

ASDJ

AINSHAMS DENTAL
JOURNAL

Print ISSN 1110-7642

Online ISSN 2735-5039

AIN SHAMS DENTAL JOURNAL

Official Publication of Ain Shams Dental School

December 2020 • Vol. XXIII

Comparing Two Suggested Techniques to Correct Improperly Angulated Implants in Mandibular Kennedy Class I Implant Supported Partial Overdenture

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Abstract

The Purpose of this study was to evaluate the amount of strains transmitted to the tilted implant in implant supported mandibular Kennedy class I partial overdenture comparing between Sphero Flex attachment and angulated abutment as the abutments are used to correct the implant tilt using strain gauge technique.

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Introduction

Edentulism is the condition associated with partial or complete loss of teeth, needless to say that edentulism in dentistry is equivalent to mortality. Edentulism either partial or complete is an indicator of oral health of a population, it may reflect the behavior and attitude towards the dental and oral care. The welfare and management of edentulous adults remains an important public health issue, having direct reference to the global goals for oral health.^{1,2}

The absence of one to 15 teeth on a jaw is called partial edentulism.³ The classification of partially edentulous patients became a need for enhancing the communication between dentists and for the paperwork required by the diagnosis and treatment plan. Throughout the years a lot of dentists have tried to conceive an ideal classification.³

Distal extension RPD is defined by The Academy of Prosthodontics as a removable dental prosthesis that is supported and retained by natural teeth only at one end of the denture base and in which a portion of the functional load is carried by the residual ridge. Distal-extension RPDs (Kennedy Class I and II) were associated with several problems related to its limited stability, retention, aesthetics and masticatory efficiency.^{4,5}

Among the prosthetic options for partial edentulism, missing teeth and supporting oral tissues are replaced with fixed partial dentures (FPDs), removable partial dentures (RPDs) and implant prosthesis overdentures, immediate dentures followed by complete dentures, implant supported overdentures, and implant retained fixed or removable prostheses.^{6,7}

The use of dental implants in the free end saddle cases change the nature of support and modifies the classification of the case from Kennedy Class I (tooth-tissue support) into Kennedy Class III (tooth-implant support). Implant assisted removable partial denture seems to overcome the numerous problems associated with the conventional RPD in addition to achieving a higher level of patient satisfaction.^{8,9}

Theoretically, the implants should be located as distally as possible to provide maximal support and stability. This is of special importance in the mandible because of the significant displacement of the denture base that is not supported by the major connector. The implants might be used for support only using healing caps or for retention with resilient attachments connected to the implants.¹⁰

O'Mahony¹¹ stated that, in order to obtain improved biomechanical results, implant placement should be parallel, so loads are axially transferred to the implants however, due to anatomic limitations and esthetics, implants may be placed with angulations.¹²

Diverse root or implant angulations may not be able to be corrected easily unless a segmenting attachment is used.¹³ Many types of attachments have been used to augment the retention and stability of an implant overdenture. Among the different types used stud, bar and magnetic attachments are the most commonly used, furthermore, other attachment systems are used as the telescopic retainers.¹⁴

Among the attachments used with the angulated implant are the angulated abutments and spheroflex attachment. Spheroflex is an implant abutment used

for over denture attachments are compatible with any implant system. The spheroflex swivel ball come with a diameter of 2.5 mm and if flexible to 7.5 in any direction, it has been designed to correct angulation problems up to 43 degrees between two implant abutments. This attachment is titanium nitrate coated and has Vickers surface hardness of 1600. The female component of this attachment is a nylon cap that comes in a variety of colors and snaps over a ball to help prevent wear and increase retention. Spheroflex attachment has self-aligning ability. When taking into consideration the elasticity of the retention cap, the mobile sphere of the spheroflex attachment inclines 7.5 degrees in all directions. It has directional rings that come in different colors white, green and red which direct the angle of the sphere entry to the retentive cap to counteract the angle by which the implant inclines from the line of parallelism. So that all the retentive caps used in the prosthesis will be parallel to each other.¹⁵

Regarding the use of angulated abutment^{16,17}, the use of angulated abutments may be the method of choice when anatomic limitations preclude the axial placement of an implant.

Material and method

This in-vitro study was conducted on 3D printed models simulating a lower Kennedy class I with two conventional implants placed bilaterally in the second molar area.

In each model one implant was placed in the right side with 7 degrees angulation to the vertical reference axis in a mesio-distal direction and the second implant

will be placed in the left side parallel to the vertical reference axis

In this study two methods was used to correct the angulated implant

- 1- Using a Sphero Flex attachment in both the right side and the left sides
- 2- Using an angulated abutment on the right side and a straight abutment on the left side

Mandibular Kennedy class I educational stone cast was used. A scan of study model of was done via planmeca CBCT machine then planning of the location and angulation of the implants was done using OnDemand3D™ App, then a Standard tessellation Language (STL) file was generated.

In this STL file two implants beds were designed representing the sites planned for the two BioHorizons implants with dimensions equal 12mm in length and 4.6mm in diameter. They were planned to be at equal distances from the midline through measuring the distance from the mid line to the crest of the ridge. At the right side the implant is planned to be 7 degree to the vertical reference axis and the left side is planned to be parallel to the vertical reference axis. Then via exocad and Materialise programs, two grooves were designed buccally and distally at each future implant sites for the attachment of the strain gauge. Those grooves were prepared 1 mm from the implants. The STL file was ready to be directly sent to the 3D printer (envision Tec DDDP). The raw printing material used is a photopolymer material which in fact is a mixture of acrylic acid esters and photo initiator that was developed for dental model manufacturing. Implants were inserted in their designed osteotomies in the model

using a ratchet. An impression of the cast was taken using rubber base impression material. Then the impression was poured and a refractory cast was made. Wax patterns of the same design was done on both casts. And dentures were fabricated constructed. Sphero flex attachment was used in the first model on both sides to correct the angulation of the implant on the right side, white on the second model we used angulated abutment on the right side to correct the angulation and a straight abutment on the left side constructed and a pick-up was done on both casts using soft liner. The strain gauges were installed in their grooves on the distal and labial aspects of posterior implants. All strain gauges were positioned parallel to the long axes of the implants.

Load was applied using the universal-testing machine at the central fosse of first molar bilaterally. The applied load started from zero up to 100N.

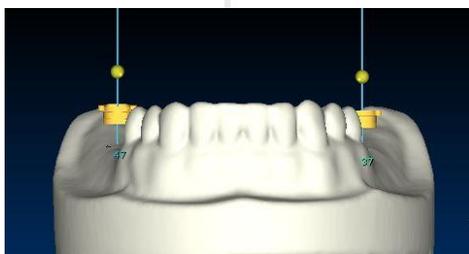


Figure (1): Frontal view showing the location of the implants on both sides.



Figure (2): The sphero flex attachment.



Figure (3): The angulated abutment on the right side.

Results

Within the limitation of this study it has been found that the self-aligning resilient ball attachment was valid in correcting stresses induced due to implant angulation, as tilting the implants produces more stresses.

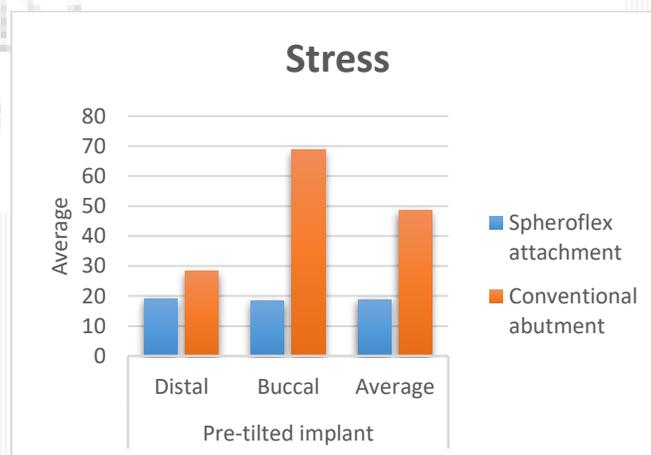


Figure (4): Bar chart showing average stress measured in pre-tilted implant.

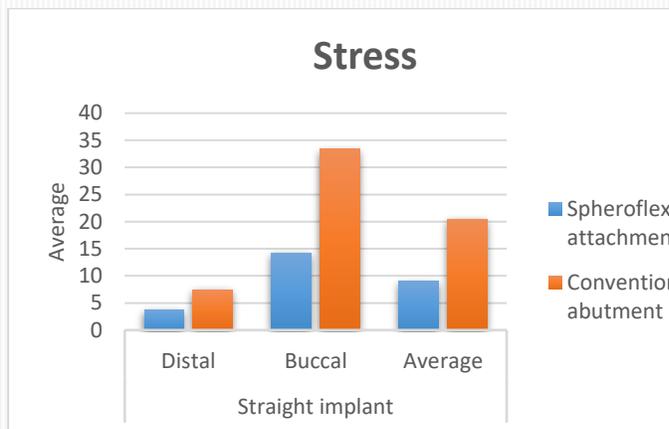


Figure (5): Bar chart showing average stress measured in straight implant.

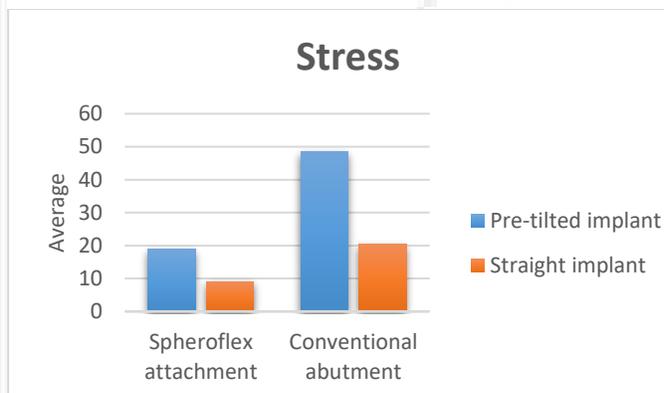


Figure (6): Bar chart showing average stress in different implants.

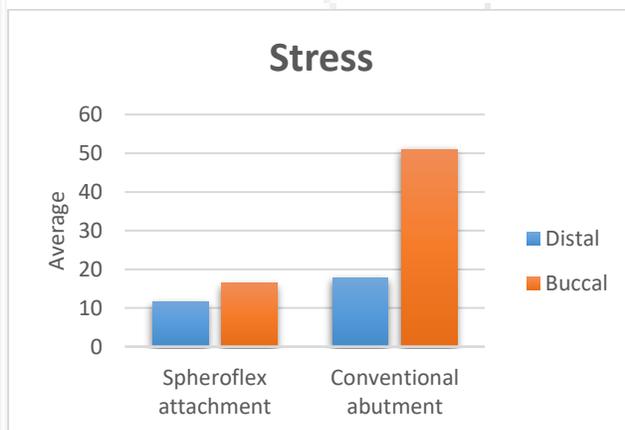


Figure (7): Bar chart showing average stress in different measurement points.

Conclusion

Correction of the angulated implant using spheroflex attachment is better than correcting it using angulated abutment

regarding the strains transmitted to the tilted implant in implant supported mandibular Kennedy class I partial overdenture.

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