Evaluation of The Final Phase Treatment Outcomes of Dento-skeletal Problems in Complete Cleft Lip and Palate Patients with and without Surgery using The Peer Assessment Rating (PAR) Index

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ABSTRACT

The primary objective of study was to assess the outcome of the final phase of treatment in cleft lip and palate patients with orthodontic treatment alone and with orthognathic surgery. The secondary objective was to determine the improvement in the occlusion of two alternatives of treatment. A sample of 27 orthodontic treatment alone cases and 7 orthognathic surgery cases who had been treated with full fixed orthodontic appliance were evaluated. The results showed that the orthognathic surgery group had greater PAR scores pretreatment than did the orthodontic treatment alone group. Posttreatment and improvement PAR score were similar between the 2 groups. Two cases in orthodontic treatment alone group presented excellent improvement whereas other cases presented great improvement. For orthognathic surgery group, all cases demonstrated great improvement of malocclusion.

Key Words: PAR score, orthodontic treatment, cleft lip and palate patient
Introduction

Most cleft lip and palate patients have many dento-skeletal problems such as anterior or posterior crossbite, congenital missing teeth at cleft site, Skeletal class III relationship (Pisek, 2007). The dentofacial deformity can affect speech, swallowing pattern, mastication and dentofacial esthetics. The one of the most common associated skeletal problems in cleft patients is a deficiency maxilla in which dental development is also impaired (Boyarskiy, Choi et al. 2006). Maxillary hypoplasia may occurs not only in the sagittal plane but also in the transverse and vertical planes of cleft patients who received cleft surgery during infancy (Adlam, Yau et al. 1989).

The nasomaxillary complex deficiency in cleft patients is variously attributed to early reconstructive surgery, tissue deficiency, and inherent growth retardation (Subtelny, 1966; Mars & Houston, 1990). The effect of primary surgery such as surgical technique, timing, and the expertise of surgeon was considered to be a great impact on the growth and development of the craniofacial complex in children with clefts (Graber 1954; Roberts, Semb et al. 1991; Shaw, Asher-McDade et al. 1992). Other factors, such as presurgical orthopedics and orthodontic treatment, are also considered to influence the final growth outcome (Peltomaki, Grayson et al. 2001).

In cleft patients, they need orthodontic treatment alone (camouflage treatment) or orthodontics combined with orthognathic surgery to correct the malocclusions. In the final phase of treatment, orthognathic surgery is usually performed due to the maxillary hypoplasia. The maxillary osteotomy is most commonly presented in cleft patients (Fonseca, Turvey et al. 2000). The purpose of orthognathic surgery is to facilitate normal jaw function, acceptable facial esthetics, and long-term stability (Bell, Jacobs et al. 1986).

Good treatment outcome is the objective of treatment that cleft lip and palate patients should receive. For this reason, the treatment outcome evaluation is essential to identify and implement the highest possible standards of care. However, the treatment outcomes quality can vary widely in cleft patients. The differences in treatment results may be related to variation in the sequence, timing, and technique of treatment, the organization and delivery of care, as well as the skills and experience of individual surgeons (Pieter, Nollet et al. 2005).

The assessment of treatment outcome and degree of improvement are essential to evaluate the final orthodontic treatment outcome. Many previous studies have examined positional changes after orthognathic surgery, by comparing cephalometric radiographs or photographs or both, before and after treatment including soft- and hard-tissue changes (Lines & Steinhauser, 1974; McDonell, McNeill et al. 1977; Suckiel & Kohn, 1978; Hunt & Rudge, 1984). The occlusal outcome after orthognathic surgery has been overlooked, mainly because there has been no suitable method for assessing occlusal changes objectively (Baker, David et al. 1999).

There are many kinds of quantitative indices that have been reported to assess orthodontic treatment need or treatment outcome, and showed the improvement or post-treatment changes (Summers 1971; Myrberg & Thilander, 1973; Gottlieb 1975; Daniels & Richmond, 2000). For example, the Index of Orthodontic Treatment Need was developed to evaluate need of orthodontic treatment and measure the quality of treatment outcomes (Orthodontic
Service, 2002). Furthermore, the Peer Assessment Rating index was developed to assess the severity of malocclusion (DeGuzman L, Bahiraei et al. 1995). This index can be used to evaluate the orthodontic outcome by comparing pre- and post-treatment casts (Deguchi, Honjo et al. 2005). The difference between the pre- and post-treatment scores reflects the degree of improvement and the success of treatment.

At the Khon Kaen University Cleft Palate Center, the final treatment outcomes have not so far been evaluated, nor has any report from other Centers been so far been found for objective evaluation of treatment outcomes. Since PAR has been widely used for assessing both pre-treatment and post-treatment orthodontic outcomes, it was decided to apply this Index to assessing outcomes for treatment of patients with oral clefts.

Materials and methods

Reliability of the PAR index

Five pretreatment and five posttreatment models in orthodontic treatment alone group and combined orthognathic surgery group are randomly selected from the pool of sample models at the Khon Kaen University Cleft Palate Center. To determine intraexaminer reliability, two trained examiners (one is the researcher, another one is an expert orthodontist) use the PAR index (as originally described by Richmond, Shaw et al. 1992) to score 10 sets of models on 2 separate days, 1 week apart, and then to compare the scores. To determine interexaminer reliability, the examiners use the PAR Index once to score 10 sets of models from the same lot selected for the intra-examiner reliability test. Reliability of PAR Index score revealed excellent agreement of reliability coefficient in both intra- and inter-reliability. The agreement between first and second examiners ranged from 0.989 to 0.994 whereas the agreement between first and second times of PAR Index score ranged from 0.988 to 0.989.

Sample

The inclusion criteria for case selection were (1) cleft lip and palate patients who have completed correction of malocclusion already (both with and without orthognathic surgery); (2) permanent dentition; (3) availability of pretreatment and posttreatment models. The exclusion criteria were (1) Cleft-associated syndrome patient; (2) orofacial cleft; (3) loss of all upper incisors; (4) loss of lower central incisors; (5) permanent teeth loss prior to their final treatment due to excessive dental caries. From pilot study to assess the orthodontic treatment outcome of 5 cleft patients in each group using the PAR index, a sample size of 35 per group is calculated at confidence level of 95%, $\alpha = 0.05$, $\beta = 0.20$. The present study located 27 subjects in the orthodontic treatment alone group and 7 subjects in the combined orthognathic surgery group.

Data collection

Each patient’s study models are assigned a number in random order by a non-examiner to ensure examiner blinding. This number is placed on the patient’s pretreatment and posttreatment models, and the patient’s name is hidden. The PAR Index score is recorded according to the criteria of Richmond, Shaw et al (1992). The one examiner (researcher) tabulates pre-treatment and post-treatment PAR scores for each
Table 1. Results of Mann-Whitney U Test comparing variables between orthodontic treatment alone and combined orthognathic surgery groups

<table>
<thead>
<tr>
<th>Orthodontic treatment</th>
<th>Combined Orthognathic Surgery</th>
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<tr>
<td></td>
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<tr>
<td><em>al</em>one (n = 27)</td>
<td>Surgery (n = 7)</td>
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<tr>
<td>Mean</td>
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<tr>
<td>SD</td>
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<td>Min</td>
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<td>Max</td>
<td>Max</td>
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<tr>
<td>Mean difference</td>
<td>P value</td>
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<tr>
<td>Pretreatment PAR</td>
<td>32.26</td>
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<tr>
<td>SD</td>
<td>7.96</td>
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<tr>
<td>Min</td>
<td>13</td>
</tr>
<tr>
<td>Max</td>
<td>45</td>
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<tr>
<td>Posttreatment PAR</td>
<td>2.67</td>
</tr>
<tr>
<td>SD</td>
<td>2.27</td>
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<tr>
<td>Min</td>
<td>0</td>
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<tr>
<td>Max</td>
<td>10</td>
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<tr>
<td>Improvement in PAR</td>
<td>29.59</td>
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<tr>
<td>SD</td>
<td>8.79</td>
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<tr>
<td>Min</td>
<td>10</td>
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<tr>
<td>Max</td>
<td>45</td>
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<tr>
<td>Mann-Whitney U Test</td>
<td>-7.6</td>
</tr>
<tr>
<td>P value</td>
<td>0.048</td>
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</table>

Statistical analysis

Descriptive statistics was used to determine the general characteristic of subjects which were age and gender in each group. Pretreatment, post-treatment, and improvement in PAR scores between orthodontic treatment alone and combined with orthognathic surgery groups were compared using Mann-Whitney U Test with mean difference and 95% confidence interval.

Results

Statistics, including means, standard deviations, and *P* values for pretreatment, post-treatment, and improvement in PAR score are presented in Table 1. Mann-Whitney U Test indicated significant differences in pretreatment PAR scores. No significant differences were performed in posttreatment PAR scores and improvement in PAR scores between orthodontic treatment alone and combined orthognathic surgery groups. These results indicate that combined orthognathic surgery cleft patients had greater pretreatment PAR scores.

Table 2 presents improvement categories between two groups by Fisher’s exact test. The degree of PAR Index score improvement was not significantly different between orthodontic treatment alone group and combined orthognathic surgery group. Two cases (7.41%) in orthodontic treatment alone group presented excellent orthodontic treatment outcome whereas other cases (92.59%) presented great orthodontic improvement. For combined orthognathic surgery group, all cases (100%) demonstrated great improvement of malocclusion.

Discussion

The PAR Index score in orthodontic treatment alone group was less than in the combined orthognathic surgery group at pre-treatment phase, which is to be expected. The PAR Index score reflected the severity of malocclusion in each group.
One factor that would have contributed to this finding is the severity of skeletal relationship discrepancy. The skeletal discrepancy in combined orthognathic surgery group is more than in orthodontic treatment alone group for both cleft patients and non-cleft patients (Baker, David et al. 1999). The skeletal problems can occur in all dimensions (sagittal, transverse and vertical planes) in cleft patients (Adlam, Yau et al. 1989). The most common skeletal discrepancy in cleft patients is a maxillary hypoplasia that presents a Skeletal Class III relationship (Pisek, 2007). The skeletal problems can affect the dental malocclusion such as anterior overjet in sagittal plane, buccal overjet in transversal plane, open bite or deep bite in vertical plane, and severe crowding or embedded tooth in severe maxillary hypoplasia. It performs that the more the severity of skeletal discrepancy in combined orthognathic surgery group, the more severe will be the dental malocclusion.

The posttreatment PAR Index scores in orthodontic treatment alone group and combined orthognathic surgery group were not different. It reflected the final treatment outcomes of cleft patients in both groups. The orthodontic treatment outcomes between orthodontic treatment alone and combined orthognathic surgery are likely to be different because the objective of treatment is different in each procedure. For orthodontic treatment alone, the objective of treatment tries to camouflage the skeletal relationship problems by orthodontic tooth movement without changing the skeletal problem. Mild skeletal Class III with anterior crossbite in cleft patients can be treated by proclination of upper anterior teeth and retroclination of lower anterior teeth to create positive overjet while skeletal problem is still remain. The facial profile of patients is not improved by orthodontic treatment alone. By contrast, the objective of combined orthognathic surgery tries to correct skeletal problems by skeletal movement because the severity of skeletal problem is too much more to correct by tooth movement alone. The anterior teeth for severe skeletal Class III cleft patients, are corrected to normal inclinations, while the skeletal discrepancy is corrected by surgical jaw movement. The combined effect of these two sets of procedures is expected to be significant improvement of the patient’s profile.

Improvement of PAR Index score or PAR Index score reduction assesses the quality or standard of orthodontic treatment of malocclusion. Richmond, Andrews et al. (1992) suggested that the mean PAR Index score reduction should be greater than 70 percent in high-standard orthodontic treatment and that specialist orthodontic treatment should reduce the malocclusion on average 78 percent using before- and after-treatment PAR scores (Richmond & Andrews, 1993). From this study, Improvement of PAR Index score were greater than 90 percent in both the orthodontic treatment alone group (91.72 %) and combined orthognathic surgery group (93.90 %). The results indicate that the cleft lip and palate patients at the Khon Kaen Cleft Center received high-standard orthodontic treatment thus bettering the minimal outcome quality of treatment that Richmond & Andrews (1993) suggested. In addition, the results of this study reflect that the cleft treatment protocol for correction of malocclusion problems developed by Khon Kaen Cleft Center is of a high-standard quality.

However, the statistical analysis presented the improvement of PAR Index score was not different between two groups. The reason is the PAR Index evaluates only the alignment and occlusion of patient. It does not mention about inclination of the teeth that
is the different point between orthodontic treatment alone group and combined orthognathic surgery group. In the orthodontic treatment alone or camouflage treatment group, the upper anterior teeth were proclined whereas the lower anterior teeth were retroclined to compensate the reverse overjet and skeletal malrelationship. By contrast, the upper and lower anterior teeth were orthodontically adjusted to the correct position and inclination while the reverse overjet or skeletal malrelationship was corrected by jaw surgery. Therefore, the improvement of facial esthetic and facial profile was different between the two groups. The PAR Index did not evaluate facial esthetic improvement but it looked only at malocclusion reduction. For that reason, the improvement of malocclusion between orthodontic treatment alone group and combined orthognathic surgery group was not different.

The PAR Index score improvement was categorized following Richmond, Shaw et al. (1992). It represented the degree of improvement and reflected the quality of orthodontic treatment outcome. In orthodontic treatment alone group, it found that 2 samples performed 100% or total improvement that means of 2 cleft patients were received excellent orthodontic treatment. Others patients in the orthodontic treatment alone group were classified in the greatly improved category, so the treatment plan and technique to treat cleft patients in this group were of high quality. In addition, all of subjects in the combined orthognathic surgery group were categorized as greatly improved the same as for the orthodontic treatment alone group. Thus there was good orthodontic and surgical treatment planning for cleft patients who had severe skeletal malrelationships and malocclusion. No examples in either group were found in the lower quality categories of “improved”, “worse-no difference” category. For that results, the degree of improvement presented high standard and quality of orthodontic treatment outcome in Khon Kaen Cleft Center. The severe malocclusion in cleft patients was eliminated by good treatment plan and technique. Therefore, the high level of improvement can reflects the good quality of treatment protocol for cleft patient in Khon Kaen Cleft Center.

The PAR Index can assess the severity of malocclusion in cleft patients as well as in non-cleft patient. The pre- and post-treatment PAR Index scores are measured easily from dental models. The orthodontic treatment outcomes can be evaluated by the post-treatment PAR Index score while the success of orthodontic treatment can be interpreted by PAR score improvement. For the Khon Kaen Cleft Center, the PAR Index is useful for orthodontic treatment outcome evaluation in cleft patients and has never been done before. The outcomes can reflect the effectiveness of Khon Kaen Cleft Center treatment protocol including the timing of each procedure, treatment plan, orthodontic technique and surgical technique for the cleft patients who have severe skeletal discrepancy. If the improvement PAR score indicates poor treatment outcomes, then search must be made for improvements to the protocol for better treatment outcome achievement.

Although the PAR Index has many advantages for assessing treatment outcomes or treatment need evaluation, it has limitations. It assesses only the dento-occlusal change from dental models. For treatment outcomes evaluation, it is necessary to evaluate not only occlusion but also soft tissue change, cephalometric measurement and functional factors (Deguchi, Honjo et al. 2005).
Because the PAR Index measures from dental models, it does not identify decalcification of teeth, gingival recession, root resorption and function of temporomandibular joint dysfunction that may result from orthodontic treatment (Birkeland, Furevik et al. 1997; Holman, Hans et al. 1998).

Conclusions

In assessment of the treatment outcomes of correction of malocclusion with and without surgery for cleft patients using the PAR Index, the following conclusions may be drawn:

1) The pre-treatment PAR Index score assessed the severity of malocclusion which, as should be expected, was greater in the combined orthognathic surgery group than in orthodontic treatment alone group.

2) The post-treatment PAR Index scores for final treatment outcomes evaluation were excellent in both groups, with no significant differences between the two groups.

3) There was no difference in the degree of improvement in the occlusion in the final phase of treatment between the two groups. Two cases who received orthodontic treatment alone presented excellent or total improvement of malocclusion while the others in both groups had marked greatly orthodontic improvement.

Acknowledgements

I would like to express my deepest and sincere gratitude to Associate Professor Keith Godfrey, for putting in all his effort and knowledge in this research. He has been responsible for this research from its beginning stage to the last final word.

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