Crowding and spacing in the dental arches: Long-term development in treated and untreated subjects

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**Introduction:** The purposes of this study were to analyze long-term changes in anterior spacing and crowding and to compare the development in orthodontically treated and untreated subjects.

**Methods:** The sample comprised 308 adolescents in the late mixed or early permanent dentition who were examined clinically at the ages of 7 to 17 years and again 25 years later. The treated subgroup of 58 subjects had received orthodontic treatment with fixed or removable appliances or both. All subjects had a full complement of teeth, except for 19 who had premolar extractions as part of their orthodontic treatment plan.

**Results:** The prevalence of maxillary anterior spacing was substantially and significantly reduced in both the untreated and treated groups from the first examination to the second. The prevalence of mandibular crowding increased significantly in the untreated and the nonextraction treated groups. The prevalence of mandibular crowding in patients treated without extractions increased by 25.6%, significantly more than in the untreated controls. The prevalence of maxillary crowding decreased by 15.8% in patients treated with maxillary premolar extractions, significantly more than in the untreated controls.

**Conclusions:** Long-lasting developmental factors seem to result in universally reduced maxillary anterior spacing, orthodontic treatment notwithstanding. Compared with untreated subjects, the long-term development of mandibular anterior crowding was unfavorable in subjects treated without extractions. Compared with untreated subjects, the long-term development of maxillary anterior crowding was favorable when treatment included extraction of the maxillary premolars.

Read the full text online at: www.ajodo.org, pages 384.e1-384.e7.

**EDITOR’S COMMENT**

When you meet with a prospective patient to discuss the benefits of orthodontic treatment, do you try to support your advice with either sound experience or high-level evidence? What do you say if there is limited evidence? Will crowding continue to worsen with no treatment? Or does orthodontic treatment lead to fewer crowding problems in the long term? The purposes of this study were to analyze the long-term changes in people with anterior spacing and crowding and to compare their development in orthodontically treated and untreated subjects.

The original sample of randomly selected subjects comprised 1641 primary schoolchildren in Reykjavík, Iceland, examined clinically at the ages of 7-17 years. This study was based on 832 subjects (50.7%) from this sample who were available for a second examination 25 years later. The untreated control group comprised 250 subjects with complete dentitions at both examinations.

The treated sample of 58 subjects was divided into subgroups: 39 were treated without extractions, and 19 were treated orthodontically with premolar extractions.

In the developing dentition, available space in the anterior region is at a minimum. But in subsequent phases of eruption, differences in the sizes of deciduous and permanent teeth, called leeway space, will alleviate anterior crowding temporarily. The counteracting forces will, however, prevail and eventually shorten the arches and cause anterior dental crowding. In this long-term follow up, the active skeletal and dental changes seen during adolescence gave way to more gradual adjustments during adulthood. The details of these patients’ occlusal examinations 25 years later is fascinating, and you will want to read this entire article online. Perhaps the most intriguing result is the long-term status of mandibular anterior crowding in subjects who were treated nonextraction. The return of their crowding was significantly worse than that observed in the untreated subjects. I seriously doubt that this is what the unsuspecting patient had in mind 25 years earlier when deciding to accept the doctor’s plan of treatment.
Q & A

**Turpin:** In what way have you added to your conclusions of 2007 and 2009 when you last published articles describing this sample?

**Jonsson:** In previous articles, we described the prevalence of malocclusion traits in a sample of middle-aged people and long-term occlusal changes of fully dentate subjects, undisturbed by tooth loss, agenesis, or orthodontic treatment. The added perspective in this article was the comparison between treated and untreated subjects. In a forthcoming article dealing with malocclusion traits and in this one describing anterior crowding and spacing, we drew 2 conclusions. First, we confirmed the inevitable weight of long-term general development, because most variables in all subject groups, treated and untreated, change in the same direction. Second, we substantiated the lasting effect, mostly beneficial, of orthodontic treatment on several occlusal traits. In this study in particular, we found that orthodontic treatment with extraction counteracts long-term development of crowding in both arches, whereas nonextraction treatment is associated with increased mandibular crowding.

**Turpin:** Are orthodontists in Iceland unique in their vision to see the value of gathering longitudinal records over such a long time to study posttreatment dental changes?

**Jonsson:** I think that longitudinal records of this kind would be appreciated by any orthodontist in the world. What is unique in Iceland, however, might be the circumstances that make it possible to collect longitudinal records. A small, uniform community with high levels of education, health services, and public registrations makes it possible to keep in contact with people and encourage them to participate in repeated examinations.

**Turpin:** If you were just starting your professional career, how would you design a long-term study to...
achieve greater understanding of the efficacy of our approach to orthodontic treatment? In other words, where are we most successful, and where do we fail?

Jonsson: The message from our studies is the importance of long-term retention. Since we now have the option of bonded retainers to hold back at least some unfavorable occlusal changes that can lie ahead, we should focus our research on comparisons between patients who keep their retainers for a long time and those who do not. Research along these lines would tell us about occlusal changes with or without retention and would help us answer questions such as “what happens if my retainer is removed?” Information about harmful side-effects of permanent retainers could additionally be derived from such a study.

### Table II. Anterior spacing and crowding at T1 and T2 in untreated and treated subjects

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>T1 %</th>
<th>T2 %</th>
<th>Difference %</th>
<th>P value</th>
<th>T1</th>
<th>T2</th>
<th>T1 %</th>
<th>T2 %</th>
<th>Difference %</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No orthodontic treatment n = 250</td>
<td>Any orthodontic treatment n = 58</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maxillary spacing ≥2 mm</td>
<td>29</td>
<td>7</td>
<td>11.6</td>
<td>2.8</td>
<td>−8.8</td>
<td>0.000 †</td>
<td>9</td>
<td>2</td>
<td>15.5</td>
<td>3.4</td>
<td>−12.1</td>
<td>0.008 ‡</td>
</tr>
<tr>
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<td>11</td>
<td>14</td>
<td>4.4</td>
<td>5.6</td>
<td>1.2</td>
<td>0.491</td>
<td>6</td>
<td>6</td>
<td>10.3</td>
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<td>0.0</td>
<td>1</td>
</tr>
<tr>
<td>Mandibular spacing ≥2 mm</td>
<td>7</td>
<td>5</td>
<td>2.8</td>
<td>2.0</td>
<td>−0.8</td>
<td>0.480</td>
<td>2</td>
<td>0</td>
<td>3.4</td>
<td>0.0</td>
<td>−3.4</td>
<td>0.157</td>
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<tr>
<td>Mandibular crowding ≥2 mm</td>
<td>22</td>
<td>39</td>
<td>8.8</td>
<td>15.6</td>
<td>6.8</td>
<td>0.002 †</td>
<td>4</td>
<td>13</td>
<td>6.9</td>
<td>22.4</td>
<td>15.5</td>
<td>0.020 *</td>
</tr>
</tbody>
</table>

**Significance levels:** *P <0.05; †P <0.01; ‡P <0.001.

T1-T2 differences within groups were analyzed with the Wilcoxon signed ranks test.

Negative signs for T1-T2 difference indicate reduced prevalence.