ORIGINAL ARTICLE

Influence of Lateral Cephalometric Radiography on Treatment Planning and Preferences in Skeletal Open-Bite Patients: Do Lateral Cephalograms Influence Treatment Planning?

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ABSTRACT

Objective: To investigate the influence of diagnostic data derived from lateral cephalometric radiographs (LCR) on treatment preferences of specialists planning skeletal open-bite treatment.

Methods: Diagnostic records of 25 patients who had been treated at the University of Zurich, Department of Orthodontics, between 1988 and 2007 comprised the study material. Inclusion criteria were 1) skeletal open-bite with no marked antero-posterior discrepancy, 2) dental open-bite, and 3) crowding less than 5 mm. Records consisted of extra-intraoral photographs, panoramic-cephalometric X-rays, casts, and results of analyses. Records, with cephalograms of randomly chosen patients removed, were digitally presented to two orthodontists (A and B), and treatment preferences were asked using Likert-type questionnaires. Three months later, the same records were redelivered with missing cephalograms provided and present cephalograms removed with the questionnaire. Data were evaluated for consistency and tendency to extract using Kappa-κ and McNemar tests.

Results: Orthodontist B had no poor-agreement scores, whereas orthodontist A presented very-poor agreement for headgear use. Both A (κ=0.833) and B (κ=0.737) had good to very-good agreement in terms of extraction decisions. Neither orthodontist had any significant tendency for extraction/non-extraction therapy (A=0.99; B=0.5).

Conclusion: Information deduced from LCRs had limited influence on treatment planning preferences in skeletal/dental open-bite patients with no marked antero-posterior discrepancy and no influence on extraction/non-extraction decision.

Keywords: Cephalometry, open bite, radiographic image interpretation, tooth extraction

INTRODUCTION

Lateral cephalometric radiograph (LCR) is a widespread diagnostic tool routinely used for orthodontic treatment planning. It is considered a crucial complementary factor for clinical evaluation. It provides linear and angular associations for sagittal and vertical levels of facial bone structures but does not comprise the transversal dimension or function - in other words, the third dimension (1,2). This drawback has led to the questioning of routine prescription and interpretation of LCR regarding its influence on specific malocclusions (3-7).

European guidelines on radiation protection in dental radiology have suggested indications for LCR prescription for marked skeletal class II or III pattern (8). However, throughout the whole course of orthodontic treatment, three LCRs are prescribed on average: diagnostic, progress, and end of treatment (9). The last one has been profoundly questioned in recent years since it cannot provide any data in the benefit of the patient but only to the specialist for scientific, educational, and legislative purposes (8). The lateral cephalogram at the end of treatment is recommended only if the information is going to change the orthodontist's decision on his or her finishing mechanics or retention regime (8). On the other hand, the diagnostic and progress LCRs have the potential to

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influence the diagnosis, treatment planning, and the immediate effects of the treatment procedures. It has been reported that data obtained from the LCRs can be used to support the decision of premolar extraction as well as the determination of anchorage need by some specialists (10,11). Similarly, the appliance preference has been found to differ between practitioners depending on diagnostic records, but the consistency of these decisions was reported to be rather low (5,6). The question that arises is, was this influence mainly focused on diagnosis of the malocclusion or could it also determine the treatment planning and its progress as well? If the answer to this question is limited to the diagnosis, then the justification of routine prescription of LCRs becomes questionable since it is the treatment planning that is critical for the patient.

Therefore, the primary aim of this study was to investigate the extent and nature of such influence that LCRs had on orthodontic treatment preferences of specialists in skeletal open-bite patients. The secondary aim was to test if LCRs influence the extraction decision, which is an irreversible intervention in the treatment plan (10,11). The null hypothesis is that omitting LCRs from the diagnostic records would not influence treatment preferences and extraction decision.

METHODS

Diagnostic records of 25 patients who had been treated at the University of Zurich, Center of Dental Medicine, Department of Orthodontics, between 1988 and 2007 comprised the study material. Inclusion criteria were (1) skeletal open-bite with no marked antero-posterior discrepancy, (2) dental open-bite, and (3) none or minor crowding. Records consisted of extra-intra oral photographs, panoramic-cephalometric X-rays, casts, and results of analyses. Records, with some patients' cephalograms intentionally removed, were digitally presented to two orthodontists (A and B), and treatment preferences were obtained by filling out Likert-type questionnaires. The same material with missing cephalograms provided and the previously present cephalograms removed were represented three months later to the same orthodontists. Principles outlined in the Declaration of Helsinki were followed, and informed consent was obtained from research subjects.

Diagnostic Records
All files were digitized, anonymized, and numbered. Frontal, profile, and three-quarter profile pictures were masked for concealing personal identity. There was no time limit given for completing the questionnaires. The principal treatment objective was to accomplish a healthy functional occlusion with appropriate soft tissue harmony. There was no restriction given in materials or financial conditions. Decision of extraction was defined as the removal of minimum one permanent tooth excluding third molars.

Questionnaire
The questionnaire comprised of 11 items asking for treatment preferences to be answered on a linear Likert-type scale. The possible answers were (1) definitely yes, (2) yes, (3) maybe, (4) no, and (5) definitely no. The questioned treatment preferences

were the use of (1) removable appliance, restricted to one jaw; (2) functional appliance; (3) Rapid maxillary expansion (RME); (4) combination of both; (5) one or two or three or four followed by fixed appliance; (6) headgear; (7) only fixed appliance; (8) extraction (third molars excluded); (9) if extraction score four or five was chosen, the possible reason being one of the following: (a) to treat the convex profile, (b) inadequate space, (c) to increase overbite, or (d) to prevent relapse; (10) surgical treatment; and (11) retention: (a) fixed retention, (b) removable retention, or (c) functional retainer.

Data Analysis
Data were dichotomized as such: one and two were corrected as "yes" and four and five as "no." Three, connoted to "do not know," was omitted for simpler analysis of the data. The processed data were analyzed using the Kappa-κ and McNemar tests. The κ-value described the strength of agreement as such:

Value of κ	Strength of agreement
<0.20	Poor
0.21–0.40	Fair
0.41–0.60	Moderate
0.61–0.80	Good
0.81–1.00	Very good

The McNemar test was used to determine a possible extraction tendency with α<0.1 presenting the significance level.

RESULTS

Orthodontist A presented a very-good agreement with and without LCRs only for the decision of surgical treatment. Extraction and RME-functional appliance combination decisions were scored with good agreement independent of the presence of LCRs. Decision for the use of headgear appliance presented very-poor agreement.

Table 1. Kappa Scores for each question and probability of chance agreements

Question	Orthodontist A			Orthodontist B		
	N (file)	Kappa	p	N (file)	Kappa	p
1	20	-	-	21	0.417	0.125
2	23	0.228	0.063	20	0.694	0.99
3	21	0.475	0.99	19	0.689	0.5
4	21	0.618	0.5	18	0.99	0.99
5	22	0.237	0.07	16	0.333	0.375
6	14	0.123	0.375	17	0.485	0.99
7	17	0.331	0.99	21	0.427	0.99
8	15	0.737	0.5	12	0.833	0.99
9	-	-	-	-	-	-
10	18	0.851	0.99	19	-	0.7
11a	-	-	-	-	-	-
11b	-	-	-	14	0.696	0.5
11c	-	-	-	-	-	-
Mean		0.258	0.3467		0.428	0.5538

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Orthodontist B presented very-good agreement with and without LCRs for extraction and RME-functional appliance combination decisions. Functional appliance, RME, and retention with removable appliance were scored with good agreement. Orthodontist B had no poor agreement scores for the questions. The detailed Kappa score for each question and the probability of chance agreements are presented in Table 1.

McNemar scores revealed no tendency for the extraction question for both orthodontists (A [McNemar=0.99]; B [McNemar=0.5]).

DISCUSSION

In this study, the influence of LCR on different treatment modalities in skeletal/dental open-bite patients with no marked antero-posterior discrepancy was evaluated. Information deduced from LCRs had limited influence on treatment planning preferences and had no influence on extraction/non-extraction decisions of the two orthodontists. Therefore, the null hypothesis that omitting LCRs from the diagnostic records would not influence the treatment preferences and the extraction/non-extraction decision is partially declined.

Treatment preferences of orthodontists depending on diagnostic material and possible influences on such decisions have been studied previously. Mainly, diagnostic materials were delivered to specialists via post or presented digitally (3-6). When the trend or tendency of the specialist population was the main question, the number of cases was reduced and the number of participants was increased in order to determine the tendency (5). On the other hand, when the influence of the diagnostic records was the main aim, then the number of records is kept high and evaluators are reduced in numbers (6). In the present study, the main aim was to evaluate the influence of omitting LCRs from the diagnostic records. Therefore, the number of participants was less and the number of cases to be evaluated was higher.

The agreement between two decisions made under different conditions and time frames by the same person is usually evaluated by using the Pearson correlation and Kappa coefficient. When the data set is dichotomous and the number of evaluators is two, Cohen's Kappa score is referred to be suitable (12). In the present study, the evaluators answered a questionnaire with a Likert-type answer sheet. The data then were dichotomized in order to make a more convenient judgement. Therefore, Cohen's Kappa score was calculated for the same orthodontist between the two evaluations. Furthermore, the p-value was calculated to determine the chance agreements. The drawback of this method was that, due to dichotomization of the data, "maybe" answers were neglected. This might have caused some data loss but was an anticipated outcome.

Adequacy of clinical examination supplemented by study models for treatment planning procedure of many discrepancies has been confirmed previously (3). The use of algorithms and clinical indicators has been shown to reduce the need of orthodontic radiographs without compromising the treatment goals (13,14).

European guidelines on radiation protection in dental radiology suggest not prescribing LCRs unless the patient has marked skeletal class II or III pattern (8). The results of this study revealed limited disagreements for treatment modality preferences and no disagreement for extraction decision when the LCRs were omitted. This is in accordance with previous studies questioning the benefit of routine LCR prescription (4-7). This outcome may lead us to a possible assumption that the routine prescription of the three sets of LCRs may not be due to actual need but as a result of the orthodontist's training.

Similarly, justification or reasoning of extraction decision was claimed to be supported by the information obtained from LCRs (10,11). However, there are reports pointing at the opposite direction in addition to the effects of extraction being controlled by the clinical via managing extraction spaces (4,5,10,11). This may highlight the importance of such an irreversible decision needed to be taken under solid diagnostic material obtained from the patient.

One possible limitation of the present study is the fact that the orthodontists could not examine the patients themselves but were asked to structure the treatment decisions using patient files. The weaknesses according to their personal opinions were (1) the poor quality of some intra-oral pictures; (2) the impossibility of examining real patients' postural positions; and (3) difficulty of inspecting the dental casts on pictures. These are some possible factors affecting the decisions of the evaluators negatively.

This study did not aim to suggest the omission of LCR use in diagnosis and treatment planning of orthodontic treatment, but rather justification of its use when necessary according to guidelines. The items being asked were only capable of questioning major treatment decisions with yes or no answers. Therefore, the conclusions drawn should be interpreted with caution.

CONCLUSION

The diagnostic validity and benefit of LCRs in orthodontic treatment planning may not be the same for all discrepancies and patients. Careful clinical evaluation and customized prescription of LCRs following guidelines may be helpful in reducing the amount of ionizing radiation two which the patients are being exposed.

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