Orthopaedic splint treatment can reduce mandibular asymmetry caused by unilateral temporomandibular involvement in juvenile idiopathic arthritis

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SUMMARY Unilateral temporomandibular joint (TMJ) arthritis in juvenile idiopathic arthritis (JIA) patients often induces asymmetric dentofacial growth. This study evaluates the effects of an orthopaedic functional appliance worn full time to reduce asymmetric mandibular growth in JIA patients.

Twenty-two JIA patients with unilateral TMJ involvement were included in the study (mean age 7.5 years, range: 3.8–13.8 years). They all received orthopaedic treatment with a functional appliance, a so-called distraction splint (mean treatment time 57 months). Panoramic tomograms or cone beam-computerized tomograms were taken before and within 12 months after treatment cessation. At both time points, the ratio between the healthy and the affected side of the mandible was evaluated in terms of inter-side differences in condylar height, ramus height, and total vertical mandibular height.

Orthopaedic functional treatment reduced mandibular asymmetries in terms of ramus height and total vertical mandibular height ($P < 0.05$). Mandibular growth rates in the affected and the non-affected sides were comparable in most patients.

Our study finds evidence to support that a distraction splint can normalize mandibular vertical growth in the affected side. We therefore suggest implementation of distraction splint therapy in the treatment of JIA patients with unilateral TMJ arthritis.

Introduction

Temporomandibular joint (TMJ) arthritis is known to alter dentofacial development in children diagnosed with juvenile idiopathic arthritis (JIA). In patients with TMJ arthritis, 40–50 per cent experience unilateral manifestation with a diagnosis based on clinical examination and panoramic tomograms (OTPs) (Pedersen et al., 2001; Twilt et al., 2004). Unilateral TMJ arthritis can lead to asymmetric mandibular growth, unstable occlusion, disturbed TMJ, and masticatory function causing asymmetric loading of joints and muscles, TMJ pain, and a compromised aesthetic appearance (Kjellberg, 1995; Mericle et al., 1996; Pedersen et al., 2001; Sidropoulou-Chatzigianni et al., 2001; Twilt et al., 2006, 2008; Billiau et al., 2007). Historical data from Stabrun et al. show that unilateral TMJ arthritis in JIA patients leads to significant jaw asymmetry and underdevelopment of the affected side when compared to JIA patients with bilateral TMJ arthritis and healthy controls (Stabrun et al., 1988). Mandibular asymmetry is a challenging clinical situation that calls for implementation of diverse treatment modalities. Over the past two decades, an orthopaedic functional appliance, a so-called distraction splint, has become a vital orthopaedic modality in the treatment of JIA patient with unilateral and bilateral TMJ arthritis at the Department of Orthodontics, Aarhus University, Denmark. Good clinical results have been obtained using the distraction splint first described in 1995 (Pedersen et al., 1995). The splint is an acrylic orthopaedic functional device worn full time that covers the occlusal surfaces of the teeth in the mandible. Its posterior height is gradually increased with 0.25–1 mm every 6th–10th week in the arthritic side. This controls the development of the upper occlusal plane by maintaining the distance between the upper and the lower jaw and thereby creating space for normalized vertical dentoalveolar development, which leads to an increased posterior face height development in the affected side with the reduced vertical dimension.

The rationale for the use of orthodontic functional appliance in JIA patients with TMJ arthritis rests mainly on empirical observation and scientific studies are few (Kjellberg et al., 1995). A single study recently published suggests limited evidence in support of a beneficial effect of the use of a functional orthodontic appliance treatment in JIA patients with bilateral TMJ involvement (Farronato et al., 2009). In this retrospective study, we present data from a cohort of JIA children with unilateral TMJ arthritis...
who have received distraction splint treatment during the past 15 years. To our knowledge, this is the first study aimed at evaluating the effects of an orthopaedic appliance worn full time by JIA patients with unilateral TMJ arthritis. The objectives of the present study were to evaluate the effect of distraction splint treatment used to reduce asymmetry of mandibular growth between the affected and the non-affected side in terms of condylar height, ramus height, and total vertical mandibular height.

Subjects and methods

A group of 54 JIA patients with unilateral TMJ arthritis were identified as candidates for inclusion in this retrospective study. All patients were diagnosed with JIA according to the International League for Associations for Rheumatology criteria (Petty et al., 2004). They all received splint treatment at the Department of Orthodontics, Aarhus University, Denmark, in the years between 1995 and 2010. A total of 22 out of 54 pre-selected candidates complied with the criteria for inclusion in the present study. These patients (mean age 7.5 years, range: 3.8–13.8 years) were diagnosed with unilateral TMJ arthritis based on clinical and radiological TMJ examinations.

Inclusion

The inclusion criteria were as follows: (1) JIA with unilateral TMJ arthritis treated orthopaedically with a distraction splint. (2) Clear signs of unilateral TMJ arthritis based on clinical examination and radiological skeletal asymmetry with reference to the mandibular lower border and the occlusal plane. (3) Persistent unilateral affection during treatment with the distraction splint. (4) Treatment was terminated if a sufficient clinical mandibular symmetry was achieved or if mandibular growth was estimated as ceased. The mandibular growth was evaluated based on a clinical assessment involving aspects such as total body height and Tanner stage. (5) Compliance with good patient cooperation and with a continuous and uninterrupted treatment course. (6) Radiological documentation with OTPs or cone beam-computerized tomographic (CBCT) scans within 6 months before initiation of orthopaedic treatment and with radiological documentation within 12 months after treatment termination. (7) Sufficient radiological quality of the scans allowing assessment of anatomical mandibular structures of importance in this study. (8) No administration of intra-articular TMJ steroid injections throughout the course of the distraction splint treatment.

The data collection process was blinded to the clinical and radiological data to avoid issues about selection bias of the included candidates. This means that all patients included were identified before the radiological and clinical material was evaluated.

Orthodontic visitation

The presence of previous/current unilateral TMJ arthritis was a critical inclusion criterion. At every visit, the patients were thoroughly examined in conformity with a standardized orthodontic clinical examination protocol to assess the status of both the affected TMJ and the contralateral, non-affected TMJ. The orthodontic examination protocol contained two parts: one part featured the patient’s self-assessment of the present TMJ status. The patient answered 14 questions addressing subjects like pain level, TMJ function, chewing capability, etc. The protocol’s second part contained 57 clinically relevant parameters, which were assessed by the examiner, e.g. maximum opening capacity, symmetry during opening, capability of laterotrusion and protrusion, etc. The clinical examinations were supplemented with radiological evaluation.

Distraction splint

All patients included were treated with a distraction splint in accordance with the protocol for the treatment of JIA patients with TMJ arthritis at the Department of Orthodontics, the School of Dentistry, Aarhus University, Denmark (mean treatment time 57 months; range 14–99 months). The distraction splint effects a slight, gradual change in the mandibular position around the z-axis, which is achieved by a continuous, gradual increase in the posterior height of the splint in the affected side (Pedersen, 1998). The splint allows the clinicians to guide eruption of the molars in a manner that prevents the lower first molar from erupting while the splint is being adjusted so that the upper first molar is allowed to erupt in coordination with eruption of the first upper molar in the unaffected side. This maintains the occlusal plane and corrects canting related to the z-axis (Figure 1). The splint is replaced approximately every second year due to the eruption of new teeth and general wear of the splint and it can be placed in the upper as well as in the lower. The splint placement is decided based on convenience in relation to changes in the dentition and is continued until an acceptable mandibular skeletal symmetry is achieved. Minor orthodontic interceptive treatments are conducted concurrently with the distraction splint treatment. In addition to this orthopaedic distraction splint treatment, all patients received individual medication monitored by the paediatric rheumatologist. For detailed information on distraction splint fabrication as well as treatment protocol, we refer to Pedersen et al. (1995)

Radiological evaluation

The TMJ arthritis diagnosis was obtained from an interplay between the standardized clinical examination and regular radiological examinations. Radiological examinations consisted of CBCT investigations from 2005 and forward
Subjects and methods

The inclusion criteria were as follows: (1) JIA with TMJ arthritis diagnosis, (2) patients (mean age 7.5 years, range: 3.8 – 13.8 years) were included were identified. This means that all patients and radiological data were evaluated to avoid issues about selection bias of treatment. (3) Persistent unilateral affection of the molars in a manner that prevents the lower first molar from erupting. (4) Later, second upper molar is allowed eruption into occlusion from the maxilla. Subsequently, splint is adjusted to guide remaining teeth into occlusion. This approach optimizes dentoalveolar development and avoids occlusal collapse in affected side—both aspects are crucial for optimal condylar growth pattern indicated by dotted lines.

Figure 1 Mode of action of distraction splint. (a) Frontal view of JIA patient with clearly asymmetric mandible due to TMJ arthritis in right TMJ illustrated by the vertical line. The z-axis is perpendicular to the vertical line. (b) Frontal view after distraction splint insertion. Condylar, ramus, and dentoalveolar vertical development normalizes and frontal facial asymmetry is reduced as illustrated by the vertical line. (c and d) Dentoalveolar effect of splint: eruption of first lower molar prevented by splint, which leaves space for eruption of first upper molar. Adjustment of acrylic splint and prevention of first lower molar eruption enables control of upper dentoalveolar development. Teeth are illustrated with their FDI World Dental Federation notation. (e) Later, second upper molar is allowed eruption into occlusion from the maxilla. Subsequently, splint is adjusted to guide remaining teeth into occlusion. This approach optimizes dentoalveolar development and avoids occlusal collapse in affected side—both aspects are crucial for optimal condylar growth pattern indicated by dotted lines.

(3D reconstructions, multiplanar cross sectional cuts, and panoramic pictures). Before 2005, regular OTPs, lateral cephalograms, and tomograms were used for the radiological evaluation. In the present study, the evaluation of the radiological study material was based on bilateral measurements on panoramic pictures of condylar height, ramus height, and total mandibular vertical height as described by Kjellberg et al. (1995). CBCT-derived panoramic pictures were used for the vertical measurements to uniformize the radiological study material because the majority of the patients had received a radiological T1 examination based on regular OTPs. At T1 and T2, a ratio between the affected and the non-affected side was calculated for each of the three variables of interest to measure the present mandibular asymmetry (affected/ non-affected side). These data were used for statistical evaluation of inter-side differences in the mandibular ratios between T1 and T2 in terms of condylar height, ramus height, and total mandibular vertical height. Reference points and lines used for mandibular growth evaluation are described in Figure 2. Radiological evaluation was blinded to the clinical data.

Statistics

The reproducibility of condylar height, ramus height, and total mandibular vertical height was evaluated by the same observer (PS) with duplicate assessment of 10 randomly chosen scans 2 months apart. All variables were evaluated for normal distribution. We hypothesized
that mandibular symmetry ideally would agree with a mandibular inter-side ratio of 1. T-tests were performed for the evaluation of T1 and T2 asymmetry in ratios between our study group and a hypothetical symmetrical group. Additionally, for all variables, paired t-tests between T1 and T2 inter-side ratios of our study group were performed. A P value of <0.05 was considered significant.

**Ethics/miscellaneous**

The non-surgical orthodontic functional treatment applied complies with the rules of the Danish Government of Health for clinical paediatric orthodontic treatment. Handling of the confidential data was approved by the Danish Data Protection Agency. Before initiating the study, the full protocol was made available on the www.clinicaltrials.gov website.

![Figure 2](image)

**Figure 2** Illustration of reference points and lines used for measurement of condylar height (a), ramus height (b), and total mandibular vertical height ratio (a + b). Reference points used were condylar head (CH), incisoral point (INC), and gonion point (GO). Condylar head point was defined as point of intersection between a line from upper sagittal margin of condylar head perpendicular to ramus line (RL). Incisoral point was defined as point of intersection between a line from most inferior point in concavity between condylar neck and coronoid process perpendicular to ramus line. Gonion point was defined as point of intersection between ramus line and mandibular line (ML) at most inferior and posterior point on ramus. Condylar height variable (CH-INC), ramus height variable (INC-GO), and total mandibular vertical height ratio (CH-GO) were measured bilaterally at T1 and T2.

**Results**

**Exclusion of patients**

From the pre-selected group of 54 candidates, 32 patients were excluded due to insufficient radiological documentation or insufficient clinical data describing the basis for the use of the distraction splint (27 persons), arthritis of their contralateral TMJ was diagnosed during the distraction splint treatment, and the treatment strategy had to be changed to bilateral distraction (three persons), insufficient quality of the OTPs (one person), and due to insufficient cooperation throughout the treatment course (one person). A total of 22 candidates were enrolled in the present study.

**Radiological evaluation**

At T1, the distribution of the radiological material was OTPs in 18 patients and CBCT-derived OTPs in four patients. At T2, the mandibular asymmetry was evaluated on regular OTPs in three patients and on CBCT-derived OTPs in 19 patients.

**Duplicate assessments**

The reproducibility showed acceptable 5 per cent coefficients of variations in the condylar height measurements and 3 per cent in the total vertical mandibular height measurements. No coefficient of variation was calculated for the ramus height variable because it was calculated from the total mandibular vertical height subtracted the condylar height.

**Mandibular ratios**

Table 1 shows the comparison of mandibular inter-side asymmetry in ratios between our study cohort and a hypothetical symmetrical group. At T1, significant mandibular asymmetry was seen in all three variables examined when compared to a hypothetical symmetrical group. At T2, a reduced mandibular asymmetry was seen in all three variables.

**Table 1** Evaluation of asymmetry between study cohort and a hypothetical symmetric group.

<table>
<thead>
<tr>
<th></th>
<th>Symmetric group</th>
<th>Study cohort</th>
<th>Difference in ratio (SD)</th>
<th>95% Confidence interval of difference</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condylar height</td>
<td>1</td>
<td>0.88</td>
<td>0.12 (0.14)</td>
<td>0.06–0.19</td>
<td>P &lt; 0.001</td>
</tr>
<tr>
<td>Ramus height</td>
<td>1</td>
<td>0.92</td>
<td>0.08 (0.12)</td>
<td>0.03–0.14</td>
<td>P &lt; 0.05</td>
</tr>
<tr>
<td>Total vertical</td>
<td>1</td>
<td>0.90</td>
<td>0.10 (0.09)</td>
<td>0.06–0.14</td>
<td>P &lt; 0.001</td>
</tr>
<tr>
<td>mandibular height</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condylar height</td>
<td>1</td>
<td>0.91</td>
<td>0.09 (0.16)</td>
<td>0.02–0.16</td>
<td>P &lt; 0.05</td>
</tr>
<tr>
<td>Ramus height</td>
<td>1</td>
<td>1.03</td>
<td>−0.03 (0.13)</td>
<td>−0.09 to 0.02</td>
<td>n.s.</td>
</tr>
<tr>
<td>Total vertical</td>
<td>1</td>
<td>0.95</td>
<td>0.05 (0.08)</td>
<td>0.02–0.09</td>
<td>P &lt; 0.05</td>
</tr>
<tr>
<td>mandibular height</td>
<td></td>
<td></td>
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</tbody>
</table>

Clinical measures are in ratios before (T1) and after treatment (T2). Mean differences between symmetric group and study cohort are included together with the 95% confidence intervals. P values are symmetric group versus study cohort. n.s., not significant; SD, standard deviation.
examined in comparison to T1 levels. However, sustained significant mandibular T2 asymmetries were seen in terms of condylar height and in the total mandibular vertical height, whereas the significant mandibular asymmetry in terms of ramus height was eliminated in comparison with the hypothetical symmetrical group.

Table 2 depicts the mandibular mean ratios, which reflect the intra-individual progression in mandibular asymmetry between T1 and T2. As can be seen, all three variables showed reduced asymmetry. Statistically significant differences were seen in terms of ramus height and total mandibular vertical height as depicted in Figure 3. Sustained mandibular asymmetry was seen in the condylar height ratio. Figure 3a features three patients with a T1 condylar height ratio above 1. These patients had clinically obvious functional impairments that indicated the presence of unilateral TMJ arthritis and radiological signs of condylar deformation were few, which made it possible for these patients to have a ratio above 1 at T1. Three patients showed signs of angular osseous apposition in the affected side at T1, which may explain why the T1 ratio between the affected and the non-affected side was above 1 (Figure 3b and 3c).

Table 2  Clinical measures of our cohort before treatment (T1) and after treatment (T2) in terms of condylar height ratio, ramus height ratio, and total vertical mandibular height ratio.

<table>
<thead>
<tr>
<th></th>
<th>T1 mean ratio (SD)</th>
<th>T2 mean ratio (SD)</th>
<th>Difference T1 – T2 (SD)</th>
<th>95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condylar height ratio</td>
<td>0.88 (0.14)</td>
<td>0.91 (0.16)</td>
<td>0.03 (0.16)</td>
<td>-0.04 to 0.11</td>
<td>n.s.</td>
</tr>
<tr>
<td>Ramus height ratio</td>
<td>0.92 (0.12)</td>
<td>1.03 (0.13)</td>
<td>0.12 (0.21)</td>
<td>0.03–0.21</td>
<td>P &lt; 0.05</td>
</tr>
<tr>
<td>Total vertical mandibular height ratio</td>
<td>0.90 (0.08)</td>
<td>0.95 (0.09)</td>
<td>0.05 (0.07)</td>
<td>0.02–0.07</td>
<td>P &lt; 0.05</td>
</tr>
</tbody>
</table>

Data are mean ratios [standard deviation (SD)]. 95% Confidence intervals of the differences are listed (95% CI). The P values are T2 mean ratio against T1 mean ratio; n.s., not significant.

Figure 3  Mandibular ratios before and after treatment. Ascending lines indicate improvements during treatment, whereas descending lines indicate exacerbation of the given parameter. (a) Condylar height ratios with intra-individual lines. (b) Ramus height ratios. (c) Total posterior mandibular vertical height ratios. * Statistical significant difference (P < 0.05) between T1 and T2 ratios.
affected and the non-affected side in most patients. The mandibular growth rates to become comparable in the mandibular asymmetry between the affected and the non-affected side. However, this inter-side mandibular T2 asymmetry in condylar height ratio remained even if the three patients referred to surgical correction were excluded.

In a population of patients with unilateral TMJ arthritis, we would expect an equal distribution of arthritis between the right and the left side. An unexpected, but interesting finding of this study was that 17 out of the 22 patients included had unilateral TMJ involvement in the left side (77 per cent).

Discussion

During mandibular growth, the amount and direction of condyloalveolar growth depends on the development of the dentoalveolar area and its surrounding soft tissue (Enlow and Hans, 1996a). Dysmorphic condylar growth seems to affect bone formation of the ramus, the mandibular basis, and the dentoalveolar area in the affected side of patients with TMJ arthritis. The main findings of this study show, first, that an orthopaedic functional appliance treatment approach that deploys a distraction splint can reduce mandibular asymmetry between the affected and the non-affected side. Second, distraction splint treatment causes mandibular growth rates to become comparable in the affected and the non-affected side in most patients. The distraction splint optimizes dentoalveolar development in the affected side to the extent that occlusal collapse may be avoided (Figure 4). Avoiding such collapse is vital to the condylar and dentoalveolar developmental coordination required to achieve optimal vertical mandibular growth. It is unlikely that the orthopaedic treatment causes the condyle to grow more than is indicated by the individual’s normal genetic predisposition, but we here present evidence to support beneficial skeletal improvement in facial asymmetry in JIA patients treated with a distraction splint for unilateral TMJ arthritis. The clinical merit of early application of a distraction splint also lies in its ability to induce comparable bilateral growth so that asymmetry is minimal when the mandibular growth period draws towards its end, even in patients who suffer from unilateral arthritis.

Our observations are consistent with the results reported in the sparse literature on JIA patients published on this matter. In 1995, Kjellberg et al. found only limited skeletal changes after orthopaedic treatment with a functional activator appliance in JIA with bilateral TMJ arthritis (Kjellberg et al., 1995). They concluded, however, that skeletal changes in combination with the occlusal improvements after treatment with fully fixed orthodontic appliance may result in better dentofacial aesthetics. In 2009, Farronato et al. described a beneficial skeletal effect of functional appliance treatment in JIA patients with bilateral TMJ arthritis. They observed that functional appliance therapy reduces the severity of facial alterations improving mandibular and condylar growth (Farronato et al., 2009). These findings are in keeping with our results.

In the present study, both the ramus height ratio and the total posterior vertical mandibular height ratio were significantly reduced, whereas no inter-side difference was seen in the condylar height ratio. This is in keeping with Enlow and Hans (1996a) who stressed the importance of
understanding mandibular vertical growth as an interplay between condylar, ramus, and dentoalveolar growth where the condylar growth follows rather than leads the growth of the whole ramus (Enlow and Hans, 1996b). It could be speculated that the significant reduction in the ramus height ratio could be ascribed to an increased bone apposition in the angular area. However, we found only little radiological evidence to support this hypothesis. According to Enlow and Hans, mandibular orthopaedics must target both the ramus and the mandibular condyle to achieve maximal effect. The principal clinical target for mandibular orthopaedic treatment is therefore the entire ramus and the muscles attached to it, not just the condyle (Enlow and Hans, 1996b). Apart from having a dentoalveolar effect, we hypothesize that the distraction splint may have a protective effect against overloading of the involved TMJ in periods with acute arthritis, thereby relieving symptoms and reducing joint contraction and stiffness. We also hypothesize that the distraction splint has a favourable effect on the potential unbeneificial soft tissue and muscle alterations that accompany TMJ arthritis in the affected side. In addition, similar to the development of the dentoalveolar process, the progressive increase in height will prevent the vertical collapse of the affected side due to the maintained distance between the upper and lower jaw.

Several clinical and experimental studies have suggested a relationship between masticatory muscle function and craniofacial growth (Kiliaridis, 1995; Bresin, 2001; Bresin and Kiliaridis, 2002; Mavropoulos et al., 2004; Pepicelli et al., 2005). Thus, experimental interference with jaw and facial muscle development has been shown to entail major changes in the mandibular shape (Pepicelli et al., 2005). This was supported by Tsolakis and Spyropoulos who observed vertical mandibular growth in rats after condylectomy had been performed if function was stimulated by having the rats wear a protrusive functional appliance (Tsolakis et al., 1997). Recently, Nakano et al. described how a functional appliance led to correction of an asymmetric mandibular growth pattern in rats after unilateral condylectomy (Nakano et al., 2009).

There are a number of limitations in this study that need consideration. Orthopaedic treatment of TMJ arthritis and mandibular growth disturbances proceeds over a long period, involves substantial intervention, and requires excellent patient cooperation. In this study, the long duration of treatment (mean 57 months) is a limitation to this treatment approach. However, it should be emphasized that the splint adaptation is relatively unproblematic in the majority of the patients. They rapidly adapt to the new occlusion and do not consider the use of the splint as a liability.

Despite general good compliance from the patients, not all achieved a completely symmetric mandibular appearance following the distraction splint treatment. However, it is important to emphasize that the distraction splint treatment reduced the mandibular and craniofacial asymmetry to such an extent that most of the patients in this study had no need for further correction. With these findings, we present an argument in favour of instituting early intervention using the splint appliance rather than awaiting asymmetric mandibular growth to occur and only then seek to increase the growth rate in the affected side.

Mandibular vertical growth was evaluated based on OTPs. The sensitivity of panoramic radiography in detecting osseous changes is low (Ahmad et al., 2009). The use of panoramic pictures to evaluate mandibular linear distances is also controversial and is associated with potential study weaknesses such as distortion and magnification errors as well as variation in the orientation of the head (Kjellberg, 1995). However, the reproducibility of panoramic pictures has been found acceptable for the evaluation of mandibular vertical dimensions as long as the variables measured do not cross the midline of the mandible (Catic et al., 1998; Kambylaftkas et al., 2006; Van Elslande et al., 2008). A small relative mean side-to-side distortion of conventional panoramic pictures has been reported (Catic et al., 1998). In the present study, the minimal amount of time between the radiological T1 and T2 comparison was 14 months. The mean time between comparisons was 57 months (range 14–99 months) and with that time frame we assume that longitudinal changes in mandibular vertical ratios can be distinguished reliably with the panoramic technique.

To avoid issues about magnification errors from the different machines used for the radiological examinations, no statistical analyses were conducted based on linear measurements in the present study. Instead, we calculated ratios for mandibular inter-side differences as an expression of mandibular asymmetry. Kjellberg et al. found that this method is not affected by positioning error, distortion, or magnification (Kjellberg et al., 1994).

The present study does not contain an untreated control group. A comparison between our cohort and historical data on unilateral TMJ arthritis patients was considered of limited value. Instead, we chose a within-patient setup with a comparison between the non-affected and affected side, which eliminates the influence of age, sex, general disease variables, and medication in addition to the radiological advantages of such design.

Conclusion

Further research on the effect of the use of the distraction splint is necessary. However, we believe that the results published in this study are of importance for clinicians as we find evidence to support that distraction splint treatment can reduce mandibular asymmetry in JIA patients with unilateral TMJ arthritis. Based on our findings, we therefore propose implementation of distraction splint therapy in the treatment of JIA patients with unilateral affection of mandibular growth caused by TMJ arthritis, which may, in
most patients, cause comparable mandibular growth rates in the affected and the non-affected side.

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References


