Treatment of lower second premolar agenesis by autotransplantation: four-year evaluation of eighty patients

Eva Josefsson, Viveca Brattström, Ulf Tegsjö and Hans Valerius-Olsson

Department of Orthodontics, Public Dental Health, Motala, Sweden, Department of Orthodontics, Eastman Institute, Stockholm, Sweden, Department of Oral Surgery, Eastman Institute, Stockholm, Sweden

Josefsson E, Brattström V, Tegsjö U, Valerius-Olsson H. Treatment of lower second premolar agenesis by autotransplantation: four-year evaluation of eighty patients. Acta Odontol Scand 1999;57:111–115. Oslo. ISSN 0001-6357.

The frequency of agenesis of the second lower premolar is 2.5–4%. In growing patients, early extraction of the deciduous molar and subsequent closure of the space is a common therapy, but in some cases space closure is deemed unlikely and autotransplantation is an alternative. The aim of the study was to analyze the outcome of autotransplantation in replacing missing lower second premolars and to evaluate the associated presurgical orthodontic treatment. The material consisted of records of all patients with teeth transplanted to the lower second premolar region during the period 1988–89 at the Department of Oral Surgery, Eastman Institute, Stockholm. The following variables were registered: sex, age, number of transplanted teeth, donor tooth, root development, recipient site, orthodontic treatment, persisting temporary molar, total number of congenitally missing teeth, the surgeon responsible, and clinical and radiological follow-up variables. Of 110 transplanted teeth, 99 had not completed root formation, and in 11 teeth the root formation was completed. The success rates after 4 years were 92% and 82%, respectively. Both premolars and molars served as donor teeth, but the main donor tooth was the upper second premolar. Fourteen percent had been orthodontically treated *only* because of the transplantation, i.e. to open the space for the donor tooth. Treatment of agenesis of the second lower premolar by autotransplantation has a good prognosis. In growing individuals the transplant not only maintains growth and development of the alveolar ridge but also provides a permanent solution to the agenesis. □ *Donor tooth; missing premolar; orthodontic treatment; prognosis; replacement*

Eva Josefsson, Department of Orthodontics, Public Dental Health, Kyrkogatan 6, S-591 35, Motala, Sweden. E-mail. Eva.Josefsson@lio.se

The frequency of agenesis of lower second premolars is 2.5–4% (1–3). The contemporary treatment alternatives are spontaneous or orthodontic space closure, fixed or removable partial dentures, implants, and autotransplantation. In growing individuals, bridgework and implants may impede the normal growth of the alveolar processes and are therefore contraindicated (4, 5).

The choice of treatment is determined by evaluation of the development of the occlusion. Early extraction of the deciduous molar before eruption of the second molar, and subsequent spontaneous or orthodontic space closure, is one alternative therapy (6, 7). When space closure is deemed unlikely or undesirable, an alternative solution is a tooth with root formation not completed (8). A major advantage is that the alveolar growth and the root development of the donor tooth are unimpeded. The method is relatively simple and a successful result offers a permanent solution (9–11). Teeth with completed root development can also be transplanted, but always require endodontic treatment after transplantation.

In several follow-up studies good results have been reported for autotransplanted teeth (9, 11–14), but today there are no published studies evaluating the outcome of autotransplantation to the lower second premolar region, solely. Our hypothesis was that autotransplantation to the region of lower second premolar is as successful as autotransplantations to other regions.

The aim of the present investigation was to analyze the outcome of autotransplantation to the lower second premolar region and to evaluate the extent to which associated presurgical orthodontic treatment was required.

Material and methods

The subjects comprised all patients treated at the Department of Oral Surgery, Eastman Institute, Stockholm in 1988–89, for autotransplantation to the lower second premolar region. The following variables were obtained from the case records: sex, age, number of transplanted teeth, donor tooth, root development (recorded in quarters of full root length), recipient site, orthodontic treatment, persisting temporary molar, the total number of congenitally missing teeth, the surgeon responsible, and, finally, clinical and radiological follow-up variables. The following clinical and radiological examination were recorded:

1. Pulp vitality. A Vitality Scanner Model 2007 was used and values between 20 and 50 for premolars and 30 and 70 for molars were registered as positive.
2. Ankylosis. X-ray diagnosis and/or high percussion tone.

3. Gingival conditions. Normal versus retracted or bleeding at probing.
4. Pocket depth. Values >3 mm were classified as pathological.
5. Mobility. Classified as normal or abnormal.
6. Periapical and juxtaradicular status. Classified as normal or abnormal.
7. Internal and external resorptions. Present or not present.
8. Root development. Classified as continued or arrested.
9. Pulpal obliteration. Classified as yes or no.

For each transplant, data were recorded 4 times during the first year, and then once a year up to 4 years after transplantation. Radiographs were taken at each follow-up using a modified parallel technique. All records were obtained by the oral surgeons.

The transplantation was defined as a 'failure' when at least one of the following conditions was noted: ankylosis, unhealed external resorption and/or extraction of the tooth.

Surgical method

The transplantation was performed under local anesthesia (Xylocain-Adrenalin 2% Astra). To ensure optimal healing conditions a daily regime of 1 g × 2 methyl penicillin and a chlorhexidine mouth rinse was prescribed for 10 days.

Preparation of the recipient site began with extraction of the persisting primary molar. In cases where the primary molar had been lost, an incision was made on top of the alveolar ridge. Minor mucoperiostal flaps are raised, buccally and palatally. The new socket was prepared with a low speed bur in a handpiece, under copious saline irrigation.

In order to avoid repeated testing of the socket, with subsequent damage to the periodontal ligament of the donor tooth, a special system was devised. A set of previously extracted and sterilized teeth of different kinds and sizes were used as test specimens. Steel wires were attached for safety. The similarity of test and donor tooth was estimated on the X-ray film. In some cases, to avoid unnecessary removal of bone, a somewhat smaller test tooth was selected initially and towards the end of the preparation a more precisely fitting tooth was tried in the alveolus.

At the donor site, a circumferential incision was made and a 'collar' of gingiva was left at the cervix of the tooth. After very careful extraction, the transplant was compared with the test tooth and the required final adjustment of the alveolus was made while the transplant was stored in a saline bath. The transplant was inserted into the prepared socket and in most cases no further adjustment was necessary. In order to avoid contact with the antagonist, most transplants were positioned in infraocclusion. No fixation was used. The transplant was retained by sutures crossed over the occlusal surface. The sutures were removed after 1 week. In cases where the donor tooth had completed root development, endodontic treatment was performed after surgery.

Table 1. Mean age of the patients (years) at time of transplantation. Donor teeth with both complete and incomplete root development

	Age	Range
Premolar	13.5	10.2–22
Molar	16.8	17.1–21

Results

Fig. 1a–d shows a typical patient suitable for transplantation. It is a 10-year-old boy with agenesis of lower left second premolar and lower left second molar and space deficiency in the upper jaw (a). The maxillary left second premolar was transplanted to the region of mandibular left second premolar (b). Fig. 1c shows the X-ray at the time of transplantation and Fig. 1d the transplant 4 years later.

In 80 patients, 39 girls and 41 boys, a total of 110 teeth had been transplanted to replace a missing lower second premolar. The age at transplantation is given in Table 1. The number and distribution of donor teeth, stage of root development, and the number of successful outcomes, in parentheses, are given in Table 2. In the upper jaw, first and second premolars and second and third molars served as donor teeth. In the lower jaw second premolars and third molars served as donor teeth. At the 4-year follow-up, 8 of the 99 teeth with root formation not completed and 2 of the 11 teeth with root formation completed were classified as 'failures'. The total number of successfully transplanted teeth was 100 (91%).

Fifty-eight teeth were transplanted to the left mandible and 52 to the right. At the time of transplantation, the primary molar persisted in 101 cases. The number of congenitally missing teeth per individual varied from 1 to 8 (Table 3).

Orthodontic treatment was performed in 52 cases, including 11 patients in whom only presurgical orthodontic treatment was required to widen the space for the transplant. The others had had orthodontic treatment for reasons other than agenesis. The mean treatment time for presurgical orthodontic treatment was 12 months.

Three surgeons performed 54, 37, and 19 autotransplantations, respectively. Four years after transplantation, all teeth showed partial or total obliteration of the pulp chamber.

The distribution and reasons for failure are given in Table 4. Of the successful transplants, one molar showed increased pocket depth and periodontal width and increased mobility. One premolar showed increased periodontal width. Three premolars showed healed external resorption. All but 2 teeth were observed for 4

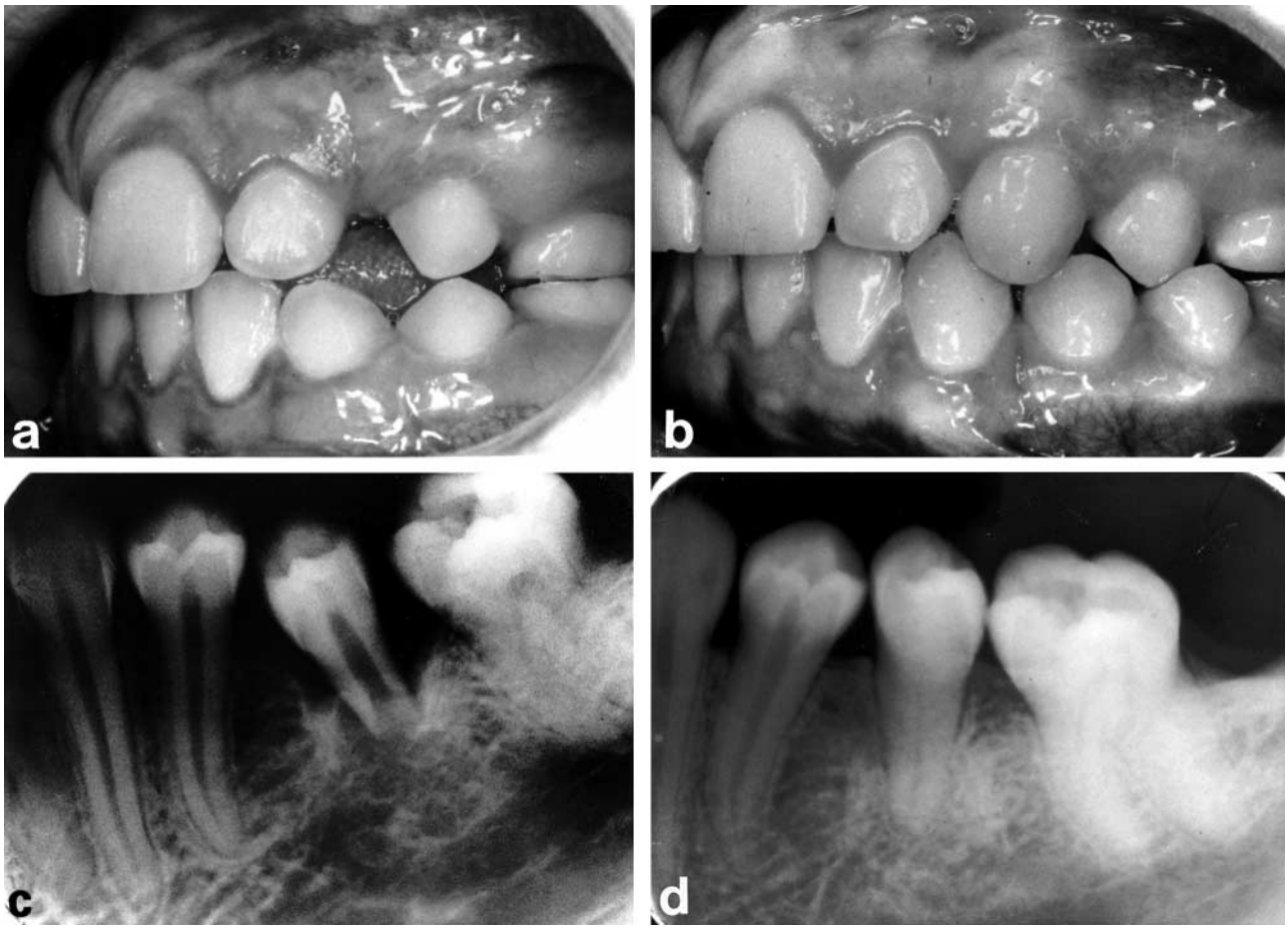

Fig. 1. (a) A 10-year-old boy with agenesis of lower left second premolar and lower left second molar. Space deficiency in the upper jaw. (b) Maxillary left second premolar transplanted to the region of lower left second premolar. (c) X-ray at the time of transplantation. (d) X-ray 4 years after transplantation.

years after transplantation; the 2 remaining teeth were observed for only 1 year postsurgery, and showed good healing and function.

There were too few failures to perform a statistical analysis. However, there was an even distribution between failure and age, sex, donor tooth, stage of root development, transplantation site, orthodontic treatment, persisting temporary molar, and surgeon.

Discussion

When agenesis of a lower second premolar is diagnosed there are a number of questions to be addressed before selection of a final treatment approach. Early extraction of the lower second deciduous molar and closure of the gap is one way of solving the problem (6), but this is not suitable in patients with spacing in the lower jaw and/or deep

Table 2. Number and distribution of donor teeth according to stage of root development. Number of successful outcomes within parentheses (x). Maxillary premolar includes first and second premolars. Maxillary molar includes second and third molars. Mandibular premolar includes second premolars. Mandibular molar includes third molars

Stage of root development	1/4	2/4	3/4	4/4	Total
Donor tooth					
Maxillary premolar	3 (3)	—	47 (44)	10 (8)	60 (55)
Mandibular premolar	—	2 (2)	3 (2)	1 (1)	6 (5)
Maxillary molar	—	9 (7)	26 (24)	—	35 (31)
Mandibular molar	—	1 (1)	8 (8)	—	9 (9)

Table 3. Distribution of congenitally missing teeth per individual

No. of congenitally missing teeth	1	2	3	4	5	6	7	8
No. of individuals	27	30	13	3	2	2	2	1

overbite. In growing individuals, however, in whom space closure is contraindicated, autotransplantation is the treatment of choice provided a suitable donor tooth, a third molar, or a crowded premolar is available. The advantage of transplantation is that the periodontal ligament of the transplant maintains growth and development of the alveolar ridge (see Fig. 1). The root formation of an autotransplanted tooth with incomplete root formation continues and, if necessary, orthodontic treatment can be performed after 3 to 6 months (15). In rare cases when the autotransplantation fails, prosthodontic treatment, a bridge, or an implant is still an alternative.

In the present study, 44 molars and 66 premolars were autotransplanted to replace missing lower second premolars. The premolars were extracted because of crowding. The success rate was 92% for teeth where root formation was not completed and 82% for teeth where root formation was completed. It should be noted that this study included only 11 teeth with root formation completed. The success rate is in accordance with studies of autotransplantation to the maxillary incisor region. In 1994, Kugelberg et al. (13) reported a total success rate of 89%, 96% for teeth with incompleted root formation and 82% for teeth with root formation completed. In a similar study by Kristerson & Lagerström (12), the corresponding rates were a total success rate of 82%, with 87% for teeth where root formation were incompleted and 67% for teeth with root formation completed. Andreasen et al. (14) studied premolars transplanted to various sites in the mouth and found that the success rate was 95% for teeth with incomplete root development and 98% for teeth with complete root development.

The hypothesis was accepted, autotransplantation to the region of the lower second premolar is as successful as to the region of the upper incisors and to various sites of the mouth (12, 13). However, the success rate for teeth with completed root formation in the present study was lower than reported by Andreasen et al. (14). It should be noted that only 11 teeth with completed root formation were included in the study.

Eleven patients required orthodontic treatment only in order to create space for the transplant. The mean treatment time was 12 months. In these cases the cost benefit aspect was considered prior to treatment, and only teeth with incomplete root formation were transplanted.

Levander et al. (16) have shown that patients with 4–16 missing teeth show a significantly greater degree of root resorption after orthodontic treatment. In the present study, 10 patients had 4–8 agenesis. Two of these patients, however, were treated orthodontically and showed no sign of root resorption.

Table 4. Reasons for and time of transplant failures in 10 cases

Transplant	Root development	Time for observation	Reason for failure
Premolar	3/4	2 days	Excess bleeding – extraction
Molar	3/4	3 months	Abscess – extraction
Premolar	3/4	2 years	Unhealed external resorption
Molar	2/4	2 years	,,
Molar	2/4	2 years	,,
Premolar	4/4	2 years	Root fracture – extraction
Premolar	4/4	4 years	Root fracture – extraction
Molar	3/4	6 months	Ankylosis
Premolar	3/4	3 years	,,
Premolar	3/4	2 years	,,

The main reasons for failure were ankylosis and persistent external resorption. It is speculated that the position of the donor tooth made extraction difficult, and the resultant minor trauma to the periodontal membrane led to both the ankylosis and the external resorption. The failure could not be related to any of the treatment variables recorded.

Conclusion

It is important and of value to have clinical evaluations of different treatment modalities. This study was therefore performed. It has shown that in cases of agenesis of the lower second premolar, autotransplantation has a good prognosis, provided it is carefully planned and timed. In growing individuals, the transplant not only maintains growth and development of the alveolar ridge, but also provides a permanent solution to the agenesis.

References

1. Grahnén H. Hypodontia in the permanent dentition. A clinical and genetical investigation. Odontol Revy 1956;7 Suppl 3.
2. Haavikko K. Hypodontia of permanent teeth. An orthopantomographic study. Suom Hammaslääk Toim 1971;67:219–25.
3. Rölling S. Hypodontia of permanent teeth in Danish schoolchildren. Scand J Dent Res 1980;88:365–9.
4. Ödman J, Gröndahl K, Lekholm U, Thilander B. The effect of osseointegrated implants on the dentoalveolar development. A clinical and radiographic study in growing pigs. Eur J Orthod 1991;13:279–86.
5. Zuccati G. Implant therapy in cases of agenesis. J Clin Orthod 1993;27:369–73.
6. Zachrisson B, Thilander B. Treatment of dento-alveolar anomalies. In: Thilander B, Rölling O, editors. Introduction to orthodontics. 5th ed. Stockholm: Tandläkarförlaget; 1985. p. 135–84.
7. Lindqvist B. Extraction of deciduous second molar in hypodontia. Eur J Orthod 1980;2:173–81.

8. Slagsvold O, Bjercke B. Indications for autotransplantation in cases of missing premolars. Am J Orthod 1978;74:241–57.
9. Slagsvold O, Bjercke B. Autotransplantation of premolars with partly formed roots. A radiographic study of root growth. Am J Orthod 1974;66:355–66.
10. Andreasen JO, Paulsen HV, Yu Z, Bayer T. A long-term study of 370 autotransplanted premolars. Part IV. Root development subsequent to transplantation. Eur J Orthod 1990;12:38–50.
11. Kristerson L. Autotransplantation of human premolars. A clinical and radiographic study of 100 teeth. Int J Oral Surg 1995;14:200–13.
12. Kristerson L, Lagerström L. Autotransplantation of teeth in cases with agenesis or traumatic loss of maxillary incisors. Eur J Orthod 1991;13:486–92.
13. Kugelberg R, Tegsjö U, Malmgren O. Autotransplantation of 45 teeth to the upper incisor region in adolescents. Swed Dent J 1994;18:165–72.
14. Andreasen JO, Paulsen HU, Yu Z, Bayer T, Schwartz O. A long-term study of 370 autotransplanted premolars. Part II. Tooth survival and pulp healing subsequent to transplantation. Eur J Orthod 1990;12:14–24.
15. Paulsen HU, Andreasen JO, Schwartz O. Pulp and periodontal healing, root development and root resorption subsequent to transplantation and orthodontic rotation: a long-term study of autotransplanted premolars. Am J Orthod Dentofac Orthop 1995;108:630–40.
16. Levander E, Malmgren O, Stenback K. Apical root resorption during orthodontic treatment of patients with multiple aplasia: a study of maxillary incisors. Eur J Orthod 1998;20:427–32.

Received for publication 17 September 1998
Accepted 6 April 1999