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DENTAL TECHNIQUE

Protocol for the clinical assessment of passive fit for multiple implant-supported prostheses: A dental technique

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ABSTRACT

With monolithic materials and the new technologies for framework production, assessment of passive fit before fabrication of the definitive prosthesis or its framework is essential to avoid prosthesis remakes. This article describes an updated clinical protocol to assess passive fit during the prosthesis fabrication process through the systematic use of tactile feel while tightening the retaining screws, the visual or radiographic evaluation when performing the 1-screw or Sheffield fit test, and the torque/time graph obtained during the placement of the implant- or abutment-retaining screws with a torque-controlled surgical motor. (J Prosthet Dent 2021;126:727-30)

New materials for fabricating monolithic or veneered implant-supported prostheses have been developed.[1-5] A monolithic prosthesis, avoiding fracture of an esthetic veneering material, is typically milled to the planned design from a block or disk of the definitive material,[6,7] usually without a cast.[3,6] However, if the correct fit is not accomplished after fabrication, modification is not possible, and the prosthesis must be remade.[5] A veneered prosthesis consists of an internal framework veneered with an esthetic material. The framework can be manufactured by addition or laser sintering, subtraction, casting, or pressing.[8] Depending on the framework's material, no modification can be performed if a lack of fit is detected.[5,9] Thus, the fabrication of monolithic prostheses or the frameworks of veneered prostheses requires a definitive cast (digital or physical) that precisely reproduces the 3D spatial position of the implants.

Fit is defined as the degree of adaptation between 2 parts.[10] Passive fit implies that this adaptation should be accomplished with no tension of the retaining screws.[4,10] A perfect passive fit is not currently possible, and a misfit ranging from 30 to 50 μm has been considered to be clinically acceptable.[10] A lack of passive fit of the definitive prosthesis may cause mechanical (screw loosening or screw fracture and monolithic prosthesis fracture) or biological (mucositis or peri-implantitis) complications.[4,9-13]

Several methods have been described to verify passive fit, including visual assessment by using the 1-screw or Sheffield fit test,[14,15] the tactile perception of the misfit with a dental explorer, the interpretation of the tactile sensation while tightening the retaining screws, and the use of intraoral radiographs.[3,10,13-20] The use of torque-controlled surgical motors to assess the torque generated while tightening the retaining screws has also been described.[21,22] The software programs associated with these instruments produce a torque/time graph for each retention screw tightened during the verification test, the framework evaluation, and the definitive prosthesis placement for the subsequent evaluation of the torque-angle signature.[22-24]

An updated clinical protocol to assess the passive fit during the prosthesis fabrication process is described through the systematic use of the tactile feel while retaining screws, the visual or radiographic evaluation when performing the 1-screw or Sheffield fit test, and the

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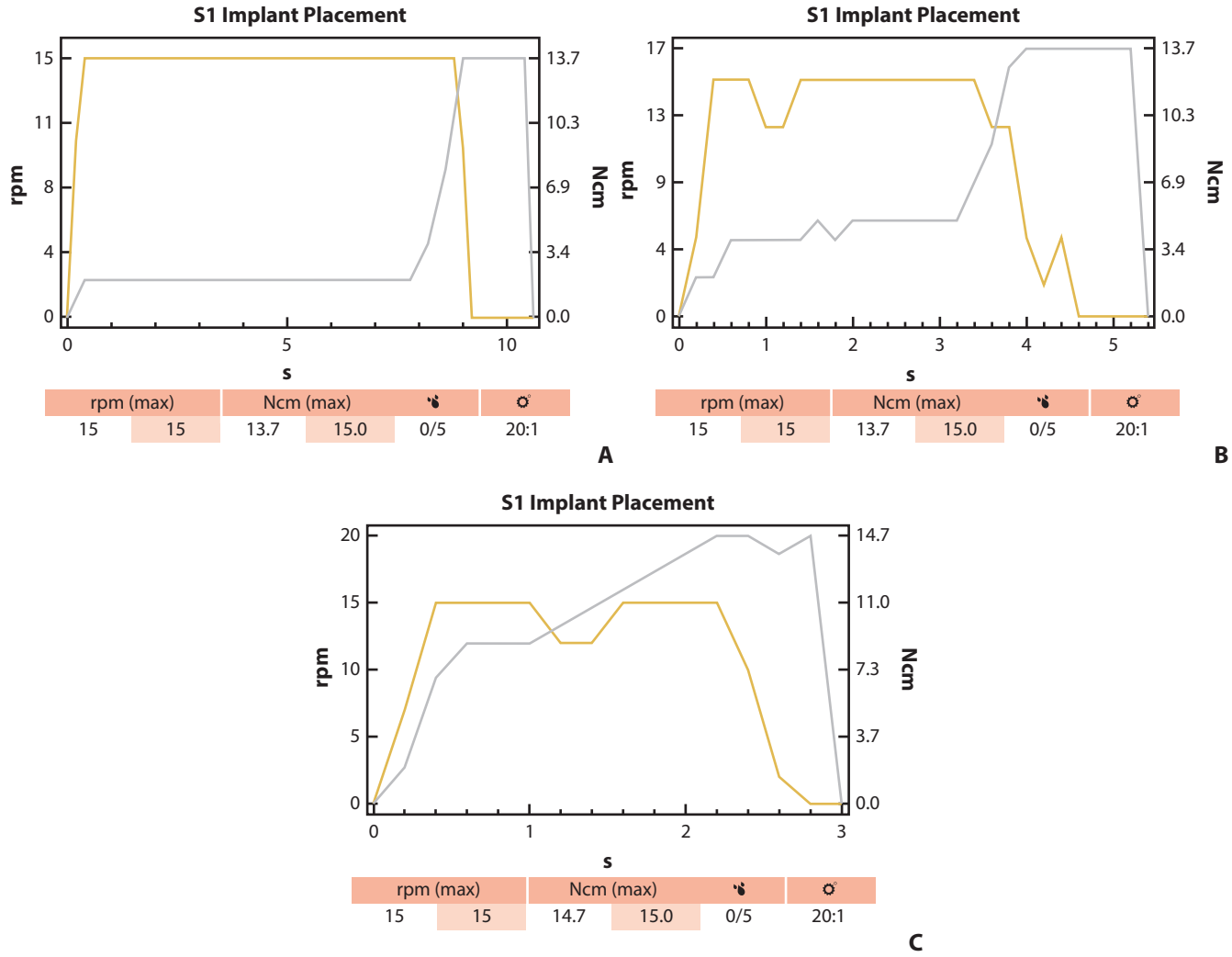

Figure 1. Graphs obtained with torque control software application when placing retaining screw. A, Short alignment zone indicates optimal passive fit. B, Extended alignment zone that ends in elastic clamping zone possibly indicates clinically acceptable passive fit. C, Extended alignment zone and no elastic clamping zone indicates lack of passive fit.

assessment of the torque/time graph obtained during the placement of the implant- or abutment-retaining screws with a torque-controlled surgical motor.

TECHNIQUE

1. Verify the passive fit of the verification test, prosthetic framework, or finished prosthesis with tactile feel while tightening all implant or abutment-retaining screws with finger pressure alternately, from side to side.
2. Loosen all retaining screws 3 complete turns. Adjust the torque-controlled surgical motor (iChiropro; Bien-Air Inc) to a maximum torque of 15 Ncm and 15 revolutions/min. Then tighten the retaining screw at the most distal position with the torque-controlled surgical motor, recording the torque/time graph with the software program.
3. Perform the Sheffield fit test by visual assessment, with or without magnification, at the opposite side of the only placed retaining screw. If the fit is subgingival, making a radiograph with a parallel positioner (RINN XCP-ORA; Dentsply Sirona Inc) or palpating with a dental explorer may be useful.
4. Tighten the retaining screw of the most mesial implant on the opposite side (the closest to the midline) with the torque-controlled surgical motor, recording the torque/time graph. Then, tighten the retaining screw of the most distal implant, and, finally, tighten the remaining ones. Record the torque/time graph with the software program during each screw placement.

DISCUSSION

Clinical characterization of passive fit is challenging, and the use of different methods for evaluating clinical misfit has been recommended. The 1-screw or Sheffield fit test evaluates the fit visually at the opposite end of the only placed retaining screw.[13-15] All frameworks should have an accurate horizontal and perpendicular fitting. First, all the retaining screws should be tightened with finger pressure, and then all but one of the most distal loosened. Radiographs can be used to evaluate the misfit if the connection is subgingival, but their validity largely depends on the misfit magnitude and the projection of the radiograph.[19] The use of a parallel positioner usually overcomes this issue. If the implant is buccally or lingually placed, a custom device that parallelizes the implant body and the radiograph may improve accuracy.[25]

The tactile sensation while tightening the prosthetic structure allows passive fit assessment.[26] The verification test, prosthetic framework, or finished prosthesis, and the threads of the implants or abutments and the retaining screws must all be cleaned before testing. When tightening retaining screws, care must be taken not to squeeze the gingiva, press the ridge with the pontic, or evaluate with tight proximal contacts. These factors might cause a feeling of resistance not related to misfit. Subsequently, if resistance is felt while tightening the retaining screws, the prosthetic axis does not coincide with that of the implant or abutment, and the tension of the retaining screws makes the structure align on the implant or abutment, which indicates a lack of passive fit.[4,26] Nevertheless, the feel is subjective and dependent on the operator's experience. The use of a torque-controlled surgical motor should help make the assessment more objective.[22] The torque/time graph's alignment zone corresponds to the first part of the ascending curve after the usually flat rundown/prevailing zone. It represents the alignment of the framework on the implant or abutment. A long alignment zone indicates a lack of passive fit so that tension is needed to align the prosthetic framework and the implant or abutment. After the alignment zone, the elastic clamping zone occurs. More rigid materials, such as metal or zirconia frameworks, will lead to a steeper slope than softer ones, such as verification test resin.[22-24] Figure 1A shows a short alignment zone and a high-slope elastic clamping zone, representing an optimal passive fit. Figure 1B shows a more extended alignment zone that ends in an elastic clamping zone, indicating a lack of passive fit, which probably could be considered clinically acceptable. The torque threshold to determine a fit as clinically acceptable has not been determined, and investigation is required. Figure 1C shows an extended alignment zone and no elastic clamping zone, indicating a lack of passive fit.[22-24]

With the described protocol, a clinically acceptable fit can be determined after systematically performing the visual or radiographic evaluation when performing the 1-screw or Sheffield fit test and the subjective and objective evaluation of the felt resistance during the retention screw tightening.

The accuracy of the digital scan or the definitive cast should be ensured with a verification test before the fabrication of the definitive prosthesis or its framework to avoid prosthesis remakes.[5,9,16,27] Passive fit is then assessed using the proposed protocol. Afterward, a resin prototype prosthesis can be made to evaluate esthetics and function before fabricating the definitive prosthesis. Using the prototype for both passive fit and esthetics and occlusion assessment has also been described, but the gingiva's pontic pressure may make passive fit assessment challenging.[18] If the fit obtained in the verification test is not satisfactory, new impressions or correction of the implants' position in the digital scan must be made.[12]

SUMMARY

This article describes an updated clinical protocol to assess passive fit through the systematic use of tactile feel while tightening the retaining screws, visual or radiographic evaluation when performing the 1-screw or Sheffield fit test, and the assessment of the torque/time graph obtained during the placement of the implant or abutment-retaining screws with a torque-controlled surgical motor.

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