

ORIGINAL ARTICLE

## Outcomes of temporomandibular joint disorder therapy: observations over 13 years

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### Abstract

**Objective.** To evaluate the outcome of temporomandibular joint (TMJ) disorder therapy with different kinds of splints. **Methods.** One-hundred-and-twenty-nine patients with TMJ disorders and meeting the primary selection criterion of reporting pain in the TMJ region were clinically evaluated. Magnetic resonance imaging of the TMJ was performed at baseline 1993–94. A protrusion splint was used whenever joint clicking could be eliminated by protrusion. In the other cases, a pivot or a Michigan splint was inserted. Re-evaluation of the patients after 12 months included a clinical examination. After 5 and 13 years, all patients were examined by means of a questionnaire. **Results.** Pain was significantly reduced in the case of more than two-thirds of the patients 1 year after the first consultation. After 5 and 13 years, the percentages of patients with reported pain had increased only slightly. However, the therapy did not reduce joint noises or mouth opening. The prevalence of joint noises was reduced to less than a quarter after 1 year, but during the next 13 years increased to the former level. Initially, one-third of the patients had mouth-opening reduction. This proportion dropped to one-third of these cases after 1 year, but increased to 40% after 13 years. **Conclusions.** Treatment using splints reduced pain in approximately two-thirds of the patients, but with no difference between the three types of splints used.

**Key Words:** *Appliance, joint noises, long-term outcomes, mouth opening reduction, pain, temporomandibular joint disorder*

### Introduction

Epidemiological studies have reported that temporomandibular disorders (TMDs) are commonly found in all age groups [1–3]. Besides pain, patients complain about joint noises like clicking or reduced mouth opening – symptoms that are often caused by internal derangement of the articular disk [4]. The therapy consists of using occlusal appliances, sometimes combined with drugs or physiotherapy [4].

Short-term studies demonstrate that the use of appliances reduces the signs and symptoms of TMD [5–8]. However, TMD remains with patients for years, and therefore long-term outcomes of therapy concepts are of interest. Long-term outcomes of patients who have undergone therapy with occlusal appliances for TMD are rare, i.e. after more than 5 years [9–13]. Most studies focus on the prevalence of TMD symptoms or investigate possible risk

factors for the development of TMD. Unell et al. [3] found an increase in reported orofacial symptoms in Swedish adults in the period 1992 and 2002. In investigating signs and symptoms of TMDs over two decades, Magnusson et al. [1] followed a randomly selected group of Swedish children over 20 years. On three occasions the children were examined clinically, and also by means of a questionnaire, with the aim of finding possible risk factors for the development of TMDs. Progression to severe pain and dysfunction was found to be rare, as was spontaneous recovery from pronounced symptoms. Furthermore, Magnusson et al. [1] found that occlusal factors were only weakly associated with TMD signs and symptoms. In a 5-year study after treatment had been performed, Ohrbach & Dworkin [9] found that 49% of their patients showed remitted signs of pain. High-reduced pain was experienced by 14%, low-reduced by 9%, 13%

had no changes in pain level, while in 16% the signs of pain were worse. It is noteworthy that the change over time of the psychological and physical variables was not congruent with the changes in pain level. Rammelsberg et al. [10] reported that, after 5 years, 33% of the patients showed remitted signs of pain, but 36% had recurrent pain.

Longer observation periods have been reported by Scandinavian and Dutch research groups [11–13]. Mejersjö & Carlsson [11] studied the frequency and severity of functional disturbance in 154 women 7 years after treatment, and only 20% showed recurrent symptoms during the treatment period. The authors emphasized the “favorable prognosis” for TMJ pain dysfunction. Pedersen & Hansen [12] reported 8 to 15 years after initial treatment that 72% in the treated group had reduced or no symptoms at the end of treatment. However, the type of treatment was not described. One of the longest observation periods for TMD treatment was published by de Leeuw [13], who re-examined 99 patients 30 years after initial treatment. During the first years, the main signs of temporomandibular joint osteoarthritis and internal derangement decreased significantly, and very few changes were observed in the next three decades.

This present prospective study, begun in 1993, investigated the outcomes of use of occlusal appliances of three different splint concepts to treat signs of TMDs such as pain, joint noises and reduced mouth opening. It was hypothesized that splint therapy significantly eliminates clinical signs of TMDs not just in the short term, but also in the long term, and that there are differences in the outcomes between the splint concepts.

## Material and methods

All 129 consecutive patients with TMD consulting the Department of Prosthetic Dentistry of the University Medical Care Center of Regensburg, Germany met the primary selection criterion of reporting pain in the region of the TMJ. Subjects who had systemic joint/muscle diseases, trauma in their medical history or major psychological disorders were excluded. The sample consisted of 90 women (69.8%) and 39 men (30.2%), ranging in age from 13 to 80 years, with a mean (SD) of 37 (14) years. All patients were clinically evaluated at base-

line in the period January 1993 to December 1994 by trained examiners in accordance with the standardized TMD status of the German Society of Prosthodontics and Material Science. Baseline data included joint sounds, pain, mouth-opening reduction and masticatory muscle pain or disorder. Additionally, all patients underwent magnetic resonance imaging (MRI) of both temporomandibular joints in order to evaluate the status of internal derangement. The imaging protocol followed the recommendations of Held et al. [14].

The trained examiners were responsible for deciding which therapy was best suited to the individual patient case. Therefore, three different types of occlusal appliances were used. Following the suggestion that disk repositioning therapy has a better prognosis in the long term [15], a protrusion splint ( $n=34$ , 26.4%) was used whenever joint clicking could be eliminated by a slight protrusion. If disk repositioning could only be achieved in a mandible position anterior of an end-to-end bite, use of a protrusion splint was rejected and a Pivot splint [16] with 0.3–0.4 mm distraction in the outermost molar region ( $n=51$ , 39.5%) was inserted. In cases where patients did not accept the fulcrum effect of the Pivot splint or had a bi- or unilateral shortened dental arch, a Michigan occlusal appliance ( $n=28$ , 21.7%) was inserted [17]. Sixteen patients (12.4%) who refused to bear a splint were treated solely by means of physiotherapy. All patients were re-evaluated after 1, 6, and 12 months, including a clinical examination. After 5 and 13 years, they were examined by means of a questionnaire. Eighty-three patients answered the 5-year evaluation (64.3%) and 39 the 13-year evaluation (30.2%). Reasons for drop-out included non-receipt of mail due to a change of address or no response to the mailing.

## Statistics

The number of patients was continuously reduced during the observation time. However, Table II demonstrates that inside each group the distribution of disk displacement, joint noises, mouth-opening reduction, splint types, gender and muscle pain after year 1, year 5 and year 13 does not change. Therefore, an age-stratified, gender-stratified, and finding-stratified representative population (Tables I and II) was found for the 5-year and 13-year questionnaires.

Table I. Distribution of subjects in age groups after year 1, year 5, and year 13

Age (years)	<i>n</i>	1-year observation <i>n</i> = 129	<i>n</i>	5-year observation <i>n</i> = 82	<i>n</i>	13-year observation <i>n</i> = 36
10–29	48	37.2%	27	32.9%	11	30.6%
30–39	30	23.3%	19	23.2%	9	25.0%
40–49	21	16.3%	15	18.3%	6	16.7%
50–59	22	17.1%	16	19.5%	9	25.0%
60–89	8	6.2%	5	6.1%	1	2.8%
Age, mean (SD)		36.2 (14.3)		37.0 (14.3)		37.0 (14.0)

Table II. Distribution of disk displacement, joint noises, mouth-opening reduction, splint types, gender, and muscle pain after year 1, year 5, and year 13

	<i>n</i>	1-year observation <i>n</i> = 129	<i>n</i>	5-year observation <i>n</i> = 82	<i>n</i>	13-year observation <i>n</i> = 36
Disk displacement	86	66.7%	57	69.5%	23	63.9%
Joint noises	66	56.6%	45	54.9%	20	55.6%
Mouth-opening reduction	32	24.0%	24	29.3%	8	22.2%
Protrusion splint	34	26.4%	24	29.3%	8	22.2%
Pivot appliance	51	39.5%	39	47.6%	19	52.8%
Michigan splint	28	21.7%	14	17.1%	6	16.7%
Gender female	90	69.8%	63	76.8%	26	72.2%
Muscle pain	62	48.1%	39	47.6%	19	52.8%

Only the group of patients with a Pivot splint was over-represented after 13 years of observation. Therefore, a multivariate analysis of variance (ANCOVA) could be performed to analyze the effects of pain, joint noises, and mouth-opening reduction [18]. The dependent variables in this analysis of variance were “pain”, “joint noises”, or “reduced mouth opening” at the start of the study and after 1 year of treatment, 5 years, or 13 years. Gender and age group were considered as fixed factors. Covariates were masticatory muscle disorders, anterior disk displacement, and treatment with an appliance [18]. ANOVA was used to investigate the influence of the three types of appliances on reported pain, joint noises, and mouth-opening reduction after 1, 5, or 13 years of observation.

## Results

In the follow-up after 1 year, it was noted that pain was significantly reduced for about two-thirds (72.8%) of the patients. After 5 years, the percentage of patients with reported pain had increased slightly to 33.7% and was 30.6% after 13 years of observation. Joint noises were found at the start of the study in 55.6% of the cases. The treatment with appliances reduced joint noises significantly. However, 5 years later, 68.7% of the patients in the sample demonstrated noises. Thirteen years after the initial consultation, 66.7% of the patients had joint sounds. A similar effect was observed for patients who suffered reduced mouth opening. Initially, 29.3% of the patients had this problem. After 1 year of treatment, only 8.5% complained about reduced mouth opening. Five years and 13 years later, 36.5% and 40.0% of the patients in the sample, respectively, reported that they had reduced mouth-opening capacity.

The multiple analysis of variance did not demonstrate that co-variables such as appliances or disk displacement had an effect on pain. Only masticatory muscle disorders and mouth-opening reduction were co-factors of pain after 1 year of treatment ( $p = 0.002$ ). After 5 and 13 years of treatment, no co-variables showed statistically significant influence. There were no hints that patients having disk displacement with reduction (confirmed by MRI)

had a better long-term prognosis than patients with displacement without reduction (Figure 1). The number of patients experiencing pain was comparably high, and joint noises and mouth-opening reduction were found to be higher in cases with disk displacement and reduction.

It could not be demonstrated that any one appliance type was statistically superior than another in reducing pain, joint noise or mouth-opening reduction after 1, 5, or 13 years of observation. Of the 16 patients who refused to wear a splint, 9 had pain (unchanged) 1 year after the initial consultation. Seven patients reported that they no longer suffered pain. After 5 years we could re-examine only 5 patients and after 13 years only 3 of this group. Due to the few cases, this group was not investigated further.

## Discussion

Although many medical centers have departments specialized in treating TMD patients, it is difficult to collect data depending on the course of TMD treatment. Typical of the country where this study was performed is that practitioners refer TMD patients to these centers primarily for diagnosis or initial treatment. Continuous observation of patients over the years seldom takes place, and may explain why in this study we had many drop-outs after 5 and 13 years. A further problem was the fact that many patients moved away and therefore could not be reached by mail. Despite this problem, it could be demonstrated (Tables I and II) that the “5- or 13-year samples” are representative. They did not differ among age groups, gender, or in the distribution of cases having disk displacement, joint noises, or reduced mouth opening. The number of cases that received a Pivot splint is over-represented only in the “13-year sample”. Therefore, the data of this sample could be evaluated.

In agreement with short-term studies, most patients seemed to benefit from appliance therapy [5–8]. Only 26.8% reported persisting pain after 1 year. In the same manner, joint noises such as clicking and reduced mouth-opening ability were reduced. However, 5 years later we observed that joint noises and

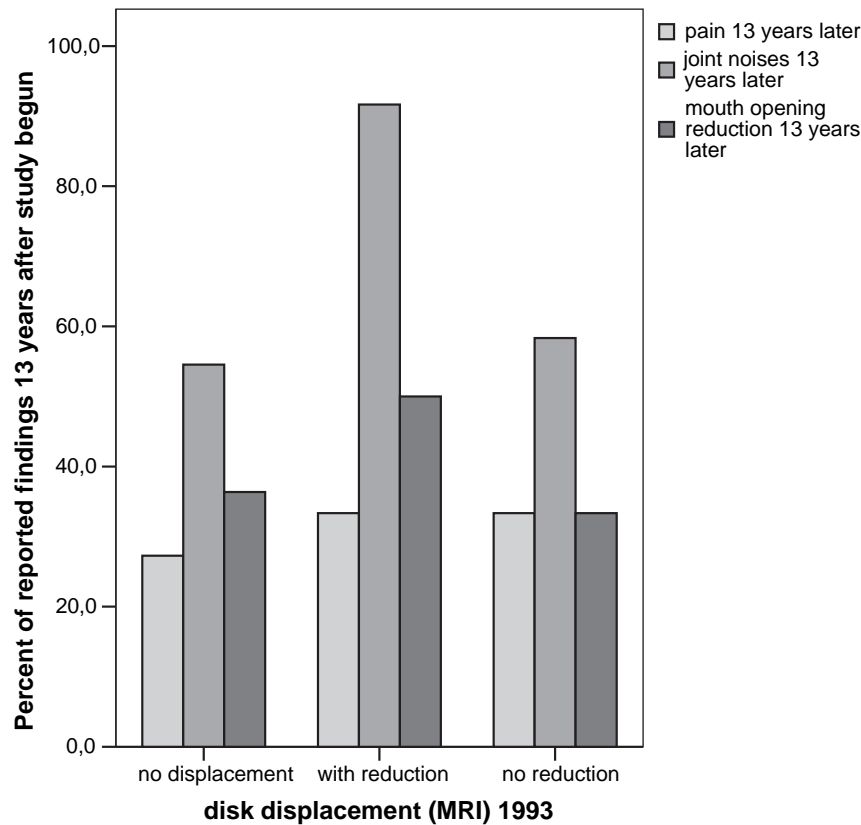


Figure 1. Percentage of reported “pain”, “joint noises”, “mouth opening reduction” 13 years after treatment depending on the amount of disk displacement.

mouth-opening reduction reached the baseline level before and increased after 13 years. Fortunately, reported pain remained at a low level of about 30%. It seemed that “pain” could be successfully reduced, but no structural improvements, e.g. disk replacement or better gliding of the joint components, were achieved in the long term. It has been suggested that joints with reducing disk displacement have a better prognosis in both clinical and radiographical findings, and thus disk-repositioning therapy is favored [19]. If we compare between our patients with and without disk-repositioning (confirmed by MRI) at the beginning of this study, we found no difference in reported pain after 13 years (Figure 1). This finding corresponds with the radiographic observation of Kurita and co-workers [20], who stated that “it seems that the improvement of the disk-condylar relationship may not lead to the improvement or prevention of radiographic evident degenerative joint diseases”.

The study results concur with the 5-year outcomes of Ohrbach & Dworkin [9], who concluded that “the 5-year outcome in pain is largely independent of readily discernible changes in clinical signs”. Rammelsberg and co-workers [10] failed to identify “predictors that distinguished remission vs. recurrence”.

Likewise in our study we could not determine the effects of clinical signs, e.g. joint noises, disk

displacement, mouth-opening reduction, which predict or affect the occurrence of pain.

A common property in this kind of study is that no untreated control is available. Kurita et al. [21] observed that some patients with symptomatic TMDs improved spontaneously over time without treatment. They evaluated 40 patients with TMDs who received no treatment during a period of 2.5 years in order to study the natural course of disk displacement. This study showed a great variation of symptoms and indicated that “about 40% of the patients will be spontaneously improved, one-third will have decreased symptoms, and one-quarter will not show any improvement”. The most improvement occurred during the first year. Earlier reports on the natural course of disk displacement [3,6] confirm this observation. It is striking that our results after 1 year of treatment, 26.8% without improvement, are very similar to those of Kurita et al. [21], in whose study one-quarter were unimproved cases without any treatment.

The question that arises is whether splint therapy has any influence on the course of TMD at all. This is underlined by the observation that treatment success was demonstrated for all different types of occlusal appliances. In this study, we could not demonstrate that Pivot splints were superior to Protrusion or Michigan splints, or vice versa. A recent study has shown that non-splint versus splint

therapy with or without additional physiotherapy or self-care strategies does not influence the result of self-reported pain after 12 months [22].

Based on poor knowledge, we are unable to decide today whether or not there is evidence to support splint therapy generally. It is therefore recommended that comprehensive treatment procedures that change the bite planes or occlusal area be used with caution [22,23]. Instead, clinicians should perform pain management to help patients overcome the "pain period".

It has been hypothesized that disk displacement follows a cascade of internal changes of the TMJ [19]. It begins with disk displacement with reduction, followed by displacement without reduction, and ends in locking and arthrosis deformans. This mechanism was not found in our study during 13 years of observation. None of the patients developed a locking, but we found discernible changes in clinical signs.

## Conclusions

Two-thirds of the patients had no pain or reduced pain after initial treatment. This level remained during the following 13 years. One-quarter did not show any improvement. Therapy with appliances did not improve the internal structure of the joint that causes joint noises or mouth-opening reduction. After initial significant improvement after 1 year, joint noises and opening reduction were again found in about two-thirds of the patients after 5 and 13 years of observation. A reluctance to use comprehensive treatment procedures is therefore advisable.

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