

Diagnosis, Screening and Treatment of Root Resorption in Orthodontic Practices in Greece and Sweden

Dimitrios Makedonas^a; Ken Hansen^b

ABSTRACT

Objective: To evaluate the perception of Greek and Swedish orthodontic practitioners regarding the possible occurrence and prognosis of root resorption occurring during orthodontic treatment and to estimate practitioners' approaches to the diagnosis of preexisting root resorption, screening of prevalence, and treatment planning approach when moderate or severe root resorption is present.

Materials and Methods: Questionnaires were received from randomly selected Greek (n = 90) and Swedish (n = 106) practitioners. Topics of the questions included (a) the presence of history; (b) the radiographic evaluation of root resorption before, during, and after treatment; (c) the treatment approach of initial prevention and protocols in cases of radiographic diagnosis of root resorption during treatment.

Results: Of the respondents, 47.1% of the Swedish practitioners and 32.3% of the Greek practitioners use periapical and panoramic radiographs to diagnose root resorption, mostly in the anterior region. Both groups recognize trauma, root form, and oral habits as predisposing factors. The majority of Swedish orthodontists perform radiographic follow-up in the first 6 months. In contrast, the Greek orthodontists perform it at 1 year or at the end of treatment. The treatment approach for root resorption that is most frequently used by Swedish orthodontists is altering the treatment plan, using light forces, and allowing resting periods, while the Greek orthodontists most frequently use lighter forces and reduce the total duration of the treatment.

Conclusions: Because there is no specific approach offered in the literature, the prevention and treatment reassessment in cases of root resorption relies on individual practitioner perception.

KEY WORDS: Root resorption; Questionnaire; Diagnosis; Screening; Treatment approach

INTRODUCTION

Orthodontically induced root resorption has received considerable interest in the literature. However, among orthodontically treated populations, incidences of root resorption varying from 1% to 100% have been reported.^{1,2} This variation could depend on several factors, including criteria for root resorption,³ examination

methods/techniques,⁴ type of orthodontic appliance and forces, extent of tooth movement, teeth examined, duration of treatment, and patient's age.⁵ However, in most studies only a small percentage of severe and/or moderate resorption was reported.^{2,3,6-12}

In the literature, recommendations and protocols for radiographic evaluation of root resorption before and during orthodontic treatment are given, as well as guidelines for considerations in the treatment planning process.¹³ Significant parameters regarding treatment approach and prevention of root resorption are the use of light and intermittent forces,^{2,14} early orthodontic treatment timing,⁴ treatment interruption/resting periods,¹³ oral habits control,^{15,16} and radiographic monitoring after 6 months of treatment (or 3 months when enhanced risk exists).^{17,18} However, because there is no evidence-based approach¹⁹ in the prevention or assessment of root resorption during treatment, measures to avoid severe resorption problems rely on the individual practitioner's perception.

^a Research Scientist, University of Gothenburg, Odontologen, Department of Orthodontics, Medicinaregatan 12C, Gothenburg, Sweden.

^b Department Head, University of Gothenburg, Odontologen, Department of Orthodontics, Medicinaregatan 12C, Gothenburg, Sweden.

Corresponding author: Dr. Dimitrios Makedonas, University of Gothenburg, Odontologen, Department of Orthodontics, Medicinaregatan 12C, Gothenburg, Sweden 41390 (e-mail: dmakedonas@hotmail.com)

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The aims of this study were to evaluate the estimates of orthodontic practitioners in Greece and Sweden regarding the occurrence and prognosis of root resorption in orthodontic treatment and to investigate practitioners' approaches regarding existing root resorption before treatment or when moderate or severe root resorption occurs during treatment.

MATERIALS AND METHODS

Three hundred questionnaires were sent to randomly selected orthodontic practitioners in Sweden (n = 150) and Greece (n = 150). The total number of registered active orthodontists was 233 and 375 in Sweden and Greece, respectively. Completed questionnaires were received from 106 Swedish orthodontists (71%) and 80 Greek orthodontists (53%).

The form included questions concerning the following topics (see Appendix 1 for the full questionnaire):

- Journal recording of possible predisposing factors for root resorption (ie, oral habits and root-shape abnormalities) and the practitioners' estimation of the importance of these factors for risks of root resorption.
- Radiographic evaluation of root resorption before, during, and after treatment (type, frequency, and regions from which radiographs were taken).
- The treatment approach for preventing root resorption; type of appliances; use of resting periods or discontinuation of treatment; and duration, type (continuous vs interrupted), and magnitude of forces used.
- Treatment approach and protocols used when root resorption was diagnosed before or during treatment.
- The practitioner's estimation of the prevalence of root resorption observed in their practice.

Of the practitioners who answered the questionnaires, 100% of the Greek respondents and only 18% of the Swedish respondents worked in private practices. Eighty-two percent of the Swedish orthodontists worked in public clinics.

RESULTS

Use of radiographs for diagnosing root resorption before treatment

Periapical radiographs constitute the most common radiographic examination for both groups. The Greek orthodontists used both periapical and panoramic radiographs (32.3%), while the Swedish orthodontists used periapical radiographs alone (31.0%) or periapical and panoramic radiographs (47.1%) (Figures 1 and 2).

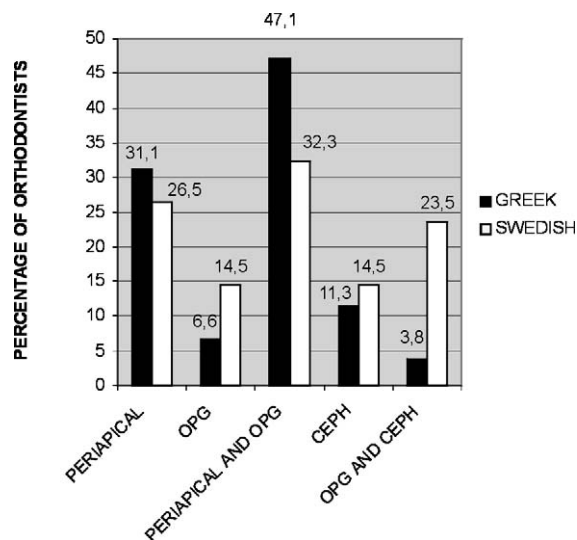


Figure 1. Amount of different types of radiographs used by Greek and Swedish practitioners to diagnose initial root resorption before treatment.

Swedish orthodontists used periapical radiographs in the upper and lower frontal regions (central and lateral incisors) and, to a great degree, in the posterior region (premolars and molars). The Greek orthodontists used periapical radiographs mostly in the upper and lower anterior region (from canine to canine) (Figure 3).

On a scale of 1 to 10 in which 1 = no importance and 10 = great importance, respondents rated the ability of different approaches to diagnose root resorption before treatment. Swedish orthodontists considered panoramic radiographs of little importance (4/10) for the anterior region and of average importance (7/10) for the posterior region. Greek orthodontists, however, considered panoramic radiographs of average importance (7/10) in both regions.

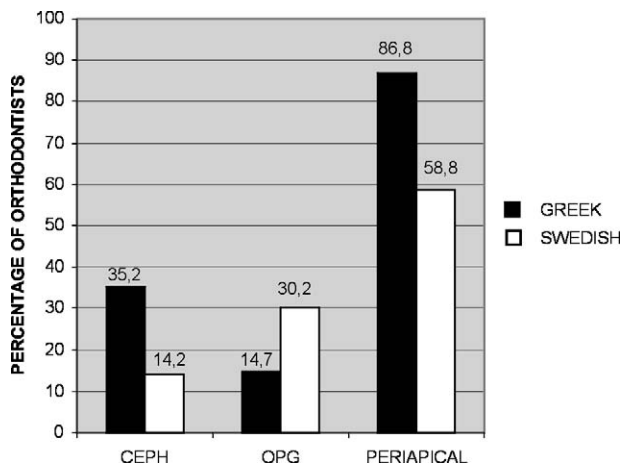


Figure 2. Comparison of the regular use of radiographs by Greek and Swedish practitioners for the initial diagnosis of root resorption.

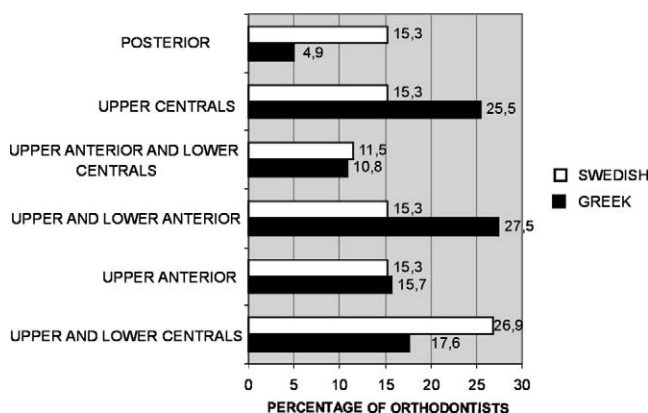


Figure 3. Number of periapical radiographs Greek and Swedish practitioners take to diagnose initial root resorption before treatment.

Evaluation and approach of risk factors for the development of root resorption

Ninety-eight percent of the Swedish and 67% of the Greek orthodontists kept a journal with predisposing factors before treatment. Both Greek (94%) and Swedish (96%) orthodontists considered trauma to be a predisposing factor of high importance. There was a difference in whether root anomalies were thought to be a predisposing factor: more Swedish orthodontists (79%) than Greek orthodontists (64%) considered root anomalies to be important. Systemic diseases and oral habits were considered to be of greater importance by the Swedish orthodontists (50% and 93%, respectively) than by the Greek orthodontists (47% and 50%, respectively).

Eighty-three percent of the Swedish respondents and 44% of the Greek respondents still carried out treatment even if they diagnosed preexisting root resorption. Among the Swedish orthodontists, 37% would stop treatment if up to one third of the root length was resorbed during treatment, and 41% would stop treatment if up to half the root length was resorbed. Among the Greek orthodontists, 48% would stop treatment if up to one third of the root length was resorbed and 29% would stop treatment if up to half the root length was resorbed.

Seventy-five percent of the Swedish orthodontists and 56% of the Greek orthodontists performed a radiographic follow-up for diagnosis of root resorption during treatment. Eighty-seven percent of the Swedish orthodontists and 15% of the Greek orthodontists per-

formed a radiographic follow-up after 6 months of treatment, whereas 25% of Swedish orthodontists and 42% of Greek orthodontists performed radiographic follow-ups after 1 year of treatment.

Eighty-three percent of the Swedish orthodontists and 76% of the Greek orthodontists had rarely treated cases with preexisting root resorption.

Both groups of practitioners gave instructions concerning the discontinuation of oral habits before treatment (91%).

Among several factors that have been recognized as being important for the development of root resorption, the Greek orthodontists consider resting periods, biting foreign objects, and bruxism as significant, whereas the Swedish orthodontists were more likely to name resting periods and bruxism as significant (Table 1).

When asked to consider the total amount of root resorption in their patients, Greek orthodontists diagnosed no root resorption in 55% of their patients after treatment, resorption of up to 2 mm in 42% of patients, and resorption of up to one-third in 2.6% of patients. The Swedish orthodontists diagnosed no root resorption in 47% of their patients after treatment, resorption of up to 2 mm in 41% of patients, and resorption of up to one-third in 8% of patients.

Treatment approaches when root resorption is diagnosed

In cases when moderate root resorption (from 2 mm up to 1/3 of the root length) was diagnosed before treatment, the most common approach for the Swedish orthodontists was the use of lighter forces, resting periods, and alteration of the treatment plan whereas Greek orthodontists tended to use lower forces and decrease the total duration of treatment (Figure 4).

In cases when severe root resorption (1/2 of the root length or more), was diagnosed before treatment, the most common approach for both populations of practitioners was not to treat or alter the treatment plan (Figure 5).

When moderate root resorption was diagnosed during treatment, both populations of orthodontists used lower forces and decreased the treatment duration. In addition, the Swedish orthodontists frequently used rest periods (Figure 6).

When severe root resorption was diagnosed during

Table 1. Evaluation of the importance of predisposing factors for root resorption, from a scale ranging from 0 (no importance) to 10 (great importance)

	Finger Sucking	Resting Periods	Bruxism	Thin Roots	Blunt Roots	Biting Objects
Greek	Low 3.6	High 7.4	Average 5.1	Average 4	Low 3.4	Average 5.4
Swedish	Low 3.5	Average 5.9	Average 5.6	Low 3.4	Low 2.0	Low 3.8

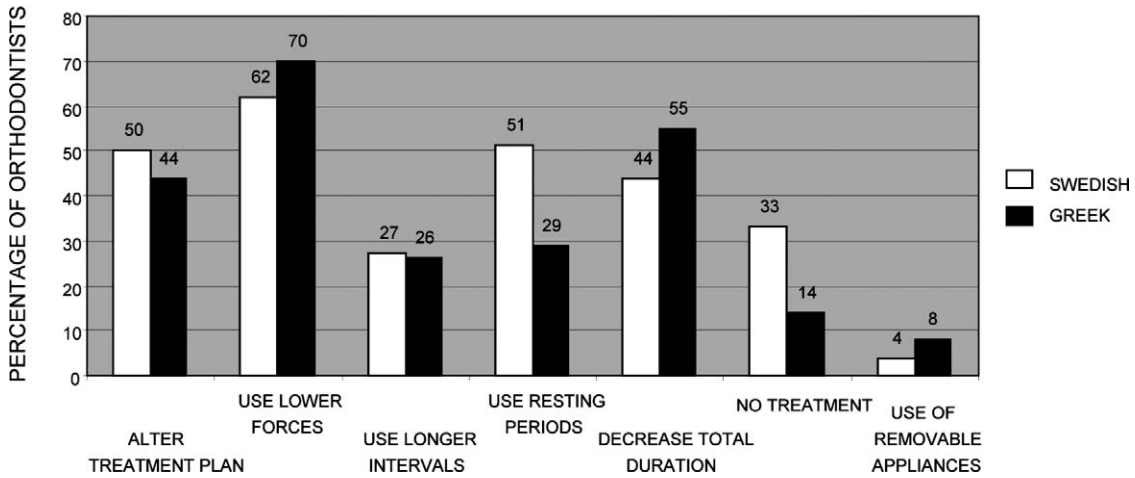


Figure 4. Treatment modalities when moderate root resorption (from 2 mm up to 1/3 of the root length) is diagnosed before treatment.

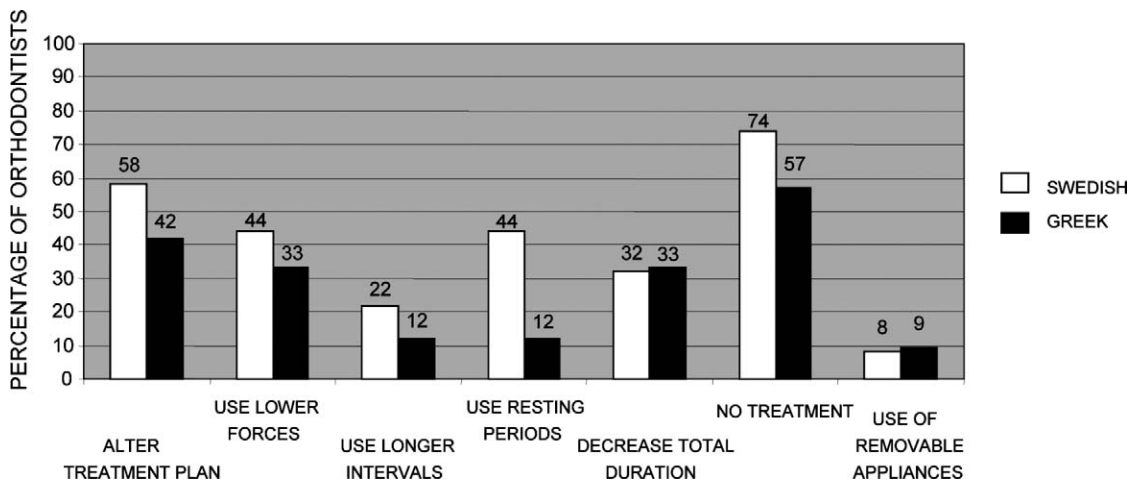


Figure 5. Treatment modalities when severe root resorption (1/2 of the root length or more) is diagnosed before treatment.

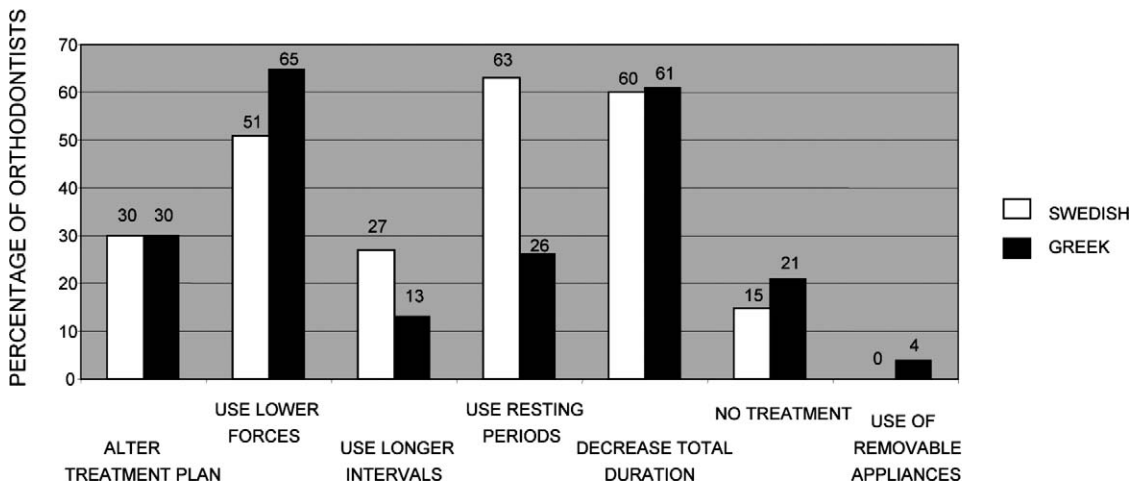


Figure 6. Treatment modalities when moderate root resorption (from 2 mm up to 1/3 of the root length) is diagnosed during treatment.

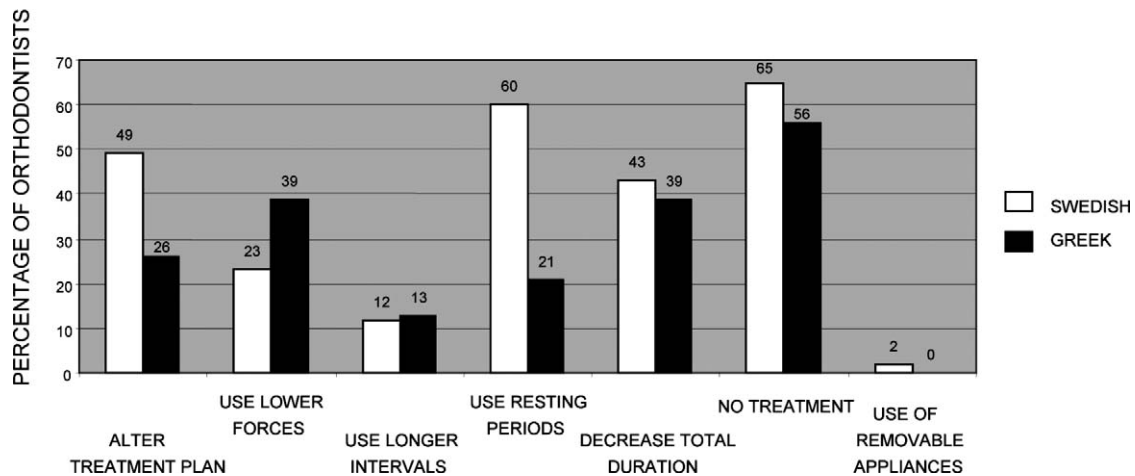


Figure 7. Treatment modalities when severe root resorption (1/2 of the root length or more) is diagnosed during treatment.

treatment, both Greek and Swedish orthodontists stopped treatment or decreased the total duration to the same degree; however, the Swedish orthodontists used resting periods most frequently. In contrast, the Greeks orthodontists used lower forces more commonly (Figure 7).

DISCUSSION

A study of the diagnosis, screening, and treatment approaches of orthodontists in two European countries reveals the techniques practitioners most commonly use for preventing root resorption. In addition, it evaluates to what degree the differences in working conditions and amount of research publications between Swedish and Greek respondents could have on their approach to the root resorption question.

The significantly greater response rate from Swedish orthodontists compared with the Greek orthodontists could raise the question of how representative the results might be. However, the purpose of this study was not to compare the two countries, but merely to investigate the difference in their perceptions and the difference in the guidelines for preventing root resorption that may occur under the differing working conditions, education, and research activities in the two countries.

Reports show that Swedish orthodontists are highly active in conducting research, producing around 2% of the world articles published, and the majority of the research is conducted in universities.²⁰ A large amount of research is also produced by several Greek researchers, but mostly in foreign institutions, probably because of limited research funding. This fact could be one part of the explanation for the different percentage of interest in answering the questionnaire.

According to the Swedish Dental Association, only 23.5% of orthodontic practitioners work in private clin-

ics in Sweden.²¹ In contrast, the majority of Greek orthodontic practitioners provide services in private practices and thus are provided with limited resources for research.

Periapical radiographs are the most common method of diagnosing root resorption in most countries. Greek orthodontists, however, give more emphasis to panoramic radiographs in the anterior region.

Among the Swedish orthodontists, oral habits and root anomalies are rated in a middle position on the scale of risk factors for developing root resorption.

The great number of Swedish orthodontists who perform a radiographic follow-up of root resorption 6 months after initiation of treatment could be explained by the influence of studies and recommendations from Levander and Malmgren and colleagues.^{5,17,18}

Greek orthodontists appeared to be more confident in their ability to prevent root resorption from developing and reported root resorption of null to 2 mm in their treated patients, compared with 88% for Swedish orthodontists. This is in accordance with the fact that the Greek orthodontists more rarely perform radiographic follow-ups of root resorption, during and after treatment.

When root resorption is diagnosed before or during orthodontic treatment, the treatment change of choice is resting periods for Swedish orthodontists and use of lower forces for Greek orthodontists. This reveals a different treatment approach between the two countries. This use of common and different modalities points out the fact that because there is no specific approach in the literature, prevention and treatment reassessment rely on the perception of individual practitioners.

CONCLUSIONS

- Although there are few sources of recommendations in the literature regarding the types of radiographic

examination and the estimation of risk factors for the development of root resorption, a high proportion of Swedish and Greek orthodontists follow similar procedures.

- Swedish orthodontists perform more radiographic follow-up during treatment, but Greek orthodontists seem more confident about avoiding root resorption.
- Because there is not a specific approach generalized in the literature, prevention and treatment re-assessment in cases of root resorption during orthodontics still relies on the perception of individual practitioners.

REFERENCES

1. Mayoral G. Treatment results with light wires studied by panoramic radiography. *Am J Orthod Dentofacial Orthop.* 1982;81:489–497.
2. Harty M, Sims M. Root resorption in bicuspid intrusion. A scanning electron microscopy. *Angle Orthod.* 1982 Jul; 52(3):235–258.
3. Janson GR, De Luca Canto G, Martins DR, Henriques JF, De Freitas MRG. A radiographic comparison of apical root resorption after orthodontic treatment with 3 different fixed appliance techniques. *Am J Orthod Dentofacial Orthop.* 1999;118:262–273.
4. Stenvik A, Mjor IA. Pulp and dentin reaction to experimental tooth intrusion. *Am J Orthod.* 1970;57:370–385.
5. Levander E, Malmgren O, Eliasson S. Evaluation of root resorption in relation to two orthodontic treatment regimes. A clinical experimental study. *Eur J Orthod.* 1994;16(3): 223–228.
6. Kaley J, Phillips C. Factors related to root resorption in edgewise practice. *Angle Orthod.* 1991;61:125–132.
7. Ronnerman A, Larsson E. Overjet, overbite, intercanine distance and root resorption in orthodontically treated patients. *Swed Dent.* 1981;5(1):21–27.
8. Alexander S. Levels of root resorption associated with continuous arch and sectional arch mechanics. *Am J Orthod Dentofacial Orthop.* 1996;110:321–324.
9. Lupi J, Handelman C, Sadowsky C. Prevalence and severity of apical root resorption and alveolar bone loss in orthodontically treated adults. *Am J Orthod Dentofacial Orthop.* 1996;109:28–37.
10. Goldson L, Henrikson C. Root resorption during Begg treatment: a longitudinal roentgenographic study. *Am J Orthod Dentofacial Orthop.* 1975;68:55–66.
11. Tahrir E, Sadowsky C, Schneider B. An assessment outcome in American Board of Orthodontics cases. *Am J Orthod Dentofacial Orthop.* 1997;111:335–342.
12. Fritz U, Diedrich P, Wiechmann D. Apical root resorption after lingual orthodontic therapy. *J Orofac Orthop* 2003;64(6): 434–442.
13. Sameshima G, Sinclair P. Predicting and preventing root resorption: Part II. Treatment factors. *Am J Orthod Dentofacial Orthop.* 2001;119:511–515.
14. Lee K, Straja S, Tuncay O. Perceived long term prognosis of teeth with orthodontically resorbed roots. *Orthod Craniofacial Res.* 2003;6:177–191.
15. Newman WG. Possible etiologic factors in external root resorption. *Am J Orthod.* 1975;67:522–539.
16. Odernick L. Nailbiting: frequency and association with root resorption. *Br J Orthod.* 1985;12:75–81.
17. Levander E, Malmgren O. Evaluation of the risk of root resorption during orthodontic treatment: a study of upper incisors. *Eur J Orthod.* 1998;10:30–38.
18. Levander E, Bajka R, Malmgren O. Early radiographic diagnosis of apical root resorption during orthodontic treatment: a study of maxillary incisors. *Eur J Orthod.* 1998;20: 57–63.
19. The Swedish Council on Technology Assessment in Health Care. Summary and Conclusions of the SBU Report on: Malocclusions and Orthodontic Treatment in a Health Perspective. 2005. Available at: http://www.sbu.se/Filer/Content1/publikationer/1/Malocclusions_Orthodontic%20.pdf. Accessed April 21, 2007.
20. Bondemark L, Lilja-Karlander E. A systematic review of Swedish research in orthodontics during the past decade. *Acta Odontologica Scand.* 2005;62:46–50.
21. Swedish Dental Association. *Dentistry in Sweden*. Stockholm, Sweden: Tandläkaförbundet. 2003.

APPENDIX 1.

Original form of the questionnaire is available online only at <http://dx.doi.org/10.2319/112006-468.1>.