

Comparison of two surgical methods in combined surgical-orthodontic correction of impacted maxillary canines

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The post-treatment periodontal condition of impacted maxillary canines was examined in two groups of patients. In one group (n = 34) the teeth were exposed in the mouth after removal of the bone and soft tissue covering of the crown. In the other group (n = 22) the bone covering the crown was removed, whereafter the muco-periosteal flap was sutured back. In both groups the orthodontic treatment procedures were basically the same. The mean treatment duration was 18 months after radical surgical exposure and 22 months after moderate surgical exposure.

The teeth were examined 1—2 years after removal of the fixed appliances. Oral hygiene and gingival inflammation were approximately the same in both groups. The palatal pocket was deeper on teeth subjected to moderate surgical exposure, and the depth also varied more. The loss of fiber attachment was not significantly different except on the palatal surface, where it was greater after radical exposure and also varied more. The interdental bone height, which was measured on radiographs, varied more after radical than after moderate surgical exposure.

Key-words: Tooth, impacted; cuspid; orthodontics, corrective; periodontium

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Fixed orthodontic appliances increase the possibilities of plaque accumulation, resulting in a general gingivitis (Baer & Cocco, 1964; Kobayashi & Ash, 1964; Zachrisson & Zachrisson, 1972) which may be accompanied by an apical migration of the gingival pocket epithelium. Recent studies have indicated that orthodontic treatment is accompanied by loss of fiber attachment (Sjølien & Zachrisson, 1973; Zachrisson & Alnaes, 1973, 1974), which for 16-year-old orthodontic patients approaches the level observed in 20—

30-year-old individuals who have received no orthodontic treatment (Glavind & Løe, 1967; Suomi et al., 1971).

The prognosis for bringing impacted canines into correct position after surgical exposure is fairly good (Lieb, 1962; Adam, 1970; Thilander, Thilander & Persson, 1973). Various forms of surgical treatment alone or combined with orthodontic treatment seem to aggravate the loss of periodontal support (Ash, Costich & Hayward, 1962; Silness, Hunsbeth & Figenschou, 1973; Zachrisson & Alnaes,

1974; *Wisth, 1975; Wisth, Norderval & Bøe, 1976*). If alternative surgical procedures are available the method which results in the least periodontal damage should be used.

The purpose of the present study was to compare the periodontal condition of orthodontically corrected impacted maxillary canines in two groups of patients subjected to different surgical procedures.

MATERIAL AND METHODS

The material comprised two groups of patients who had been treated for unilateral impaction of a maxillary canine. The patients in both groups had Angle Cl. I occlusions. Extraction of permanent teeth in order to create space for the impacted canine was not necessary in any of the patients. The etiology of the impactions was not systematically investigated.

In one group ($n = 34$) the bone and mucosa covering the crown was removed, a pin was cemented to the tip of the cusp, and the crown was left exposed during orthodontic treatment. This group, called the 'radical exposure group', has been described in detail elsewhere (*Wisth et al., 1976*).

In the other group ($n = 22$), called the 'moderate exposure group', a muco-periosteal palatal flap was raised, the bone covering the crown was removed, and a pin was cemented. Thereafter the flap was replaced and sutured.

In some cases the tooth was initially brought down by a spring soldered to a palatal archwire, but in most instances the whole upper dentition was banded and stabilized by edgewise wires, and the canine was moved vertically and buccally by a spring attached to the buccal aspect of the first molar band. As soon as the

tooth was sufficiently extruded it was banded for further correction. The force used was approximately 30 grams. Fibrectomy was not carried out in any of the patients. The periodontal conditions were examined one to two years after removal of the fixed appliances. The mean age in the 'radical exposure group' was then 17 years 3 months, and the mean age in the 'moderate exposure group' was 18 years 2 months.

Oral hygiene and gingival inflammation of the treated teeth and their freely erupted contralaterals were evaluated, using the Plaque Index and the Gingival Index (*Silness & Løe, 1964; Løe & Silness, 1963*). Recording of gingival pocket depth and loss of fiber attachment (LA) was performed on all surfaces of the treated canines and contralateral teeth according to *Glavind and Løe (1967)*. The interdental bone height was measured on standardized roentgenograms (*Benkow, 1968; Eggen, 1969; Wisth et al., 1976*) by the use of a calibrated magnifying glass (magnification $4\times$) after marking the cemento-enamel junction (CEJ) and the bone margin (BM) where the periodontal space had a normal width with a needle. The measurements were taken parallel to the long axis of the teeth. The method errors for the different registrations were of acceptable magnitude (*Wisth et al., 1976*). The statistical comparison of the two groups included testing of the means (Students' two sample t-test) and testing of the variability of the results (Variance ratio test, F). If the F-values were significant an alternative t-test (*Hald, 1952*) was used.

RESULTS

The mean duration of treatment after radical surgical exposure was 18 months; the mean age of the patients at the start of

Table 1. *Periodontal condition of corrected impacted maxillary canines after radical or moderate surgical exposure. Values from Students' two sample test are indicated by t and values from the variance ratio test by F*

	Surface	Radical exposure		Moderate exposure		t	F
		\bar{x}	S.D.	\bar{x}	S.D.		
Pocket depth	Mesial	2.59	0.82	2.91	0.81	-1.43	1.02
	Buccal	1.85	0.66	1.73	0.63	0.68	1.10
	Distal	2.68	0.77	3.00	0.87	-1.44	1.28
	Palatal	2.06	0.34	2.46	0.67	-2.95**	3.88**
Loss of attachment	Mesial	0.91	0.67	0.81	0.73	0.53	1.19
	Buccal	0.82	0.80	1.00	0.44	-0.96	3.31**
	Distal	1.12	0.84	1.09	0.68	0.14	1.53
	Palatal	1.85	1.58	1.09	0.87	2.06*	3.30**
Distance from CEJ to BM	Mesial	2.06	0.79	2.17	0.24	-0.63	10.84**
	Distal	2.05	0.90	1.91	0.31	0.70	8.43**

* — $p < 0.05$

** — $p < 0.01$

the treatment and at examination was 15 years 9 months and 17 years 3 months, respectively. In the 'moderate surgical exposure group' the treatment lasted 22 months as an average, and the age at start and examination was 16 years 2 months and 18 years 2 months, respectively.

A comparison of hygiene, gingival and periodontal conditions of the normally erupted contralateral canines in the two treatment groups did not reveal significant differences.

Oral hygiene and gingival inflammation of the treated teeth were also very similar in the two groups; score 0 and score 1 were most frequent, and no surface received a score of 3.

A comparison of pocket depth and LA in the two treatment groups (Table I) revealed that the palatal pocket of the teeth subjected to moderate surgical exposure was significantly deeper, and the depth also varied significantly more ($p < 0.01$). The LA did not differ between the two groups, except on the palatal surface, where the value was significantly greater

($p < 0.05$) and also varied more ($p < 0.01$) after radical exposure. The variability of the LA was greater also on the buccal surface after radical exposure ($p < 0.01$).

The interdental bone height did not differ significantly between the groups, but the variability was greater after radical surgical exposure ($p < 0.01$).

DISCUSSION

The aim of orthodontic treatment should not only be to correct a malocclusion but to correct it with minimal injuries to the teeth and supporting structures. When alternative treatment procedures are available it is important, therefore, to be able to select that mode of treatment which causes the least damage.

Orthodontic correction of impacted canines can be performed in different ways: the tooth may be moved actively both in the vertical and buccal direction, or it may be let to erupt spontaneously after surgical exposure, and is then moved buccally. It would appear that orthodontic

treatment during the entire period is preferable since the tooth can then be guided into its correct position from the start of treatment. A pin must then be attached to the cusp of the tooth. The advantages of a radical removal of the mucosa and bone covering the crown are that the position of the tooth can be readily inspected at each visit, and if the pin should break, it can be recemented without difficulty. On the other hand, the crown is often difficult to cleanse, and plaque accumulation may cause inflammation of the mucosa around the crown.

When only the bone covering the crown is removed and the mucoperiosteal flap is sutured back oral hygiene may be better, but at the same time direct inspection of the tooth position becomes impossible, and the eruption of the tooth may be retarded due to scarring of the mucosa. In this study the mean duration of treatment was indeed four months longer after this procedure. Such a prolonged period of plaque accumulation might accentuate the periodontal damage of the non-treated contralateral canines which were banded as a part of the anchorage system. A comparison of the two treatment groups showed, however, that the loss of attachment was independent of a variation of the treatment duration within the limits of this study.

As would be expected plaque accumulation and gingival inflammation of the corrected canines were similar in the two groups. It also seems unlikely that any difference in the periodontal conditions of the two treatment groups should be the result of a systematic difference with respect to oral hygiene during the period prior to examination since the patients were treated according to the same orthodontic technique, and received the same oral hygiene instructions during treatment.

The comparison of the periodontal status of the two treatment groups revealed, however, some significant differences. The palatal pocket depth was greater in the group subjected to moderate surgical exposure, and the depth also varied more. A possible explanation is that the removal of the mucosa in the 'radical exposure group' had the same effect as a gingivectomy, which will result in a reduction of the pocket depth if the oral hygiene is good. The loss of fiber attachment on the palatal aspect was, however, greater after radical surgical exposure, and also more variable. This may indicate that the risk of permanent damage of the marginal periodontal fibers is greater when this method is used.

The greater variability of the loss of attachment on the buccal aspect, and the variation in the interdental bone height also indicates a greater tendency towards periodontal injury after radical surgical exposure.

It seems likely that the moderate surgical procedure causes the least periodontal damage. The mean differences were, however, small. If one desires to be able to inspect the position of the tooth regularly, or to reduce the duration of treatment the radical surgical exposure can be used.

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