Analysis of vertical root fracture in endodontically versus nonendodontically treated teeth on patients with periodontitis

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I. Introduction

Vertical root fracture(VRF) is defined as a fracture of the root that is longitudinally oriented at a more or less oblique angle towards the long axis of the tooth,[1] or a longitudinal fracture confined to the root that usually begins on the internal canal wall and extends outward to the root surface.[2] Because most symptoms and signs of VRF are non specific, and may mimic periodontal disease or failed endodontic treatment, a definite diagnosis of VRF is often difficult for dentist.[3] Previous studies[4-7] reported theat common clinical symptoms of VRF are the presence of dull pain, swelling, and sinus tract, with a deep localized probing defect. Radiographs may show widening of the periodontal ligament and osseous resorptive defects. The clinical and radiographic findings are related to the extent and location of the fracture. VRF is mostly found in older people.[5]

VRF usually occurs in endodontically treated teeth with or without post insertion.[5,7] Considerable loss of tooth structure during instrumentation and excessive pressure during obturation have been reported as the most likely causes of VRF.[5,8,9] Overpreparation of dowel space and subsequent forcing of a post into place are considered as secondary causes of VRF.[5,10]

Root fractures in nonendodontically treated teeth are usually apical extensions of coronal fractures associated with cracked or split teeth.[11,12] VRFs in nonendodontically treated teeth should therefore be differentiated from root fractures that began as

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coronal fractures(cracked or split teeth). True VRF in nonendodontically treated teeth confined to the root surface is uncommon.

The true causes of VRF in nonendodontically treated teeth are still unknown. Yang et al[13] suggested that these fractures might be related to special diet patterns or chewing habits in Chinese. Yeh[14] proposed that the VRFs might result from an excessive, repetitive and heavy masticatory stress; he referred to these fractures as "fatigue root fractures." The clinical features of VRF in endodontically versus non endodontically treated teeth have yet to be investigated. Comparison of their clinical features may enhance the understanding of the contributing causes or risk factors of VRF. Therefore, the purpose of this study was to present and compare the clinical features, including the age and gender of the patients and the tooth types of the VRFs, in endodontically and nonendodontically treated teeth through a 2 years survey of 156 cases in Korean patients.

II. Material and Method

Reviewed were 156 consecutive cases of vertical root fractures observed in 144 Korean patients between November 2002 and October 2004. The final diagnosis of VRF in all uncertain cases was confirmed by surgical exploration. Cases of root fractures that might be related to cracked or split teeth were excluded. Accordingly, only true VRF cases confined to the root were included. Information was collected from each patient's dental history, clinical examination, and radiograpic findings. The clinical data recorded were as follows: age and gender of the patient, involved tooth, location of the fracture, symptoms and signs, missing teeth, subjective symptoms, diagnostic methods, treatment procedures, duration after endodontic therapy.

Age and gender of the patients, as well as tooth type and root distribution of VRFs(in numbers and percentages), were presented and compared in endodontically versus nonendodontically treated teeth.

Symptoms and signs associated with the VRF were all recorded, including mild discomfort or severe pain, periodontal abscess formation, sinus tract, and the presence of deep probing depths(>5mm). Radiographic findings included the presence of angular osseous defects, periapical radiolucency, diffuse widening of periodonal ligament, widening of root canal space, and separation of root fragment.

The percentages of clinical and radiographic findings were calculated. Possible causes of VRFs were also postulated from dental history taking or any unusual findings on clinical and radiographic examination. In addition, sex, age group, tooth type, response to electric pulp test, and treatment modalities were also recorded. Chi-square test was used for statistical method.

III. Result

The age and gender distribution of patients with VRFs in endodontically and nonendodontically treated teeth is shown in Table 1. Of the 66 patients with VRFs in

Table 1. Age and gender distribution of patients with VRFs

		No. of patients* by age group(%)							
		20-29y	30-39y	40-49y	50-59y	60-69y	70-79y	Total	F value	P value
Endo	Male	3(5)	6(9)	12(18)	18(27)	6(9)	3(5)	48(73)		
	Female	3(5)	3(5)	0(0)	3(5)	9(14)	0(0)	18(27)	17.240	p<0.01
	Subtotals	6(9)	9(14)	12(18)	21(32)	15(23)	3(5)	66(100)		
Nonendo	Male	0(0)	9(11)	12(15)	36(44)	9(11)	0(0)	66(81)		
	Female	0(0)	0(0)	3(4)	3(4)	9(11)	0(0)	15(19)	16.919	p<0.01
	Subtotals	0(0)	9(11)	15(19)	39(48)	18(22)	0(0)	81(100)		

* x^2-test , Endo: Endodontically treated teeth / Nonendo: Nonendodontically treated teeth
* Includes 3 patient who had VRFs in both endodontically and nonendodontically treated teeth

endodontically treated teeth, the incidence was 2.7 times higher in male than in female patients. Ages ranged from 23 to 70 years, with a mean of 52.5 years. Most VRFs(91%) occurred in patients 30 to 69 years old. The highest incidence occurred in the 50-to-59-years age group in men and in the 60-to-69-years age group in women. Of the 81 patients with VRFs in nonendodontically treated teeth, the incidence was 4.4 times higher in men than in women. Ages ranged from 34 to 69 years, with a mean of 54.1 years. Mosts patients(89%) were between 40 and 69 years old, and the highest incidence occurred in the 50-to-59-years age group. In both male and female patients, the mean age for VRFs in endodontically treated teeth was lower than that for VRFs in nonendodontically treated teeth.

Clinical symptoms and signs are shown in Table 2. Of the 156 observed cases of vertical root fractures, the clinical and radiographic signs and symptoms most frequently found were the presence of deep probing depth in 117 cases(75%) and mild pain/discomfort in 91 cases(58%). In 76 cases(49%),

Table 2. Symptoms and signs of 156 cases of VRF

Symptoms and Signs*	No. of Teeth	%
Mild pain/discomfort	91	58
Severe pain	38	24
Periodontal abscess	76	49
Sinus tract	33	21
Deep probing depths	117	75
Angular osseous defect	73	47
Periapical radiolucency	43	28
Diffuse widening of periodontal ligament space	59	38
Widening of root canal space	49	31
Separation of root fragments	37	24

* Combination of a number of symptoms/signs can be manifested.

Table 3. No. of missing teeth in VRF patients

No. of Missing Teeth	No. of Patients	%
0	50	35
1	13	9
2	36	25
3	6	4
4 and above	39	27
Total	**144**	**100**

Table 4. Existence or nonexistence of a subjective symptom

Presence of subject symptom	No. of Endodontically treated teeth (%)	No. of nonendodontically treated teeth (%)	Total	F value	P value
Yes	58(37)	62(40)	120(77)		
No	8(5)	28(18)	36(23)	7.735	p<0.01
Total	**66(42)**	**90(58)**	**156(100)**		

* x^2-test

patients complained of periodontal abscess and angular osseous defects were found in 73 cases(47%). In 50 of nonendodontically treated teeth(90 cases), electric pulp test was performed, and 36 cases(72%) showed a positive response.

The number of missing teeth in the VRF patients is shown in Table 3. 105 patients (73%) had less than four missing teeth. In the 90 teeth of nonendodontically treated teeth with VRFs, 76(84%) had no restoration. Three fractured teeth had crown restorations and eight were abutments of bridge restorations, including two as the distal abutment of a cantilever bridge. There were only two class V composites and one class II amalgam restoration. In the 76 fractured teeth without restoration, 63(83%) showed moderate to severe attrition.

Classification by presence of a subjective symtom is shown in Table 4. In 66 cases of endodontically treated teeth, 58 cases was presented subject symptom, only 8 cases was not. In 90 cases of nonendodontically treated teeth, 62 cases was presented subject symptom, 28 cases were not.

Classification by diagnostic methods is shown in Table 5. In 66 cases of endodontically treated teeth, diagnosis by flap operation completed in 32 cases, in 34 cases by radiographic and/or clinical methods. In 90 cases of nonendodontically treated teeth, diagnosis by flap operation completed in 37 cases, in 53 cases by radiographic and/or clinical methods.

Table 5. Classification by diagnostic methods

Diagnostic methods	No. of Endodontically treated teeth (%)	No. of nonendodontically treated teeth (%)	Total	F value	P value
Radiographic	11(7)	30(19)	41(26)		
Clinical	17(11)	8(5)	25(16)		
Radiographic +clinical	6(4)	15(10)	20(13)	12.877	p<0.01
Flap op.	32(21)	37(24)	70(45)		
Total	**66(42)**	**90(58)**	**156(100)**		

* x^2-test

Classification by treatment types is shown in Table 6. In 66 cases of endodontically treated teeth, amputation or hemisection was done in 36 cases and extraction was done in 22 cases. In 90 cases of nonendodontically treated teeth, amputation or hemisection was done in 57 cases and extraction was done in 24 cases.

Duration after endodontic therapy in endodontically treated teeth is shown in Table 7. Of 43 cases, 31 cases(72%) were below 5 years and 12 cases(28%) were cver 5 years.

There were 156 cases(teeth) of VRFs documented in 144 patients. The distribution of VRFs in endodontically and/or nonendodontically treated teeth is shown in Table 8. Among the 144 patients, 132(92%) had only 1 fractured teeth; the others(8%) had 2 fractured teeth. Only 3 patients(2%) had VRFs in both endodontically and nonendodontically treated teeth.

The sites of fractured roots in molars are shown in Table 9. Mesiobuccal roots and palatal roots of upper molars and mesial roots of lower molars were most susceptible in both groups. But, there was no statistically significant difference.

Table 6. Classification by treatment types

Treatment	No. of Endodontically treated teeth (%)	No. of nonendodontically treated teeth (%)	Total	F value	P value
Extraction	22(14)	24(15)	46(30)		
Amputation or hemisection	36(23)	57(37)	94(60)	1.224	p>0.05
Maintenance or negligence	8(5)	9(6)	16(10)		
Total	**66(42)**	**90(58)**	**156(100)**		

* x^2-test

Table 7. Duration after endodontic therapy(in endodontically treated teeth)

	No. of Teeth	%
Below 1 year	6	14
Below 5 years	25	58
Over 5 years	12	28
Total	**43**	**100**

Table 8. Distribution of VRFs in endodontically and/or nonendodontically treated teeth

Total no. of fractured teeth	No. of patients(%)					
	Endodontically treated teeth only	Nonendodontically treated teeth only	Teeth treated both endodontically and nonendodontically	Total	F value	P value
1	63(44)	69(48)	0(0)	132(92)		
2	0(0)	9(6)	3(2)	12(8)	39.776	p<0.01
total	**63(44)**	**78(54)**	**3(2)**	**144(100)**		

* x^2-test

The distribution of VRF by tooth type varied. Of the 156 fractured teeth, 58% were nonendodontically treated. All VRFs in endodontically treated teeth occurred in the posterior teeth(Table 10). Of 66 cases, 57 (86%) occurred in molars and were more frequent in mandibular molars(45%) than in maxillary molars(41%). Only 9 cases(14%) occurred in premolars. Of the 57 cases in molars, 39 cases occurred in first molars, 18 cases occurred in second molars. Of the 48 cases in males, 21 were in mandibular first molar and 9 were in maxillary first molars.

Table 9. Sites of fractured roots in molars

Molars	Sites	No. of endodontically treated teeth(%)	No. of nonendodontically treated teeth(%)	F value	P value
Maxillary	Mesiobuccal	9(33)	18(46)		
	Distobuccal	0(0)	0(0)		
	Palatal	18(67)	21(54)	1.085	p>0.05
	Fused	0(0)	0(0)		
	Subtotals	27(100)	39(100)		
Mandibular	Mesial	24(80)	36(75)		
	Distal	6(20)	9(19)	.000	p>0.05
	Fused	0(0)	3(6)		
	Subtotals	30(100)	48(100)		

* x^2-test

Table 10. Distriburation of VRF in endodontically and/or nonendodontically treated teeth by tooth type

Tooth Type	No. of endodontically treated teeth (%)		subtotal	F value	P value	No. of nonendodontically treated teeth (%)		subtotal	F value	P value
	Male	Female				Male	Female			
Maxillary premolar	6(9)	0(0)	6(9)			3(3)	0(0)	3(3)		
Maxillary first molar	9(14)	6(9)	15(23)			18(20)	6(7)	24(27)		
Maxillary second molar	6(9)	6(9)	12(18)			15(17)	0(0)	15(17)		
Mandibular premolar	3(5)	0(0)	3(5)	11.928	p<0.05	0(0)	0(0)	0(0)	25.200	p<0.01
Mandibular first molar	21(32)	3(5)	24(36)			9(10)	9(10)	18(20)		
Mandibular second molar	3(5)	3(5)	6(9)			30(33)	0(0)	30(33)		
Total	**48(73)**	**18(27)**	**66(100)**			**75(83)**	**15(17)**	**90(100)**		

* x^2-test

Of the 18 cases in females, only 9 cases were in first molars. All VRFs in non-endodontically treated teeth occurred in the posterior teeth(Table 10). Of 90 cases, 87 (97%) occurred in molars and were more frequent in mandibular molars(53%) than in maxillary molars(44%). Only three cases (3%) occurred in premolars. Of the 87 cases in molars, 42 cases occurred in first molars, 45 cases occurred in second molars. Of the 75 cases in males, 30 were in mandibular second molars and 18 were in maxillary first molars. Of the 15 cases in females, all of 15 cases were in first molars.

The incidence of VRF was found to be highest in first molars in both groups. The incidence of fracture in molars was also higher in nonendodontically treated(84%) than in endodontically treated(53%) teeth. For endodontically treated teeth, the incidence of VRF was more than 1.6 times higher in mandibular first molars than in maxillary first molars(23%),maxillary second molars(18%), maxillary premolars (9%), and mandibular second molars(9%), mandibular premolars(5%). The incidence of fracture in endodontically treated premolars (14%) was more than 4 times that for non-endodontically treated premolars(3%). VRF was none in both endodontically and non-endodontically treated anterior teeth

IV. Discussion

Diagnosis of VRF is a problem in as much as the condition is easily misdiagnosed as a periodontal or endodontic lesion. It is possible that many teeth with VRFs are extracted without being identified as such, especially among nonendodontically treated teeth.[15]

True VRF in nonendodontically treated teeth is seldom reported, and the incidence of its occurrence is so far unknown. Previous cases were reported mostly in Chinese patients.[13,14,16] In our study, most of the

cases were collected during recent years, this is due both to increasing awareness of VRF occurrence on the part of dentists and to confirmation by flap surgery in all uncertain cases. Results from this study showed that VRFs in nonendodontically treated teeth presented similar clinical signs and symptoms to those of endodontically treated teeth.[5,7] Although signs and symtoms of VRF are often nonspecific, clinical findings, such as a deep localized periodontal pocket depth and radiographic widening of the periodontal ligament or root canal space, are suggestive.[3~7,13,14] Joseph et al.[17] reported that pattern of bone resorption in vertically fractured was most typically a V-shaped pattern osseous defect(dehiscence) in 91%. Yang et al.[13] reported widening of root canal space in all cases, but the incidence is much lower herein(31%). Widening of the root canal space is a very helpful sign for diagnosis of VRF, and may lead to more definite diagnosis with the presence of other associated signs and symptoms. Root canal space widening and separation of root fragments, as evident radiographically in 55% of all cases in this study, are more apparent in the later stage of the VRF, when the fracture become more extensive. Lang et al.[18] reported for pattern of periodontal destruction associated with incomplete root fractures. Teeth with root fractures demonstrated smaller mean probing depths than in teeth with periodontal or periodontal-endodontic lesions and radiographic bone loss was greater in teeth with periodontal and periodontal-endodontic lesions. In uncertain cases, surgical exploration is indicated for diagnosis.

Overall, the incidence of VRF in endodontically versus nonendodontically treated teeth is unknown. Through a survey of 2 years and a large collection of 156 cases, our study demonstrates that 58% of VRFs occured in nonendodontiallly treated teeth. Apparently, VRFs in nonendodontically treated teeth are common in Korean patients. This observation may indicate an underdiagnosed clinical entity.

Information pertaining to the question of whether a patient may have VRF in multiple teeth is still limited. Yeh[14] reported that 5 of 46 patients had 2 fractured teeth. In our study, 8% of patients had 2 fractured teeth; only 2% had VRF in both endodontically and nonendodontically treated teeth. Root fractures occurring in both groups seem to be very rare. Because most patients(98%) had VRF in either endodontically or nonendodontically treated teeth, it is possible that these 2 groups of patients had certain uncommon clinical characteristics or risk factors predisposing them to a particular type of VRF.[15]

The gender distribution of VRF in endodontically treated teeth was not given in previous reports.[4,5,7] VRF differences with regard to patient gender in endodontically versus nonendodontically treated teeth were demonstrated in our study, men being seen more often in cases of nonendodontically treated than in cases of endodontically treated teeth. Other reports[3,13,16] have also shown VRF in nonendodontiallly treated teeth to occur more frequently in males. However, Yeh[14] reported that most the pa-

tients in his study were betel nut chewers with severely attrited dentition, noted no gender difference. The higher incidence of VRF in nonendodontically treated teeth in males may be related to factors such a stronger masticatory force, increased attrition, habitual chewing of hard food, and less pliable supporting bone.[15] These risk factors may have less influence on endodontically treated teeth, in which the incidence of VRF in males is only slightly higher. However, further study is needed before any conclusion can be made.

As in previous reports,[3,5,7,14] most of the VRFs in our study were found in patients 30 to 69 years of age. We also showed that the mean age was lower in patients with VRF in endodontically treated teeth. This suggests that endodontic treatment and post insertion could result in significant loss and weakening of tooth structure and could increase the risk in younger patients. Duration until fracture after endodontic therapy in endodontically treated teeth was 5.7 years on average.

The results of this study agreed with other reports[13,14,16] that VRF occurred more often in older individuals. Gher et al.[12] reported that the increase of fractured teeth or VRF may be related to the increase of fractured teeth or VRF may be related to the increase of restorations and endodontic treatment with age, which may be responsible for the weakening of tooth structures. However, teeth with VRF in our study were often attrited, unrestored, and had no endodontic treatment. It is therefore speculated that the higher incidence in the older age of VRF in nonendodontically treated teeth may be related to other factors, such as the increase of attrition or the less pliable supporting structures.[3]

Posterior teeth seem to be more susceptible to VRF. Testori et al.[4] reported premolars to have the highest incidence of VRF in endodontically treated teeth. Lin and Langeland[19] reported that VRF occurs more often in molars, especially second molars. Tamse et al.[20] reported that the maxillary second premolars(27.2%) and mesial roots of the mandibular molars(24%) were the most fractured. However, we showed first molars to be the teeth most frequently fractured in both groups. This may be related to the heavier masticatory force associated with first molars, to thin or flat roots in first molars, or to the habitual use of first molars in the chewing of hard food.[3] Cameron[11] reported that the higher incidence of cracked teeth in molars may be related to a "nut cracker effect" of the jaws. It is postulated that the masticatory force is almost vertical at the attrited occlusal surface of first molar, thus directing the stress to concentrate apical areas of roots, which may be the weakest points of the attrited tooth. Besides, our results also showed fracture occurs most often in thin or flat roots, with a mesiodistal diameter(i.e. in mesiobuccal roots of upper molars and mesial roots of lower molars). These findings support the study of Rosen and Partida Rivera,[21] which demonstrated that the incidence of root fracture in increased as the mesiodistal diameter of the root decreased.

Differences in VRFs with respect to tooth distribution were demonstrated in endodontically versus nonendodontically treated teeth in our study. VRF in nonendodontically treated anterior teeth seldom occurred, possibly because of the direction of the masticatory force, which is usually more lateral than vertical and thus more likely to cause horizontal or transverse, rather than vertical root fracture.[15]

The differences that have been described in patient and tooth distribution of VRF between endodontically and nonendodontically treated teeth suggest that they have certain uncommon contributing factors, such as endodontic treatment and post insertion in endodontically treated teeth and moderate to severe attrition in nonendodontically treated teeth. Biologic or anatomical variations of the endodontically treated and the nonendodontically treated teeth are therefore important contributing factors of VRF. Grippo[22] suggested that the mechanical loading factors affecting the teeth are the magnitude, direction, frequency, location, and duration of the force. The stress induced on the tooth structure may therefore result in different patterns of fracture, depending also on the biologic or anatomical conditions of the crown, root, or supporting bone. For a nonendodontically treated tooth, possibly excessive and repetitive masticatory force, exerted vertically on an attrited occlusal surface, may concentrate the stress at the weaker apical areas. Cracks or fatigue are thus initiated, with eventual coronal propagation of the fracture.[3] However, VRFs on endodontically treated teeth may have a different pattern of crack initiation and propagation. Because of the weakening of root structure by endodontic treatment or post insertion, the apical point may not always be the weakest part of the root or point of crack initiation. The fracture may then begin at the apex or midroot or at some other position[2,9]. Morfis et al.[23] reported that VRF was 3.69% of the teeth in all 460 teeth. Causes of VRF in endodontically treated teeth are suggested to be over-instrumentation, excessive condensation force, or post insertion procedures.[5,7,10] These dental treatments weaken the root structures and are crucial risk factors in VRF. Lertchirakarn et al.[24] reported for effects of root canal sealers on VRF resistance of endodontically treated teeth, and that force at fracture of roots obturated with Ketac-Endo was significantly higher than those obturated with AH Plus and Tubliseal. Also, Carmen Llena-Puy et al.[25] reported that the use of a prefabricated, cylindrical, cemented intraradicular retainer increased the time between endodontics and VRF. However, VRF in endodontically treated teeth usually occurs a long period of time after these procedures. Testori et al.[5] and Gher et al.[12] reported an average of 5 to 10 yr for VRF to occur after endodontic treatment and post insertion. It is possible that other risk factors such as attrited occlusal surface, damaging chewing habits, excessive occlusal force, root morphology(e.g. as flat or thin root), increased density of bone, may serve as other contributing factors in the case of VRF. The identification and evaluation of these risk factors may enhance our understanding of the mechanism and etiology of VRF, in both endodontically

and nonendodontically treated teeth. Identifying patients with risk factors of VRF may be especially valuable in future prevention.

Damaging habits, such as chewing of ice cubes, popcorn kernels, or hard candy, may be closely related to the cause of cracked teeth.[11] Patients with cracked teeth also have prominent masticatory muscles.[26] Yang et al.[13] suggested that, in true nonendodontic VRF in Chinese patients, certain diet pattern or chewing habits may be related, such as chewing of bones in meat. Our study also showed that 77% of all patients had less than four missing teeth even with a mean age of 53.3 yr, these patients had generally intact dentition. Patients with a physiological natural dentition may be more confident of their teeth and thus inclined to chew harder food or exert an excessive masticatory force. But, further analysis of the chewing habit or diet patterns in these patient is therefore needed.

V. Conclusion

Vertical root fracture(VRF) often presents no specific signs and symptoms, and it is therefore difficult for dentists to make a definite diagnosis of the condition. The purpose of this study was to present and compare the clinical features of VRF, and to enhance the understanding of contributing cause or risk factors of VRF. The 2 years survey of 156 cases was observed in 144 Korean patients. The clinical data recorded were as follow: age and gender of the patient, involved tooth, location of the fracture, symptoms and signs, missing teeth, subjective symptoms, diagnostic methods, treatment procedures, duration after endodontic therapy. Chi-square test used for statistical method.

The results were as follow:

1. Our study demonstrates that 58% of VRFs occured in nonendodonticallly treated teeth.
2. The higher incidence of VRF occured in males.
3. Posterior teeth seem to be more susceptible to VRF.
4. The mean age was lower in patients with VRF in endodontically treated teeth.
5. The major symptom and sign was deep probing depth.
6. Duration after endodontic therapy was average 5.7 years.
7. The rate of less than four missing teeth was up to 73% in number of missing teeth.
8. The rate of presence of a subjective symptom was up to 77%.

VRF in nonendodontically treated teeth are not uncommon comprise a large proportion of such fractures in Korean patients. The higher incidence of VRF in males and molars may be related to factors such a stronger masticatory force, increased attrition, habitual chewing of hard food, and less pliable supporting bone. But, it is still difficult for dentists to make a definite diagnosis of the condition. It is considered that further study on VRF may enhance making a definite diagnosis and treatment of VRF.

VI. References

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-국문초록-

치주질환자에서 근관치료의 유무에 따른 수직 치근 파절의 실태분석

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수직 치근파절은 특이성을 나타내지 않기 때문에 치과의사가 정확한 진단을 하기 어렵다. 따라서 수직 치근파절의 임상적 특징, 진단적 증상을 파악하여 향후 근관치료된 치아나 치료되지 않은 치아에서 수직 치근파절의 유발인자와의 관련성 및 고찰을 통해 수직 치근파절의 예방 및 치료에 응용할 수 있을 것으로 생각된다.

연구대상은 조선대학교 부속치과병원 치주과에 내원한 환자 중 최근 2년간 144명의 환자에서 근관치료를 받았거나 받지 않았던 치아 중 임상적 및 방사선학적으로 수직 치근파절로 진단된 156개의 증례를 대상으로 하였다. 모든 불확실한 증례에서 수직 치근파절의 최종 진단은 외과적 탐지를 통해 이루어졌고, 금이 간 치아와 관련될 수 있는 치근파절의 증례의 경우는 제외되었다. 근관치료된 치아와 치료되지 않은 치아, 환자의 나이와 성별, 치아종류 및 파절된 치근부위, 자각증상의 유무를 기준으로 각각의 수치와 백분율로 분류하였다. 수직 치근파절의 증상과 증후별로 분류하였으며, 진단방법에 의한 분류, 치료방법에 따른 분류, 근관 치료 후 수직 치근파절이 발생한 기간에 따른 분류를 시행하고 통계분석을 하여 다음과 같은 결과를 얻었다.

1. 근관치료를 받지 않았던 치아의 수직 치근파절의 발생율은 58%였다.
2. 성별에 따른 발생률에 있어서 남성의 호발양상을 나타내었다.
3. 근관치료된 치아에 있어서 치료되지 않은 치아에 비해 호발연령이 낮았다.
4. 전치부의 수직 치근파절은 관찰되지 않았으며 특히, 강한 교합력을 필요로 하는 구치부에서의 높은 발생율을 나타냈다.
5. 수직 치근파절의 가장 주된 증상 및 증후는 깊은 치주낭 깊이였다.
6. 근관 치료 후 수직 치근파절이 발생한 기간은 평균 5.7년이었다.
7. 다수 증례에 있어서 3개 이하의 결손치를 가졌고, 자각증상이 나타났다.

이상의 결과에서 한국인에 있어서 근관치료를 받지 않은 치아의 수직 치근파절은 드문 현상이 아님을 알 수 있었고 남성과 구치부에 있어서의 높은 발생율을 알 수 있었다. 그 이유로는 강한 교합력, 딱딱한 음식의 저작습관, 치조골 흡수에 따른 낮은 저항성, 골 유연성의 저하 등으로 여겨진다. 그러나, 수직 치근파절은 아직까지 정확한 진단을 내리기는 여전히 어려운 상태이며, 이를 위한 다양한 진단방법 및 더 나은 연구가 필수적이라 하겠다. 그리고, 향후 보다 많은 증례에 대한 분석, 치주질환에 이환되지 않은 경우의 분석, 치료 후 생존 기간에 대한 고찰 등도 필요하리라 사료된다.

주요어 : 수직 치근 파절, 근관치료