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Basal Implants- A Narrative Review

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Abstract

According to the concept of basal implantology the jaw bone comprises of two parts the crestal bone and the basal bone. The traditional implants use the crestal bone which is subjected to higher rate of resorption whereas the basal bone provides excellent quality cortical bone for retention of the dental implants. Basal implantology also known as bicortical implantology or just cortical implantology is a modern implantology system which utilizes the basal cortical portion of the jaw bones for retention of the dental implants which are uniquely designed to be accommodated in the basal cortical bone areas. Thus, it cannot be denied that basal implantology fits the principle "Primum Nihil Nocere", i.e., "First Do No Harm". Whenever robust surgical procedures are involved conventionally, basal implants come to the rescue.

Keywords: Basal Implant, BOI Implant, BCS Implant, Disk Implant, Basal Implantology, Immediate Loading.

Introduction

Implant placement in severely atrophic jaws is especially challenging because of the poor quality and quantity of the future implant bed. The crestal implants require appropriate vertical height for implant placement. Ridge augmentation procedures are often used to overcome inadequate vertical height for the placement of dental implants. Despite acceptable success rates, these approaches involve unpredictable degrees of morbidity at the donor and/or recipient sites and poor prognosis. Furthermore, increase in cost, time and also the patients are reluctant for the surgical procedures. Basal implants were developed primarily for immediate loading and in places where, there is inadequate vertical bone height as in atrophied ridges. These basal implants are synonymously

called lateral implants or disk implants. These two types of implants are not only differentiated by the way they are inserted but also by the way forces are transmitted.

History

Basal implants were developed and improved in several stages, primarily by French and German dentists. The first single-piece implant was developed and used by Dr. Jean-Marc Julliet in 1972. It was not until the mid-1980s that the French dentist, Dr. Gerard Scortecci, presented an improved basal implant system complete with matching cutting tools. In 1997 Dr. Ihde Dental has started producing lateral basal implants in the way the "Diskimplants" were made.

Types of Basal Implants

There are four basic types of basal implants available

a. Screw Form.

b. Disk Form.

c. Plate Form.

d. Other Forms.

Both of the types can be further categorized into

Screw Form

a. Compression Screw Design (KOS Implant)

b. Bi-Cortical Screw Design (BCS Implant)

c. Compression Screw + Bi-Cortical Screw Design (KOS Plus Implant)

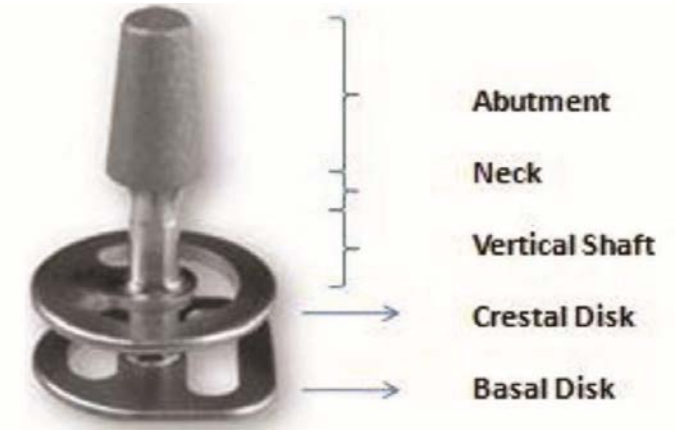

Figure 1: Basal Disk Implant/Basal Osseo integrated Implant (BOI)

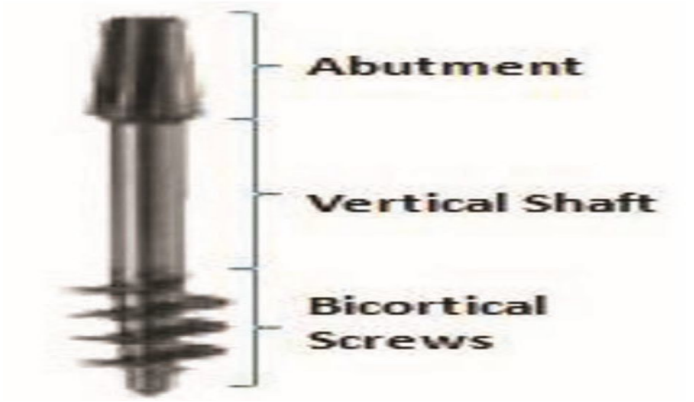

Figure 2: Bi-Cortical Screw (BCS) Implant

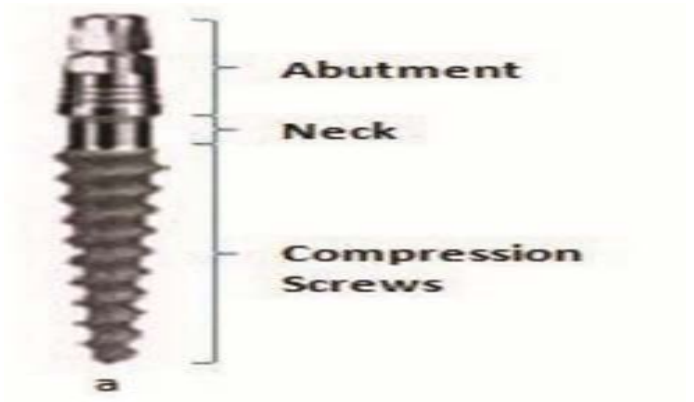

Figure 3: KOS Implant with Compression Screws

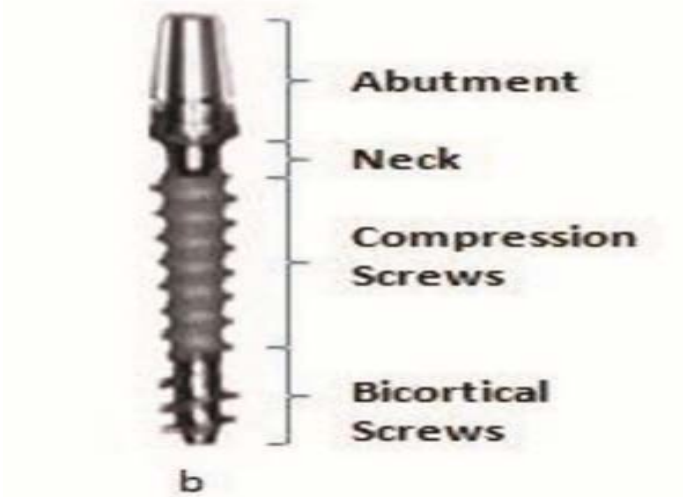

Figure 4: KOS+ Implant with Compression and Bicortical Screws

Disk Form Basal Osseo integrated Implant (BOI) / Trans-Osseous Implant (TOI) / Lateral Implant1)

- According to abutment connection.
  i. Single Piece Implant.

ii. External Threaded Connection.

iii. Internal Threaded Connection

a) External Hexagon.

b) External Octagon.

- According to basal plate design

i. Basal disks with angled edges.

ii. Basal disks with flat edges also called as S-Type Implant.

According to number of disks

i. Single Disk.

ii. Double Disk.

iii. Triple Disk.

Plate Form

a. BOI-BAC Implant.

b. BOI-BAC2 Implant.

Other Forms

a. TPG Implant (Tuber pterygoid).

b. ZSI Implant (Zygoma Screw).

Classification of Basal Implants

Description	Design	Mode of integration	Type of osteotomy
Lateral basal implants	Force transfer surfaces are intended for transmission of force to the cortex.; thin, polished vertical implant sections. Elastic implant design	1. Dual integration in the area of force transmitting discs 2. Gradual integration along the other vertical implant sections	T-shaped, lateral, bicortical
Screwable basal implants	Polished, tapping apical threads; thin, polished vertical implant sections. Elastic implant design.	1. Osseofixation of the force transferring thread. Gradual integration along the other vertical implant sections	Crestal, trans-cortical
Combination implants	Polished, tapping apical threadable; compression thread along the vertical axis of the implant. Stiff implant design.	1. Osseofixation of the force transferring thread. 2. Compression of the cancellous bone along the vertical axis of the implant.	Crestal, trans-cortical

Draw backs with conventional root form implant

- Requires large amount of bone.
- Require wider bone at crest to accommodate its neck which usually found lacking in many cases because of bone loss.
- Mostly require bone augmentation procedures at the time or before the implant insertion
- Sometimes the implant is placed into the poor density spongy bone which cannot be loaded immediately- may require healing time up to 3-6 months.
- Because of vital structures such as maxillary sinus and mandibular canals in the back region of jaws, these implants may require large amount of bone augmentations (sinus augmentation, block grafting, nerve repositioning), multiple surgical steps, higher cost and longer healing times.
- Has a screw connection which may lead to future screw loosening/ screw breakage problems under the prosthesis.
- Peri-implantitis- Theses implants have rough surface which is prone to collect bacterial infection once exposed to oral environment or placed at the infected region. Hence these implants cannot be placed into the infected tooth socket.
- Crestal bone loss- maximum stress/ load comes on the bone crest which may cause crestal bone loss.
- Wide neck diameter and rough surface of these implants require thick, keratinized and stable/non-mobile gingiva around its neck to avoid the problems such as soft tissue.
- Delayed loading remains safer for single-tooth replacements and two implants.
- Connection with strong, healthy natural teeth is possible in selected cases.

Contraindications of Basal Implants

Relative Contraindications

- In heavy smokers
- Individuals with poor oral hygiene
- A history of substance abuse or chronic alcoholism.
- Candidates with erythropoietin or metabolic disorders, or immunodeficiency syndrome
- Patients undergoing radiotherapy.
- Individuals with a history of prolonged use of corticosteroids, and those taking anticoagulants or at risk for cardiac disease

Absolute Contraindications

- Heavy bruxism, clenching, uncontrolled malocclusion, and/or a history of fractured teeth, especially when associated with psychological problems or epilepsy.
- High-dose IV bisphosphonates for treatment of severe osteoporosis or cancer (risk of osteonecrosis of the jaw)
- Facial and trigeminal neuropathies associated with a depressive State
- Severe heart disease, recent stroke, or heart attack (risk of infectious endocarditis)
- Severe or uncontrolled diabetes but not controlled diabetics (normoglycemic).
- Untreated renal insufficiency
- Ongoing radiotherapy for cancer (risk of osteoradionecrosis of the jaw, especially after radiation of the head and neck region)

Advantages of Basal Implants

- Immediate loading- BOI and BCS basal implants are specifically designed to utilize strong cortical bone of the jaw. Hence these implants are considered to be the best option for immediate loading.
- BOI (Lateral basal implants)- is inserted from the lateral aspect of the jaw bone and it require minimum bone height of 3 mm and that means:
- Virtually every patient can be treated without bone grafting.
- Because bone grafting is avoided, also risk groups, such as smokers and controlled diabetes patient, can successfully receive these implants
- BCS (Screw Basal Implant): - is inserted like a conventional implant, but it transmits loads only into the opposing deep cortical bone. that means
- Strictly cortical anchorage of the implant guarantees for safe load transmission and osseointegration
- The neck of this implant can be bended to make multiple implantheads parallel for passive seating of the prosthesis.
- Peri-implantitis incidence – Peri- implantitis is the single most common cause for failure of conventional implants. This happens mostly because of the rough implant surface as well as the interface problems between the multiple parts of the implant. Judicious use of monobloc, smooth surface basal implants eliminate the threat of peri-implantitis by almost 98%
- Minimally invasive, minimal surgical complications

Monobloc Design

Basal implants are one-piece implants in which the implant and the abutment are fused into one single piece. This minimizes failure of implants due to interface problems between the connections which exist in conventional two- and three-piece implants.

Disadvantages Of Basal Implants

- For BOI implants open flap surgery is needed. Gingival incision and suturing are necessary, unlike BCS implants, as BCS implants may be inserted without a flap procedure.
- SKILL: Only a properly trained operator can

accomplish the surgical procedure without any complication. If placed by inexperienced or untrained hands, problems are bound to come.

Complication of Basal Implants

- Functional overload osteolysis - The masticatory forces transmitted via the basal implants to an endosseous location create local microcracks in the cortical bone. If microcracks accumulate at the bone/implant interface, the reduction in mineralization can also be detected on radiographs where the osteolytic area initially exhibits only diffuse radiological borders. As long as the bone substance is not torn away from the implant and the area is not superinfected, the loss of mineralization remains diffuse but usually reversible. Basal implants in this status have a good chance of getting reintegrated at a high degree of mineralization, if loads are reduced to an adequate amount.
- Infection - It spreads submucosally. This may result in infected vertical parts if the implants are submerged below the mucosal level over time, eliminating the necessary gateway for suppuration as the area of penetration is closed with scar tissue. Any inflammation of this type will spread just like a submucosal abscess and is treated in the same way. In rare cases, reduction osteotomies or the replacement of implants will be required if vertical bone growth becomes excessive.

Immediate Loading

Principles of Orthopedic Bone Surgery And Comparision To Dental Implantology

The common teaching in orthopaedic surgery regarding primary healing has been discarded today, based on the results of histology, that all healings are of the secondary type.

In immediate loading protocols with basal implants, primary stability reached in cortical areas must be good and durable enough to allow integration into woven bone and remodelling thereafter. Whether or not stability is given and maintained depends on the implant design, the quality of the bone (including the effects of compression and corticalization along the vertical axis of the implant), and on the early (immediate) and sufficient splinting which will distribute the masticatory forces.

Scientific Evidence For Immediate Loading

Immediate functional loading of implants has long been proven adequate and generally validated scientifically. This applies in particular to implant systems which, were designed based on the manufacturer's instructions and are intended to be used in one-stage procedures with immediate functional loading.There is no trustworthy scientific evidence that specific characteristics of the endosseous implant surface (etching, sandblasting) would favour or facilitate immediate loading. However, these surface characteristics can promote the development or persistence of the so-called peri- implantitis. The approach of treating surfaces for the express purpose of reducing healing time is unknown in traumatology. On the other hand, there have been sufficient studies and extensive clinical experience from dental and orthopaedic surgery to the effect that macromechanically designed anchorage in cortical bone can facilitate immediate loading. As a rule, the first and second cortical bone layer are harnessed for this purpose.

Immediate Loading And Early Implant Loss Under Load

If implants project out of the mucosa and are immediately loaded, their design and surface properties must be adequate.

- As a rule, the diameter of the mucosal penetrating area of the implant should be chosen as thin as possible (2-3 mm).
- Those parts of the implant which provide the current anchorage should be as far away from the mucosal penetration area as possible.
- Cortical bone has superior mechanical properties compared to spongy bone.
- Compression bone along the vertical axis of a screw implant leads to a corticalisation of this bone. This increases the stability.
- Loss of stability of immediately loaded dental implants often is not the result of initial infection, but the result of crack accumulation and subsequently increased remodelling. Implants in living bone tend to become loose under load. The reason for this phenomenon is that in the living bone several developments add up to the weakening of the bone:
- Upcoming remodelling weakens the bone at the same time
- weakened bone loses tremendous amounts of mineralization
- Low mineralized bone loses its inborn protection against bacterial attack, without however gaining enough blood supply and then switching over to a blood-derived anti-infective capacity.
- The primary aim of all treatments including basal implants is to bring the patient back to regular mastication on immediately loaded constructions, which splint the implants and allow the implants to integrate safely.
- In addition, placement of parallel implants is avoided, because the non-parallel implants splinted by a plate create good macro retention within the bone. This divergent placement reduces the risk of loosening and increases stability.

If Consensus on Immediate Loading

- The International Implant Foundation in Munich / Germany has published in 2019 “the consensus on immediate loading of dental implants”. This consensus does not address single tooth restorations specifically. It refers to loading of segment-bridges with a minimum of three stable - implants or circular restorations. It is as follows:
- Contemporary implant-prosthetic planning requires patients to be at least presented with the option of immediate functional loading. The decision in favour of or against this treatment option in a specific case would then be subject to the decision prerogative of the treatment provider in cooperation with a comprehensively informed patient. Experience has shown that patients generally do opt for immediate loading.
- Diagnostic findings and patient preferences govern the choice of implant system.
- Diagnostic findings and the implant system used govern the individual treatment plan
- Disclosure of extraneous controlling mechanisms

Where there is very little bone, immediate reconstruction is necessary even on the day of surgery. In combination with compression screws and the presence of sufficient bone around the lateral basal implant, the prosthetic construction can beset with permanent cement no later than on the fifth post-operative day. In the distal portion of the upper jaw, the support should take place in the third cortex. As in lateral and screwable basal implant the vertical implant part only connects the load transmission areas with the abutments, (i.e. thy have no further function), they should be kept as thin as possible and polished. Decisive for the successful insertion and especially for immediate loading is the primary stability achieved by osseo-fixation. Later also such implant parts

my integrate, which are not ossseo-fixated in the first place.

Immediate Loading Vs Immediate Implantation

Immediate loading restores the masticatory function quickly. The issue of immediate loading must be separated from the issue of immediate implantation. In Crestal implantology the success of immediate implantation thus depends on the presence of sufficient amount of intact bone apically to the extracted tooth to ensure primary stability. Implants inserted in this way are not eligible for immediate loading. Therefore, the recommended approach is to perform two separate procedures involving the use of membrane coverage, especially if adjuvant bone grafting is performed as well. Unfortunately, this approach is not consistent with the universal desire of all patients to have their chewing function immediately restored. All the problems that have just been discussed are not normally an issue with BOI implants.

Immediate Loading Vs Delayed Loading

A decision must be made by what time the implants will be ready to accept masticatory loads. Common situations warrant immediate loading, while exceptional situations involve a healing period of 40 days before the superstructure is inserted. While this concept should not be applied religiously, it does explain the correct temporal sequence of BOI-based restorative treatments.

Common situations (regular cases) are defined as follows:

- Presence of alveolar ridge.
- Bone quality of I, II or III according to Misch.
- Congruence between jaw arch and dental arch.
- Adequate primary stability of the implants.
- No pre-existing bone lesions around the implant site.
- Exceptional cases are defined as follows:
- Absence of an alveolar ridge.
- Bone quality of III or IV according to Misch
- Lack of congruence between jaw arch and dental arch
- Inadequate primary stability of the implants.
- Previous surgery around the implant site.

In other words, the available bone structure (e.g. by three-dimensional imaging) is not the sole criterion in deciding for or against immediate loading. Other factors in the equation include the spatial configuration of the superstructure, masticatory relations, the leverage associated with tooth length, the current and planned masticatory function, pre-existing bone lesions (e.g., by past implantation procedures), and so forth.

Delayed loading is used in the "exceptional situations" where immediate loading is contraindicated according to the above criteria. In that case, the restoration is inserted around 6 weeks after implantation procedure, when the primary phase of bone healing has been completed.

Crestal implants are routinely doomed once they show clinical mobility and signs of inflammation which automatically implies that the bone integration has been lost. BOI implants are different in this respect because they can also become mobile by reversible overload osteolysis. Once the affected implants are freed from their load-bearing prosthetic function or once the loads are corrected and reduced, the inherent functional stresses within the cortical structure will gain the upper hand. This will in many cases lead to renewed Osseo adaptation of the implants. Subsequently, the implants can be restored to clinical service.The term "Osseo adaptation" indicates

the tendency of cortical bone to close any gaps along its surface. Any under mineralized or connective-tissue segments are competitively displaced in the process until close contact of the cortical bone structure to the implant Surface is established. A thin residual layer of connective tissue will remain, however. This is also the case in "osseointegration".This approach can only work as long as no infectious have advanced to the cortical area weakened by low mineralization. If infection occurs, the bone tissue will turn to granulation tissue that does not remineralize. As a result, functional stimuli will redefine the stress of the trajectories within the cortical bone and move them away from the implant site. The only way to make these trajectories is to return to soft tissue reduction by surgical intervention.Matrix formation for postoperative bone repair takes place between days 12 and40 after the implantation procedure. BOl implants should not be repositioned during that time. It is therefore recommended to leave the temporary or definitive bridge in place and not to make any modifications to the prosthetic structure after day 11 and before day 41. Failure to heed this advice may prevent the development of a uniformly textured matrix which will eventually result in an inferior bone structure characterized by poor mineralization. Some claim, on thebasis of bone physiology, that modifications to the prosthetic design should have occurred after the initial phase of inflammation (i.e. after day 7) and not resumed, if not prior to the initial phase of mineralization has been completed (i.e. before day 41). Therefore, temporary restorations are usually inserted right during the surgical procedure in these cases.

Immediate Loading And The Need For Continuous Prosthetic Adjustments

The following considerations elucidate the issue of immediate loading from a different perspective:

- By immediately loading the bone that has been injured by the implantation procedure, the direction of healing can be defined in advance.
- Many patients will still exhibit a deleterious functional pattern when the first restoration is inserted. Once the masticatory surfaces have been rebuilt, the muscle activity and functional pattern will change accordingly, to which will eventually give rise to morphological alterations of the jawbone itself.
- As a consequence, the masticatory surfaces need to be adjusted by the additive and/or subtractive means. In some situations, the necessary adjustments would be so extensive that it could be simpler and less expensive to replace the masticatory surfaces altogether. This approach will also enable the dentist to correct any changes that the soft-tissue relations may have undergone in the meantime.

Only Loaded Boi Implants Can Stimulate the Bone

The bone functions are impaired by implantation procedures. As explained, deformation of the implant with the subsequent suction-pump effect on the bone involve a number of desirable effects. These effects, however, presuppose that the implant is loaded. Therefore, immediate loading of BOI implant is always a good idea because it will jump- start the flow of nutrients.Experience has been that unloaded BOI implants show an increased tendency toward plaque accumulation. Furthermore, delayed loading does not seem to offer any advantages over immediate loading in terms of implant survival. It is therefore recommended to use immediate loading whenever possible.

Difference Between Conventional (Crestal) and Basal Implantology

Features	Crestal implants	BOI implants	Clinical Advantages
Threaded pin/ vertical aspect of implants	Surface enlarged: - microdesign thread, etching/sand blasting	Machined surface	BOI implants are less infection prone
Load transmission	Vertical; close to or far from the mouth depending on the design	Basal, far from the mouth	Load transmission area in infection protected regions
Load transmission vs. infection	Load transmission area roughly coincide with infection entry paths	Load transmission areas are removed from infection entry p[paths	BOI implants are less infection prone
Nutrient an d oxygen supply	Enossal supply of nutrientsand transport speed are limited	Periosteal supply of nutrients can be regulated within wide margins	Overload situations can be caught and repaired by increasing the nutrient supply
Mucosal emergence point	Should be located in attached mucosa if the vertical aspect has a rough texture	May be located in either attached or unattached mucosa	Much freedom in positioning BOI Implants; wounds may be closed with widely mobilised flaps after extractions
Synchronizatio n of bone and superstructure	Restoration is synchronized with crestal/alveolar aspect of the bone due to connection	Restoration is synchronized with basal aspect of the bone due to rigid connection	The fate of the alveolar bone is of no consequence for the preservation of BOI implants; large bridges synchronize basal bone areas; interfaces compensate for any lack of synchronicity

Recall requirements	Frequent	Less frequent than natural teeth	Low cost to patients during maintenance Phase treatment success not very dependent on oral hygiene
Nicotene abuse	Influences the implants chance of survival	Influences only the initial soft tissue healing process	Smoking is not contraindication; it only constitutes a risk duringinitial wound healing
Implant volume	Screw 5×13 mm: 200 mm^2	EDS 9G9: 67 mm^2	Better blood supply to the implant side.
Volume of bacteria and debris in a 2 mm pocket (assuming the layer is 0.01 mm thick)	Diameter volume 3.75mm 0.24mm^3 4.8 mm 0.30mm^3	Diameter volume 1.9mm 0.12mm^3	Thin penetration areas show less debris and significantly less bacterial attack surface. Less bacteria related changes of blood flow in direction and quantity.
Abutment diameter	3.3-6.5mm	1.9-2.3mm	Infection repelled “on both sides”.

Conclusion

The concept of basal Implantology requires profound knowledge on maxillofacial anatomy both of the resorbed and non-resorbed state. The surgical and the prosthetic protocol have to be carried out rigorously, without compromise. Good care has to be taken not to overload the bone around single implants, even while they are splints inside a larger prosthetic construction. Active biological osseointegration along the vertical axis of the implant is not necessary for the functioning of these implants. With the help of strategic implant, almost 100% of patients can be treated today with fixed teeth throughout their life. The procedure is predictable and affordable; however, it requires an intense training of the treatment provider. Most of the traditional rules of crestal dental implantology cannot be applied to the basal implantology. These principles respect the properties of native bone and they avoid unnecessary bone augmentations.Periimplantitis does not occur around polished, thin implant designs, such as BCS and BOI. Note however, that these designs cannot prevent the gradual bone loss, which is called atrophy. The position of strategic implants must be well chosen for this reason and adequate prosthetic workpieces must be fabricated to provide long lasting aesthetics.

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