Orthodontic therapy of handicapped children - treatment time and success: a retrospective study

Moritz Blanck-Lubarsch1§, Ariane Hohoff1, Dirk Wiechmann2, Thomas Stamm1

1Department of Orthodontics, University Hospital Muenster, Westphalian Wilhelms - University, Muenster, Germany

2Department of Orthodontics, Hannover Medical School, Hannover, Germany

§Corresponding author

Email addresses:

MBL: blancklubarsch@uni-muenster.de

AH: hohoffa@uni-muenster.de

DW: wiechmann@dw-consulting.de

TS: stammt@uni-muenster.de
Abstract

Background

The aim of this retrospective study was to analyse treatment time, differences in peer assessment rating (PAR) index and aesthetic component (AC) of the index of orthodontic treatment need (IOTN) concerning pre- and post-treatment in handicapped (HC) children compared to non handicapped (NHC) controls.

Methods

Based on inclusion and exclusion criteria medical records at the Department of Orthodontics at University Hospital Muenster of HC and randomly selected NHC controls were analysed retrospectively concerning PAR score, AC score, treatment time, number of appointments and chair time divided in moderate and considerable. Sample size calculation, descriptive statistics as well as nonparametric Mann-Whitney-U-Test were applied.

Results

Twenty-nine HC children (21 boys, 9 girls; mean age 9.8 years pre-treatment) and 29 NHC children (12 boys, 17 girls; mean age 11.7 years pre-treatment) were enrolled in this study.

Pre- and post-treatment HC patients had significantly higher PAR score (median 21.0 / median 6.0) and AC score (median 9.0 / median 3.0) compared to NHC patients (PAR: median 17.0 / median 0.0; AC: median 5.0 / median 1.0).

However, the overall PAR score reduction, as well as the overall AC score reduction did not differ significantly between HC and NHC patients.
The overall treatment time did not differ between the patient groups. Overall, more considerable chair time took place in the handicapped patient group compared to the control group ($p<0.05$), whereas moderate chair time was more often in NHC patients ($p=0.001$).

The age at first and last appointment showed significant statistical differences. Consequently HC attended orthodontic treatment 2 years earlier than NHC children.

**Conclusions**

The PAR and AC score at the beginning and the end of treatment showed a significantly higher value for HC patients, while overall treatment time and number of appointments did not differ. Overall chair time was higher for HC patients.

**Keywords**

orthodontic treatment; handicapped children; treatment time; success; peer assessment rating (PAR) index; index of orthodontic treatment need (IOTN); aesthetic component (AC)

**Background**

Due to medical development and increasing numbers of treatment options, gravidity and delivery have become less dangerous for both, the mother and the infant. Consequently, fewer gravidity and delivery complications are observed in the developed world and even early born infants have significantly higher survival chances. Nevertheless, the number of handicapped children rises [1]. Subsequently, the integration of handicapped people and their families in daily and social life plays an increasingly important role [2, 3].

A subgroup of the great variety of challenged people, are those with craniofacial disorders. Craniofacial disorders have different ethology and various treatment concepts but there is one
aspect they have in common: They share a unique facial appearance which, unlike internal medical disorders that remain undiscovered by the public, exposes them to society [2, 4].

As scientifically proven, facial and dental appearance make a difference in social integration, penalising this patient collective at early age. Shaw et al. showed that dentofacial appearance influences social attractiveness. They found people with normal dental appearance to be perceived as better looking, more desirable to make friends with, more intelligent, and less likely to show aggressive behaviour [5, 6]. According to a survey lead by Becker et al., the primary motivation for parents of HC children to have their children undergo orthodontic therapy was to increase their facial attractiveness [2]. Consequently, this knowledge is reason enough to think about paving the way of patients with craniofacial disorders by enabling them to orthodontic treatment. The fact, that malocclusion occurs more often in physically and mentally handicapped children constitutes an additional important reason for treatment [7-9].

The results published at present show that treatment of this challenged patient collective is possible but not easy in management and that matchable data on treatment results is rare [10]. Becker et al. outlined that major problems of orthodontic treatment in handicapped children are the maintenance of an adequate oral hygiene and difficulties in appointment attendance [11].

As malocclusion and aesthetic components are often seen as subjective criteria, only the use of standardised indices is capable of shedding light on this highly individual patient collective. A manifold number of indices for orthodontic questions have been described [12]. Two profoundly established indices are the peer assessment rating (PAR) index and the index of orthodontic treatment need (IOTN), which were also applied in our study. The PAR index provides a way to define the individual occlusal non-conformance in regard to the entire malocclusion of the jaw and to tie comparison between different patients’ cases at variable points of treatment. To accomplish these demands the index is able to uncover all potential occlusal anomalies known.
The occlusion improvement representing successful treatment can be evaluated by change of the score [13].

The IOTN implies a clinical consistent called dental health component (DHC) and an aesthetic component (AC) [14]. The index differentiates three categories: no treatment need (1-4), borderline need (5-7) and great treatment need (8-10) [15]. Beyond, the component is able to give suggestion on patients’ cooperation [15].

Additionally Pubmed research was applied to the term "orthodont*" crossed with a combination of "handicapped OR special need OR disabled" in relation to "success", "outcome" and "treatment time". According to the published literature a focus has been laid on the challenge of treating HC, however there is only little reference concerning orthodontic treatment outcome in this special needs group. Consequently the aim of the study was to analyse treatment time, differences in PAR score and AC score of IOTN concerning pre- and post-treatment in a handicapped patient group compared to a non handicapped control group.

**Methods**

**Subjects**

Medical records from 1989 till 2008 of the Department of Orthodontics at University Hospital Muenster were screened for orthodontic treatment of handicapped children. The term “handicapped” was defined according to the International Classification of Functioning, Disability and Health (ICF) [16].

**Inclusion criteria**

The inclusion criteria for the handicapped (HC) group were: (i) handicapped children defined according to ICF, (ii) treatment with removable and/or multibracket appliances, (iii) photo and
model documentation at the beginning and the end of treatment. Written informed consent was obtained from all participants or their relatives for data analysis and publication of the associated images.

**Exclusion criteria**

The exclusion criteria were: (i) patients with history of orthodontic treatment, (ii) adult patients, (iii) incomplete medical records or (iv) discontinuation of treatment.

**Control group**

The non handicapped (NHC) control group consists of randomly selected healthy children treated at the Department of Orthodontics with removable and/or fixed appliances. The inclusion criteria ii and iii and also the exclusion criteria of the HC group applied to the NHC group.

To inspect if there is a variation in treatment time needed, the date of treatment admittance and the date of orthodontic treatment completion were extracted from medical records. The date of birth was also identified to compare the age at first and last appointment at the Department of Orthodontics. Additionally the medical dysfunction, gender, type of appliance (fixed or removable) and number of appointments was itemized in moderate and considerable chair time. As a consequence of the retrospective study design we defined moderate chair time as less time consuming orthodontic treatments such as changing elastics or power chains or wire bending (removable appliances), whereas considerable chair time implied procedures like wire change, bracket bonding or rebonding, refixation of Herbst appliances or maxillary expansion appliances.

In order to examine differences in the HC collective and the NHC control group, standardised indices were applied. The peer assessment rating (PAR) index was used to examine occlusion improvement between pre- and post-treatment and to compare total treatment outcome.
between both groups. To record the PAR a qualified examiner scored all pre- and post-treatment dental study models. To conduct the analyses a PAR ruler was used.

Furthermore the aesthetic component (AC) of the index of orthodontic treatment need (IOTN) was performed to assess the change of patients’ dental attractiveness [17]. The AC of the IOTN was allocated by a qualified examiner with the AC scale by comparing photographs from the patient collective at the start and the end of treatment [18].

**Statistics**

Descriptive and statistical analysis were performed using the software SPSS Statistics Release 21.0 (IBM Corporation, New York, U.S.A.). The Mann-Whitney-U-Test was applied and the median value and the mean value were calculated to check the hypothesis. The significance level was defined as 0.05.

**Sample size**

Sample size calculation was performed in line with the guidelines of the German Health Insurance for active treatment time (36 month) and retention (12 month). Further treatment need had to be requested at the health insurance, meaning the costs increased the average case. Therefore, active treatment time was estimated to be 36 months for the NHC group and 48 months for the HC control group, a standard deviation in both groups from 12 months was defined.

The same was made for the AC index by the assumption that the AC score for NHC group was located at 6 (middle of borderline treatment need) and for HC group at 9 (middle of great treatment need) with a standard deviation of 3 (range of one AC group). For a power of 80 % and a confidence interval of 95 % the sample size needed for each group was 17 in both calculations.
Results

Subjects

By the inclusion criteria 29 handicapped children were enrolled in this study. The patients' mean age was 9.8 years at the beginning and 14.2 years at the end of treatment. The group consisted of 21 boys and 8 girls. Eighteen of them were treated with fixed and removable appliances, while 7 were treated by fixed only and 4 by removable appliances only.

Control group

By the inclusion criteria 29 non handicapped children with mean age 11.7 years at start and 16.0 years at end of treatment were enrolled in this study. The group consisted of 12 boys and 17 girls. Twenty-six of them were treated with fixed and removable appliances, while 1 was treated by fixed only and 2 by removable appliances only.

PAR index

The PAR score at treatment admittance varied significantly between the control group and the handicapped children. Post-treatment outcome showed higher PAR scores for HC in comparison to NHC. The PAR score at the end of treatment varied significantly between the HC (PAR median value 6.0) and the NHC (PAR median value 0.0). In addition there was a difference in the boxplot, showing a wider range for the NHC (Fig. 1).

Taking a look at the PAR score reduction (Fig. 2), no statistic differences could be found between the groups (score HC median value 11.0; score NHC median value 16.0).

Aesthetic component
The aesthetic component also showed significant differences at treatment admittance between HC and NHC (p<0.001). The ACs' mean value of HC patients ranged between 7 and 10 while the NHC control group showed results between 4 and 6 (Fig. 3). Correspondingly, as defined by the AC score, HC are of 'great treatment need' while NHC are of 'borderline treatment need'. The AC at treatment completion also varied significantly between the HC and the NHC (p<0.001).

However, the range of AC score between pre- and post-treatment was the same for both groups (HC and NHC median value 4,0) and did not reach statistical significance (Fig. 4).

**Treatment time**

There was no statistical significant difference in the overall treatment time and the number of overall appointments between the two groups.

Additionally the number of appointments was itemised in moderate and considerable chair time (Fig. 5). Overall, more considerable chair time took place in the HC patient group compared to the NHC control group (p<0.05) whereas moderate chair time was more often in NHC patients (p=0.001).

The age at first and last appointment showed significant differences (Fig. 6). In line with this HC started treatment at the average age of 9,8 years and completed treatment at the age of 14,2 years, while the NHC children aged 11,7 years at treatment start and 16,0 years at the end of treatment. Consequently HC patients attended orthodontic treatment 2 years earlier than NHC children (Fig. 7).

**Discussion**

PAR / AC pre-treatment
At admittance, differences in the PAR and AC score between HC and NHC to the disadvantage of HC could be outlined. This fact could be explained by van der Linden et al. who identified two main reasons for influence on dentofacial morphology. They found genetic and environmental factors to determine dentofacial appearance [19]. Environmental factors such as generalised muscular hypotonia could often be found in HC patients [20]. Literature on genetic factors is rare.

**PAR / AC post treatment**

At end of treatment an inferior outcome of HC compared to NHC rated by the PAR and the AC score was acknowledged. These results may be attributed to the fact that parents and orthodontists put the focus on functional outcome and are willing to subordinate aesthetic effects. In addition less sufficient oral hygiene may force the orthodontist to reduce treatment time in order to avoid dental damage, such as caries, periodontitis or other [11]. Nevertheless it must be mentioned that, while statistically significant differences regarding the AC score do exist between both patient groups, most of the HC patients achieve a post-treatment AC score of 4, i.e. they exhibit no treatment need any more (Fig.3).

**Range of PAR / AC**

Amazingly no differences in the range of the PAR and AC score between pre- and post-treatment measurements could be found between the HC and NHC patients. Both showed a significant reduction of the respective scores. These findings raise the question if there is a genetic disposition for orthodontic treatment outcome, as suggested by van der Linden et al. [19].

**Treatment Time**

As shown by our results, the overall treatment time in HC and NHC is equal and does not differ in a statistically significant way. The same is true for the total number of appointments.
With regard to the post treatment outcome, the question is raised if HC are in need of longer orthodontic treatment to achieve results similar to those of the NHC group. However, Becker et al. identified the absence of an adequate level of oral hygiene leading to the premature end of orthodontic treatment as one major problem for insufficient success [11].

Taking a closer look at the differentiation between considerable and moderate chair time, there is a difference in the HC versus the NHC group. HC children showed higher rates of considerable chair time, while NHC children showed higher rates of moderate chair time. An attempt to explain could be the higher mental and physical limitations of these patients, which can lead to more complications at the appliances. Nevertheless our results outline that one must not expect longer overall treatment time but more considerable chair time by treating HC patients.

As we found out HC patients attended orthodontic appointment significantly earlier than NHC patients, which may be due to an omnipresence of doctors and a more intensely observed maturation in these children (Fig. 7).

Our results outline only a limited insight into the treatment of a complex patient collective, however, it has become obvious that there is a great need to promote therapy options and make orthodontic treatment accessible for these children. Furthermore they give reason enough why orthodontists should not hesitate to treat members of this special needs group.

**Conclusions**

Differences in PAR and AC score between HC and NHC children at admittance of orthodontic treatment to the disadvantage of HC patients could be outlined. Furthermore an inferior treatment outcome also rated by AC and PAR score for HC children was acknowledged.
The comparison of the overall treatment time and the number of appointments showed no significant differences within HC and NHC children.

Overall, more chair time was required in the handicapped patient group.

Ethical approval

The investigation was performed in compliance with the current revision of the Declaration of Helsinki, and with the International Conference for Harmonisation Good Clinical Practice (ICH-GCP) regulations and guidelines. Only data, which was open to the authors for clinical practice, were used and the ethic committee of the Westphalian Wilhelms - University did not see reason for application (Letter from Sept. 4th 2013).

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

TS and AH suggested the original idea for the paper. TS and MBL developed the study design. MBL collected the data, did the literature research and wrote the main part of the manuscript. MBL made the statistical analysis and contributed to the interpretation of the results. TS contributed to the statistical analysis and data handling and reviewed the manuscript. DW reviewed the paper for content, including the final version of the manuscript. All authors read and approved the final manuscript.

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**Figures**

Figure 1. Change in PAR score between pre- and post-treatment for both NHC and HC group. There are significant differences in PAR scores within the groups pre- (p=0.037) and post-treatment (p<0.001).

Figure 2. Reduction of the PAR score between pre- and post-treatment.

Figure 3. Change in AC score between pre- and post-treatment for both NHC and HC group. There are significant differences in AC scores within the groups pre- (p<0.001) and post-treatment (p<0.001).

Figure 4. Reduction of the AC score between pre- and post-treatment.

Figure 5. More considerable chair time took place in the HC group compared to the control group (p<0.05) whereas moderate chair time was more often in NHC patients (p=0.001).

Figure 6. There is a significant difference between the HC and NHC patient collective at the time of first (p=0.018) and last appointment (p=0.021).

Figure 7. HC children attend orthodontic treatment 2 years earlier than NHC children.
Reference


Figure 1
Figure 2
Figure 5

Box plots comparing the number of appointments for 'considerable chair time' and 'moderate chair time' between NHC and HC groups. The plots show a wider range for the HC group with 'considerable chair time' compared to the NHC group, indicating a higher variability in the number of appointments.
Figure 6