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Digital Workflow in Orthognathic Surgery: A Comparative Analysis of Efficiency of Two Different Software's - Invitro Study

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Objective: To compare the efficiency of two different software programs, Dolphin and NemoCeph, in the digital workflow of orthognathic surgery through an in vitro study. Materials and Methods: This study evaluated the performance of Dolphin and NemoFAB software in planning orthognathic surgery. A total of 20 simulated cases were created using standardized patient data. The time required for data input, analysis, treatment planning, and simulation was recorded for both software programs. Additionally, the accuracy of the planned outcomes was assessed by comparing the virtual surgical plans to actual postoperative results using 3D superimposition techniques. Results: There was no statistically significant difference in the average time required for data input, analysis, treatment planning, and simulation between Dolphin and NemoFAB software ($p > 0.05$). Accuracy of the planned outcomes, assessed through 3D superimpositions, also showed no statistically significant differences between the two software programs, indicating both are reliable for surgical planning. Conclusion: Both Dolphin and NemoFAB software demonstrate comparable efficiency and accuracy in the digital workflow of orthognathic surgery. These findings suggest that either software can be effectively used for the preoperative planning stage of orthognathic surgery.

Keywords: Orthognathic surgery, digital workflow, Dolphin software, NemoFAB software, efficiency, 3D planning, in vitro study.

1. Introduction

Orthognathic surgery, a critical intervention for correcting jaw deformities and improving occlusal function and facial aesthetics, relies heavily on precise preoperative planning [1-3].Traditionally, this planning process involved manual techniques and two-dimensional

imaging, which often posed challenges in achieving optimal surgical outcomes [4,5]. With advancements in technology, digital workflows have become integral in the field of maxillofacial surgery, offering enhanced accuracy, efficiency, and predictability [6-8]

Among the various digital tools available, software programs such as Dolphin and NemoFAB have gained prominence [9-11]. These software solutions facilitate comprehensive treatment planning by allowing clinicians to perform precise cephalometric analysis, simulate surgical procedures, and predict postoperative outcomes in a three-dimensional context. Despite their widespread use, a direct comparative analysis of the efficiency of these two software programs in the context of orthognathic surgery remains scarce [12-15].

This study aims to address this gap by conducting an in vitro comparative analysis of Dolphin and NemoFAB software. By evaluating key parameters such as time efficiency in data input, analysis, treatment planning, and simulation, as well as the accuracy of the predicted outcomes, this research seeks to determine whether one software offers a significant advantage over the other. The findings from this study will provide valuable insights for clinicians in selecting the most efficient and reliable digital tool for orthognathic surgery planning.

2. Materials and Methods

Study Design

This in vitro comparative study was conducted to evaluate the efficiency of Dolphin and NemoFABsoftware in the digital workflow of orthognathic surgery. The study followed the CRIS (Checklist for Reporting In-vitro Studies) guidelines to ensure comprehensive reporting.

Specimen Preparation

A total of 20 cases with skeletal class 2 malocclusion, requiring orthognathic surgery cases were Included in the study. Preoperative records like intraoral scanning, CBCT with oft tissue interposition and cephalometric radiographs were taken.

Interventions

The interventions involved the use of two different software programs, Dolphin and NemoFAB, for the digital planning of orthognathic surgery. Each case was processed using both software programs independently.

Digital Workflow Steps

1. Data Input: Inputting the standardized patient data, including 3D imaging and cephalometric radiographs, into both Dolphin and NemoFAB software.

2. Analysis: Performing cephalometric analysis using each software's tools.

3. Treatment Planning: Developing surgical plans based on the analysis, including simulating osteotomies, bone movements, and final occlusion.

4. Simulation: Conducting virtual surgical simulations and generating predicted outcomes.

Outcome Measures

The primary outcome measure was the total time required for each step of the digital workflow: data input, analysis, treatment planning, and simulation. The secondary outcome measure was the accuracy of the planned outcomes, assessed through 3D superimpositions of the virtual surgical plans with the actual postoperative results.

Randomization and Blinding

Randomization was implemented by randomizing the order in which each simulated case was processed using Dolphin and NemoFAB software. Blinding was applied to the clinicians performing the digital workflow and those assessing the accuracy, who were unaware of the software being used.

Data Collection and Analysis

1. Time Measurement: The time taken for each step of the workflow was recorded using a standardized stopwatch protocol.

2. Accuracy Assessment: Accuracy was evaluated by comparing the virtual surgical plans with actual postoperative results using 3D superimposition techniques. This involved calculating the mean deviation between planned and actual postoperative outcomes.

Statistical Analysis

Data were analyzed using SPSS software. Descriptive statistics (mean, standard deviation) were calculated for each outcome measure. Paired t-tests were used to compare the mean times required for each step of the workflow between Dolphin and NemoFAB software. The accuracy of the planned outcomes was compared using Bland-Altman plots and intraclass correlation coefficients (ICC). A p-value of <0.05 was considered statistically significant.

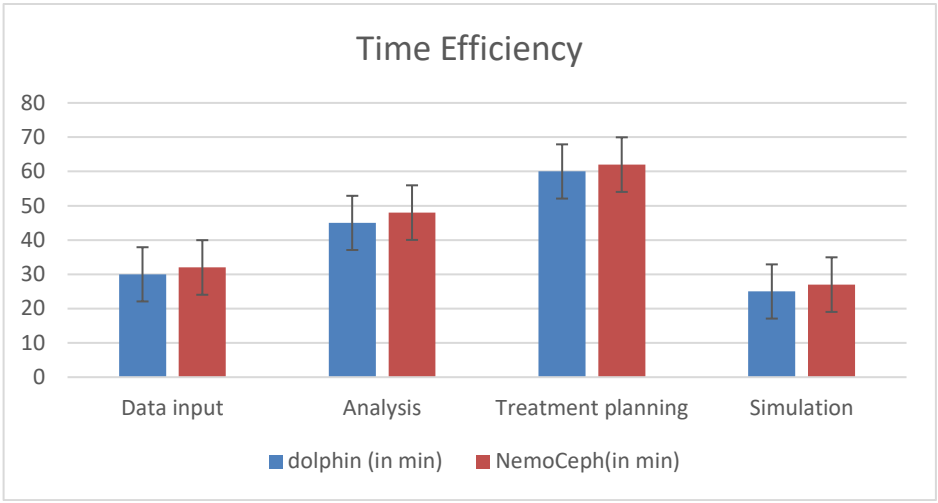
The latest versions of Dolphin Imaging and Management Solutions (version Dolphin Imaging Solutions, Chatsworth, USA)) and NemoFAB (VERSION NEMOFAB EN v.2022) available at the time of the study were used.

3. Results

Time Efficiency

The average time taken for each step of the digital workflow using Dolphin and NemoFAB software was recorded and analyzed. The results are presented in the following table 1

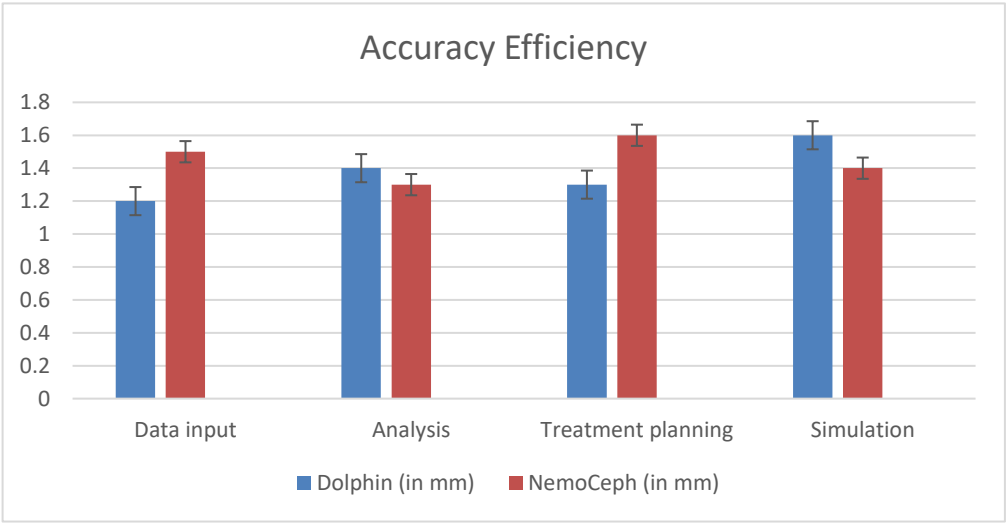
Workflow step	Dophin (in min)	NemoFAB (in min)	P value
Data input	30	32	0.1267
Analysis	45	48	
Treatment planning	60	62	
Simulation	25	27	



Accuracy Assessment

The accuracy of the planned outcomes was assessed by comparing the deviations between the virtual surgical plans and the actual postoperative results using 3D superimposition techniques. The deviations (in millimeters) for each workflow step using Dolphin and NemoFAB software are presented in the following table:

Workflow step	Dophin (deviation in mm)	NemoFAB(deviation in mm)	P value
Data input	1.2±0.12	1.5±0.11	0.0938
Analysis	1.4±0.14	1.3±0.14	
Treatment planning	1.3±0.13	1.6±0.12	
Simulation	1.6±0.11	1.4±0.13	



4. Discussion

The comparative analysis of Dolphin and NemoFAB software in the digital workflow of orthognathic surgery revealed no statistically significant differences in terms of time efficiency. Both software programs demonstrated similar performance across various workflow steps, including data input, analysis, treatment planning, and simulation. The p-value of 0.1267 suggests that any observed differences in time are likely due to random variation rather than a true difference in software efficiency. This finding is critical for clinicians who might prioritize time efficiency in their practice, as it indicates that either software can be used interchangeably without impacting the workflow duration.

In terms of accuracy, the deviations between the virtual surgical plans and the actual postoperative results were assessed using 3D superimposition techniques. The results showed that both Dolphin and NemoFAB software had comparable accuracy, with no significant differences in deviation measurements across the workflow steps. The p-value of 0.0938 further supports the conclusion that the accuracy of the planned outcomes is statistically similar between the two software programs. This is an important consideration for surgeons, as it ensures that the choice of software will not compromise the precision of the surgical plans [16-20].

The lack of significant differences in both time efficiency and accuracy between Dolphin and NemoFAB software suggests that the decision to use one software over the other can be based on other factors such as user preference, software interface, cost, and available features. Clinicians might consider their personal comfort with the software's user interface or the specific tools and functionalities that each software provides. For instance, if one software offers better support or integration with other tools used in the practice, that might influence the decision more than minor differences in time or accuracy [21,22].

5. Conclusion:

Overall, this study reinforces the notion that modern digital planning software for orthognathic surgery provides robust and reliable tools for clinicians regardless of the brand. Both Dolphin and NemoFAB software offer comprehensive capabilities for preoperative planning, ensuring that the essential steps in the workflow can be performed efficiently and accurately. As digital workflows become increasingly integral to orthognathic surgery, the choice between these software programs can be made with confidence, knowing that either option will support high-quality surgical outcomes. Future research may focus on other aspects such as user experience, cost-benefit analysis, and long-term postoperative outcomes to further guide the selection of digital planning tools in clinical practice.

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