Case Report

Short Root Anomaly - A Potential "Landmine" for Orthodontic and Orthognathic Surgery Treatment of Patients

Ejvis Lamani, Katelyn B. Feinberg, Chung H. Kau

Department of Orthodontics, University of Alabama at Birmingham School of Dentistry, Birmingham, AL, USA

Abstract

Short root anomaly (SRA) is a poorly understood developmental disorder and can significantly compromise the patient's dental treatment. This case report describes the treatment of a 15-year-old girl with SRA and discusses the implication of this disorder on orthodontic and orthognathic treatment of patients.

Keywords: Orthodontic/orthognathic treatment impact, root resorption, short root anomaly

Introduction

Short root anomaly (SRA) was first described by Lind as a dental disorder affecting tooth root development, resulting in short roots with rounded apices and reduced crown to root ratios.[1] This disorder affects teeth bilaterally with a predilection for maxillary incisors, and maxillary and mandibular premolars.[2] It is often accompanied with additional dental anomalies including hypodontia, supernumerary teeth, microdontia, dens invaginatus, taurodontism, and obliterated pulp chambers.[3-7]

SRA has a prevalence that ranges from 2.4% to 2.7% in Caucasians up to 10% in Mongolians.[2,8,9] Familial cases of SRA with an autosomal dominant pattern of inheritance have been observed.[2,5] Reports of this disorder are on the rise, especially in Hispanic populations.[2] However, more studies regarding the prevalence of SRA in many populations are needed.

In addition, patients with SRA have an increased risk of root resorption during orthodontic treatment.[1,10,11] This combined with the compromised crown to root ratios of these patients may result in major adverse clinical outcomes such as tooth loss.

Patients with a skeletal discrepancy require both orthodontics and orthognathic surgery to achieve best esthetic and functional results. For these patients, orthodontic alignment usually represents the first phase of their comprehensive treatment, dental decompensation.[12] Thus, proper diagnosis of SRA becomes important not only for orthodontic treatment planning but also in the successful treatment of orthognathic surgery patients. Increasing awareness of this disorder among orthodontists and oral surgeons will allow clinicians to individualize the patient's treatment plan to minimize root resorption.

In this case report, we present the orthodontic treatment of a patient with SRA and discuss the impact of this disorder in orthodontic/orthognathic treatment planning.

Access this article online

Quick Response Code:

Website: www.amsjournal.com

DOI: 10.4103/ams.ams_128_16

Case Report

Diagnosis and etiology

The patient was a 15-year-old Hispanic female who presented to clinic with a chief complaint of crooked teeth. The patient had an unremarkable medical history and no history of dental trauma. She reported good health with a recent dental checkup of having no caries and healthy periodontium.

The patient had a straight profile with slightly increased lower facial hight [Figure 1]. Her lips were competent at rest and she had inadequate incisor display on smile. Her upper dental midline was canted and to the right. Clinical examination and analysis of dental casts revealed moderate to severe crowding with Class I molar and end on Class II canine relationship [Figures 1 and 2]. She had an anterior cross bite and an edge-to-edge

Address for correspondence: Dr. Ejvis Lamani, Department of Orthodontics, University of Alabama at Birmingham School of Dentistry, 1919 7th Avenue South, SDB 313, Birmingham, AL, USA. E-mail: ejvis@uab.edu

How to cite this article: Lamani E, Feinberg KB, Kau CH. Short root anomaly - A potential "Landmine" for orthodontic and orthognathic surgery treatment of patients. Ann Maxillofac Surg 2017;7:296-9.

incisor relationship. The panoramic radiograph showed a complete dentition with developing third molars [Figure 3]. The radiograph also revealed the presence of generalized short roots with rounded apices consistent with the diagnosis of SRA. The maxillary central incisors and first premolars were the most severely affected teeth. Furthermore, signs of external resorption were seen on the maxillary left incisors. Cephalometric analysis indicated a skeletal Class I base (ANB = 1.7°) with dental alveolar protrusion (U1-Apo = 9 mm, L1-Apo = 7 mm) and high mandibular plane angle (FMA = 37.5°). The patient is past her peak growth and close to CVS 6.

Treatment objectives

The treatment objectives were to alleviate crowding and establish proper overjet and overbite and Class I canine relationship for optimum function and esthetics while minimizing the risk of root resorption.

Treatment alternatives

To achieve our objectives, two treatment options were presented to the patient and her parents. The first option consisted of correcting the malocclusion with four premolar extractions. This protocol would provide a better esthetic result, but the risk of root resorption would be high. The second option consisted of nonextraction treatment with proclination of incisors and broadening of the arches. The patient and parents selected to continue with the second treatment option.

Treatment progress

The patient was treated with maxillary and mandibular fixed self-ligating appliances (Damon Q). After initial alignment with 0.013 CuNiTi, 0.018 NiTi, and 014 × 025 NiTi, space for the maxillary laterals was opened with NiTi coil springs. When adequate space had been obtained, maxillary lateral incisors were aligned into the arch with an auxiliary archwire going through the accessory slot of the Damon Q brackets.

To prevent the bite from opening, vertical elastics were used initially anteriorly, followed by a Class II vector to correct the anteroposterior dental relationship. The patient was instructed to wear the Class II triangle elastics for a total of 5 months. During this time, the patient was monitored for root resorption with panoramic radiograph.

After 15 months of treatment, due to patient's noncompliance with hygiene instructions, appliances were removed, and the patient was fitted with retainers. Fixed retainers (lower 3-3 and upper 2-2) were delivered with overlay removable Essix retainers. The patient was instructed to wear removable retainers for 24 h a day for the first 6 months and then continue with nighttime wear for the remainder of the year.

Treatment results

At the end of the orthodontic treatment, slight lip protrusion was observed without significant changes in the facial profile [Figure 4]. Improvements in the patient's dental midlines were evident. Her smile became consonant, and an increase in incisor and gingival display was observed. The intraoral photographs show satisfactory dental alignment with bilateral Class I occlusion and normal overjet and overbite. Expansions (approximately 2 mm) were noted in both arches. Positive overbite and overjet were achieved by incisor extrusion and proclination, respectively.

The cephalometric analysis revealed no changes in the ANB angle and a slight decrease in FMA (from 37.5° to 36.1°) [Table 1 and Figure 5]. Superimpositions of lateral cephalograms did not indicate any significant growth of maxilla and mandible [Figure 6]. The maxillary and mandibular incisors displayed evidence of extrusion and increases in incisal angulations. The panoramic radiograph showed that some root resorption (<2 mm) had occurred.

The patient was followed for 3 months and was compliant with wearing the retainers. The retainers were still fitting nicely, and no relapses were observed at the follow-up visit.

Discussion

SRA is a poorly understood disorder that affects tooth root development and varies in prevalence from 2.4% to 10%.[5,8] Lind first introduced this term in 1972 to describe abnormally short root morphology of maxillary central incisors with compromised crown to root ratios.[1] More recent studies have identified maxillary and mandibular premolars as the second most commonly SRA-affected teeth.[2,8]

This genetic disorder is often accompanied by hypodontia, supernumerary teeth, microdontia, dens invaginatus, taurodontism, and obliterated pulp chambers.[3-7] Furthermore, an increase in matrix metalloproteinase (MMP-9) collagenase activity has been seen in gingival crevicular fluids of SRA patients.[13] Since collagenase activity (including MMP-9) is important in periodontium remodeling during orthodontic tooth movement, the alterations seen in patients with SRA may play a role in the increased risk for root resorption seen in these individuals during orthodontic tooth movement which if severe can result in tooth loss.[1,14]

Root resorption can be detected histologically as microscopic lacunae on root surface in the absence of radiographic evidence.[15,16] This falls within the reparative capacity of cementum. However, aggressive progression and dentin exposure increase the likelihood

Table 1: Cephalometric analysis

Measurements	Pretreatment	Posttreatment
SNA (°)	79	79.1
SNB (°)	77.3	77.4
ANB (°)	1.7	1.7
FMA (MP-FH) (°)	37.5	36.1
U1-APo (mm)	9	12.2
U1-SN (°)	103	113.3
Interincisal angle (U1-L1) (°)	122.8	108.2
L1-APo (mm)	7	9.6
IMPA (L1-MP) (°)	90.6	96
Upper lip to E-plane (mm)	−4	−2.7
Lower lip to E-plane (mm)	−0.3	0.9

Figure 1: Pretreatment facial and intraoral photographs

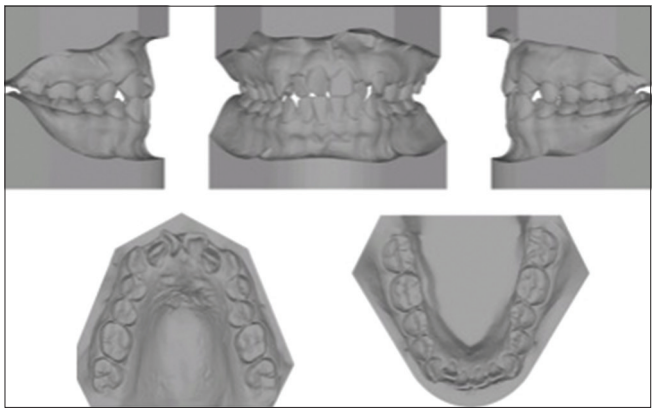

Figure 2: Pretreatment dental casts

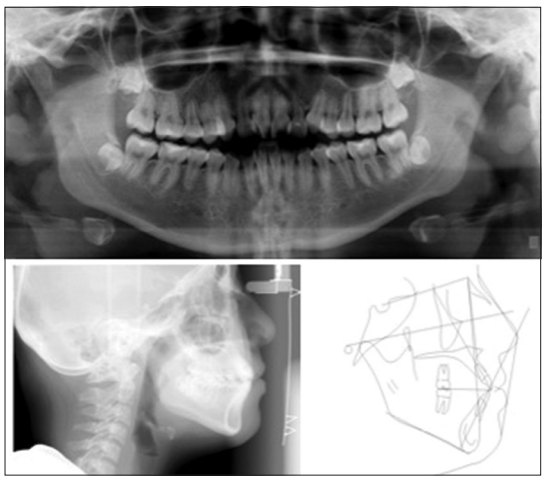

Figure 3: Pretreatment panoramic and cephalometric radiographs and tracing

of permanent root resorption. Clinically, root resorption may not be apparent until permanent root structure has been lost. Nevertheless, the understanding that SRA predisposes patients to root resorption can be applied to orthodontic treatment planning, minimizing the adverse clinical outcomes.

For patients with bimaxillary dentoalveolar protrusion, of which the one presented here is not a severe example, teeth extraction and arch distalization are the more esthetic orthodontic treatment options given.[17] However, premolar extraction and whole tooth distalization display apical root displacement that often results in root resorption.[18,19]

In the case reported here, the correct diagnosis of SRA influenced the patient's selection of nonextraction orthodontic treatment. Fortunately, as mentioned above, the degree of dentoalveolar protrusion in our patient allowed for further incisor proclination without detrimental results to the patient's overall esthetic goal. Even with the selected treatment plan and avoidance of complex mechanics, minor root resorption was observed in maxillary incisors and premolars.

However, in severe bimaxillary protrusion cases or Class II and Class III patients when extraction could be used to camouflage the skeletal discrepancy, preexisting conditions such as SRA should be carefully evaluated. In these cases, consideration should be given to treatment options combining orthodontics with orthognathic surgery.

At present, there are no studies identifying orthognathic surgery as a risk factor for root resorption. A search of the literature did identify a case report of an anterior open bite patient with short maxillary incisors treated with surgery in combination with orthodontics, in which root resorption was observed at the completion of treatment.[20] However, the very long treatment time (47 months) due to the need to reopen extraction spaces of maxillary premolars before the 3-piece LeFort I osteotomy may have contributed to the root resorption. Thus, including orthognathic surgery in treating SRA patients without significantly increasing the treatment time may still be the superior option to a camouflage treatment of noncrowded Class II and Class III malocclusions.

Currently, there are no reliable markers for orthodontic patients to predict the occurrence and severity of root resorption. Correct diagnosis of SRA empowers the clinician with another diagnostic tool that can be used to individualize orthodontic treatment plans leading to more successful outcomes while minimizing or eliminating undesired orthodontic complications.

Conclusion

SRA is a rare disorder that can be a useful tool in identifying patients susceptible to root resorption during orthodontic tooth movement. Proper diagnosis of this condition will allow clinicians to individualize the treatment protocol to achieve the treatment goals and patient satisfaction.

Acknowledgment

Authors would like to thank the Department of Orthodontics staff at the University of Alabama at Birmingham School of Dentistry.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information

Figure 4: Posttreatment facial and intraoral photographs

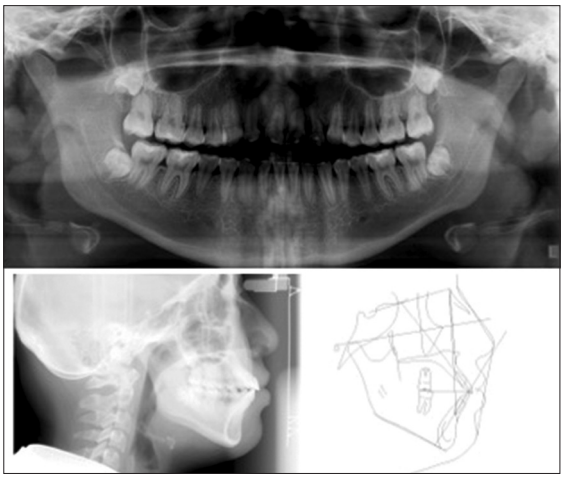

Figure 5: Posttreatment panoramic and cephalometric radiographs and tracing

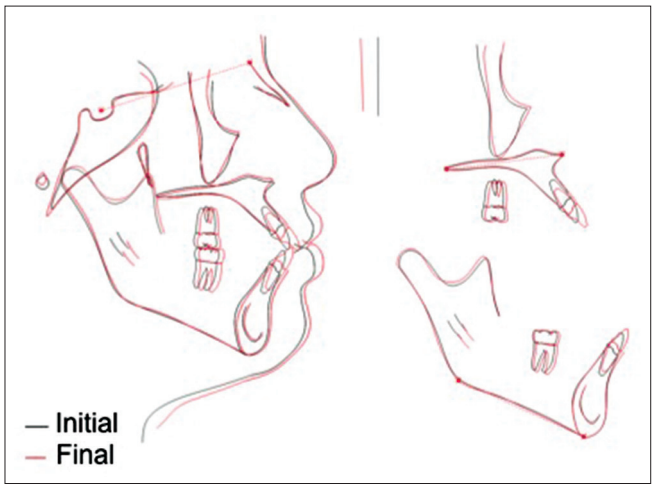

Figure 6: Initial and final cephalometric tracings superimposed on sella-nasion line at sella and maxillary and mandibular superimpositions

to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

This work was supported by the Department of Orthodontics, University of Alabama at Birmingham School of Dentistry, Birmingham, AL, USA.

Conflicts of interest

There are no conflicts of interest.

References

1. Lind V. Short root anomaly. Scand J Dent Res 1972;80:85-93.
2. Puranik CP, Hill A, Henderson Jeffries K, Harrell SN, Taylor RW, Frazier-Bowers SA. Characterization of short root anomaly in a Mexican cohort – Hereditary idiopathic root malformation. Orthod Craniofac Res 2015;18 Suppl 1:62-70.
3. Lerman RL, Gold R. Idiopathic short root anomaly. J Pedod 1977;1:327-33.
4. Edwards DM, Roberts GJ. Short root anomaly. Br Dent J 1990;169:292-3.
5. Apajalahti S, Arte S, Pirinen S. Short root anomaly in families and its association with other dental anomalies. Eur J Oral Sci 1999;107:97-101.
6. Desai RS, Vanaki SS, Puranik RS, Rashmi GS, Nidawani P. An unusual combination of idiopathic generalized short-root anomaly associated with microdontia, taurodontia, multiple dens invaginatus, obliterated pulp chambers and infected cyst: A case report. J Oral Pathol Med 2006;35:407-9.
7. Nagaveni NB. An unusual occurrence of multiple dental anomalies in a single nonsyndromic patient: A case report. Case Rep Dent 2012;2012:426091.
8. Apajalahti S, Hölttä P, Turtola L, Pirinen S. Prevalence of short-root anomaly in healthy young adults. Acta Odontol Scand 2002;60:56-9.
9. Ando S, Kiyokawa K, Nakashima T, Shibo K, Sanka Y. Studies on the consecutive surgery of succedaneous and permanent dentition in Japanese children 4. Behavior of short-rooted teeth in the upper bilateral central incisors. J Nihon Univ Sch Dent 1967;9:67-82.
10. Jakobsson R, Lind V. Variation in root length of the permanent maxillary central incisor. Scand J Dent Res 1973;81:335-8.
11. Marques LS, Generoso R, Armond MC, Pazzini CA. Short-root anomaly in an orthodontic patient. Am J Orthod Dentofacial Orthop 2010;138:346-8.
12. Proffit WR, Sarver DM. Combined surgical and orthodontic treatment. In: Fields HW Jr, Proffit WR, Sarver DM, editors. Contemporary Orthodontics. St. Louis, Missouri: Elsevier Mosby; 2013. p. 685-725.
13. Apajalahti S, Sorsa T, Ingman T. Matrix metalloproteinase -2, -8, -9, and -13 in gingival crevicular fluid of short root anomaly patients. Eur J Orthod 2003;25:365-9.
14. Newman WG. Possible etiologic factors in external root resorption. Am J Orthod 1975;67:522-39.
15. Abass SK, Hartsfield JK Jr. Orthodontics and external apical root resorption. Semin Orthod 2007;13:246-56.
16. Vlaskalic V, Boyd RL, Baumrind S. Etiology and sequelae of root resorption. Semin Orthod 1998;4:124-31.
17. Kook YA, Park JH, Bayome M, Sa'aed NL. Correction of severe bimaxillary protrusion with first premolar extractions and total arch distalization with palatal anchorage plates. Am J Orthod Dentofacial Orthop 2015;148:310-20.
18. Nanekrungsan K, Patanaporn V, Janhom A, Korwanich N. External apical root resorption in maxillary incisors in orthodontic patients: Associated factors and radiographic evaluation. Imaging Sci Dent 2012;42:147-54.
19. Liou EJ, Chang PM. Apical root resorption in orthodontic patients with en-masse maxillary anterior retraction and intrusion with miniscrews. Am J Orthod Dentofacial Orthop 2010;137:207-12.
20. Tanaka OM, Guariza-Filho O, Carlini JL, Oliveira DD, Pithon MM, Camargo ES. Glossectomy as an adjunct to correct an open-bite malocclusion with shortened maxillary central incisor roots. Am J Orthod Dentofacial Orthop 2013;144:130-40.