ISSN - 1519-0501 DOI: 10.4034/1519.0501.2010.0102.0024

Comparison between Manual and Software Surgical Planning Predictions in Orthognathic Surgery

Comparação Entre os Prognósticos do Planejamento Cirúrgico Manual ou por Software em Cirurgia Ortognática

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RESUMO

Objetivo: Avaliar comparativamente o prognóstico do planejamento cirúrgico por software com o método manual.
Método: Radiografias laterais cefalométricas e modelos de estudo pré e pós-cirurgia de vinte pacientes Classe III (12 mulheres e 8 homens, média de idade: 22,5 ± 2,3) que tinham se submetidos à cirurgia no Departamento de Ortodontia. Para o planejamento manual, com combinação de oclusogramas pré e pós-cirurgia com radiografias cefalométricas laterais de cada paciente, foram feitas análises tridimensionais. Prognósticos da movimentação esquelética foram elaborados. Em seguida, mensurou-se tridimensionalmente a movimentação esquelética. Quinze variáveis angulares e lineares foram avaliadas e os resultados analisados estatisticamente. Para cada paciente, o prognóstico manual e por software antes e após a cirurgia foram comparados entre si. O teste t pareado foi usado para verificar possíveis diferenças ($p<0,05$).
Resultados: Não foram observadas diferenças entre os métodos.
Conclusão: O Software Dolphin Imaging (versão 10) tem boa acurácia para a predição do resultado pré e pós-cirúrgico de cirurgias ortognáticas.

DESCRITORES

Procedimentos cirúrgicos ortognáticos; Validação de programas de computador; Má oclusão de Angle classe III.

ABSTRACT

Objective: To evaluate the proximity of computer imaging software surgical planning prediction methods, with standard manual methods.
Method: Lateral cephalometry radiographs and study cast records of pre and post surgery of twenty longface Cl III patients (12 Females and 8 Males, mean age: 22.5 ± 2.3), that had been undergone surgery in Department of Orthodontics. For manual prediction, with combination of pre and post surgical occlusograms with lateral cephalometric radiograph tracings of each samples, three dimensional analysis was done. Predictions of skeletal movement with tacing overlay method, has prepared. Finally, measured the rate of skeletal movements at in three dimensional of spaces. Fifteen angular and linear variables were measured, and the results, analyzed using the statistical software statistics. For each patient, the manual and computer software prediction before and after surgery were compared with each other. The paired t-test was used to evaluate possible differences between manual and computer software prediction ($p<0.05$).
Results: The difference of the variables of the software prediction in the pre and postsurgical stages in comparison with standard manual prediction method was insignificant.
Conclusion: Dolphin Imaging software (version 10.0) has a good accuracy for prediction of pre and postsurgical outcome of orthognathic samples.

KEYWORDS

Orthognathic surgical procedures; Software validation; Malocclusion, Angle class III.

INTRODUCTION

The need for orthognathic surgery to correction of skeletal deformities is increasing, because recently, more adult people are going to do orthodontic treatments. Prediction of the outcome of orthognathic surgery is very important in treatment of these deformities, that usually has been performed with manual tracings[1].

Recently technologic advancement induce using computer, in planning and prediction of the outcome of orthogenetic surgery treatments[1-3]. Several investigations has been performed to compare the accuracy of manual and software-aided predictions[4-6].

The aim of this study was determining the proximity between predictions performed with Dolphin imaging software (version 10.0) and the standard manual method pre and postsurgery[7,8].

MATERIALS AND METHODS

Lateral cephalometry radiographs and study cast records of pre and post surgery of twenty longface Cl III samples, that had been undergone orthognathic surgery were prepared. Casts of each patient were mounted in centric occlusion (Figure 1).

Figure 1. Mounted upper and lower casts in maximum intercuspation.

With use of Xerox copy, an image of the upper and lower occlusal aspect view of dental arches (occlusogram) was prepared (Figures 2 and 3). Combination of pre and post surgical occlusograms with lateral cephalometry radiographs tracing, three dimensional analysis was doing (Figure 4).

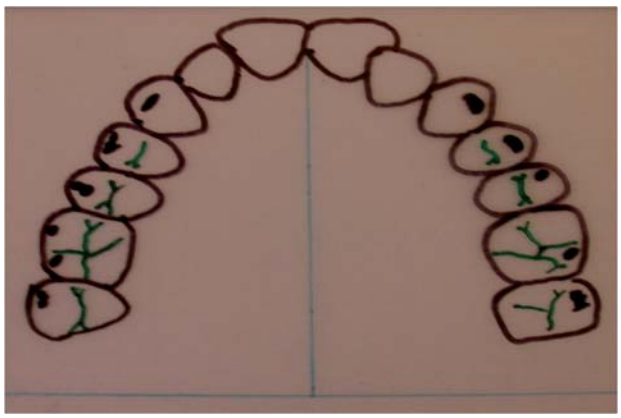


Figure 2. Occlusogram of the upper arch.

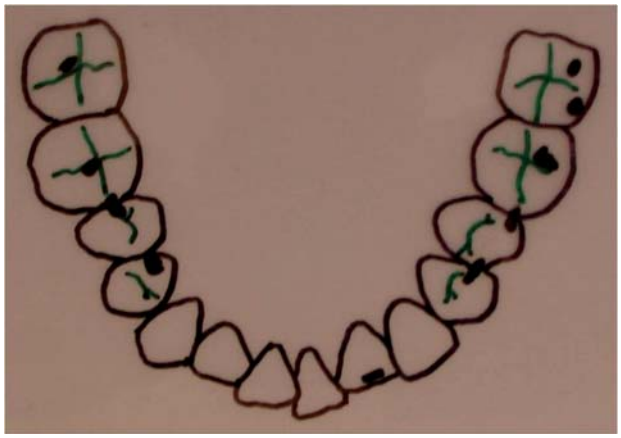


Figure 3. Occlusogram of the lower arch.

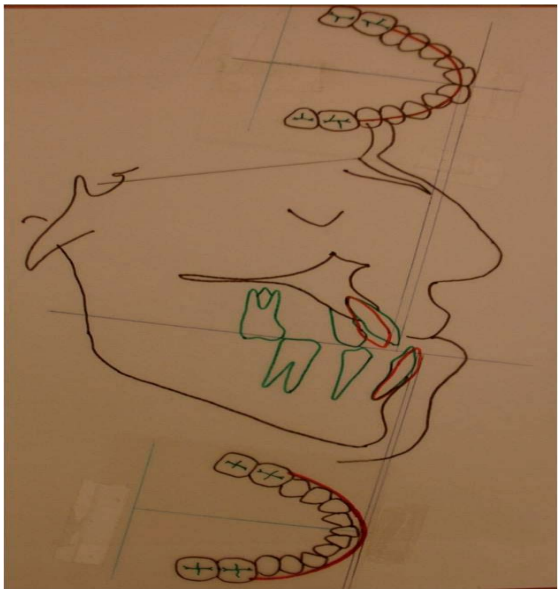
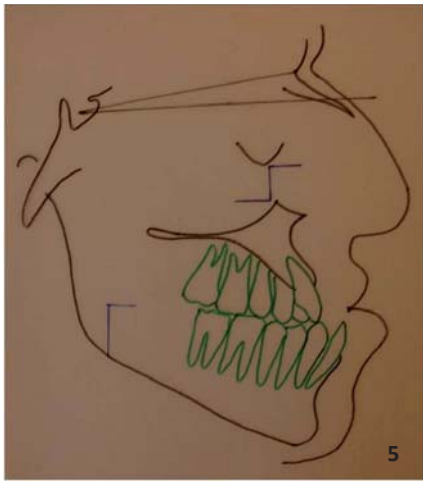
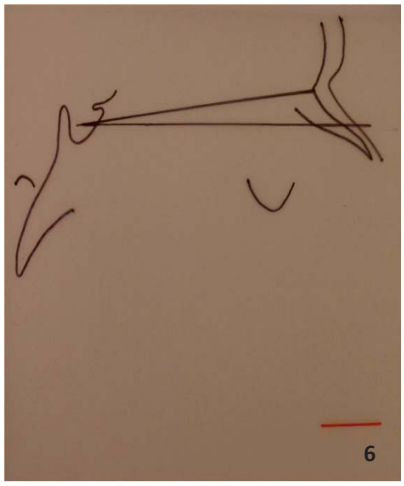


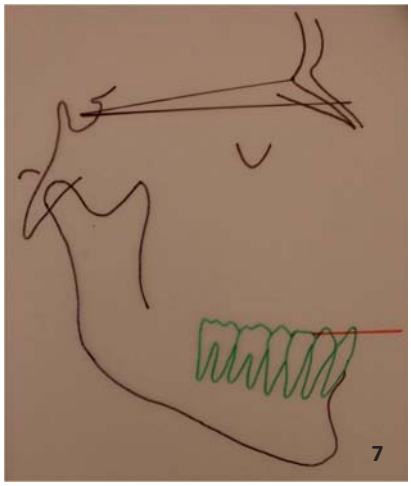
Figure 4. Combination of pre and post surgical occlusograms with lateral cephalometry radiograph tracing.

Postsurgical outcome was predicted manually, shown in the Figures (5 to 10) as following: Presurgical manual prediction (Figure 5); Incisor at rest line,(2 mm below the upper lip) (Figure 6); Autorotation of the mandible around the condyle (2 mm upper to rest line) (Figure 7); Reposition of the maxilla on mandible until A

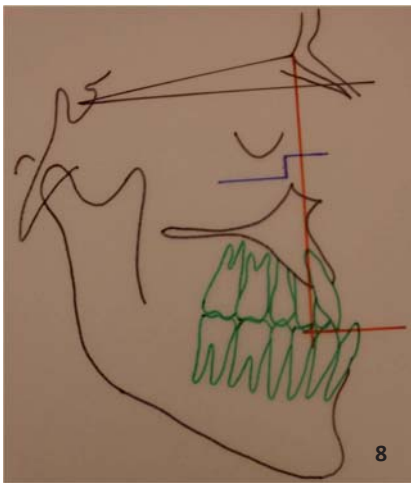
point superimposes on N.Perp line (Figure 8); Reposition of the mandible to achieving maximum intercuspation (Figure 9) and Postsurgical manual prediction (Figure 10).

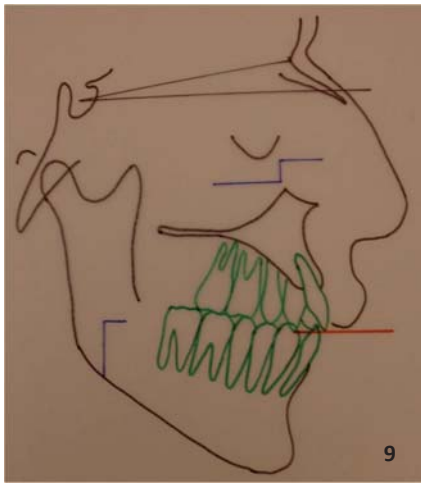


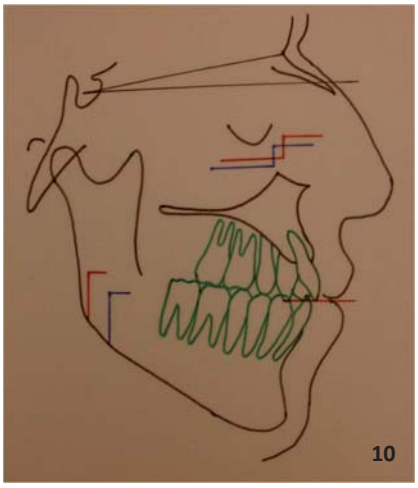




Figures 5, 6 and 7. Presurgical manual prediction (Fig. 5), Incisor at rest line (2 mm below the upper lip) (Fig. 6) and Rotating the mandible around the condyle, 2 mm upper to rest line (Fig. 7).







Figures 8, 9 and 10. Reposition of maxilla on mandible until A superimposes on N.Perp line (Fig. 8), Reposition of mandible to achieving maximum intercuspation (Fig. 9) and Postsurgical manual prediction (Fig. 10).

Entering of the measurements from manual prediction tracing, in the treatment panel, was used to predict postsurgical outcome with Dolphin imaging software, shown in the Figures 11 to15 as following:

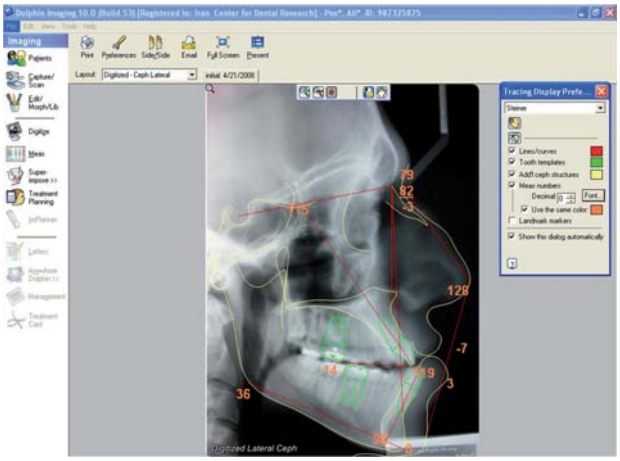


Figure 11. Digitized cephalometry in Dolphin imaging software.

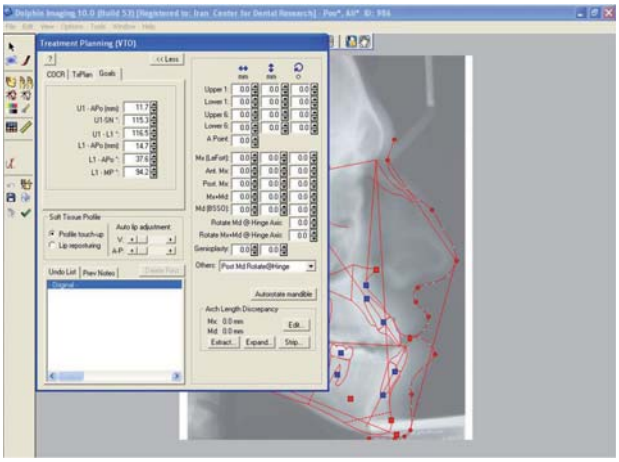


Figure 12. Entering of the manual data to the treatment panel for prediction of presurgical outcome.

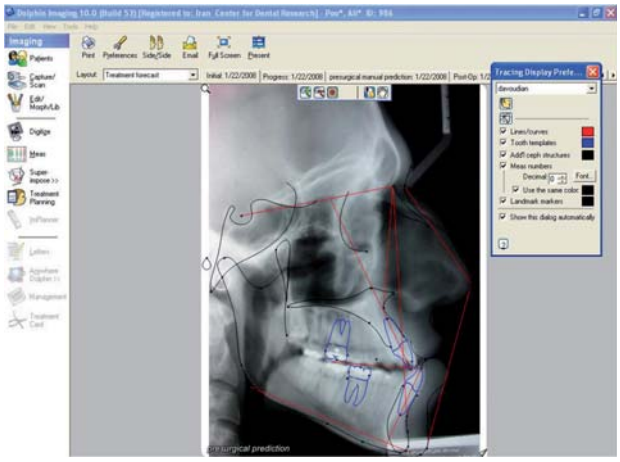


Figure 13. Presurgical software prediction.

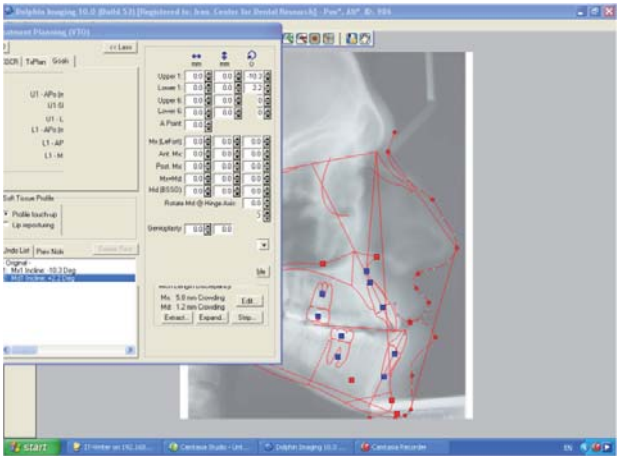


Figure 14. Entering of the manual data to the treatment panel for prediction of postsurgical outcome.

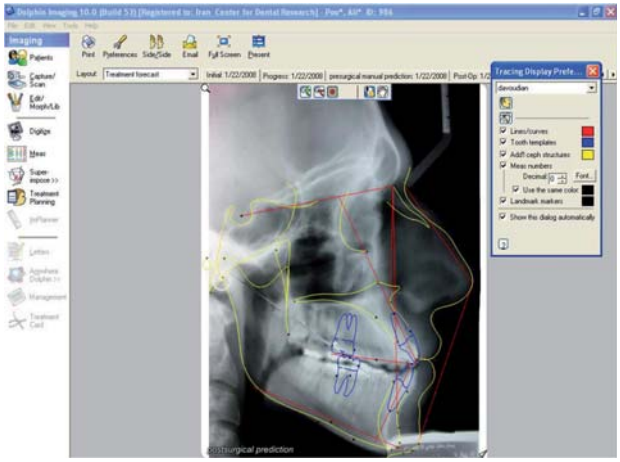


Figure 15. Postsurgical software prediction.

Based on literature review, the manual method was accepted as golden standard. For every patient, in the pre and postsurgical stages, the correlation between manual and software aided predictions were determined, respectively. For these comparisons, the paired t-test was computed ($p<0.05$).

RESULTS

The below measurements were calculated for the real outcomes and predictions before and after the surgery: Angular measurements: U1 to SN, L1 to MEGO, L1 to A.pog; Linear measurements: U1/A.perp, L1/A.Pog., U1/PP, U6/PP, L1/MeGo, L6/MeGo.

Comparison between manual and software prediction of presurgical outcome: All variables were not statistically significant.

Comparison between manual and software prediction of postsurgical outcome: Except SNA, U1/A. Perp, other variables were not statistically significant.

DISCUSSION

While it is not confirmed through the repetitive examination of outcome measurements showing at least comparable or preferably improved accuracy when compared with that of the traditional manual technique, routine utilization of software aided cephalometric predictions cannot be justified. The data for prediction of pre and postsurgical stages of the manual and software-aided prediction were not significantly different, respectively.

Previous investigation on Quick ceph software, offered a reasonably accurate method of prediction[9]. The results of this study showed that Quick Ceph tended to overestimate horizontal landmark position and underestimate vertical changes. However, the mean differences and standard deviations were less than values reported for manually prepared prediction profiles.

Some researchers in their studies[1,10] found similarity between manual and software method for the prediction of postsurgical outcome. Computer programs cannot consistently predict the skeletal changes occurring after orthognathic surgery but their results may be considered inside a clinically acceptable range[11]. They stated last-minute changes by the surgeons as the meaningful cause of the errors in prediction. Previous study indicated that Version 8.0 of Dolphin Imaging Software needs to re-assessed for software errors that may result in clinically significant miscalculations, and to facilitate compensation of radiographic magnification when using linear measurements[7]. This finding was because of using surgeon manual data for movement of the jaws with the software during investigation.

In addition to difficulty in locating A point, according to others authors[12] positioning the apex of upper incisors in the cephalometric view is not so easy, therefore there

was significant difference for the SNA and U1/A.perp measurements in postsurgical comparisons.

The most important limitation in this study was probable imprecision in calculating the movements occurred in manual method based on different positions of surgical reference lines. The accuracy of the expert selecting the best profile would be another limiting factor in this investigation.

Recent advancement of computer technology in different clinical fields of medicine has made increasingly problematic to assess the efficacy of the technology before it becomes available in the market and used by numerous clinicians. Although a multitude of cephalometric analysis software programs have been commercially available for several years, there are few studies evaluating the reliability and the accuracy of measures by the programs. There are also few studies comparing differences across different versions of digital tracing softwares. It can be more easier for the practitioner to select technology that is reliable and accurate by referring to associated investigations.

This study provides a basis to assess other software programs. Further studies in this area will, no doubt, improve our ability to select the best program by more knowledge about the advantages and disadvantages of other softwares. But, for now, the orthodontic clinicians can use Dophin imaging software (version 10) instead of traditional manual methods for prediction of orthognathic treatment of longface class III patients with clinically acceptable accuracy.

CONCLUSION

Dolphin Imaging software (version 10.0) has a good accuracy for prediction of presurgical and postsurgical outcome of longface Cl III orthognathic patients.

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Recebido/Received: 24/01/10
Revisado/Reviewed: 10/03/10
Aprovado/Approved: 15/04/10

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