-anquilosed teeth. This is also similar to literature results and was also discussed above [9,13,15,16]. Teeth with endodontic treatment also show a lower survival rate over time than vital teeth and this may be explained by a higher risk of root resorptions and anquilose in these cases, which is reinforced by the graphic that shows that incomplete root development at the time of surgery is linked to higher cumulative survival rate than in teeth with complete root development [9,13,15,16]. The final graphic shows us that teeth that present normal color have higher cumulative survival rate, possibly because they are generally vital teeth.

When predicting the prognosis for tooth autotransplantation it is important to evaluate the ability of this technique for replacing a missing tooth. A large number of cases are needed to predict the prognosis before surgery. Our study, in short, shows us that having this knowledge allows the clinician to select transplanted teeth cases very carefully and with a high level of stringency.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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