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Autotransplantation of Impacted Canines: A Retrospective Study of 23 Clinical Cases

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ABSTRACT

The impaction of maxillary and mandibular canines is a common clinical problem that requires a multidisciplinary approach for diagnosis, management, and optimal treatment. Dental autotransplantation is a surgical technique that represents an alternative to surgical-orthodontic approach, which can often be too complex due to the position of the impacted tooth or too long and therefore difficult for the patient to accept.

This retrospective study aims to analyze 23 impacted canines that were extracted and subsequently autotransplanted into their original location. The study correlates surgical outcomes in terms of success, loss, or survival with the time required for extraction and the extra-alveolar time to which the autotransplanted canines were subjected. In particular this study aims to highlight how the time required for extraction and the extra-alveolar period of the donor tooth are critical for the transplant's prognosis.

Patients were subsequently followed up for a minimum of 6 months and a maximum of 12 years.

As highlighted by this retrospective study, the relationship between autotransplantation success and reduced management times for the included canine is confirmed, both in terms of extraction and extra-alveolar times.

INTRODUCTION

A dental element is defined as impacted when its spontaneous eruption into the dental arch does not occur, regardless of whether it replaces the corresponding deciduous dental element or not. From an epidemiological perspective, the incidence of dental impaction is estimated to be around 20% in developed populations, with a prevalence in females being 2:1 compared to males. Among impacted dental elements, canines, especially the upper ones, rank second in terms of frequency of impaction after third molars.[1]

Given their importance in terms of chewing and aesthetics, early diagnosis of canine impaction is crucial to avoid future complications and to plan timely intervention. Therefore, accurate radiographic and clinical examinations are essential to assess the position and developmental status of impacted canines.

MATERIALS AND METHODS

Nineteen patients (14 females and 5 males, between 13 to 33 years old) undergoing autotransplantation of both maxillary and mandibular canines were considered in this study. In two patients, two canines were transplanted, totaling 23 dental elements analyzed. 30 seconds for explantation (the time taken for extraction of the tooth element), and 15 minutes for extra-alveolar time (the time between extraction and subsequent re-implantation at the recipient site) were considered as cut-offs. The impacted canines extracted and subsequently replanted were 12 maxillary and 9 mandibular.

Of the 23 tooth elements analyzed, 9 required an explantation time >30 seconds and a further 6 elements had an extra-alveolar management time >15 minutes; all the autografted canines subsequently underwent orthodontic treatment except for 5 elements.

At the follow-up of a minimum of 1 year and a maximum of 12 years, 13 autotransplanted canines were treated endodontically.

PATIENT	EXPLANTATION TIME	EXTRA-ALVEOLAR TIME	ORTHODONTIC TREATMENT	ENDODONTIC TREATMENT
1	< 30 sec	< 15 min	Yes	Yes
2	< 30 sec	> 15 min	Yes	Yes
3	< 30 sec	> 15 min	Yes	Yes
4	< 30 sec	> 15 min	Yes	Yes
5	< 30 sec	<15 min	Yes	Yes
6	< 30 sec	> 15 min	Yes	Yes
7	< 30 sec	< 15 min	Yes	Yes
8	< 30 sec	< 15 min	Yes	Yes
9	< 30 sec	< 15 min	Yes	No
10	< 30 sec	< 15 min	No	Yes
11	> 30 sec	< 15 min	Yes	No
12	< 30 sec	< 15 min	Yes	Yes
13	> 30 sec	< 15 min	Yes	Yes
14	> 30 sec	< 15 min	Yes	No

15	> 30 sec	> 15 min	Yes	Yes
16	< 30 sec	< 15 min	Yes	No
17	< 30 sec	< 15 min	Yes	No
18	>30 sec	< 15 min	No	Yes
19	>30 sec	<15 min	Yes	Yes
20	>30 sec	>15 min	No	Yes
21	<30 sec	<15 min	No	No
22	>30sec	<15min	No	No
23	>30sec	<15min	Yes	No

RESULTS

In terms of complications, of the 23 autotransplanted canines, 5 reported root resorption, 1 reported a periodontal defect due to incorrect surgery, 1 a suspected ankylosis, while the other 16 autotransplanted teeth elements did not report any complications.

The 16 autotransplanted canines without complications resulted in a successful surgical procedure: 6 reported a survivable condition and finally 1 canine was considered lost after 7 years.

PAZIENTS	FOLLOW UP	COMPLICATIONS	OUTCOMES
1	12 years	/	Success
2	7 years	Root Resorption	Failure
3	7 years	/	Success
4	2 years	/	Success
5	1 year	Root Resorption	Survival
6	3 years	/	Success
7	4 years	/	Success
8	2 years	/	Success
9	2 years	/	Success
10	4 years	Root Resorption	Survival
11	3 years	/	Success
12	5 years	Periodontal Defect	Survival

13	6 years	/	Success
14	1 year	/	Success
15	1 year	Root Resorption	Survival
16	1 year	Ankylosis	Survival
17	1 year	/	Success
18	1 year	/	Success
19	3 years	/	Success
20	2 years	Root Resorption	Survival
21	1 year	/	Success
22	6 months	/	Success
23	1 year	/	Success

DISCUSSION

The resolution of issues arising from canine impaction is determinant for the proper restoration of both canine guidance and aesthetics, which, in the absence of deciduous elements, are certainly compromised. The therapeutic alternatives are various and can involve orthodontics, prosthodontics, and, as in this case, surgery. In particular, this study aimed to analyze the outcomes of a surgical treatment, such as autotransplantation, as an alternative to orthodontic-surgical recovery, which is not always possible and requires a high level of compliance and a long treatment duration. [2]

Analysing the collected data, it can be observed that the success rate, defined as the reintegration of the element into the patient's dental arch in the absence of complications affecting the periodontal ligament and root dentine, stands at around 69.6%, while the survival rate, understood as the reintegration of the element into the patient's arch despite the development of complications such as ankylosis, root resorption, or periodontal defects, is around 26.1%. The percentage of lost elements is 4.3%. The results are in accordance with those reported in the literature. [3,4]

The preservation of the periodontal ligament of the donor tooth has a fundamental importance, as it allows the creation of an attachment of the transplanted tooth between the root cementum and the post-extraction socket. If the periodontal ligament is damaged during the extraction or replantation phases, the integration of the donor tooth would result in ankylosis, leading to the survival of the element according to the success criteria outlined in this study. Therefore, a reduced extra-alveolar time and, above all, a non-traumatic extraction are crucial factors for the survival of the periodontal ligament. [5] For these reasons, data have been presented to analyze key time parameters for the survival of the periodontal ligament, namely, extraction time of more than or less than 30 seconds and extra-oral time greater or lesser than 15 minutes. The literature does not provide a reference extraction timing; however several studies highlight that atraumatic extraction is an important prognostic factor in preventing the possible onset of complications. [6-8]

Therefore, the authors have decided to assess the extraction time as a potential reference parameter to evaluate the atraumatic nature of the tooth extraction.

The results of these analyses are reported, but they do not show statistically significant differences between the two groups in terms of success, survival, or failure rates. This discrepancy may be explained by the limited number of elements considered and the skills of the operator, which allowed for ligament survival despite longer extraction times and/or extra-alveolar periods, enabling the formation of a new periodontal attachment. Furthermore, it is useful to note that in the literature, the extraction time considered is one minute, whereas in this case, no further time intervals are reported beyond 30 seconds. Therefore, the number of recorded successes could be due to extractions lasting less than a minute but longer than 30 seconds.

	EXPLANTATION TIME > 30 s	**EXPLANTATION TIME < 30s**
SUCCESS	9	7
SURVIVAL	4	2
FAILURE	1	0
TOTAL	14	9
% SUCCESS	64,2%	77,8%
% SURVIVAL	28,6%	22,2%
% LOST	7,2 %	0%

	EXTRA-ALVEOLAR TIME < 15 min	**EXTRA-ALVEOLAR TIMEN> 15 min**
SUCCESS	13	3
SURVIVAL	4	2
FAILURE	0	1
TOTAL	17	6
% SUCCESS	76,5%	50%
% SURVIVAL	23,5%	33,3%
% LOST	0%	16,7%

Endodontic treatment performed after the transplant seems to be associated with a higher success rate compared to treatment carried out before extraction or extra-orally.[9, 10] However, the literature reports that the highest success rate is observed in cases of incompletely formed apices (50-75%), as they allow for the revascularization of the tooth and, consequently, the preservation of the element's vitality.[11] In the case of mature teeth with closed apices, endodontic treatment should be performed two weeks after the autotransplantation, allowing for the healing of the periodontal ligament and minimizing the risk of pulp infection.[11] In this study, the endodontically treated elements were treated more than two weeks after autotransplantation, and as a result, this may have influenced the outcomes, which report a success rate of 61.5%.

	ENDODONTIC TREATMENT	**NO ENDODONTIC TREATMENT**
SUCCESS	8	8
SURVIVAL	4	2
FAILURE	1	0
TOTAL	13	10

% SUCCESS	61,5%	80%
% SURVIVAL	30,8%	20%
% LOST	7,7%	0%

In cases where the stability of the transplant is insufficient, the use of flexible orthodontic splinting for 7-10 days seems to favor a higher success rate of the therapy, while dental realignment appears to be recommended 3-9 months after autotransplantation.[9, 12] In this study, the use of orthodontic therapy with the aim of realigning the transplanted canines appears to be associated with a good success rate (72.2%), in line with a physiological reorganization of the periodontal ligament, which allowed for its movement.

	ORTHODONTIC TREATMENT	**NO ORTHODONTIC TREATMENT**
SUCCESS	13	3
SURVIVAL	4	2
FAILURE	1	0
TOTAL	18	5
% SUCCESS	72,2%	60%
% SURVIVAL	22,2%	40%
% LOST	5,6%	0%

The studies available in the literature on autotransplantation are mainly retrospective ones. In order to reduce bias, it would be beneficial to further investigate the topic with prospective studies. However, considering the functional and aesthetic success rate of the therapy, autotransplantation of impacted canines can be considered a valid alternative, especially in cases where canines cannot be predictably recovered orthodontically, or when patient compliance is reduced. Even though, in such cases, effort and care from the patient are still required, the therapy will certainly have a shorter duration compared to orthodontic recovery.

CONCLUSION

The impaction of canines represents a commonly encountered clinical issue, for which early diagnosis through accurate clinical and radiographic exams is essential for planning a prompt intervention aimed at recovering impacted teeth in the dental arch.

Autotransplantation of teeth is a valid solution both aesthetically and functionally for the treatment of impacted canines. As highlighted by the results obtained in this retrospective study, tooth autotransplantation represents a valid aesthetic and functional solution for the treatment of impacted canines, thus providing an alternative therapeutic option to surgical-orthodontic recovery that should be considered, especially in patients who are not willing to undergo long and complex orthodontic treatment. Individual success, both in the short and long term, is still difficult to predict; however, this study highlights how the time factor in critical, both in terms of extraction duration and the time the tooth spends outside the alveolus. Nonetheless, it is important that patients are informed of the potential for failure and the risks associated with the procedure prior to undergoing it.

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