

Comparative Evaluation Between The All-on-four and Four on Pillars Techniques in 3D Virtual planning associated with guided surgery on atrophic jaws

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ABSTRACT

Thorough technical knowledge and anatomical understanding are critical for optimal surgical results. The difficulty of complete maxillary surgery can vary significantly depending on the complexity of the anatomy or bone defect. In this work, we analyze and compare two methods of software-guided planning for the manipulation of dental implants, associated with the All on Four (ALL) and Four on pillars (FOUR) techniques used in patients with atrophic maxillae. Forty-two images of totally edentulous patients were analyzed, and surgical planning was performed Using both methods. The average area of the Four on pillars technique is 4.9x(p<0.0001)greater than the average area of the All on four technique ,this represents a difference of 489%.This means that, for the same force applied by the jaw, we will have a 4.9x smaller pressure, that is a better distribution of forces on the jaws. It was not possible to notice a statistical difference between the success proportions(p=0.2542),this means that both techniques have a non-different(similar) success proportion. We conclude that the area of the polygon formed in the Four on pillars surgical plan is larger than in the All on four plan and this results in significantly less pressure on the implants. We also concluded that it was not possible to notice a statistical difference between the proportions of success, which shows that there is no technique with successful performance advantages over the other.

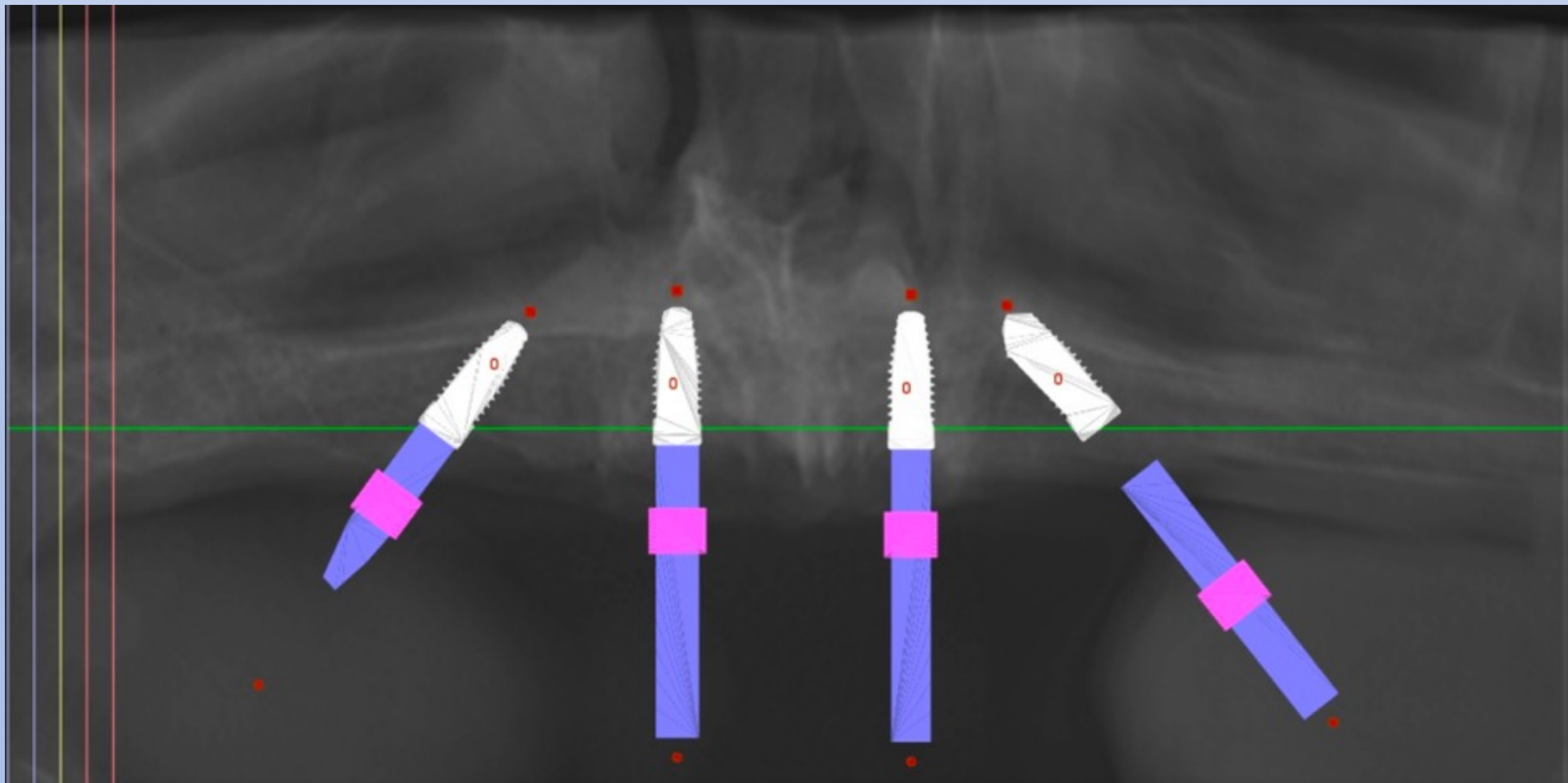


Figure 1.All on Four 3D planning

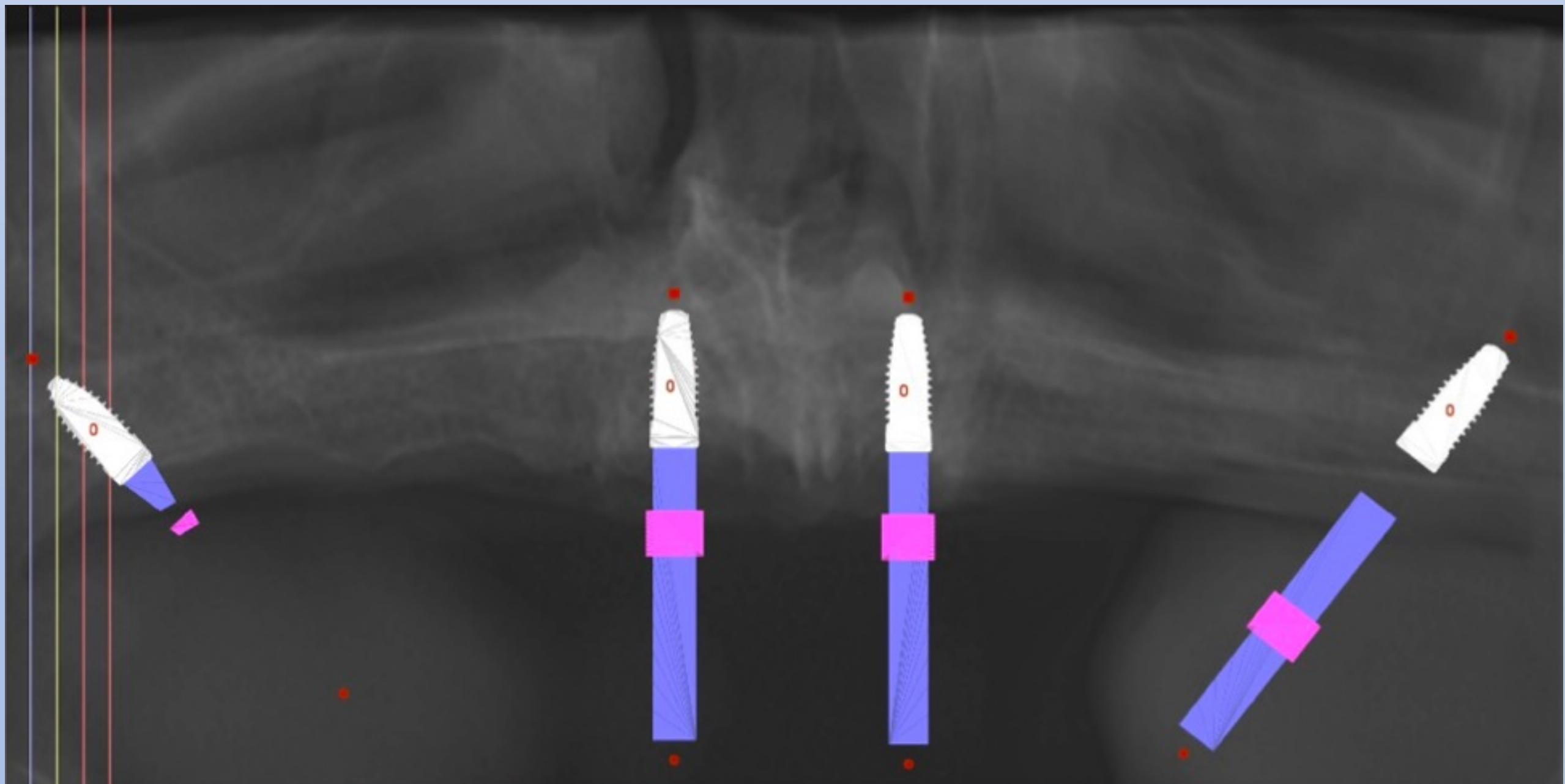


Figure 2. Four on pillars 3D planning

MATERIALS AND METHODS

For this work, 42 CT scans of maxillary edentulous people were evaluated. Exams were performed in 2019 at a radiological dental clinic in the city of Osasco SP Brasil, metropolitan region of São Paulo city. The analyzed images were obtained through CBTC scans of total edentulous maxillae, made in a dental scanner, brand Soredex, model Cranex 3D. This work was submitted and approved by the Ethics Committee of Universidade Brasil under approval number 4,652,975. All procedures performed in this study were in accordance with the ethical standards and with the 1964 Helsinki declaration and its later amendments.

In the planning carried out, Dérig® implants (Dérig, 2021) were virtually installed, implants that appear in the Implant viewer software library (Implantviewer, 2021). 3.5 mm morse taper implants were used, models indicated for this technique. In each exam, both techniques were planned following the orientation of each of the groups: ALL and FOUR. All implants should have 100% bone tissue contact.

For the All on Four planning, the plans were carried out following the orientation of two implants in the canine pillars, more anteriorly and two more implants tangent to the anterior wall of the maxillary sinus (Siadat et al, 2018; Greenberg, 2017; Durkan, Oyar, & Deste, 2019; Soto-Penaloza et al., 2017). Figure 1 shows the All on four planning.

For the Four on Pillars planning, the installation of the implants was virtually guided by two implants in the canine pillars and two more implants in the tuberosity region of the maxilla, anchoring the apex of the implant in the pterygoid process of the maxilla (Anandakrishna, & Rao, 2012; Peñarrocha, 2009; Balshi et al., 1995; Balshi et al., 1999, Smidt et all 2018). Figure 2 shows the Four on pillars plan.

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To assess the area formed by the 4 implants (Figure 3 and 4), the area closest to the bone ridge was selected in the axial section, being the region in which the masticatory force is most demanded on the implants. Using the ImageJ software (Rasband, 2018) version 1.52k, the images were individually calibrated and measured by determining the areas formed by the polygons in each planning. The axial image is scaled 1:1 and next to it there is a real millimeter ruler. Through the ruler (Figure 4) the measure of 1 cm was calibrated and in the ImageJ software the cm/pixel ratio was calibrated. In this way, the formed polygon was able to measure in real values how many square centimeters were formed in each planning. To analyze the area formed in surgical planning, the Shapiro-Wilk normality test was performed in each of the two groups (ALL and FOUR) to choose the most appropriate statistical treatment. As we compared the planning by the two methods, in the same patient, we used a paired test, as there is a dependence between the area values. In case both groups pass the normality test, the paired t-test will be used, and if at least one of them does not pass, the Wilcoxon signed-rank test will be used.

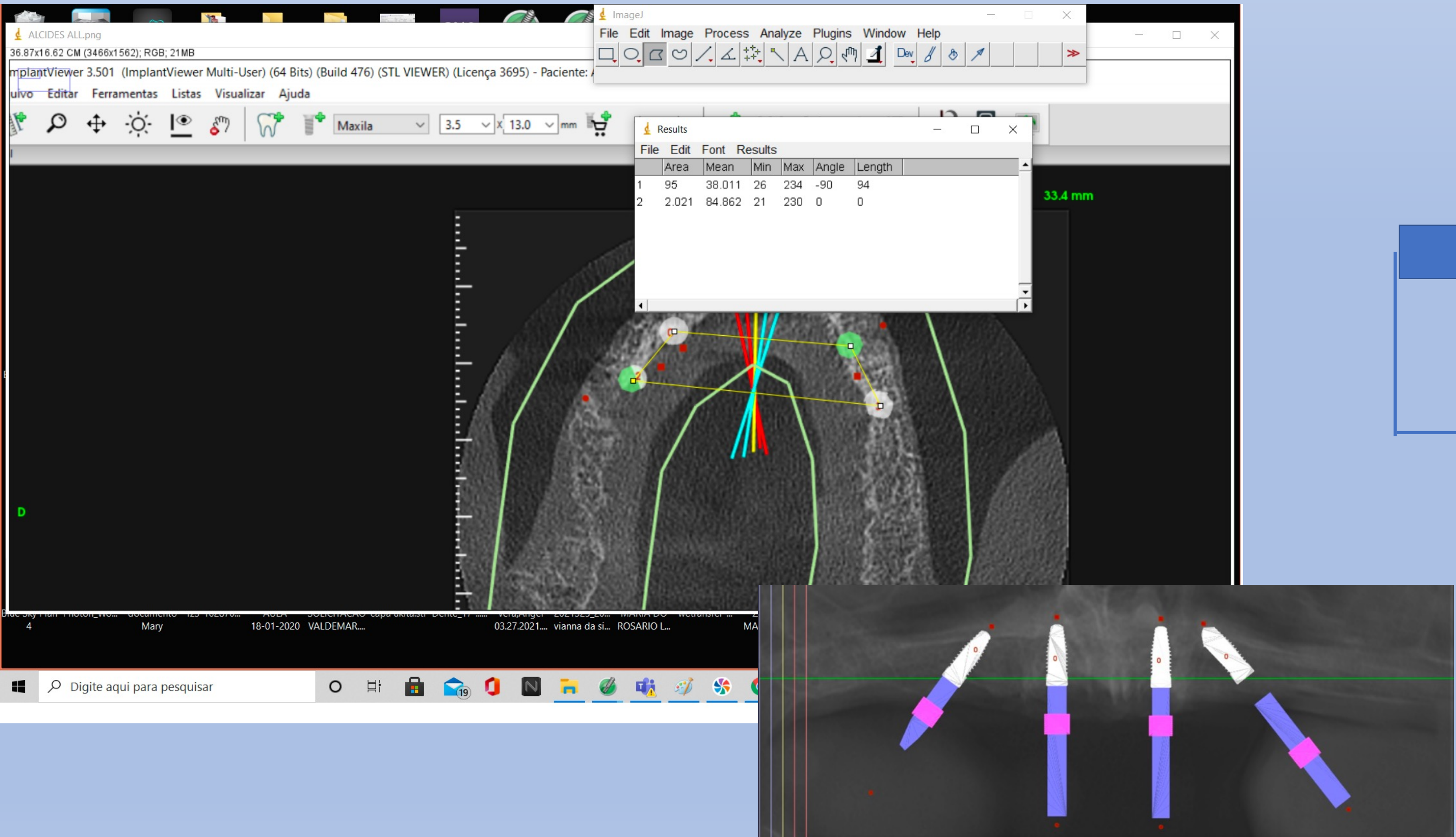


Figure 3 .Formation of polygons in the All On Four technique.

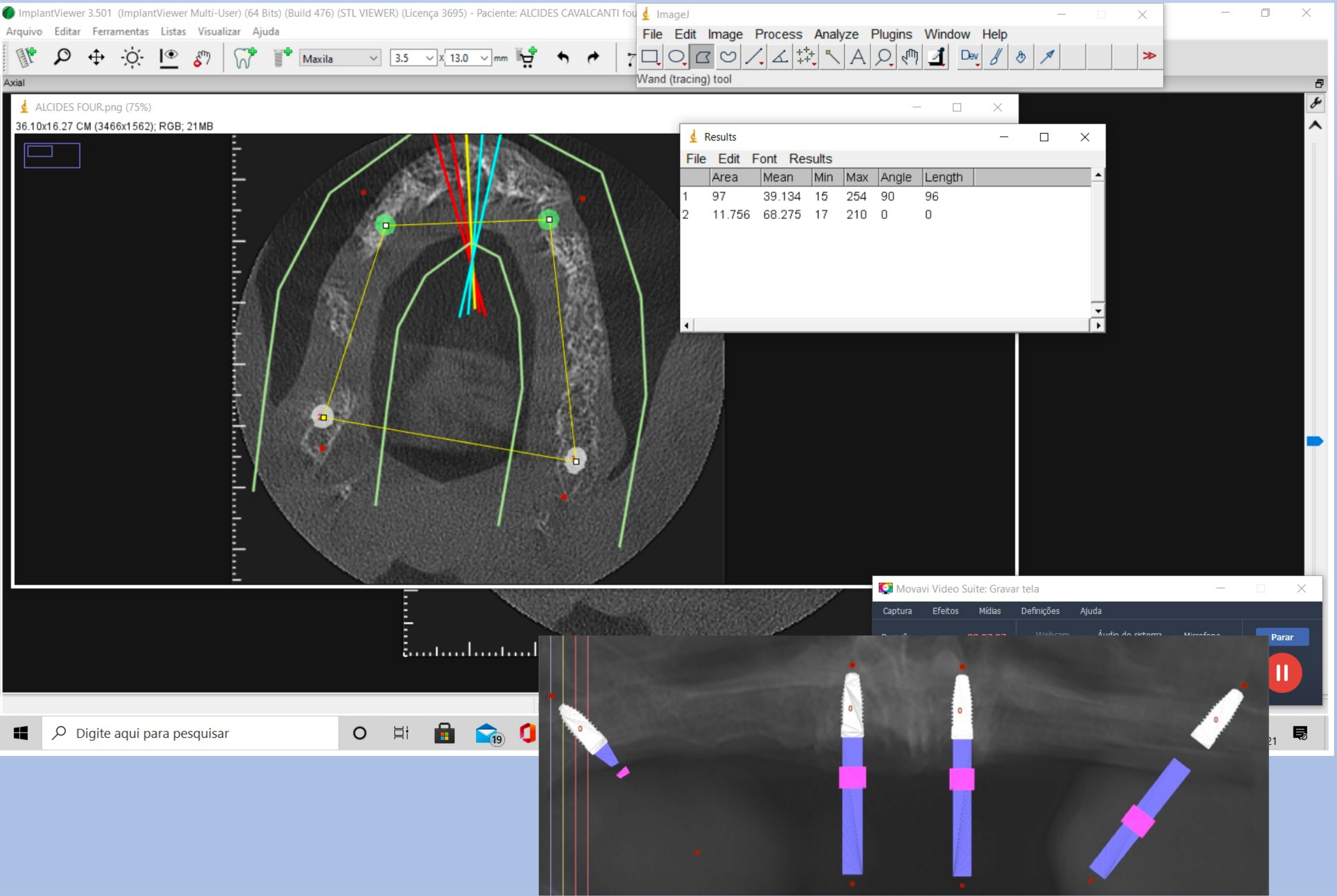
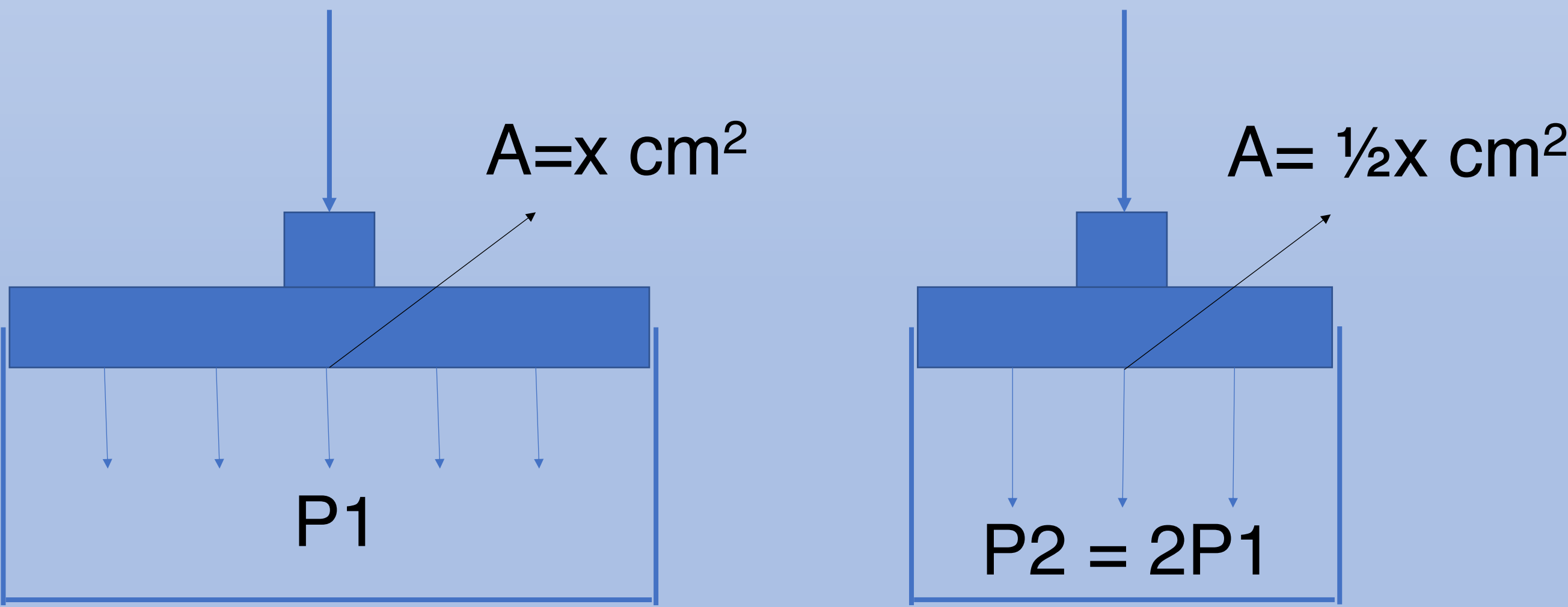


Figure 4. Formation of polygons in the Four On Pillars technique.

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RESULTS

Computed tomography scans of 42 patients were evaluated, 4 males and 38 females. The mean age of patients was 64.0±10. In 11 patients, none of the plans could be carried out due to the lack of bone structure. 1 patient had a local injury, which also made planning impossible. The flowchart in Figure 4 represents the analysis performed. Each study group passed the normality test (Shapiro-Wilk), Figure 5 shows the Q-Q plot, illustrating the test result. The proximity of the points to the red line suggests data normality.

To compare the areas formed in the two surgical plans, we considered only the patients where planning by the two treatments were possible (n=22), as shown in Figure4. Figure 6 shows the averages of the areas formed by the polygon; the error bars represent the standard deviation. The average area of the Four on pillars technique is 4.9x larger than the average area of the All on four technique, this represents a difference of 489%. This means that, for the same force applied by the jaw, we will have a 4.9x smaller pressure, that is, a better distribution of forces on the jaws.

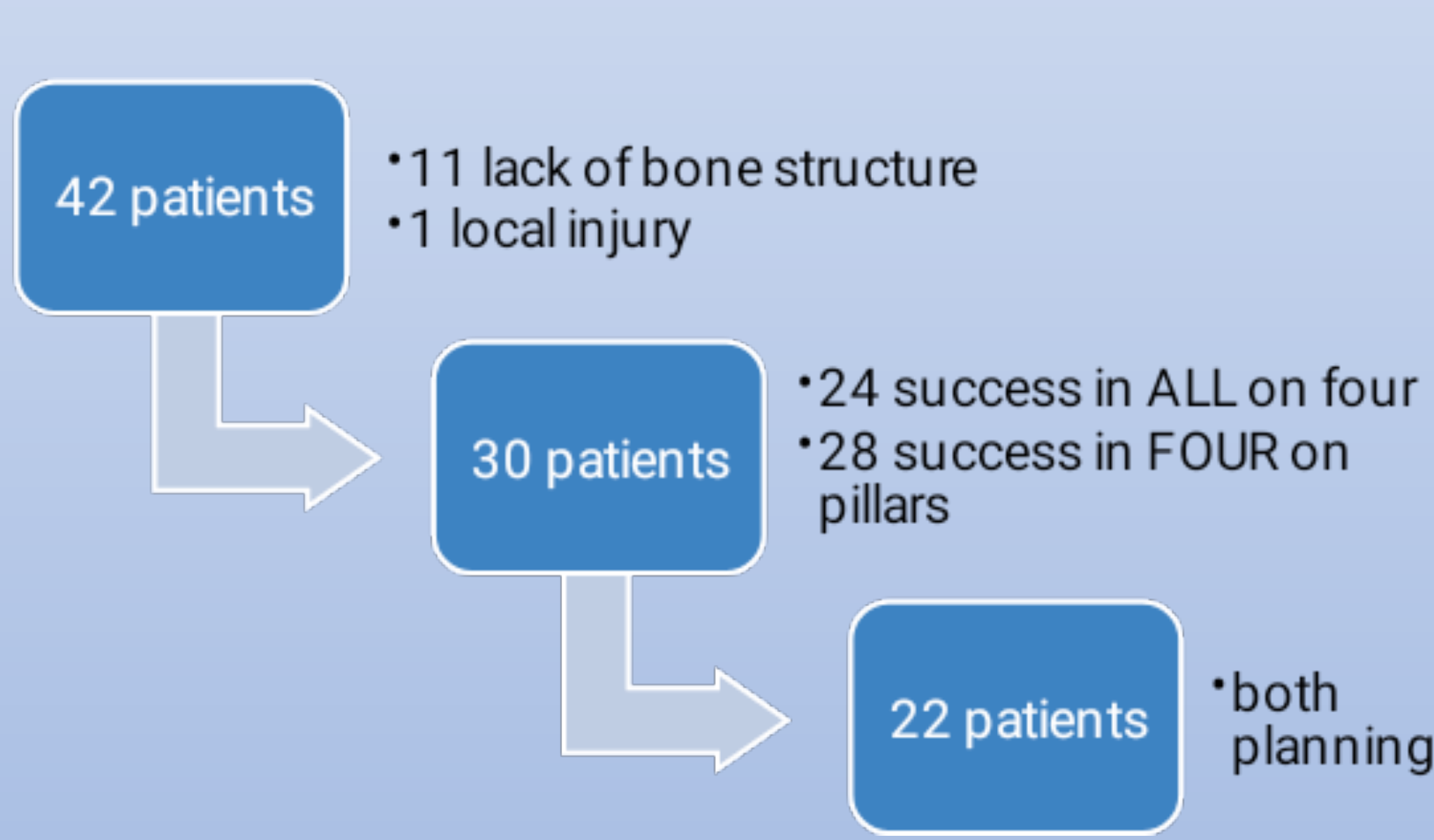


Figure 4. Flow chart of analyzed images

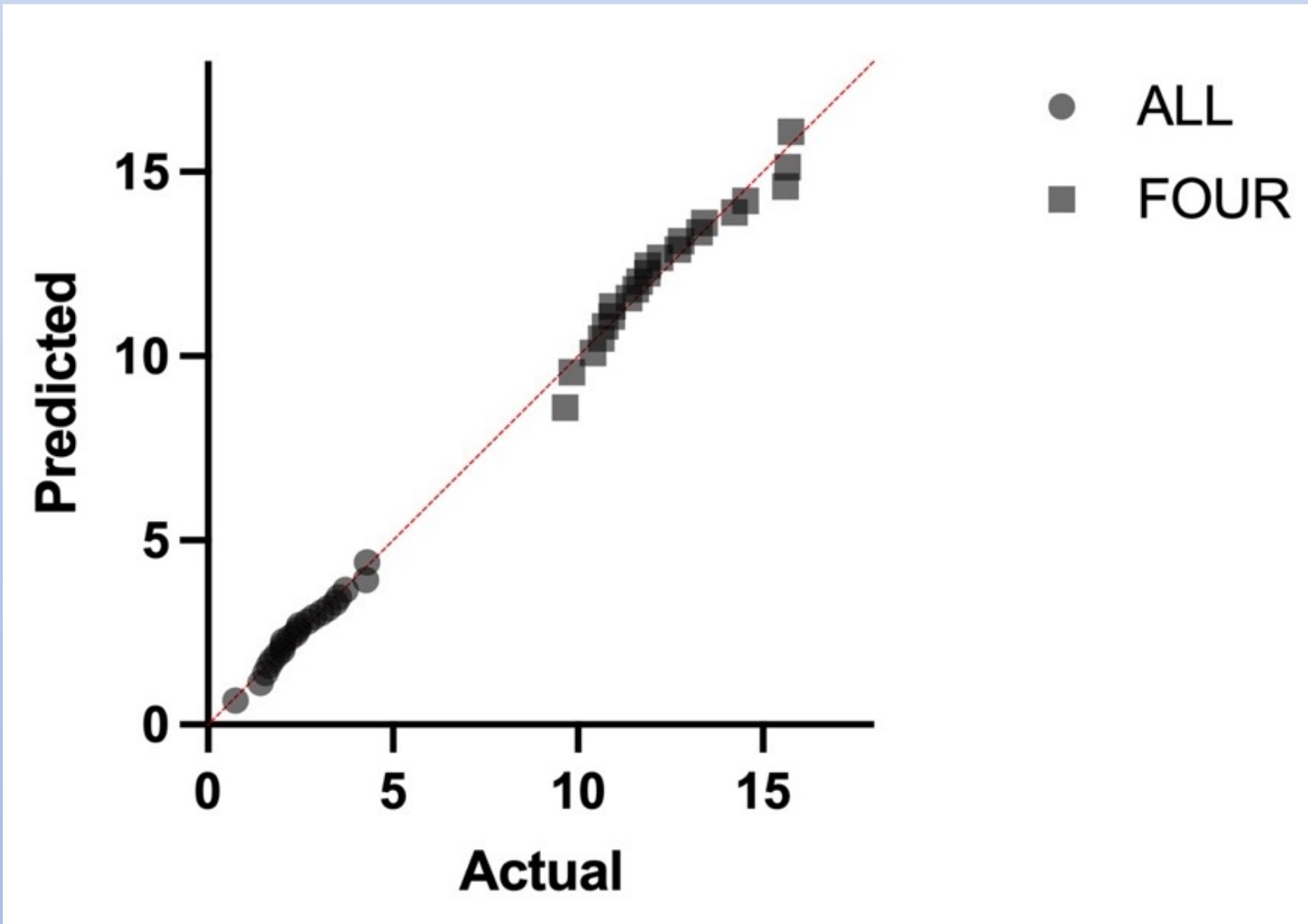


Figure 5. Q-Q chart for normality

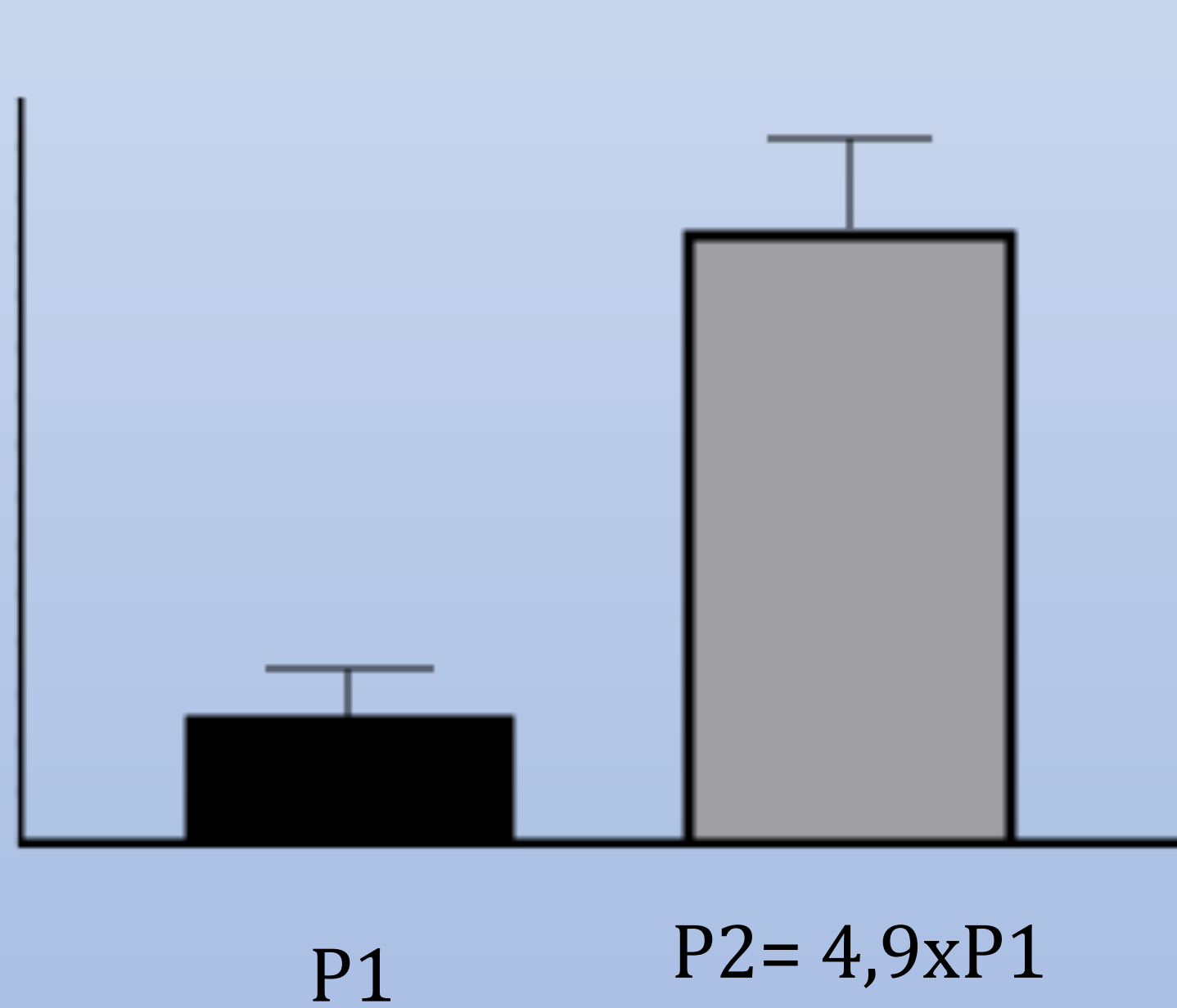


Figure 6. Planning area

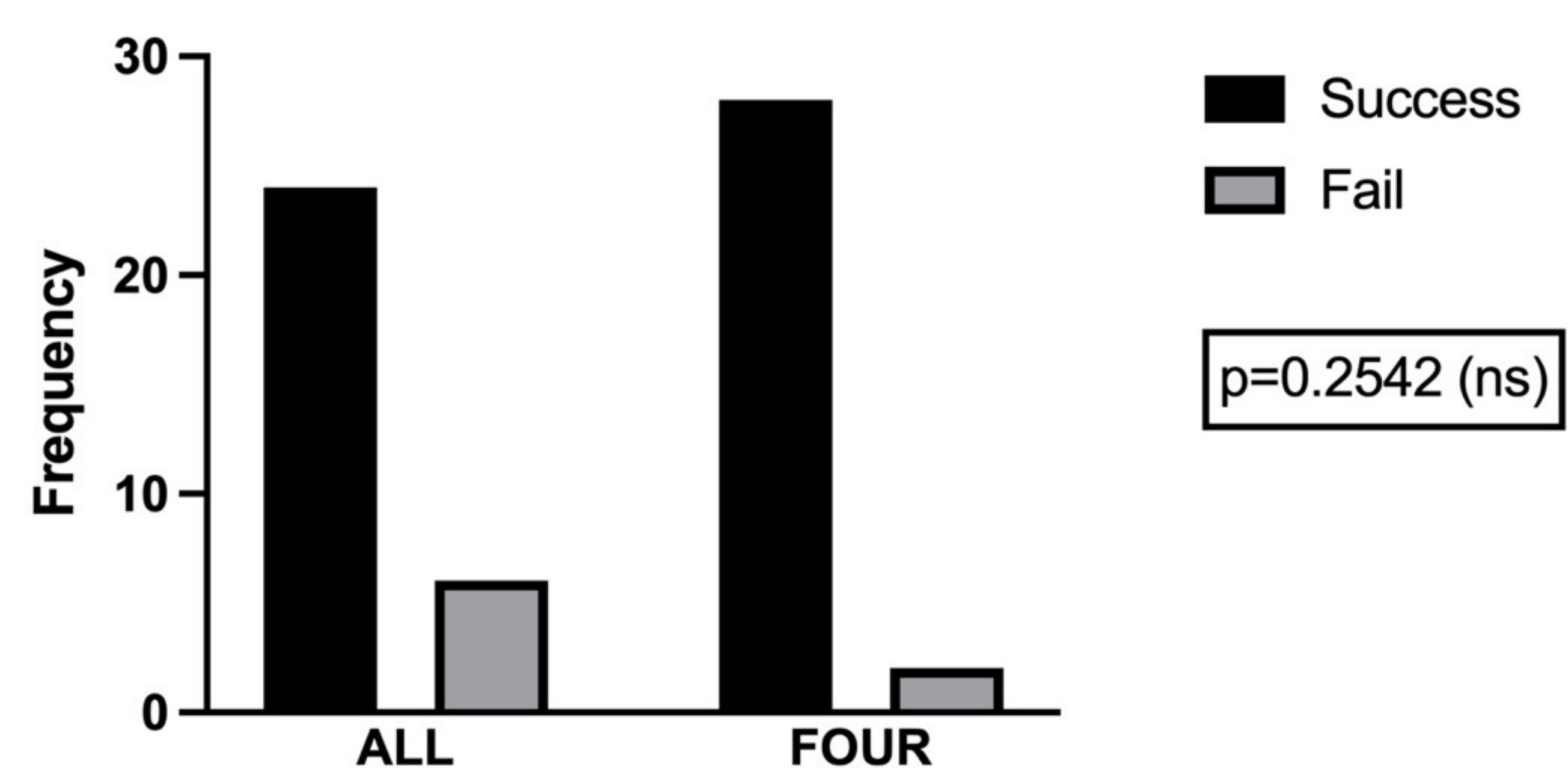


Figure 7. Success rate of Four on pillars and All on four plans

CONCLUSION

- The area of the polygon formed in the Four on Pillars surgical plan is on average 4.9x larger than in the All on Four plan. This results in significantly less pressure on the implants.
- NO statistical difference between the proportions of success for indication of both treatments which shows that there is no performance advantages of one technique over the other.

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