The Sheffield Fit Test - Revisited

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Abstract:

Purpose: To introduce a test for verifying a passive fit of implant supported frameworks on the master cast or in the patients mouth.

Materials and methods: The test is in two main parts. Part 1 involves checking the fit of the framework using finger pressure firstly, then assessing the fit by tightening one of the most distal abutment/implant screws using a screwdriver with finger pressure. With only this single connection the entire framework should have an accurate horizontal and perpendicular fit when viewed under magnification. Sometimes a slight “shadow” or suspicion of a vertical discrepancy, exists between framework and implant replica/abutment. In these cases a satisfactory passive fit may be confirmed by part 2 of the test. If a suspected fit discrepancy can be closed using a 13mm wide strip of modelling wax, representing 20 KN/m2 pressure load on the implant, without the wax distorting, then the fit is deemed to be clinically acceptable. If the wax does distort or is unable to close the discrepancy, the framework should be re-made.

Conclusions: A valid fit test is presented for use with implant frameworks. Applied correctly this test allows a clinical assessment of fit to be made. This can reduce the amount of re-makes, which need to be made. Without the correct implementation of the test many unnecessary re-makes are often made.

Keywords: Sheffield fit test, Implant retained prosthesis

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Introduction:

The “Sheffield Fit Test” is a standardized test, used to verify a passive fit of implant supported frameworks returned onto their master casts or the patient’s mouth.

The “Sheffield Fit Test” was developed in the early 1990s at the Sheffield University, School of Clinical Dentistry (1) and was used to assess the suitability of fit of both wax/acrylic patterns and cast frameworks on the model and in the mouth. This confirmed the accuracy of the impression and other clinical stages. The Sheffield fit test being used both in the laboratory and in the mouth. Although it was developed before the advent of CAD/CAM technology, and was developed when cast frameworks were the only option, variations of this test still remain the most widely used and reliable framework fit test (2-6) and still referred to specifically as the “Sheffield test” by researchers (2,3). However, many of the essential elements of the test have been lost or abused over the years and in many cases the test is being applied incorrectly.

The “Sheffield Fit Test” can be used wherever there is a metal one-piece, screw retained framework, the test is relevant regardless of the metal/alloy composition of its construction, the method of its fabrication and or where different implant systems have been used. The Sheffield fit test, as with all visual assessments of fit, will be less effective the more that the framework-to-implant-abutment fitting surfaces are removed from visible inspection.

This article revisits the original test to show that it is just as applicable in today’s digital world as it was when it was first designed and introduced into the “lost wax casting” age.

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The original Sheffield fit test was designed to be in 2 parts, firstly to determine if a discrepancy in fit existed and secondly to assess whether any discrepancy of fit was so severe as to warrant a re-make of the framework. Most operators , who still use the test, only apply the first part of the test and very often that is applied incorrectly. This can lead to unnecessary re-makes of the framework.

The Sheffield Fit Test:

Preparation:

The fitting surfaces of the framework, abutment heads and the master cast must first be scrupulously steam cleaned.

Sheffield Fit Test Part 1:

Fitting accuracy is initially assessed by finger pressure to seat the framework onto its abutment/implant replicas before lightly tightening one of either of the two most distal abutment/implant screws using the appropriate screwdriver. Never use the torque wrench to carry out the test and do not use laboratory screws or impression coping screws for this as they may not be as accurate as the clinical retaining screws. With this single screw connection, the entire framework should have an accurate horizontal and perpendicular fitting when viewed under magnification (Figure 1), ideally X 20, but any magnification is preferable to the naked eye.

If the framework satisfies the Sheffield fit test, then screw tightening can begin with any screw because the framework fits passively everywhere.

Sometimes a very slight ‘shadow’ or suspicion of a vertical discrepancy exists between the framework and an implant/abutment replica remote from the test screw. In these cases a satisfactory passive fit may be confirmed by test 2.

Sheffield Fit Test Part 2:

If a suspected fitting discrepancy can be closed by pressure from the edge of a 13mm wide strip of modelling wax at a room temperature of 20ºC, representing a 20KN/m2 pressure load on the implant, without the wax distorting, then the fit is clinically satisfactory without further attention. Finger pressure should be exerted on top of the strip of wax about 1.5 to 2 cm from the point where the wax contacts the framework (figure 2). Alternatively, and if available, a tension gauge may be used to undertake the same test (Figure 3).

Figure 4a, shows a framework with a slight misfit or “shadow”. When using the “Sheffield Fit Test (Figure 4b) the gap can be closed without any buckling or distortion of the wax strip. This would be deemed to be a satisfactory framework fit.

Figure 5a shows a framework with a slightly larger misfit between the framework and the abutment. In this case the wax strip cannot close the gap without buckling and distorting (Figure 5b). Therefore the amount of pressure needed to close the gap could cause

enough stress on the implants and surrounding bone to cause damage and potential lose of osseointegration or breakage of the retaining screws. Hence this fit is not considered to be acceptable and the framework should be re-made.

Non-parallel placement of implants does not prevent the “Sheffield Fit Test” from being applied and the one screw Sheffield fit test will reveal fitting errors. However, if the test is carried out on extremely angulated implants/abutments and excessive pressure has been used to tighten the retaining screw, movement of the framework is usually inevitable at this point. Only tighten the screw using a screwdriver held between the fingertips to finger pressure. A degree of common sense is needed in these cases to enable the fit to be assessed. In these cases it is essential for the clinician to tighten all the retaining screws down evenly together using finger pressure and not to tighten one screw down fully to maximum torque before tightening the rest.

In practice, the framework manufacturer usually gives very little information to the clinician regarding the correct order in which the retaining screws should be placed and tightened. However, in non-parallel cases the tightening order can be extremely important if a passive fit is to be achieved.

Although the sequence of screw tightening is not part of the Sheffield test, we suggest that intuitively the most central or the most parallel screw should be placed first, then other screws progressively placed, alternately, away from this central screw. All screws should be tightened as evenly as possible using a screwdriver to finger pressure tightness as evenly as possible. Once the framework is securely fastened down to finger pressure all

screws (in the same order) can be finally tightened with the torque wrench, not exceeding the maximum torque as suggested by the specific manufacturer, for example 15Ncm for prosthetic screws onto abutments and 35Ncm if screwing straight onto the implant (this information on torque settings may vary slightly from manufacturer to manufacturer) This procedure is analogous to fitting a wheel back onto a car!

Conclusions:

- The “Sheffield fit test” for implant frameworks is as relevant today as it was when it was first designed.
- The “Sheffield fit test” will assess the fit of all implant retained frameworks, irrespective of their manufacturing route.
- Applied correctly the “Sheffield fit test can quickly determine whether a framework remake is necessary or not.

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Figure 1

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Figure 2

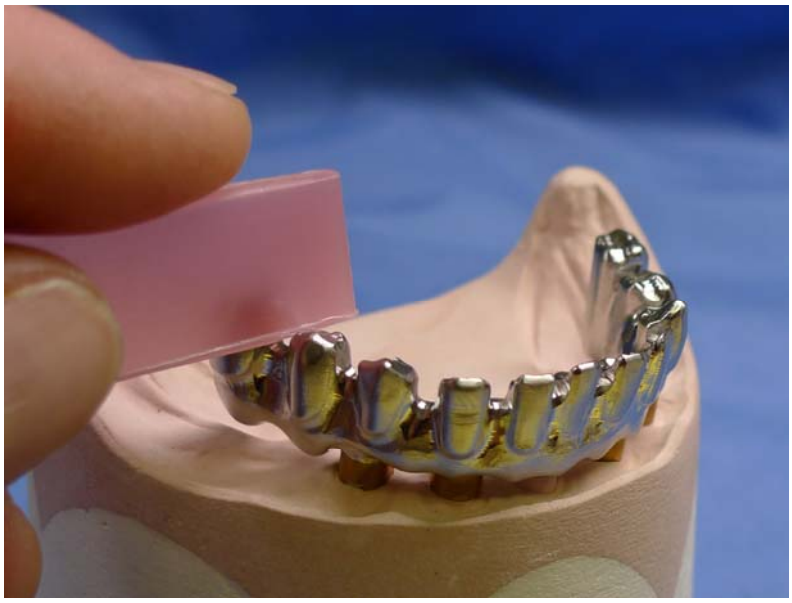

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Figure 3

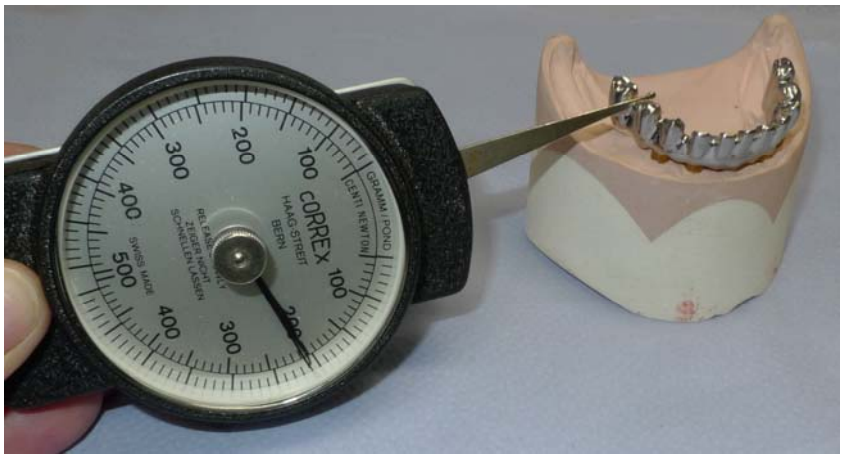

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Figure 4a

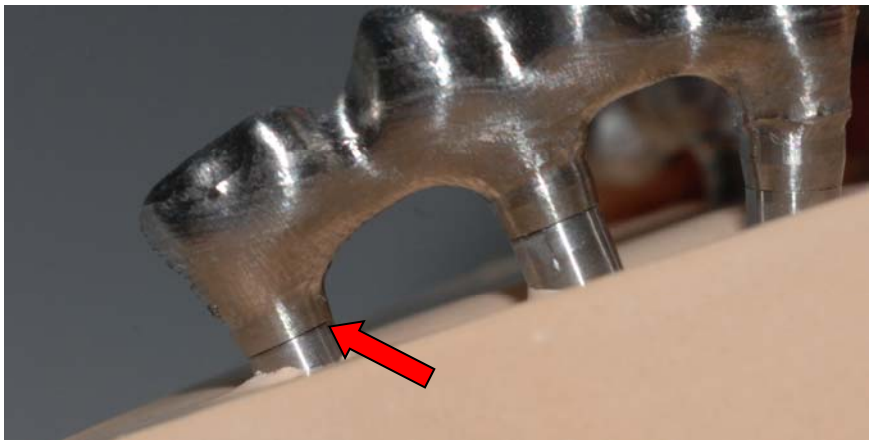

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Figure 4b

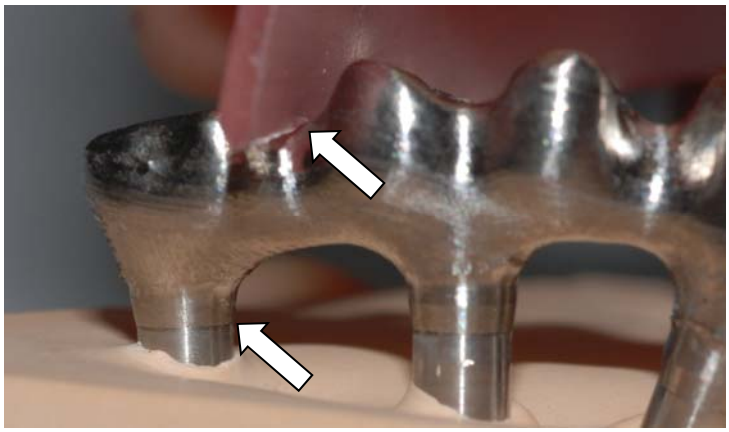

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Figure 5a

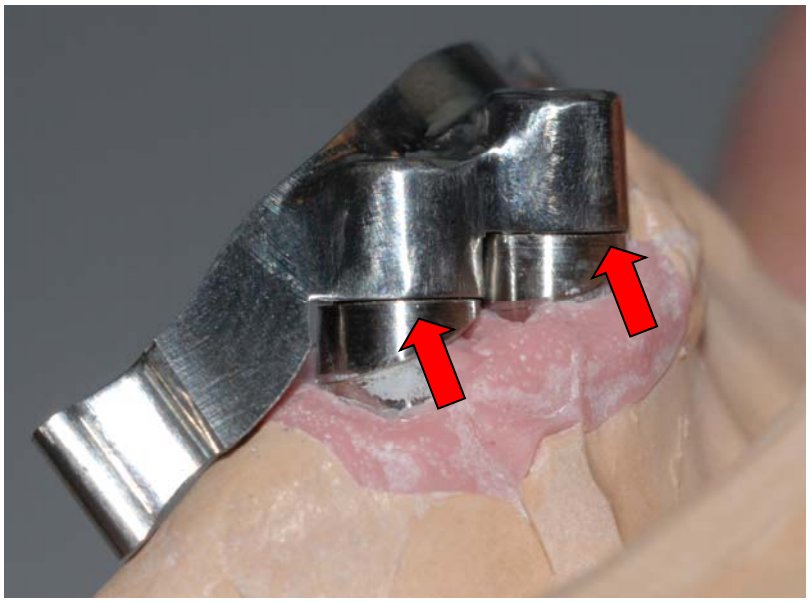

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Figure 5b

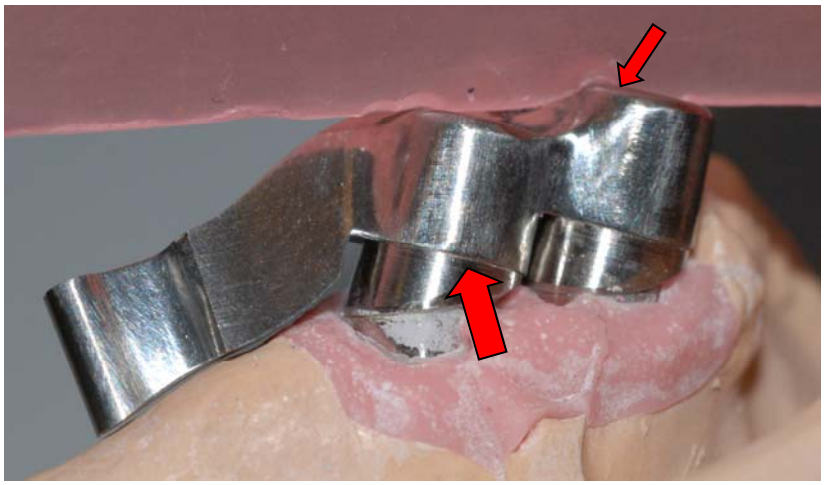

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Figure legends

Figure 1. The framework should fit its master model without visible gaps under x 20 magnification and with only one connecting screw in place.

Figure 2. A 13 mm wide strip of modelling wax can exert a pressure of up to 20kN/m^2 without buckling. When spread over all the implants on tightening the framework to place in the mouth, this force is insufficient to cause damage to the
Implants, retaining screws or the supporting bone.

Figure 3. A tension gauge can also be used to carry out the Sheffield fit test. Here the correct maximum load of 200 grams (20kN/m^2) is being exerted.

Figure 4a. With one retaining screw in the opposite distal abutment a slight “gap” or misfit is observed between the framework and the abutments at the other end of the framework.

Figure 4b. The misfit is able to be closed using the wax strip without any buckling or damage to the wax strip (less than 20kN/m^2 or 200 grams of pressure). This framework is therefore clinically acceptable.

Figure 5a. A noticeable gap/misfit between the framework and the abutment is seen with one retaining screw in the opposite distal abutment.

Figure 5b. Although the wax strip used in the Sheffield Fit Test is able to close the gap/misfit the wax has buckled and distorted (more than 20kN/m^2 or 200 grams of pressure). This amount of pressure on the implants, retaining screws and surrounding bone could lead to the permanent damage of one or all.