

Dental prosthetic options



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Introduction:

Prosthetic options to replace a missing tooth fall into two main categories: Fixed prostheses and removable prostheses.

When choosing the suitable treatment option to replace a missing upper incisor, multiple variables involving the patient wishes, expectations, dentist skills and training, cost of treatment, and clinical findings should be taken into consideration (Al-Quran et al., 2011). These factors will have a strong influence on the short and long terms success of the treatment selected.

Based on the conservation of neighbouring teeth and annual failure rates, dental implants are the treatment of choice to replace a missing central maxillary incisor, followed by conventional bridges, and removal partial dentures (Pjetursson & Lang, 2008).

Facial growth in relation to age:

Craniofacial development is a continuous process that starts intra-uterine and has shown different rates between males and females (Brahim, 2005) .

Skeletal maturation in males is reported to be reached at the age of 20, while females reach the maturation phase earlier, at the age of 17-18 years (Heij et al., 2006).

Therefore, it has been recommended, when selecting the prosthetic option to replace a missing tooth, to take the patient's age into consideration. Dental Implants should be avoided until the cessation of jaw development

mentioned earlier (Daftary et al., 2013) or after the end of the growth spurt (Heij et al., 2006).

If dental implants are used before the vertical maturation is reached, it will not grow vertically with the alveolar bone and will be submerged at different levels depending at the patient's age when the implants were inserted (Brahim, 2005).

Dental trauma and the surrounding tissues:

In most scenarios, it is rare that a single incisor will be traumatized with no damage on adjacent incisors, surrounding bone, or soft tissues. If any damage sustained to neighbouring teeth, the status and prognosis of these teeth should be assessed, as it will have a strong impact on the selection of the definitive treatment option.

Traumatic avulsion of teeth, account for 0.5% - 3% of all dentoalveolar trauma, and it is associated with damage to the alveolar bone, specially the buccal plate (Andreasen, 1970).

After tooth extraction, reduction of the alveolar bone height and width can be as high as 50% in the first year (Schropp L, 2004) with the highest amount of bone loss within the first three months (Pietrokovski & Massler, 1967).

Bone loss is not even between the buccal and palatal bone plates, with more bone loss in the buccal plate (Pietrokovski & Massler, 1967) and bone width than height (Van Der Weijden et al., 2009).

There are several treatment options that could be used for replacing a lost maxillary central incisor:

1. Removable Partial Denture (RPD):

RPD have the advantages of minimal clinical skills required, minimal chair time, and preservation of neighbouring teeth. On the other hand, the patient satisfaction is low, with a sense of insecurity, high risk of accidental breakage, and loss.

Still, RPD is the quickest, cheapest replacement option of a missing incisor, and usually used as a temporary treatment until healing is complete and bone remodelling is minimal.

2. Resin Retained Fixed Bridges (RRB):

Resin retained bridges share the advantage of removable dentures of having minimal effect on abutment teeth with no risk of pulpal injury and the reversible nature of the prostheses. It is also relatively of low cost and acceptable aesthetic result (metal frame could be masked by opaque cement on expense of translucency).

The commonest failure associated with RRB is frequent debonding of 20% over 5 years (Pjetursson et al., 2008) which could cause social embarrassment to the patient.

The patient could also be given an Essex Type retainer with a single tooth in the gap as an emergency prosthesis until recementation of the resin retained bridge is done.

RRB could be used as a final prosthetic option but more often is used as an interim measure as it could be reversed at any time, with 87.7% 5 years prognosis (Pjetursson et al., 2008)

If the prosthesis is planned to be a temporary option, Rochette type wings are made with holes to facilitate frequent removal.

3. Conventional Bridge:

This is an irreversible treatment, replacing the missing tooth with a 2 or 3 units' conventional bridge. These offer superior retention and aesthetics over RRB by the mean of full coverage of the abutment teeth. The main drawback is the need to reduce the sound tooth structure of the abutments with 20% risk of nerve damage and higher caries risk. The reduction of tooth structure is more for porcelain fused to metal or full ceramic/Zirconia crowns than full crown which is a requirement in the anterior aesthetic zone.

According to previous studies, " if the adjacent teeth are severed, or in need of being crowned, the conventional bridge is to be preferred (Annual failure rate: 1.14%)" (Pjetursson & Lang, 2008).

The success rate is reported to be 90 % for 10 years and 72% for 15 years (Pjetursson et al., 2008) and (Burke & Lucarotti, 2012).

4. Endosseous dental implants:

When considering the success rate, dental implants are reported to have the highest documented survival rate of 94% for 5 years (Attard & Zarb, 2003) and 89% over 15 years (Pjetursson et al., 2008).

Dental Implants have numerous advantages over the previously mentioned treatment options.

Comparing dental implants to other fixed treatment modalities, there is no danger of pulpable damage of adjacent teeth, as no abutment teeth preparation is involved. Implants also facilitate the patient's daily oral hygiene routines around the prosthesis, since there are no connectors between the prostheses and abutment teeth, making flossing possible.

Furthermore, the maintenance and regular follow ups by the dentist is easier for dental implants. Removing a conventional bridge is a challenging task compared to screw retained implant supported crowns which could be removed and re-inserted multiple times when required (not applicable to cemented crowns).

For implant supported restorations in the anterior maxillary region, a detailed patient assessment, implant site assessment, and proper treatment planning is the key for a successful restoration. The planning should be derived from the restorative point of view not guided by the availability of bone. The following points should be carefully assessed:

1. Lip position at rest and smile:

The patient's aesthetic expectations should be coupled with the upper lip position at rest and when smiling.

In most cases, 2 mm of the incisal edge of the central incisors should show at rest, and it could be either 100% of all the incisors (high smile line), more

than 75% visible (medium smile line), or (low smile line) showing less than 75% of the incisors.

With low smile line lip position, the aesthetic challenges are lower, and the emphasis on soft tissue contouring and papilla regeneration is also lower (Tjan et al., 1984).

If the patient's expectations are high while having high smile line, patient education should take place prior to implant treatment as the implant treatment could be deemed a failure if did not meet the patient's aesthetic requirements despite been successful in every other aspect.

2. Attached gingiva and surrounding soft tissue:

The attached gingiva could have thick, moderate, or thin architecture. Thick gingiva is more common than the thin biotype; it appears as a more stippled, flat fibrous band of attached mucosa, masking the underlying bony contours. It is associated with higher resistance to recession, better soft tissue contouring, and resistance to peri-implant disease. On the other hand, thin gingival biotypes are found in 15% of population (Tjan et al., 1984) and it is a thinner mucosal layer with the bony scalloping showing through it. This type is more prone to exposure of the implant and compromising the aesthetic result (Tjan et al., 1984).

The thin biotype has been associated with long triangular teeth and more incisally positioned contact points, while the thick biotype is associated with shorter, square crowns with more apically positioned contact points (hence, more papillary regeneration).

3. Implant size used:

Implant size has a direct effect on the emergence profile of the coronal restoration and aesthetics. Natural existing teeth and available bone are helping factors when selecting the right implant diameter, while implant length should provide a safety distance to the surrounding anatomical structures.

The implant diameter should allow 1.5 mm between implant and neighbouring teeth (and 3mm between adjacent implant fixtures) (Jivraj & Chee, 2006).

The gingival biotype also should not be overlooked when selecting the fixture diameter, for example; if wider implants are used with thin gingival biotype, the risk of recession is higher (Rodriguez & Rosenstiel, 2012).

4. Implant position:

For the most aesthetic emergence profile, implants should be placed 1.5 mm – 2 mm from the adjacent tooth, 3mm – 4mm apical to CEJ (Jivraj & Chee, 2006), and ideally should be placed under the proposed cingulum of the coronal restoration.

A diagnostic wax up and a prefabricated surgical stent are of very important in deciding the crown and implant positions, and evaluating the amount of bony defect and the need for bone graft. Transferring the surgical stent into the patient's mouth will allow the visualization of the amount of incisor show and smile lines.

The implant position and angulation will dictate the abutment type and the retention method used for the restoration (screw or cement retained).

5. Available bone quality and quantity:

Bone density has been classified by Lekholm and Zarb (1985) into 4 categories:

1. Homogenous compact bone,
2. Thick cortical bone around dense trabecular bone,
3. Dense trabecular bone covered by thin cortical bone,
4. Very thin cortex enclosing minimal density trabeculae.

Types 3 and 4 are associated with more failure rates, and are more found in the maxilla. Therefore, under -preparation of the osteotomy site could be done to gain higher initial stability.

Branemark et al 1977 defined osseointegration as “ direct structural and functional connection between living bone and load carrying implant”.

Implant fixture should be in direct contact with healthy bone in three dimensions. Therefore, the amount of available bone required around any dental implant is 1. 5 mm buccally and palatally, 3 mm between adjacent implants and at least 1. 5mm -2mm between implants and adjacent teeth (Misch, 2008) and (Rodriguez & Rosenstiel, 2012).

If buccal bone width is not sufficient, a smaller diameter implant that will be functionally and aesthetically sound could be selected. It will also allow slight palatal positioning (Rodriguez & Rosenstiel, 2012). Bone grafting/augmentation procedure could be done to add the bone thickness (Esposito et al., 2009) and bone could be sourced from:

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- Patient's own bone (Autogenous graft): commonly could be harvested from calvarian bone, iliac crest, mandibular ramus or chin. This provides highest reported success rates (Esposito et al., 2009).
- Different human bone (Allograft): usually from cadaveric bone. Bone undergoes special treatment to be deproteinized and freeze-dried (Esposito et al., 2009).
- Animal sources (Xenograft) usually cows or pigs.
- Synthetic materials (Alloplast): artificial graft material which could be used solely or in conjunction with autogenous grafts (Esposito et al., 2009).
- Bone regeneration membranes: these are used to act as a barrier between the superficial soft tissue and the grafted bone or material to prevent ingrowth of the fibrous tissue and allow pure bone development. These membranes could be either natural or synthetic, resorbable or non-resorbable.

If block bone graft is used, it should be allowed to heal for minimum 3 months before implant placement, while bone augmentation with alloplastic materials and membranes could be done simultaneously (Esposito et al., 2009).

It is worth mentioning that porcine-derived bone and membranes may not be acceptable by some patients based on their religious beliefs and a specific consent should be obtained.

The bone height will also impact the papilla formation, together with the crown shape and level of contact points; the papilla regeneration is favourable in square crown, broad apical contact points, and when the

distance is around 4-5 mm between bone crest and contact points (Rodriguez & Rosenstiel, 2012) and (Tarnow et al., 2003).

Vertical bone augmentation has been shown to be unpredictable (Esposito et al., 2009) and the patient should be aware of the black triangles (lack of papilla) if vertical bone is deficient (Tarnow et al., 2003).

Conclusion:

Based on the previously discussed factors and the evidence available, dental implant would be the treatment of choice if the neighbouring teeth are of good prognosis and the aesthetic results are realistic. It is safe to place an implant in 20 years old male, as the growth of the jaws is complete. A diagnostic wax up and stent could be made to evaluate the aesthetics, and available bone. A 4.5 mm buccal width is not enough to place a suitable size implant in a suitable bony envelope, so a block bone graft will be needed before the implant placement. If the source of the trauma was sports related and likely to occur again, a mouth guard should be worn to protect the implant and teeth during activity.

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