A Radiographic Study of Roots in Extraction Sites

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One of the goals of orthodontic therapy is aimed at minimizing relapse problems. To achieve that goal, various philosophies have been advocated, the placement of lower incisors over basal bone, the overcorrection of Class II or deep bite cases, the overcorrection of rotated teeth, and/or the overparalleling of roots in the extraction site.[1]

The development of effective mechanical procedures and appliances today permits the orthodontist to achieve the above desired tooth movements. However, successful retention of the teeth in these altered positions appears to be another matter. Much of our knowledge of the retention and postretention phases of treatment is empirical and our retention procedures appear to be largely arbitrary.[2]

STATEMENT OF THE PROBLEM

Since the extraction of teeth is often necessary to correct an orthodontic problem and since it is common thought that the relapse of the approximating teeth adjacent to the extraction site is definitely undesirable, the present study was undertaken to determine what, if anything, happens to the roots of the teeth in the extraction sites during the retention and postretention phases of orthodontic treatment.

REVIEW OF THE LITERATURE

Rocke[1] stated that, prior to the termination of active treatment, periapical x-rays should be taken to check for root parallelism across extraction sites. It was recommended that the root apices of the canines and second premolars should be converging toward one another.

Edwards[2] described a procedure to prevent relapse following canine retraction in extraction cases. He considered the gingival cleft which frequently develops between orthodontically approximated teeth as a possible factor in relapse. Edwards felt that there was an inability of the tooth to move through the gingival tissue resulting in an accumulation of excess gingivae interproximally. Surgical removal of this tissue following approximation tended to alleviate relapse. He concluded that the relapse in this instance was due to the excessive, slowly adapting gingival fibers found to be high in oxytalin fiber content rather than the transeptal and periodontal ligament fibers, which appeared to adapt readily to their new positions.

Aisenberg[3] grouped the fibers of the periodontal membrane into two groups, one attached tooth-to-tooth and the other attached tooth-to-tooth or tooth-to-subepithelial connective tissue. He stated that we may alter the arrangement and attachment of the former group when including changes in bone, but we are not so certain about being able to alter the latter group. The subepithelial (transeptal) tissues do not conform to tooth movement as does bone; hence, this may be a factor in relapse. Aisenberg continued to state that some type of retaining appliance is essential and retaining appliances should be designed in a manner that will permit the individual teeth to be immediately subjected to functional stresses.

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Erikson et al.[4] found that, following the removal of a tooth in orthodontic procedure, a new and elongated transeptal fiber bundle was built. In subsequent closure of the space, this fiber bundle became coiled and compressed thereby splitting and resorbing the bony crests. When the retaining appliances were removed, the contact points became abnormal. Contact points should be just as important in orthodontics as in operative dentistry.

Reitan,[5] experimenting with dogs, rotated teeth to study tissue rearrangement. Fiber rearrangement was considered complete when the fibers were observed to approximate a nonrotated, right angle relationship to the surface of the root. He found that the marginal gingival fiber bundles remained displaced and stretched even after 232 days of retention. By way of contrast, fibers of the middle and apical areas of the root were rearranged after periods of 147 and 83 days, respectively. He attributed relapse to the prolonged contraction of these displaced gingival fiber bundles and other supra-alveolar structures since they do not have the relatively plastic osseous tissue to eliminate residual tensions secondary to tooth movement. Reitan concluded that overrotation, early correction of the rotation or transection of the stretched transeptal fibers would be of clinical value in preventing relapse.

Methods

Periapical x-rays and bite wings of the extraction sites were obtained on 28 orthodontically treated cases. The majority of the patients were first premolar extraction cases and retention and postretention times varied from 1 to 13 years. A total of 110 extraction sites were studied.

Cases selected were those on which good, diagnostic quality, relatively undistorted x-ray views of the extraction sites were obtained at the conclusion of treatment.

All of the cases were treated with the edgewise appliances, .022 brackets. Extraction spaces were closed with Bull type closing loops.

Situations were compared in which: 1) roots of the teeth had been overparalleled with apices actually touching (Fig. 1), 2) overparalleled, but root apices *not* touching (Fig. 2), 3) roots parallel and no space between the crown (Fig. 3) and 4) the undertreated cases where roots were insufficiently paralleled and diverged (Fig. 4).

The various situations described above will be labelled for ease of communication as conditions 1, 2, 3 and 4, respectively.

Findings

X-rays findings in all five cases resulting in condition 1, where root apices that converged and actually touched at the conclusion of active treatment, showed that the roots continued to remain in that position throughout the retention and postretention phases. The root apices did not relapse but maintained contact; spaces between the crown generally remained open (Fig. 1).

Results at the conclusion of treatment in cases where root apices converged but did not touch (condition 2) were: 28 improved, 20 remained the same and 1 became significantly more overparalleled (Fig. 2).

In instances where the roots and crowns were upright and paralleled (condition 3), 25 cases remained the same, 4 improved and 3 became worse (Fig. 3). It was observed that the crown spaces generally closed and the roots remained parallel in cases where there were slight spaces of 1 to 2 mm remaining between the crown, but where the roots were paralleled.

Fig. 1 Condition 1 above: below, 8 years, 1 month postretention, illustrating apices still touching.

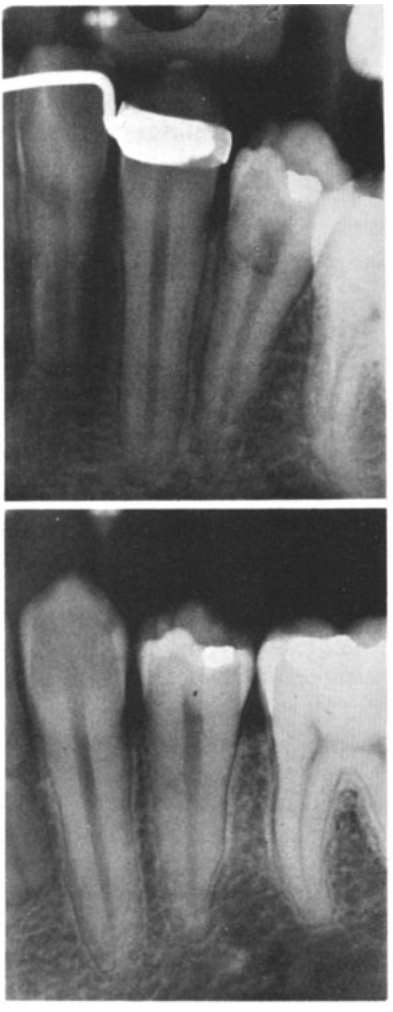

Fig. 2 Condition 2 above: below, 5 years, 7 months postband removal, roots remain overparalleled.

In the undertreated cases where roots were insufficiently paralleled (condition 4), 3 cases improved, 7 cases remained the same and 6 cases became worse (Fig. 4).

Discussion

The observations made during this investigation indicate that extreme overparalleling of roots to the extent the apices actually touch in the extraction sites does not help solve the problem of relapse in the extraction sites. A study of the normal physiology of the supra-alveolar fibers and the middle and apical areas may offer an explanation of this phenomenon. Close convergence of the root apices does not allow the crowns of the teeth to touch, thus leaving a space between the crowns. The supra-alveolar fibers do not have the ability to pull the crowns together. Hence, the root apices remain where they are placed, and the spaces in the coronal areas remain open

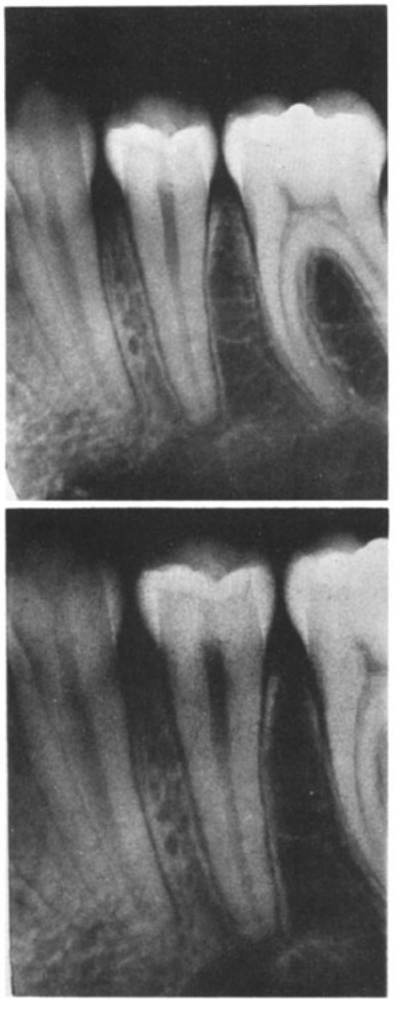

Fig. 3 Condition 3 above: below, 4 years, 10 months postretention. Roots and crowns remain upright and parallel.

Fig. 4 Condition 4 above: below, 2 years, 4 months postband removal. Illustrates further divergence of roots and an arch collapse.

as well. Bone or tissue in the apical areas of the roots does not appear to have the ability to push the apices apart.

Overparalleled roots that upright leave spaces in the coronal areas in the uprighting procedure. The closure of tooth crowns in the site has not been possible when the roots converge.

Parr[6] and Silverman[7] stated that periodontal problems occur when roots of teeth are too close together. In these situations infectious processes destroy the thin interdental, cancellous bone which breaks down readily leaving the buccal and lingual plates of compact bone intact. Pocket formation is due to the radiating effect of the irritant. Inflammatory processes are volumetric. The greatest intensity is in the center and then the inflammation radiates. In addition, when the roots of

teeth are too close together, instrumentation to curette and eliminate the irritants is difficult.

Overall, the findings indicate that the best treatment procedure is to keep the roots and crown parallel, upright, and with equal amounts of supporting bone between each root. Postretention results are most favorable in these instances (Table I).

TABLE I

Condition	*Better*	*Same*	*Worse*
1	0	5	0
2	28	20	1
3	4	25	3
4	3	7	6

Summary

1) Roots that are overparalleled to the extent that the apices touch do not relapse to the desired upright positions.

2) Roots that are overparalleled, but the apices do not touch, tend to upright but, in so doing, leave space between the crowns.

3) Roots that are underparalleled at the completion of active treatment tend to maintain their positions or diverge even farther.

4) The best postretention results were cases in which roots and crowns were positioned in normal, upright parallel positions. Slight spaces remaining in these situations appeared to close evenly.

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