How to secure subgingival margin in restorative crown therapy using an intraoral scanner

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Introduction

Dentists put in a lot of effort to ensure precision in tooth preparation, isolated margins, and in the selection of appropriate impression materials, with the aim of acquiring the best impression in restorative crown therapy. These efforts form the basis in order to get the best restoration fit as well as to reproduce the most accurate physiological shape which are critical factors in restorative therapy.

The clinical use of intraoral scanners has been effective in various areas, and this is expected to increase. In order for the intraoral scanner to be effectively used in the fabrication of definitive prosthesis, it is necessary to improve the precision through the development of intraoral scanners, but we also need to overcome the limitations of the current digital scanner.

In this regard, effort can be made to minimize the failure in acquiring the impression of the subgingival margin, which is one of the clinical limitations of existing scanners using optical systems.

Furthermore, we should use intraoral scanners for anterior restorative therapy which has high aesthetic demands, introduce the clinical practice of taking the impression of the finishing line set in the subgingival space, and further develop the digital dentistry field by sharing cases as well as through active discussions.

The new method of acquiring impressions by using an intraoral scanner instead of the conventional impression method has become a new clinical tool which will gain increasing prominence in the future with the development of digital equipment. Dentists and dental technicians should synergize their efforts to secure accurate data when using intraoral scanners.

About Dr. Gyeongan Joe

Dr. Gyeongan Joe graduated from Chosun University’s College of Dentistry, and also completed his Master’s and PhD studies from his alma mater. He is a director of the NAG study group and a famous lecturer internationally, giving talks about occlusion and esthetic dentistry. Dr Joe is a board member of the Korean Academy of Esthetic Dentistry and maintains a private practice at OK dental clinic, Yongin-Si, Kyeonggi-Do, Republic of Korea. He is also the author of ‘Esthetic Harmony’ and ‘BPS - Biofunctional Prosthetic System’.
Requirements for Crown

In order to understand unchanged biological principles, the operator needs to have a basic knowledge and solid foundation in clinical practice. Among them, good marginal fit and suitable subgingival and supragingival reproduction are the most important factors in prosthodontics treatment. Precise tooth preparation for the abutment, considering the biological environment, should first be achieved, and based on this, one will be able to get the optimum fit and a shape that does not damage the biological environment, resulting in a restoration that ensures positive prognosis.

There are various options for anterior restoration, and the corresponding preparation method for the abutment tooth varies according to the criteria of the operator and the aesthetic needs of a patient. However, the formation of subgingival margins, which are frequently used in traditional full crown restoration, is not an easy process, starting from the abutment tooth preparation to the impression-taking and finally the shape reproduction. Dentists should be committed towards drawing a clear and visible preparation finish line as well as ensuring a smoothly polished teeth surface.

Principles of Impression Taking

In order to reproduce a margin of an accurate shape and physiological subgingival patterns in clinical practice, it is important to ensure there is sufficient spaces around the margins. In order to achieve this, various kinds of cords and techniques have been developed. This is the most important aspect to maintaining the physiological stability of the gingiva around the restoration and can be described as the technical key of impression-taking.

In the VPS silicone impression-taking technique, spaces around the margins provide the dental technician with clear information on the regions around the restoration and, as a result, this space serves as a precaution that ensures the best restoration. This technique is hence the very basic treatment process that a dentist must acquire.

As the impression material goes deep into the margins and surroundings, especially into the lower direction, in the stone model, clear information on the shape of the margin and emergence profile can be read, allowing the dental technician to reproduce the subgingival shape with ease. In clinical practice, dentists should make continued efforts in achieving the desired outcome.

How to secure the space around the subgingival margin using retraction cords

In the past, gingival retraction using retraction cords was the most effective in efforts to secure the required space around the margin. In general, ensuring there is sufficient space for the penetration and curing of impression materials used as well as the control of exudate are the most influential factors for precision. Hence, the improvement in manufacturing and clinical technology to enhance the precision are required.

For gingival retraction using retraction cords, the dual cord technique and single cord technique are commonly used, depending on the periodontal environment around the abutment tooth. However, for general impression-taking with VPS silicone material, it is thought that the dual cord technique is the most effective in achieving the goal of impression-taking as mentioned above.
In the dual cord technique, the 1st cord plays an important role in ensuring vertical depth and blocking the rise of exudate. However, in cases of thin biotype gingiva or shallow sulcus, tissue may be damaged during the process. The 2nd cord serves to secure the horizontal space. The thickness and depth of the 2nd cord is hence very important. The thickest part of the 2nd cord should be placed at the margin to ensure horizontal width.

The figure above shows gingival retraction being performed using the dual cord technique. The thickest part of the 2nd cord should be located in the margin. The 2nd cord in the region indicated by the yellow arrow has been inserted too deep causing the cord to be covered by the gingiva.

As seen from the figure above, the impression-taking in this situation results in disconnected results, as one is not able to secure the technical key at the same location.

Another example of not being able to secure space around margins is due to the 1st code being inserted either too shallow or embedded too deep. Also, when a cord is too thin, it will be too difficult to have a clear, sufficient space around the target margin. However, what happens to these cases when we take digital impressions?

### Taking subgingival margins using an intraoral scanner

The doubts on the possibility of proceeding with these steps of restoration using digital impressions have gradually lessened with the development of the intraoral scanner. Depending on the restoration option, the positioning of margins may differ, but as seen in previous cases, if sufficient space can be secured around the margin, it is possible to secure an effective margin with an appropriate technique for digital impressions using an intraoral scanner. This also serves as an opportunity to expand the scope of digital dentistry applications.

The difference between VPS silicone impressions and digital impressions is that while the rubber impression material secures a space with the use of physical pressure, digital impression secures a space by obtaining the margin shape through an optical system using light and reflection, although there are differences depending on the individual intraoral scanner. There are pros and cons to such an optical system so one should leverage on the strengths of the system but also take certain precautions. Using this method with a solid understanding of how it works is expected to result in effective outcomes. The following is a case presentation using digital impressions.
Case Presentation

In order to restore the missing maxillary right central incisor, a 4-unit full zirconia fixed partial denture will be constructed using the maxillary right lateral incisor, left central incisor, and left lateral incisor as abutment teeth. No other specific techniques are required. Instead, a more rigorous and meticulous compliance of various principles in restorative therapy is required. A dentist should ensure that during the tooth removal stage, no undercut should be formed, and qualities such as roundness, high polished surface and sharp finishing line, etc. should be achieved.

In order to secure the space around the margin, a stable periodontal tissue must first be secured, and the gingiva retracted within the physiological range by using a retraction cord of the appropriate size on the surrounding gingiva. The digital impression-taking method that follows may be slightly different depending on your intraoral scanner brand although the method may be similar between different models of the same brand. The model used for this case was the Medit i500. This device uses an LED light source and operates on the optical triangulation scanning method in which two cameras acquire impressions by analyzing the three-dimensional differences of reflected light. The technology for digital impressions is thought to be more important than the method. The procedure is introduced as follows.

Figure 1.

Avoiding sharp edges during tooth removal is a principle which needs to be followed when doing restorations such as when working with VPS silicone impressions. Even when using digital impressions, sharp edges can cause distortions in the STL data, what is known as “Edge Loss”, which can be a significant factor in the fit of the eventual prosthesis.

Figure 2.

The position of the finishing line was set to about 1 mm of the subgingival region. In order to clarify the shape of the margin in the bridge abutment tooth formation as shown in the above figure, the undercut is often formed when the angle of the bur ends at a different angle from the path of insertion. In the final step, the angle of bur should be parallel to the path of insertion.

Figure 3.

After the tooth removal, the retraction cord is inserted around the margin using the dual cord technique. The 1st cord uses a 2-0 black silk for suture and the 2nd cord uses a # 2 Bredent.

Figure 4.

An important point is that cord packing should be done only when the gingiva is healthy. In addition, one of the advantages of digital impression is the ability to take impressions of each tooth separately. For example, if the base of two adjacent teeth are too close, rather than inserting the second cord at the same time as shown above, inserting the second cord only on the tooth which you are taking the impression of and then moving on to the adjacent tooth will minimize tissue damage and make gingival retraction easier.
Figure 5.

The above scan data is an image capture of the digital impressions taken by the intraoral scanner. The 2nd cord is shown in the captured image. The actual images taken were up to one molar tooth on the left and right, considering the occlusion. The procedure of securing the space of the marginal part of the abutment tooth is performed after this data was taken.

Figure 6. (a-c)

For the procedure, you can first erase the entire region around the margin of the teeth which you wish to take the impression. Then, re-scan the deleted area and the areas will be automatically combined. Once you are ready, dry the cord and its surroundings in the mouth and prepare to remove the cord.

Figure 7.

As soon as the cord is removed, the region is quickly scanned before the exudates come out. On the right side of the figure, you will be able to see the well-separated space around the margin. The area is scanned in 360 degrees as quickly and as close to the space as possible. It usually takes 1-2 seconds to scan using the Medit i500. An important thing to take note of is the appropriate gingival retraction according to the health of the periodontal tissue and the periodontal type around the abutment teeth.

Figure 8.

The above figure is a maxillary left central incisor scan data acquired via this method. Although the image isn’t clear as it’s a screen capture of the video, the shape of the overall margin is clearly visible without diffuse reflection by exudate. In order to obtain scan data of the margin of adjacent teeth, it is necessary to preserve the data of the maxillary left central incisor and for this reason, the set region is kept locked so that the corresponding region does not get exposed to the light sources.

Figure 9.

The green area highlighted in the figure above is an area that is locked such that it does not get affected by the light source when scanning the margin of the adjacent teeth. The procedure to scan the adjacent maxillary left lateral incisor is conducted as described earlier (Figure 6a-c), followed by the procedure in (Figure 7).
You can see that the screen captures from the processed scan data are relatively clear. Digital impressions, like VPS silicone impressions, also show data that is not clearly separated from the gingiva in areas where the second cord has no horizontal clearance of the space. In addition, although in part, the first cord is near the finishing line and the cord image appears in dark-blue color. Therefore, it is thought to be advantageous to use a thread that is as tightly twisted as possible. In case of healthy periodontal state or a thick gingival type with a bit of depth in sulcus, scanning using only a single cord with some thickness can be an option.

The above figure shows the scan data from a different case acquired using a well-controlled single cord technique. Compared with (Fig. 10), the image of the first cord on the subgingival margin is not seen and the area around the margin is very clear. This method is optionally used in clinical practice.

The figure on the right and the figure below show the three-dimensional space around the acquired abutment tooth margin. The separation of the gingiva is clearly shown, and this information can be helpful for the dental technician in the formation of the sub-gingival contour.
Figure 13. 4-unit fixed partial denture is designed through CAD design.

Figure 14. Well-acquired subgingival margin impressions help in getting the best fit and in the reproduction of physiological subgingival forms.

Figure 15. The state just before entering the furnace after coloring the cut bridge. The zirconia block used was KUWOTECH’s ZIRMON A-2 Block, and the coloring liquid was also from KUWOTECH.

Figure 16. This figure shows the state right after the furnace step. Staining and glazing are conducted in this state and the zirconia bridge is completed.
To test the clinical fit of the completed zirconia fixed partial denture, a fit test was performed using light body type VPS silicone impression material. The fit was verified to be adequate across the entire margin. Many clinicians tend to be suspicious of scan data from intraoral scanners. However, it is thought that the CAM software and the processing performance of the equipment and the problem of the plasticizer during the plasticization of the machined block have more influence on the fit in the workflow using intraoral scan data. The efforts in the clinical practice of dentists should be focused on the best possible formation of the abutment tooth as well as taking clear impressions of the area around the margin.

The figure shows good results in terms of functionality as well as aesthetically. Formation of subgingival margins and physiological subgingival shape maintain a healthy gingiva.

A state of healthy gingiva can be seen after 1 month.

A figure of healthy gingiva as seen from occlusion surface after 1 month.
Conclusion

A traditional method using a retraction cord is introduced as a way of taking the digital impression of a subgingival margin. A common consensus is that most clinical cases can be sufficiently resolved by appropriate cord selection according to the type of surrounding gingiva in healthy periodontal conditions.

As illustrated above, although intraoral scanners are being incorporated into clinical practice, the full effectiveness of these scanners in clinical practice can only be demonstrated when the understanding and technical approaches are faithful to the fundamentals of dentistry. Regardless, more research as well as technology advancements will be required to make improvements on areas which are still facing many limitations.
About Medit

Since our foundation in 2000, Medit has worked to improve and revolutionize 3D imaging technology for both the industrial and dental fields. We strive to create the highest quality products for our customers while also working to bring down cost. Because of this, we have produced some of the most advanced and most affordable 3D scanners on the market.

Medit has achieved double-digit annual growth over several years through unparalleled technology and creative product development with the aim to maximize client convenience.

Developing our own patented state-of-the-art technology, Medit’s mission is to provide the opportunity of success and growth to both our clients and employees.