

# The Final Orthodontic Treatment Outcome Evaluation in Patients with Cleft Lip and Palate at Khon Kaen University Cleft Lip and Palate Center: A Pilot Study

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*The primary objective of the present study was to use the Peer Assessment Rating (PAR) Index to assess the outcome of the final phase of treatment in cleft lip and palate patients with orthodontic treatment alone and with orthognathic surgery. A secondary objective was to determine the improvement in the occlusion of the two treatment alternatives. The study sample consisted of 27 patients who received orthodontic treatment alone and 7 patients who received orthodontic treatment combined with orthognathic surgery were evaluated. The results showed that the orthognathic surgery group had greater PAR scores pre-treatment than did the orthodontic treatment alone group. Post-treatment and improvement of PAR scores were similar for both groups. Two subjects in orthodontic treatment alone group had excellent improvement whereas other cases presented less but still desired improvement. For the orthognathic surgery group, all cases demonstrated great improvement in malocclusion.*

**Keywords:** PAR score, Orthodontic treatment, Cleft lip and palate patients

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Most cleft lip and palate patients have many dento-skeletal problems such as anterior or posterior cross bite, congenital missing teeth at the cleft site, and skeletal Class III relationship<sup>(1)</sup>. One of the most common associated skeletal problems in cleft patients is a deficient maxilla in which there is frequently significant displacement of teeth.

The nasomaxillary complex deficiency in cleft patients is variously attributed to early reconstructive surgery, tissue deficiency and inherent growth retardation<sup>(2,3)</sup>. 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<sup>(4-6)</sup>. Other factors, such as pre-surgical orthopedics and orthodontic treatment, are also

considered to influence the final growth outcome<sup>(7,8)</sup>.

In the final phase of treatment, cleft patients with varying degrees of Class III dental and jaw relationships need orthodontic treatment alone (OTA), and often described as “camouflage” treatment, or orthodontics combined with orthognathic surgery (COS) to correct the malocclusions<sup>(9)</sup>. Orthognathic surgery is usually performed due to the maxillary hypoplasia<sup>(10)</sup>. The purpose of orthognathic surgery is to facilitate normal jaw function, acceptable dento-facial esthetics, and long-term stability<sup>(11)</sup>.

The evaluation of treatment outcome is essential to identify and implement the highest possible standards of care. However, the quality of treatment outcomes can vary widely among cleft patients. The differences in treatment results may be related not only to the effects of the primary surgery, but to the possible effects of any subsequent revisionary surgery, bone grafting, preliminary orthodontic treatment, or variable oral health<sup>(12)</sup>.

Proper care of cleft lip and palate patients requires continual monitoring and evaluation. Record of the dento-skeletal changes that have led to the final

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orthodontic outcome is an important component of the overall evaluation of patients' rehabilitation. Many previous studies have examined positional changes after orthognathic surgery, by comparing hard- and soft-tissue changes using before and after treatment cephalometric radiographs, or photographs, or both<sup>(13-16)</sup>. The occlusal outcome after orthognathic surgery has been overlooked, mainly because there has been no suitable method for assessing occlusal changes objectively<sup>(17)</sup>.

Several semi-quantitative indices have been developed to assess orthodontic treatment need or treatment outcome, enabling determination of treatment changes<sup>(18-21)</sup>. The Peer Assessment Rating Index (PAR) was developed primarily to assess outcomes of orthodontic treatment<sup>(22)</sup> and subsequently validated as a means of determining the severity of malocclusion and treatment difficulty<sup>(23)</sup>. Thus, this index can be used to evaluate the orthodontic outcome by comparing pre- and post-treatment dental casts<sup>(24)</sup>. The difference between the pre- and post-treatment scores reflects the degree of improvement and the relative success of treatment.

At the Khon Kaen University Cleft Lip and Palate Center, the final treatment outcomes have not so far been evaluated, nor has any report from other centers so far been found for objective evaluation of treatment outcomes using the PAR. Since PAR has been widely used for assessing both pre-treatment and post-treatment orthodontic outcomes among non-cleft subjects, it was decided to apply this index to assessing outcomes for treatment of cleft lip and palate patients.

## Material and Method

### Reliability of the PAR index

Five pre-treatment and five post-treatment models in the orthodontic treatment alone group (OTA) and combined orthognathic surgery group (COS) were randomly selected from the pool of sample models at the Khon Kaen University Cleft Lip and Palate Center. There was a preliminary study to determine intra- and inter-examiner reliability, two trained examiners (one was the first author, the other was the third author) used the PAR Index, as originally described by Richmond, Shaw et al<sup>(22)</sup>, to score the 10 sets of models on two separate days, one week apart and then to compare the scores. Reliability of the 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 (Table 1).

### Sample

The inclusion criteria for case selection were as follows: (1) cleft lip and palate patients who had completed correction of malocclusion already (both with and without orthognathic surgery); (2) permanent dentition; (3) availability of pre-treatment and post-treatment models. The exclusion criteria were (1) cleft-associated syndrome patient; (2) external facial cleft; (3) loss of all upper incisors; (4) loss of lower central incisors; (5) permanent tooth loss prior to their final treatment due to excessive dental caries. The present study located 27 subjects in the OTA group and 7 subjects in the COS group. The number of subjects was limited because data recording (pre- and post-treatment dental models) during treatment was incomplete.

### Data collection

Each patient's study model was assigned a number in random order by a non-examiner to ensure examiner blinding. This number was placed on the patient's pre-treatment and post-treatment models and the patient's name was hidden. The PAR Index score was recorded according to the criteria of Richmond and Shaw et al<sup>(22)</sup>. One examiner (the third author) tabulated pre-treatment and post-treatment PAR scores for each group and degree of improvement (pre-treatment minus post-treatment PAR scores).

According to ethical guidelines stated in the Helsinki's Declaration, the present study was granted approval by the Institutional Review Board (IRB) committee at Khon Kaen University.

### Statistical analysis

Pre-treatment, post-treatment and improvement in PAR scores between the OTA and COS groups were compared using Mann-Whitney U-Test with mean difference and 95% confidence intervals. Improvement

**Table 1.** Correlation coefficients illustrating intra- and inter-reliability

Reliability	ICC	95% CI of ICC
Intra-examiner 1	0.989	0.956-0.997
Intra-examiner 2	0.994	0.977-0.999
Inter-examiner (1 <sup>st</sup> time)	0.989	0.957-0.997
Inter-examiner (2 <sup>nd</sup> time)	0.988	0.951-0.977

of the PAR score categories between the two groups was compared using Fisher's exact test at 95% confidence intervals.

### Results

Statistics, including means, standard deviations and p-values for pre-treatment, post-treatment and improvement in PAR scores are presented in Table 2. Mann-Whitney U-Test indicated significant differences in pre-treatment PAR scores. No significant differences were found in post-treatment PAR scores and improvements in PAR scores between the OTA and COS groups. These results indicate that patients who required surgery had greater pre-treatment PAR scores. Table 3 shows improvement in categories between the two groups. The degree of PAR index score improvement was not significantly different between the orthodontic treatment alone group and combined orthognathic surgery group. Two cases (7.41%) in the OTA group presented excellent orthodontic treatment outcome whereas other cases (92.59%) presented great orthodontic improvement. For the COS group, all cases (100%) demonstrated great improvement of malocclusion.

### Discussion

The mean pre-treatment PAR Index score in the orthodontic treatment alone (OTA) group was less than in the combined orthognathic surgery (COS) group, which is to be expected. The PAR Index score reflected the severity of malocclusion in each group (although the difference may be of doubtful significance). One factor that would have contributed to this finding could be in the difference in severity of skeletal relationships between the two groups. The skeletal problems can occur in all dimensions (sagittal, transverse and vertical planes) in cleft patients<sup>(25)</sup>. The most common skeletal discrepancy in cleft patients is a maxillary hypoplasia that presents a skeletal Class III relationship<sup>(1)</sup>. The skeletal problems can affect the dental malocclusion such as anterior overjet in the sagittal plane, buccal overjet in the transversal plane, open bite or deep bite in the vertical plane and severe crowding or embedded teeth in cases of severe maxillary hypoplasia. It follows that the more the severity of skeletal discrepancy in combined orthognathic surgery group, the more severe will be the dental malocclusion.

Post-treatment PAR Index scores in the OTA and COS group were not different. The treatment

**Table 2.** Results of Mann-Whitney U-Test comparing variables between orthodontic treatment alone and combined orthognathic surgery groups

	Orthodontic Treatment Alone (n = 27)				Combined Orthognathic Surgery (n = 7)				Mean difference	p-value
	Mean	SD	Min	Max	Mean	SD	Min	Max		
Pre-treatment PAR	32.26	7.96	13	45	39.86	9.35	24	49	-7.6	0.048
Post-treatment PAR	2.67	2.27	0	10	2.43	1.51	1	5	0.24	1.000
Improvement in PAR	29.59	8.79	10	45	37.43	8.79	23	48	-7.84	0.054

**Table 3.** Results of Fisher's exact test comparing improvement categories between orthodontic treatment alone and combined orthognathic surgery groups

	Orthodontic Treatment Alone (n = 27)		Combined Orthognathic Surgery (n = 7)		p-value
	n	%	n	%	
Total improvement	2	7.41	0	0.00	1.000
Greatly improved	25	92.59	7	100.00	
Improved	0	0.00	0	0.00	
Worse-no difference	0	0.00	0	0.00	

outcomes of the OTA and COS groups might be expected to be different because the objective of treatment is different in each procedure, but there was no significance difference of outcomes. For orthodontic treatment alone, the objective of treatment is to camouflage the dento-skeletal relationship problems by orthodontic compensations without correcting the skeletal problem. Mild skeletal Class III with anterior cross bite in cleft patients can sometimes be treated by proclination of upper anterior teeth and retroclination of lower anterior teeth to create positive overjet but the skeletal problem remains. The facial profile of patients is not improved by orthodontic treatment alone. By contrast, the objective of combined orthognathic surgery is to first correct the existing dental compensations that, while improving teeth positions within each jaw, produce increased negative incisor overjet; then followed surgical correction of the basic skeletal problems. The combined effect of these two sets of procedures is expected to be significant improvement of the dental occlusion and patient's profile.

Improvement of PAR Index score, or PAR Index score reduction, assesses the quality or standard of orthodontic treatment of the malocclusion. Richmond and Andrews et al<sup>(26)</sup> suggested that the mean PAR Index score reduction should be greater than 70 percent with high-standard orthodontic treatment and that specialist orthodontic treatment should reduce the malocclusion on average 78 percent using before- and after-treatment PAR scores<sup>(27)</sup>. From the present study, the improvement of PAR Index scores was greater than 90 percent in both the orthodontic treatment alone group (91.72%) and combined orthognathic surgery group (93.90%). These results indicated that the cleft lip and palate patients at the Khon Kaen Cleft Lip and Palate Center received high-standard orthodontic treatment by bettering the minimal outcome quality of treatment that Richmond and Andrews suggested. In addition, the results of the present study reflected that the cleft treatment protocol for correction of malocclusion problems developed by Khon Kaen Cleft Lip and Palate Center was of a high quality.

It must be noted that although there was no significant difference between the outcomes for the OTA and COS groups, this does not necessarily reflect the outcomes when judged using facial esthetic criteria, such as nose-lip-chin profiles. The PAR Index is limited to assessing dental and not soft tissue profile changes.

From the study of Deacon et al<sup>(28)</sup> that assessed orthodontic outcomes for unilateral cleft lip and palate

patients who received OTA in the United Kingdom, the pre-and post-treatment PAR scores were both higher than those for the present study (Table 4). However, the percentages for improvement of PAR were reversed, the percentage of improvement of the former study being less than in the present study. No great significance could be attached to this difference because of the small number of subjects (six) in Deacon et al's study compared with 27 subjects in the present Khon Kaen University Cleft Lip and Palate Center study's OTA group. There was the added possible confounding variable of ethnic differences for the two studies.

Although the PAR Index has several advantages for assessing orthodontic treatment outcomes and treatment need, such as face and content validity, and simplicity of use, including not requiring live presence of subjects, it has limitations. It assesses only the dento-occlusal changes using dental models. For comprehensive treatment outcome evaluation, it is necessary to evaluate not only the dental occlusion but also cephalometric and soft tissue changes and functional factors<sup>(24)</sup>. Because the PAR Index measures on dental models, it does not identify other possible detrimental outcomes such as tooth decalcification, gingival recession, root resorption and temporomandibular joint dysfunction that may result from orthodontic treatment<sup>(29,30)</sup>.

## Conclusion

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

**Table 4.** Report included in comparison study in pre-treatment, post-treatment and improvement PAR Index score

PAR Index score	Orthodontic Treatment Alone	Population
Pre-treatment		
Deacon et al (2007)	41.0	UK
Present study	32.26	Thailand
Post-treatment		
Deacon et al (2007)	12.0	UK
Present study	2.67	Thailand
Improvement		
Deacon et al (2007)	69.0 (%)	UK
Present study	91.72 (%)	Thailand

1) The pre-treatment PAR Index score assessed the severity of malocclusion which, as would 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 outcome 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 markedly great orthodontic improvement.

4) The outcomes for all subjects treated by either method bettered the recommended standard suggested by Richmond and Andrews et al<sup>(26,27)</sup>.

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#### Potential conflicts of interest

None.

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## การประเมินผลการรักษาทันตกรรมจัดฟันขั้นสุดท้ายในผู้ป่วยปากแหว่งเพดานโหว่แบบสมบุรณ์ของศูนย์ปากแหว่งเพดานโหว่ มหาวิทยาลัยขอนแก่น: การศึกษานำร่อง

มนตรี มโนสุตประสิทธิ์, ทศนีย์ วังศรีมงคล, ศุภทินันท์ ด้านธำรงกุล

วัตถุประสงค์แรกของการศึกษา เพื่อประเมินผลการรักษาในช่วงสุดท้ายของผู้ป่วยปากแหว่งเพดานโหว่ที่ได้รับการรักษาด้วยวิธีจัดฟันเพียงอย่างเดียว และวิธีจัดฟันรวมกับการผ่าตัดขากรรไกร วัตถุประสงค์ที่สองเพื่อประเมินดูการแก้ไขการสบฟันของทั้งสองวิธีการรักษา ตัวอย่างจำนวน 27 ราย ในกลุ่มจัดฟันเพียงอย่างเดียว และ 7 ราย ในกลุ่มจัดฟันรวมกับการผ่าตัดขากรรไกร เป็นผู้ป่วยที่ได้รับการรักษาด้วยเครื่องมือจัดฟันชนิดติดแน่น ได้ถูกนำมาใช้ในการวิเคราะห์ ผลการศึกษาพบว่าในกลุ่มจัดฟันรวมกับการผ่าตัดมีค่าพาร์ (Peer Assessment Rating: PAR) ก่อนการรักษา มากกว่ากลุ่มจัดฟันเพียงอย่างเดียว ค่าพาร์หลังการรักษา และค่าพาร์การแก้ไขการสบฟัน ในทั้งสองกลุ่ม ไม่มีความแตกต่างกัน ในกลุ่มจัดฟันเพียงอย่างเดียวพบว่า ตัวอย่างจำนวน 2 ราย มีระดับการแก้ไขการสบฟันในระดับ ดีเยี่ยม ในขณะที่ตัวอย่างที่เหลือมีการแก้ไขการสบฟันในระดับ ดี ส่วนในกลุ่มจัดฟันรวมกับการผ่าตัดพบว่า ตัวอย่างทั้งหมดมีการแก้ไขการสบฟันอยู่ในระดับ ดี

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