Effects of Surgical Orthodontic Treatment for Malalignment due to the Prolonged Retention of Deciduous Canines in Young Dogs

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ABSTRACT. This study was conducted to clarify the effects of surgical orthodontic treatment for malalignment caused by the prolonged retention of deciduous canines in young dogs. Fifty-five dogs with malocclusion or pre-malocclusion were divided into two groups. Group 1 received surgical orthodontic treatment (32 dogs) using modification of Ross [9] and Yamane's [14] method of treating for malalignment due to prolonged retention of deciduous canine teeth; Group 2 received no treatment (23 dogs). Occurrence of malocclusion 1–3 weeks after treatment of the group receiving surgery was only 3.8%. However, malocclusion was seen in 73.4% of the non-treatment group approximately 2 years after the first examination. Surgical orthodontic treatment was very useful in treating malalignment due to prolonged retention of deciduous canines in young dogs.—**KEY WORDS:** dog, malalignment, retention of deciduous canine, surgical orthodontic treatment.

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In dogs, it is generally accepted that primary dentition begins to erupt at 3–4 weeks old and complete eruption of deciduous teeth occurs at 5–8 weeks old [6]. Some variations are caused by health, nutrition, sex, or breed [7]. Loss of the primary dentition is recognized at 3–5 months old. Complete permanent dentition in the dog is seen at about 6–7 months old [1–4, 10].

Retention of deciduous teeth beyond the normal time disturbs the pattern of the erupting permanent dentition. If this problem is not treated, malocclusion due to delayed eruption, version, rotation, and inclination of permanent teeth may occur [5, 11]. Abnormal position of the canine tooth usually induces abnormal bite, soft tissue trauma of gingiva and palate, abrasion of teeth, overload of the jaw joints or teeth, malocclusion of the molars, deposition of dental plaque and calculus, and periodontitis. Malocclusion generally contributes to much more serious oral conditions [8, 11]. However, in recent publications dealing with treatments for dental malalignment, most studies reported complicated techniques [4, 5, 8, 9, 12, 13]. Ross [9] reported on surgical correction for malocclusion with external fixation, but his method is difficult for inexperienced surgeons. There is no previous report of simpler surgical orthodontic treatments for malalignment due to the prolonged retention of deciduous canines.

In this study, we attempted to clarify the effects of

surgical orthodontic treatment for malalignment due to the persistence of deciduous canine in dogs.

MATERIALS AND METHODS

Animals: Fifty-five dogs were used in this study. Forty-six dogs were presented for vaccination or with other diseases to the veterinary hospital and found to have abnormal dentition due to prolonged retention of deciduous canine and the other 9 dogs were presented with a chief complaint of abnormal dentition. The animals were divided into two groups. Thirty-two dogs received surgical orthodontic treatments consisting of extraction of the retained deciduous canine and immediate tipping movement of the permanent canine (treatment group). Twenty-three dogs did not receive surgery because the owner did not agree to surgical treatment or loss of suitable time to treat (non-treatment group).

Treatment group: The breeds of the thirty-two dogs received surgical treatment were as follows; 11 Malteses, 10 Pomeranians, 4 Toy Poodles, 4 Yorkshire Terriers, 1 Miniature Schnauzer, 1 Shiba Dog, and 1 Shetland Sheepdog.

The dogs varied in age from 5 to 11 months (average 7.3 months) and in body weight ranging from 1.3 to 8.7 kg (average 2.6 kg). Out of 32 dogs, 25 were male and 7 were female. The 78 regions of surgical orthodontic treatment included right maxil-

la (17), left maxilla (14), right mandible (25), and left mandible (22). Grades of occlusal abnormality before treatment of the total 78 regions were divided into 4 groups. Grade I: normal condition was seen; Grade II: mild malalignment (pre-malocclusion) was seen in 24 regions; Grade III: moderate malocclusion (no injury) was seen in 45 regions; and Grade IV: severe malocclusion with injuries was seen in 9 regions (Table 1). Five cases in the treatment group were from the three litters (case Nos. 22 and 23; 28 and 29; 8 and 14 of non-treatment group).

Non-treatment group: The breeds of twenty-three

dogs received no treatment were as follows; 10 Pomeranians, 9 Malteses, 2 Miniature Pinschers, 1 Toy Poodle, and 1 Beagle. The dogs varied in age from 6 to 11 months old (average 8.0 months), and in body weight ranging from 1.3 to 6.1 kg (average 2.4 kg) at the first admission. Out of 23 dogs, 15 were male and 8 were female. Malocclusion or pre-malocclusion due to the prolonged retention of deciduous canine was observed: 11 in right maxilla, 15 in left maxilla, 21 in right mandible, and 17 in left mandible. The grades of occlusal condition of the total 64 regions of this group included Grade I : 0; Grade II: 24; Grade III: 35; and Grade IV: 5 (Table

Table 1. Effects of surgical orthodontic treatment for malalignment caused by the prolonged retention of deciduous canine in young dogs (treatment group)

No.	Breed	Sex	Age (Month)	B.W. (kg)	Malocclusion before surgery				Malocclusion 1-3 weeks after surgery						Comments	
					Regions and Grade		Number		Regions and Grade		Number					
1	Maltese	♀	9	1.9	※┐II			1	→	┐I				0		
2	Maltese	♀	7	3.4	┐III	┐III	┐III	┐III	4	→	┐I	┐I	┐I	┐I	0	
3	Maltese	♀	9	1.3	┐III				1	→	┐I				0	
4	Maltese	♂	7	2.8			┐III	┐III	2	→			┐I	┐I	0	
5	Maltese	♂	7	2.1			┐IV		1	→			┐I		0	
6	Maltese	♂	7	1.9			┐III	┐III	2	→			┐I	┐I	0	
7	Maltese	♂	9	2.6	┐III		┐IV		2	→	┐I		┐I		0	
8	Maltese	♂	7	1.8	┐IV	┐III	┐III	┐II	4	→	┐I	┐I	┐I	[┐I]	0	※[1,2]
9	Maltese	♂	7	2.1	┐III	┐III			2	→	┐I	┐I			0	
10	Maltese	♂	7	1.9			┐IV		1	→			┐I		0	※1,3
11	Maltese	♂	6	2.3	┐III	┐III	┐III	┐III	4	→	┐I	┐I	┐I	┐I	0	
12	Pomeranian	♂	7	1.9	┐IV				1	→	┐I				0	
13	Pomeranian	♂	10	2.3			┐IV	┐IV	2	→			┐I	┐I	0	
14	Pomeranian	♂	7	2.4			┐III	┐III	2	→			┐I	┐I	0	
15	Pomeranian	♂	7	1.8	┐II	┐II	┐II	┐II	4	→	┐I	┐I	┐I	┐I	0	
16	Pomeranian	♂	8	2.7			┐III	┐III	2	→			┐I	┐I	0	
17	Pomeranian	♂	11	3.6			┐IV	┐IV	2	→			┐I	┐I	0	
18	Pomeranian	♀	7	3.3	┐II	┐II	┐III	┐III	4	→	┐I	┐I	┐I	┐I	0	
19	Pomeranian	♂	7	1.9	┐III	┐III	┐III	┐II	4	→	┐I	┐I	┐I	[┐I]	0	※[1,2,3]
20	Pomeranian	♂	7	2.1	┐II	┐II	┐III	┐III	4	→	┐I	┐I	┐I	┐I	0	
21	Pomeranian	♂	9	2.3		┐III	┐II	┐III	3	→		┐I	[┐I]	┐I	0	※[2,3]
22	Toy Poodle	♀	5	1.9	┐II	┐II	┐II	┐II	4	→	┐I	┐I	┐I	┐I	0	
23	Toy Poodle	♂	5	2.2	┐II	┐II	┐II	┐II	4	→	┐I	┐I	┐I	┐I	0	
24	Toy Poodle	♂	6	1.8			┐III		1	→			┐I	┐I	0	
25	Toy poodle	♂	5	4.4			┐III	┐III	2	→			┐I	┐I	0	
26	Yorkshire Terrier	♂	10	2.1	┐II	┐II	┐III	┐III	4	→	[┐I]	┐I	┐I	┐I	0	※[2]
27	Yorkshire Terrier	♂	7	2.5			┐III	┐III	2	→			┐I	┐I	0	
28	Yorkshire Terrier	♀	7	2.1			┐III		1	→			┐III		1	※4
29	Yorkshire Terrier	♂	7	2.3			┐III	┐III	2	→			┐III	┐III	2	※4
30	Miniature Schnauzer	♀	7	4.9	┐III	┐III			2	→	┐I	┐I			0	
31	Shiba Dog	♂	5	8.7	┐II	┐II			2	→	┐I	┐I			0	
32	Shetland Sheepdog	♂	6	3.4			┐III	┐III	2	→			┐I	┐I	0	
Total 32		♂:25♀:7	Av.7.3	Av.2.6	17,	14,	25,	22	78	→	0,	0,	2,	1,	3	

┐ : Right maxilla, ┐ : Left maxilla, ┐ : Right mandible, ┐ : Left mandible.

※ I, II, III, IV means degrees of malocclusion.

I : No malocclusion (with no retained deciduous canine).

II : Mild malalignment (pre-malocclusion).

III: Moderate malocclusion (malocclusion with no injury).

IV: Severe malocclusion (malocclusion with injury).

※1: External fixation was needed after movement.

※2: Two or more operations were done.

※3: A part of alveolar bone was excised.

※4: The moved permanent canine returned to the pre-operative position due to early loss of the wedge.

Table 2. Occurrence of malocclusion when abnormal dentition caused by the prolonged retention of deciduous canine was not treated (non-treatment group)

No.	Breed	Sex	Age (Month)	B.W. (kg)	Malocclusion in young period					Age (Year. Month)	B.W. (kg)	occlusion about 2 years later						
					Regions and Grade		Number					Regions and Grade		Number				
1	Pomeranian	♂	7	2.8			※	┐III	┐III	2	→	3Y.1M	5.5			┐III	┐III	2
2	Pomeranian	♂	8	2.5	┐III	┐III		┐IV	┐IV	4	→	3Y.7M	3.0	┐IV	┐IV	┐IV	┐IV	4
3	Pomeranian	♂	7	1.8	┐III	┐III		┐III	┐III	4	→	3Y.1M	2.3	┐III	┐III	┐IV	┐IV	4
4	Pomeranian	♀	7	3.1	┐III	┐III		┐III	┐III	4	→	3Y.8M	3.5	┐III	┐III	┐IV	┐IV	4
5	Pomeranian	♂	7	2.1					┐III	1	→	4Y.1M	3.6				┐III	1
6	Pomeranian	♂	9	1.5	┐III	┐III		┐III	┐III	4	→	3Y.1M	2.8	┐III	┐III	┐III	┐III	4
7	Pomeranian	♂	7	1.4	┐II	┐II		┐II	┐II	4	→	1Y.5M	2.8	┐I	┐I	┐I	┐I	0
8	Pomeranian	♀	10	3.5		┐II		┐IV		2	→	3Y.5M	5.0		┐I	┐IV		1
9	Pomeranian	♂	8	2.9	┐II	┐II		┐II	┐II	4	→	2Y.3M	3.7	┐I	┐I	┐I	┐I	0
10	Pomeranian	♀	6	2.8				┐II	┐II	2	→	2Y.8M	3.9			┐III	┐III	2
11	Maltese	♂	11	3.1				┐IV		1	→	3Y.1M	3.3			┐IV		1
12	Maltese	♂	8	3.5	┐II	┐II		┐II		3	→	2Y.3M	3.7	┐I	┐I	┐I		0
13	Maltese		8	1.9				┐III	┐III	2	→	3Y.2M	2.1			┐IV	┐IV	2
14	Maltese	♀	7	1.8				┐III	┐III	2	→	2Y.1M	2.1			┐IV	┐IV	2
15	Maltese	♀	9	2.5		┐II		┐IV		2	→	2Y.2M	2.6		┐I	┐IV		1
16	Maltese	♂	8	1.9				┐III	┐III	2	→	2Y.1M	2.0			┐IV	┐IV	2
17	Maltese	♂	8	1.3	┐II	┐II		┐III	┐III	4	→	2Y.4M	2.7	┐III	┐III	┐IV	┐IV	4
18	Maltese	♂	10	1.4		┐III		┐III	┐III	3	→	3Y.3M	2.6		┐III	┐III		3
19	Maltese	♂	7	1.9				┐III		1	→	2Y.5M	2.1		┐III			1
20	Miniature Pinscher	♀	9	1.6	┐II	┐II		┐II	┐II	4	→	2Y.9M	1.7	┐III	┐I	┐IV	┐I	2
21	Miniature Pinscher	♀	9	2.1	┐III	┐III		┐III	┐III	4	→	3Y.2M	4.1	┐III	┐III	┐IV	┐IV	4
22	Toy Poodle	♂	7	2.1				┐III	┐III	2	→	2Y.7M	2.8			┐IV	┐IV	2
23	Beagle	♂	7	6.1	┐II	┐II		┐II		3	→	2Y.2M	9.4	┐I	┐I	┐IV		1
Total 23		♂:15 ♀:8	Av. 8.0	Av. 2.4	11,	15,	21,	17,	64	→	Av. 2Y.9M	Av. 3.4	7,	8,	18,	14,	47	

┐: Right maxilla, ┐: Left maxilla, ┐: Right mandible, ┐: Left mandible.

※ I, II, III, IV means grades of malocclusion.

I: No malocclusion in spite of having prolonged retention of deciduous canine.

II: Mild malalignment (pre-malocclusion).

III: Moderate malocclusion (malocclusion with no injury).

IV: Severe malocclusion (malocclusion with injury).

2). Three cases were from the same parentage or litter (case Nos. 13 and 14 were same parentage; case Nos. 14 and 8 of the treatment group were from the same litter).

Surgical orthodontic treatment (immediate tipping movement): We modified the surgical orthodontic treatment techniques reported by Ross [9] and Yamane [14]. That is, the retained deciduous canine tooth was first extracted under general anesthesia after radiographic examination of the teeth. Then, the permanent canine, receiving an immediate tipping movement, was moved gradually to the correct position by a dental elevator carefully inserted into the periodontal space. Fixation of the permanent canine after movement was made by driving a wedge made of the root of the extracted deciduous canine into the alveolar cavity [14]. After fixation, the gingiva around the tooth was sutured with a 3-0 nylon or catgut. A few cases needed additional external fixations by wires and/or self cure resin. The dogs were prevented from chewing hard materials for about 2 to 3 weeks after surgery.

RESULTS

Treatment group: Results from thirty-two dogs in the treatment group are summarized in Table 1. Figs. 1 to 3 show the typical photographs at pre- and post-surgical orthodontic treatment of a 7-month-old male Pomeranian.

Good eruption of the crowns and good growth of the roots of the permanent teeth was seen in 96.2% (75 out of 78 regions) in one to three weeks after surgery. Five out of 75 regions needed other additional techniques. Three regions required external fixation; 4 regions needed repeated surgery; and 3 regions required excision of alveolar bone. In the other 3 regions (Nos. 28 and 29) early loss of the wedge caused the loss of good fixation, and the moved permanent canine returned to the preoperative position.

Non-treatment group: Results in the non-treatment group are shown in Table 2. After 1 year and 5 months to 3 years and 8 months follow-up observation without any treatment, occurrence of malocclusion due to prolonged retention of deciduous canine teeth was seen in 73.4% (47/64

Fig. 1. Pre-treatment photograph of abnormal dentition in a 7-month-old male Pomeranian. Prolonged retention of the right maxillary deciduous canine caused the permanent canine to erupt mesial to the normal position. Buccal version of the maxillary permanent canine is also seen. Contact is made with the crown of the mandibular permanent canine.

Fig. 2. Photograph of the post-surgical orthodontic treatment. Immediate tipping movement of the right maxillary permanent canine to the normal position was done. No contact of maxillary and mandibular canine is seen.

Fig. 3. Photograph at 1 month after the surgical orthodontic treatment. Normal bite is seen.

Fig. 4. A 3-year-and-3-month-old male Maltese with untreated malocclusion. Injuries of hard palate occurred due to severe linguo-version of the mandibular permanent canine. Deposition of debris is seen in spite of young age.

regions). Malocclusion, such as mesio-version in the maxillary permanent canine or linguo-version of the mandibular canine which tended to touch the hard palate of the maxilla or the crown of the 3rd maxillary incisor, was seen in almost all cases. Occlusal abnormalities were recognized as follows. Grade III were seen in 22 regions, and Grade IV in 25 regions. No occurrence of malocclusion (Grade I) of the permanent canine was seen in 17 regions despite the retained deciduous canine.

Figure 4 shows malocclusion in a 3-year-and-3-month-old male Maltese in the non-treatment group. Injuries of the hard palate due to linguo-version of the mandibular permanent canine occurred. Deposition of dental plaque was also seen despite the dog's young age.

DISCUSSION

Prolonged retention of deciduous canines is often seen in pure toy breeds. Some influencing factors, such as heredity, are suggested by Kawase [8] and Ross [9]. The above tendency is also supported in this study, that is, Pomeranian, Maltese, Toy Poodle, and Yorkshire Terrier tended toward prolonged retention. Some cases of retained deciduous canine teeth were seen in dogs from the same litter and/or parentage. The occurrence of malocclusion was more frequent in male than female. The incidence of abnormalities in the mandible was high in both the treatment and non-treatment groups.

Malocclusion occurred in many cases (47/64: 73.4%) when abnormal dentition due to prolonged retention of deciduous canine teeth was not treated. However, in the group that received surgical orthodontic treatment, only a few cases (3/78: 3.8%) developed malocclusion. In such cases, good fixation after surgery was not obtained because of early loss of the wedge. If re-operation had been done, good result might have been obtained. Malocclusion generally contributes to serious oral conditions [5, 8, 11]. Retained deciduous canine teeth adversely affected the permanent dentition in the non-treatment group.

There are some reports of surgical or non-surgical orthodontic treatment for malocclusion [4, 5, 8, 9, 12, 13]. However, most treatments show complicated techniques. There is no previous report of surgery for malocclusion due to prolonged retention of deciduous canine teeth using only this simple technique: immediate tipping movement and fix-

tion by a wedge made of extracted deciduous canine. In this study, surgical orthodontic treatment was performed in the early eruption period. Incomplete root formation of the permanent tooth facilitated its movement, similar to the movement of an impacted tooth in humans.

This method of surgical movement of the teeth, used in the present study, is a simple procedure for moving and fixing the teeth. In most of our dogs, the movement of permanent tooth was induced after extraction of the deciduous canine. In both the maxillary and mandibular jaws, the permanent canine was moved towards the cavity created by the extraction of the deciduous canine. The root of the permanent canine was immature at the time of movement allowing relatively easy movement by this method.

Tholen and Hoyt [11] reported that an abnormally retained deciduous tooth should be extracted as soon as possible. They also recommended the treatment by partial amputation of the crown followed by endodontic therapy of the dispositioned permanent canine if it is not successfully corrected. It is possible to improve occlusal condition only by extraction of the retained deciduous canine. Preventing malocclusion by only extracting the retained deciduous canine in Grade II condition has been suggested. However, a Grade II of occlusal condition may develop to Grade III or IV soon, if the retained deciduous canine remains, because of fast growth of the teeth in this eruption period. If surgery is delayed, the success rate from extraction of the deciduous canine alone will reduce. Furthermore, when malocclusion occurred after extraction of the retained deciduous canine, it is very difficult to move the permanent canine to the correct position at a later time because of growth of the alveolar bone. Some cases will require excision of alveolar bone to allow movement.

It is still difficult to decide whether to extract retained deciduous canine with or without immediate tipping movement. In this study, we chose to move the permanent canine tooth at the same time as extraction of the retained deciduous canine in all cases. Further study will be needed to clarify the optimal stage and method for the surgery through longer period observation.

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