*Original Article*

# Influence of lateral cephalometric radiography in orthodontic diagnosis and treatment planning

**Ana Reis Durão[a]; Ali Alqerban[b]; Afonso Pinhão Ferreira[c]; Reinhilde Jacobs[d]**

**ABSTRACT**

**Objective:** To evaluate the impact of additional lateral cephalometric radiography in orthodontic diagnosis and treatment planning.

**Materials and Methods:** Forty-three patients seeking orthodontic treatment, and for whom pretreatment diagnostic records were available, were randomly selected. Ten qualified orthodontists were involved in this study. The patients' records included three photographs of the angle trimmed dental casts, digital lateral cephalometric and panoramic radiographs, and standard clinical photographs comprising seven intra- and four extraoral pictures. Records were evaluated in two sessions. At the first session, orthodontists evaluated records without lateral cephalometric radiography (LCR). In the second session, the same information was presented, but with LCR. Between the two sessions the order in which the cases were presented was altered to avoid bias.

**Results:** The percentage of agreement between sessions was lower for diagnosis than for treatment planning. Concerning skeletal classification, the least experienced orthodontist was the least consistent (28%), while the more experienced orthodontist was the more reliable (67%). In terms of treatment modalities, in general there was an agreement of 64%. The most frequent modifications in treatment modalities were seen in Class II malocclusion patients.

**Conclusions:** The results of our study suggest that the majority of Portuguese orthodontists judge that LCR is important to producing a treatment plan. Despite that, it does not seem to have an influence on orthodontic treatment planning. (*Angle Orthod.* 2015;85:206–210.)

**KEY WORDS:** Cephalometry; Orthodontics; Treatment; Diagnosis

## INTRODUCTION

Since the introduction of lateral cephalometric radiography (LCR) by Broadbent in 1931, it has been widely used in orthodontic assessment and treatment planning.[1–3] Despite that, its usefulness in orthodontics remains questionable. Silling et al.[4] stressed that LCR was only needed for Class II division 1 patients. Later, Han et al.[5] stated that patient examination together with dental casts provided sufficient information with which to render a diagnosis. According to them, only 55% of treatment plans were changed after LCR evaluation. In the same vein, Bruks et al.[6] suggested that in 93% of the cases treatment plans remained unchanged after LCR evaluation. They evaluated the patient, dental casts, and extraoral photographs. In contrast Pae et al.[7] revealed that in patients with Class II division 2 occlusion and bimaxillary protrusion, this radiography could change the decision with regard to teeth extraction. In 2008, Nijkamp et al.[8] reinforced that LCR does not seem to have any impact on orthodontic treatment planning for Class II division 1 patients. Recently, in 2011 Devereux et al.[9] concluded that only in one out of six patients' orthodontists decided to change their treatment decisions with regard to tooth extraction. In contrast with the previous study, they suggested that LCR may be justified for orthodontic treatment. Considering the controversy in the literature,

[a] Invited Assistant, Department of Dental Radiology, Faculty of Dental Medicine, University of Porto, Portugal.

[b] Doctorandus, Department of Oral Health Sciences, Faculty of Medicine, University Hospitals Leuven, Leuven, Belgium.

[c] Full Professor, Department of Orthodontics, Faculty of Dental Medicine, University of Porto, Portugal.

[d] Full Professor, OIC, OMFS IMPATH research group, Department of Imaging & Pathology, Faculty of Medicine, Oral & Maxillofacial Surgery, University Hospitals Leuven, Leuven, Belgium.

Corresponding author: Dr Ana Reis Durão, Faculdade de Medicina Dentária da Universidade do Porto, Rua Dr. Manuel Pereira da Silva, 4200-393 Porto, Portugal
(e-mail: paula.o.reis@gmail.com)

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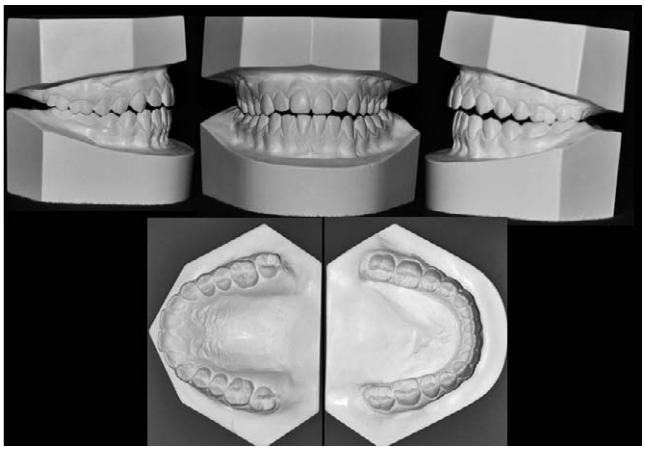

**Figure 1.** Dental cast photographs.

the present aim was to further explore the impact of additional LCR in orthodontic diagnosis and treatment planning.

## MATERIALS AND METHODS

Forty-three patients with pretreatment diagnostic records were randomly selected. All patients were seeking orthodontic treatment at the Faculty of Dental Medicine of the University of Porto. The study was approved by the Ethics Committee of the Faculty of Dental Medicine of University of Porto (900079). The Patients' ages ranged from 10 to 42 years (24 female and 19 male). Orthodontic diagnostic records included

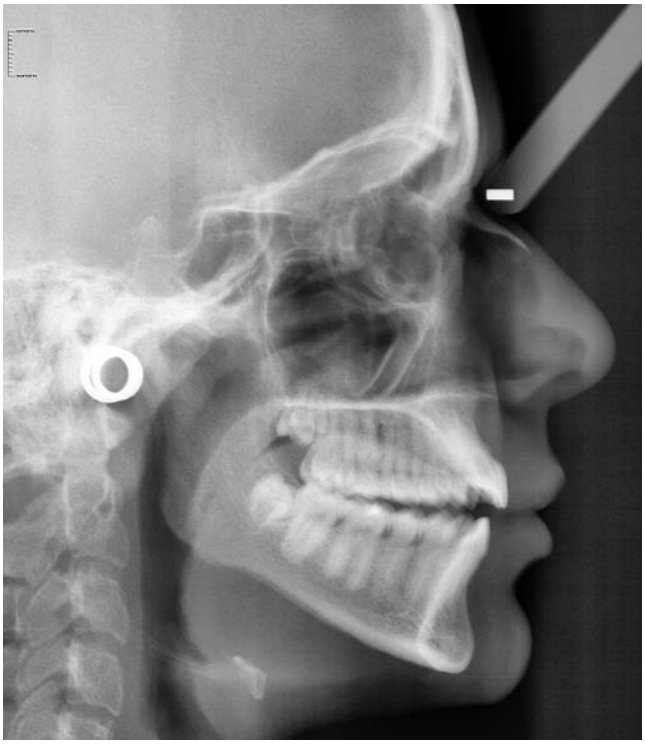

**Figure 2.** Digital lateral cephalometric radiography.


**Figure 3.** Panoramic radiographs.

three photographs of the angle trimmed dental casts (Figure 1) and digital lateral cephalometric (Figure 2) and panoramic radiographs (Figure 3), as well as standard clinical photographs comprising seven intra- (Figure 4) and four extraoral pictures (Figure 5). The patient's identification was blurred to avoid recognition. All blinded information was saved in a pdf file and recorded on a compact disk and given to each observer. Ten qualified orthodontists were involved in this study. Their experience ranged from 5 to 24 years. Patient records were evaluated during two sessions. The time interval between observations was at least 8 weeks. At the first session orthodontists evaluated records without LCR. In the second session the same information was presented, but this time LCR was added. Between the two sessions the order in which the cases were presented was altered to avoid bias.

The evaluation process for the two sessions involved the use of a questionnaire concerning diagnosis and treatment planning; the questionnaire contained the following elements/questions:

1. Skeletal relationship: neutro, disto, or mesio-relation?
2. Angle classification of occlusion based on molar relationship: on Class I, Class II, Class?

**Figure 4.** Intraoral photographs.

**Figure 5.** Extraoral pictures.

3. Detection of abnormality?
4. The nature of the treatment will be as follows: orthopedic growth modification; orthognathic surgery; or dentoalveolar compensation?
5. Is there enough space for all teeth to erupt?
6. Would you extract teeth in this patient? If yes, which?
7. Would you expand the upper arch?
8. Would you use anchorage in the maxilla or mandible or both?
9. Do you expect any complications during the treatment?
10. How long do you expect that the treatment will take?
11. Would you need additional information to make a decision? Which? and
12. How long has it been since you qualified as an orthodontist?

### Statistical Analysis

The percentage of agreement of the answers between the two sessions (ratio of agreement between cases and the total cases used) was evaluated. This was carried out for each patient to test for differences in the percentages of changed decisions for diagnosis and treatment planning.

**Table 1.** Mean Percentage of Agreement Between the First and Second Sessions for all Observers

| Questions | % of Agreement |
|---|---|
| 1 | 43 |
| 2 Right | 47 |
| 2 Left | 50 |
| 3 | 87 |
| 4 | 64 |
| 5 | 58 |
| 6 | 56 |
| 7 | 58 |
| 8 Maxilla | 58 |
| 8 Mandible | 67 |
| 9 | 65 |
| 11 | 63 |

## RESULTS

The percentage of agreement between sessions was lower with regard to diagnosis than it was with regard to treatment planning (Table 1). Treatment planning seemed to be changed, on average, in 36% of the cases by adding LCR. In addition, the skeletal classification diagnosis was changed, on average, in 56% of the cases, and, in general, in 52% of the cases the malocclusion classification seemed to be altered. The most frequent changes appeared in Class II malocclusion patients.

With regard to skeletal classification, the least experienced observer was the least consistent (28%), while the more experienced observer was the more reliable (67%). On average, 10 cases were classified in the first session as Class II, and after evaluating the LCR the diagnosis of the skeletal classification changed to Class I. In nine cases skeletal classification was altered from Class I to Class II. Overall, only in a single case did the orthodontists change from Class III to Class I. The presence of abnormality revealed a very good agreement between the two sessions (87% overall). With regard to treatment modalities, in general there was an agreement of 64%. The most experienced observer revealed 80% agreement between sessions, changing the treatment plan in only eight cases, while the lower percentage was of 37%, seen in an observer with 10 years of practice. In 26 cases the treatment modality was changed in the majority of cases, being altered from dentoalveolar compensation to surgery. The most frequent modifications in treatment modalities were seen in Class II patients. One observer changed the decision to extract in 19% of the cases after evaluating the LCR. Table 2 demonstrates the comparisons with regard to treatment duration, in months, between the first and second sessions. Only two observers revealed statistically significant differences. After viewing the LCR, one observer suggested that the treatment should be longer. On the second

**Table 2.** The Mean Differences in Proposed Treatment Plan Duration (Months) Between the Two Sessions

| | Mean, mo | SD[a] | *P** |
|---|---|---|---|
| Observer 1 | | | .297 |
| First session | 28.23 | 15.057 | |
| Second session | 30.39 | 13.647 | |
| Observer 2 | | | .077 |
| First session | 24.42 | 3.794 | |
| Second session | 25.57 | 3.262 | |
| Observer 3 | | | .366 |
| First session | 22.59 | 2.976 | |
| Second session | 23.30 | 1.946 | |
| Observer 4 | | | .142 |
| First session | 27.07 | 6.724 | |
| Second session | 25.26 | 5.164 | |
| Observer 5 | | | .328 |
| First session | 26.38 | 5.323 | |
| Second session | 25.58 | 6.103 | |
| Observer 6 | | | .979 |
| First session | 20.93 | 4.614 | |
| Second session | 21.00 | 4.824 | |
| Observer 7 | | | .234 |
| First session | 30.28 | 9.881 | |
| Second session | 31.26 | 4.640 | |
| Observer 8 | | | .033* |
| First session | 25.26 | 3.600 | |
| Second session | 32.09 | 15.868 | |
| Observer 9 | | | .726 |
| First session | 28.47 | 5.934 | |
| Second session | 28.09 | 7.091 | |
| Observer 10 | | | .044* |
| First session | 28.50 | 7.285 | |
| Second session | 28.09 | 7.091 | |

[a] SD indicates standard deviation.
* $P < .05$.

occasion another observer proposed a shorter treatment duration. Two orthodontists stated that LCR was needed for a correct evaluation of all cases. At the second observation, one still needed the LCR analysis (in 27 out of 43 cases), and the other was satisfied. One revealed that to perform a precise diagnosis, dental casts together with LCR were necessary for all cases. The others judged the LCR helpful only for some cases, varying between Class I and Class II (Table 3). Consensus was achieved related to clinical examination. In general, the orthodontists stressed the need to examine the patients personally.

## DISCUSSION

We performed this study to highlight the usefulness of two-dimensional cephalometric imaging for orthodontic treatment planning. LCR has been routinely used since its discovery, although major concerns arise when patients are exposed to radiation when it is not clearly justified. According to the ALARA principle, there is a need to reduce radiation exposure and eliminate unnecessary radiographs. We selected the patients at random to allow our sample to be representative of a population, rather than choosing any particular malocclusion or specific age. Forty-three patient files were selected. At first an experimental observational setup was performed with three orthodontists who evaluated five patient files and validated the questionnaire. After that the study proceeded. Patient records were reordered at the second observation so that orthodontists could not recognize the sequence. We performed two observation sessions, with a minimum of 8 weeks between sessions. Observers had some differences in terms of their background experience. The most experienced observer had completed 24 years of practice, while the least experienced observer had only 5 years of experience. The observer's background plays an important role

**Table 3.** Number of Additional Information Elements Required for Each Observer in the First and Second Observations

| | Additional Information Required | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | First Occasion | | | | Second Occasion | | | |
| Observer | LCR[a] | DC[a] | LCR + DC | LCR + DC + CBCT[a] | LCR Analysis | DC | LCR Analyses + DC | Facial and LCR Analysis |
| 1 | 2 | 18 | 16 | 2 | | 28 | 10 | |
| 2 | 43 | | | | 27 | | | |
| 3 | 21 | | | | 2 | | | |
| 4 | 16 | | 11 | | 10 | 10 | 8 | |
| 5 | 29 | | | | 7 | 9 | | |
| 6 | 27 | | | | 6 | | | |
| 7 | 28 | | | | 25 | | 5 | 7 |
| 8 | 43 | | | | | | | |
| 9 | | 43* | | | | 43* | | |
| 10 | 29 | | | | 29 | | | |

[a] LCR indicates lateral cephalometric radiography; DC, dental casts; and CBCT, cone beam computed tomography.
* Plus intra-oral x-rays, natural head position.

regards to the necessity of having additional diagnostic tools to perform a diagnosis. It was suggested that the need for LCR or its analysis was more dependent on background rather than on years of experience. For example, observer 8, who was the most experienced observer, thought that LCR would be helpful for all cases, and observer 5, with only 6 years of experience, only judged it necessary to use LCR in 27 of the cases. However, after viewing the LCR, observer 8 ascertained that cephalometric analysis was not necessary. In contrast, observer 6 judged that the cephalometric analyses would be helpful.

In general, the biggest complaint from orthodontists was the absence of (1) clinical examination and (2) the reason why the patient sought orthodontic treatment. Today digital records are accepted for diagnosis and treatment planning for professional examinations. Two orthodontists revealed that in order to perform a correct diagnosis and treatment planning they needed LCR for all cases. Another orthodontist ascertained that for all cases the natural head position, dental casts in centric relation, and LCR together with clinical examination of the patient would be important to render a diagnosis and develop a treatment plan. The need for cephalometric analysis was also asserted by some orthodontists. Two orthodontists revealed that they did not need a cephalometric analysis, while the radiographic examination was useful. One orthodontist required a cone beam computed tomography for two cases; in these cases the patients had impacted canines.

The questionnaire involved 12 questions; the first three questions concerned diagnosis. Questions number 4 and 6–10 related to treatment planning. In general, the percentage of agreement was higher regarding treatment planning. Some authors[4,10] have ascertained that experienced orthodontists can achieve a correct diagnosis and treatment plan without viewing LCR. Other authors believe that diagnosis based on clinical examination together with photographs and dental casts can provide sufficient information to develop a treatment plan. In this study, we found a moderately high percentage of agreement for treatment planning between the two sessions. This could suggest that LCR may not have an influence on orthodontic treatment planning. With regard to skeletal pattern classification, our sample contained 19 patients with Class I occlusion; 19 patients with Class II occlusion, and five patients with Class III occlusion. For that reason, it is impossible to ascertain that LCR is not needed for all patients since there is a great variation in malocclusions. To define strict selection criteria to perform LCR is difficult. Even textbooks do not express this issue very clearly. The indication for LCR must be constructed on an individual basis rather than based on general conditions.[6,8,10] Regarding treatment duration between the two sessions, the only statistically significant difference was found for two observers. Further studies focusing on this subject are encouraged.

## CONCLUSIONS

- The results of our study suggest that the majority of Portuguese orthodontists judge that LCR is important to producing a treatment plan.
- Despite that, it does not seem to have an influence on orthodontic treatment planning.

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