**SHORT COMMUNICATION**

# EFFECT OF DECREASED CROWN HEIGHT SPACE IN DENTAL IMPLANTOLOGY- AN APPRAISAL

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**ABSTRACT**

Though oral rehabilitation with dental implants is quite a predictable and well-documented technique, long-term survival may be hampered by various factors. The biomechanical factor crown height space (CHS) has been an object of research frequently. A situation that often occurs in areas of tooth loss is an increase in the interocclusal space because of bone resorption, requiring lengthy crowns and thus a disproportionate crown implant ratio (CIR), that is, with implants shorter than crowns. A reduced CHS has biomechanical issues related to the strength of implant material and/or prosthetic components, flexibility of the material, and retention requirement of the restoration. In fixed restorations, the movement of the material may increase porcelain fracture, screw loosening, and/or uncemented restorations. The current literature review is a discussion on the biomechanical consequences of decreased crown height space.

**KEYWORDS**
Biomechanical, Crown height space, Dental implant, Stress

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## Introduction

Issues related to CHS are accentuated by an excessive CHS that places more forces on the implant and prosthetic system, and reduced CHS makes the prosthetic components weaker. A reduced CHS has biomechanical issues related to a reduced strength of implant material or prosthetic components, an increased flexibility of the material, and a reduction of retention requirement of the restoration. The fatigue strength and flexure of a material is related to its radius to the power of 4[1]. In fixed restorations, the flexure of the reduced-diameter material may cause porcelain fracture, screw loosening, or uncemented restorations. Therefore, in the situation of reduced CHS, material failures are more likely[2].

Skeletal discrepancies (deep bite), reduced OVD from attrition or abrasion, minimal bone atrophy after tooth loss, and supraeruption of unopposed teeth may all result in less than ideal space for prosthetic replacement of the dentition. Traditional prosthetic and restorative procedures are indicated to restore the proper OVD and plane of occlusion. However, on occasion, even when the opposing arch is corrected, the CHS may still be less than ideal (<8 mm). The 8-mm minimum requirement for CHS consists of 2-mm occlusal material space, 4-mm minimum abutment height for retention, and 2 mm above the bone for the biological width dimension (which does not include the sulcus because a crown margin may be 1 mm subgingival for retention or esthetics). When the reduced OVD is in partially edentulous patients, the OVD may be restored by orthodontics, which is the preferred method. This correction may also require a surgical orthognathic surgery, such as a Le-Fort I osteotomy and superior repositioning. However, prosthetics is a common approachand may involve an entire arch.

## Crown Height Space (CHS)

When the opposing teeth are in the correct position and the CHS is insufficient, additional space may be gained surgically with osteoplasty and soft tissue reduction of one arch, provided adequate bone height remains after the procedure for predict- able implant placement and prosthetic support.

If a removable implant-supported prosthesis is planned, an aggressive alveoloplasty should often be performed after tooth extraction to provide adequate prosthetic space. Additional prosthetic space can also be obtained in many clinical situations by soft tissue reduction, especially in the maxilla. Soft tissue reduction should be performed in conjunction with second-stage surgery if the implants heal in a submerged location. This allows the thicker tissue to protect the implants from uncontrolled loading by a soft tissue–supported prosthesis during healing. If the implants heal per-mucosally, then the reduction procedures should be done during implant placement. Soft tissue reduction procedures may include gingivectomy, removal of connective tissue, or apical repositioning of flaps. Efforts should be made to maintain adequate keratinized tissue around the implants. Soft tissue reduction also has the benefit of decreased probing depths around the implants. However, the definition of CHS is from the bone to the occlusal plane; therefore, although the prosthetic space is improved, the CHS remains similar when only soft tissue

reduction is performed. Too little CHS can be further complicated when the surgeon places the implant above the bone.

## Crown Height Space Evaluation

When the CHS is less than ideal, the following prosthetic parameters should be identified[3]:

Available space
Abutment taper
Surface area of abutment
Cement type
Surface finish
Occlusal topography and material
Load on final restoration
Fit of restoration to abutment
Retention of prosthesis
Implant manufacturer
Implant platform to occlusal plane dimension

The consequences of insufficient CHS include a decrease in abutment height (which may lead to inadequate retention of the restoration), inadequate bulk of restorative material for strength or esthetics, and poor hygiene conditions compromising long-term maintenance.[4] In addition, the final restoration flexes inversely to the cube of the thickness of material. A fixed prosthesis half as thick will flex eight times as much and will further result in loss of cement retention, loosening/fracture of fixation screws, or porcelain fracture.[5] Inadequate thickness of occlusal porcelain or acrylic, or unsupported occlusal material caused by inadequate metal substructure design, may also result in complications such as component fracture. Minimum restorative requirements vary in function of the implant system. The minimum restoration space may be determined by limiting the occlusal material to 1 mm and reducing the abutment height to the top of the retaining screw.

When fabricating a cemented restoration, the restoration technique (indirect versus direct) may be influenced by the CHS. Because additional abutment height for retention may be gained by a subgingival margin, the indirect technique (making an implant body level impression) may have an advantage over a direct intraoral impression. An implant body level impression permits the subgingival restoration to be placed more than 1mm subgingival, with greater accuracy, representing benefit in a reduced CHS situation, especially when the soft tissue is several millimetres thick. The indirect technique is also used for custom abutments, which can be designed with increased diameter to increase the overall surface area for retention. A custom abutment may also be fabricated to decrease the total occlusal convergence angle to increase retention for cemented prostheses.

The retention and resistance difference between a 3-mm high and a 5-mm high implant abutment may be as great as 40% for a 4.5-mm-diameter abutment. Less than 3 mm of abutment height indicates a screw retained crown, 3 to 4 mm requires a screw retained or resin-cemented restoration, and greater than 4 mm of abutment height allows for clinician's preference[6]. Splinting implants together, regardless of whether they are screw retained or cement retained, can also increase retention.

Conditions such as cement hardness, surface condition of the abutment, and occlusal material (zirconia vs. porcelain vs. metal) are also to be considered in limited CHS situations[7]. The occlusal material is important to consider in reduced CHS for two primary reasons. When zirconia or metal is used as the occluding surface, it is possible to provide greater retention for the prosthesis as a result of an increase in abutment height. The abutment height may be greater because the occlusal space required above the abutment is only 1 mm, whereas porcelain requires 2 mm of occlusal space and acrylic resin requires 3 mm or more. When a screw is used to retain the crown, the strength of occlusal porcelain is reduced by 40%. Acrylic resin requires the most dimension for strength and is much more likely to fracture when the CHS is limited. This is why acrylic resin overdentures require more CHS than a porcelain-metal fixed prosthesis.

The surgeon may magnify the prosthetic problem of limited CHS by placing the implant at an angle to the ideal position. Angled abutments lose surface area of retention from the abutment screw hole and further compromise the limited space conditions. In addition, a 30-degree taper on an abutment to correct parallelism loses more than 30% of the abutment surface area and dramatically decreases the retention for the abutment. Overdentures also exhibit greater complications in situations of reduced CHS. Removable prostheses have space requirements for elements such as a connecting bar and the type and position of attachments and restorative material (metal versus resin) [8].

## Conclusion

According to English, the minimum CHS for individual attachments is 4.5-mm CHS for locator-type attachments and between 12 and 15 mm for a bar and O-rings.[9]Marinbach reported the ideal CHS for removable prostheses is >14 mm and the minimum height is 10.5 mm (i.e., non-bar overdenture).[10] The lowest possible profile attachment should be used in situations of reduced CHS to fit within the contours of the restoration, provide greater bulk of acrylic resin to decrease fracture, and allow proper denture tooth position without the need to weaken the retention and strength of the resin base. Overdenture bars may be screw retained or cement retained. The most common current method of retention for a fixed prosthesis is screw retained. The most common method of bar retention by almost the same percentage for overdentures is screw retention; yet the advantages of cement retention for a fixed prosthesis also apply to an overdenture bar. Therefore, in minimum CHS situations, the screw-retained bar has a clear advantage.

## Authors Contribution

Nikita Singh: Manuscript editing, Literature search, data collection
Aardra Aniyan: Manuscript drafting
Vaishnavi Rajaraman: Manuscript editing

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