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College of Dentistry

All on 4 and all on 6 implant supported prosthesis

A Project Submitted to The College of Dentistry, University of Baghdad, Department of prosthodontics in Partial Fulfillment for the Bachelor of Dental Surgery

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Certification of the Supervisor

I certify that this project entitled " **All on 4 and all on 6 implant supported prosthesis** " was prepared by the fifth-year student (**Marymar Mohammed Salah)** under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Supervisor's name:

Lecturer Dr. Hasanain Kahtan Alalwan

Dedication

All thanks to Allah for making me pass all the hard days, and this work is specially dedicated to my parents, who have never failed to give me financial and moral support; to my sister, who always gives me the right words in the most desperate times; to my brother, who always stood behind me; and to my little sister, our batter fly and to Dr. Muhanad, who teaches me to not be limited and motivates me.

Acknowledgment

First of all, I thank **God Almighty**, who blessed me with wisdom, patience, and willpower to reach this level in my life.

I would like to thank Professor **Dr. Raghad Al Hashimi**, the dean of the College of Dentistry, University of Baghdad for providing me the opportunity to complete my work.

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List of Abbreviations

mm	**millimetre**
IOD	implant overdenture
CHS	Crown hight space
OD-1	Overdenture option 1
S	**six**
F	four
A-p	anteroposterior
FEA	finite element analysis

Introduction

A dental implant is a prosthetic device made of alloplastic material(s) implanted into the oral tissues beneath the mucosal and/or periosteal layer and on or within the bone to provide retention and support for a fixed or removable dental prosthesis; a substance that is placed into and/or on the jaw bone to support a fixed or removable dental prosthesis the majority of patients who were treated with implant supported prostheses reported an increase in their quality of life, assurance, and self-confidence including psychological advantages as well as the preservation of dental structure next to the teeth to be replaced due to its high success rates and predictability, its clinical implication is increasing rapidly **(Sonoyama *et al*., 2002; Den Hartog *et al*., 2008;Aglietta *et al*., 2009).**

Common oral conditions have been shown to have a substantial effect on well-being and quality of life. The loss of one or more natural teeth often results in disability, as essential daily living activities, such as speaking and eating are impaired, and also in handicap, for example, by decreased social interaction because of embarrassment associated with denture wearing **(Allen *et al*., 2001).**

The main role of prosthodontics is the rehabilitation of patients after loss of teeth and oral function. Individuals with less education and low income tend to have poorer dental status because of poor finances. Older individuals accustomed to their conventional dentures do not show interest in implant treatment **(Bhat *et al*., 2012).**

Moreover, a large number of patients experience difficulties in adapting to removable prostheses, while a smaller number are unable to accept removable prostheses at all. This may be explained by anatomical, physiological, psychological, and/or prosthodontics factors **(Balsi *et al*., 1994).**

Functional tests have demonstrated inferior masticatory ability in subjects with removable prostheses in comparison to dentate controls. Even with excellent prostheses, many patients experience difficulty with denture retention, speech and mastication **(Best, 1993;Chowdhary et al., 2010).**However, with the advent of new technology more restorative options have become available. Among these, implant treatment has come into focus, since it provides excellent long-term results in rehabilitation of partially or completely edentulous patients **(Narby *et al*., 2008).**

An implant-retained prosthesis provides greater stability, improved biting and chewing forces, and higher client satisfaction than a conventional denture. The financial cost lays a question mark in the people who are aware about implants. Thus, this study was planned to evaluate the knowledge and attitude of patients toward implant treatment as an option for replacement of missing teeth **(Eckert *et al*., 2002; Akeredolu *et al*., 2007).**

Four and six implant-supported fixed full-arch prostheses with various framework materials were assessed under different loading conditions. The principle involves the use of 4 or 6 implants restored with straight and angled multiunit abutments, which support a provisional, fixed, immediately loaded, full-arch prosthesis placed on the same day of surgery. The treatment has been developed to maximize the use of available bone and allows immediate function**(Maló *et al* 2005 ;Weinstein *et al* 2010; Malo *et al* 2010).**

Aim of the Review

➢ This review aims to comprehensively understand the concept, advantages and other prosthodontic related aspects of all on 4 and 6 implant supported prosthesis treatment option for completely edentulous patients.

Chapter one

Review of literature

1.1 Implant

1.2 Implant classification

1.2.1 Depending On Anatomical Site

A. Subperiosteal

B. Transosteal

C. Endosteal (Manappallil ,2003).

A. Subperiosteal implants : Because there is often not enough bone in which to place an endosteal implant, dentists turned to placing implants on and around bone rather than it in the form of subperiosteal implants.In 1943, Dahl placed metal structures on the mandible and maxilla with four projecting posts. Goldberg and Gershkoff made an impression taken of the mucosa covering the edentulous ridge. On the model produced from this impression they generated a multifenestrated narrow cobaktcobalt-chrome- molybdenum reasonably accurate**(Lemons and Natilla, 1996).**

B. Transosteal implants: In 1975, Small introduced the transosteal staple bone plate, a reconstructive device placed through a sub mental incision and attached to the mandible with multiple fixation and two transosteal screws to support a full arch prosthesis. Current application of this device has been limited to the mandible only. Other transosteal implants of historical importance are the single transosteal implant of cranin and the transmandibular implant of Bosker **(Small and Misiek, 1984).**

C. Endosteal root-form implants: Atwo-stage threaded titanium root-form implant was first presented in North America by Branemark in 1978 at a

conference in Toronto. Branemark had found in conjunction with Vital microscopy studies that titanium placed in the femurs of rabbits could not be remove from the bone after a period of healing. Branemark developed and tested a two-stage dental implant system utilizing pure titanium screws, which he termed fixtures. The first fixtures were placed in patients in 1965, and intensive studies offered clear evidence of prolonged survival. freestanding function, bone maintenance, and significant improvement in the benefit-to-risk ratio over all previous dental implants **(Branemark 1985).**

1.2.2 Depending on the reactivity with bone

A. Bilotolerant

B. Bioinert

C. Bioactive

Biologic classification is based on tissue response and systemic toxicity effects of the implant and is divided into three classes of biomaterials: biotolerant, Bioniert, and bioactive. In terms of the long-term effects at the bone implant interface. Biotolerant materials, such a polymethyarcrylate (PMMA), are usually characterized by a thin fibrous tissue interface.The fibrous tissue layer develops as a result of the chemical products from leading to irritation of the surrounding tissues.

Bioinert materials, such as titanium and aluminum oxide, are characterized by direct bone contact, or osseointegation, at the interface under favorable mechanical conditions. Osseointgation is achieved because the material surface is chemically non reactive to the surrounding tissues and body fluids.

Finally bioactive materials, such as glass and phosphate ceramics, have a bone-implant interface characterized by direct chemical bonding of the implant with surrounding bone. This chemical bond is believed to be caused by the presence of free calcium and phosphate compounds at the implant surface **(Block *et al*., 1997).**

1.2.3 Depending on the type of integration

A. Ossointegrated

B. Fibrointegrate

Branmark (1982) proposed that implants integrate with bone such that the bone is laid very close to the implant material without an intervening connective tissue.

Osseointergration can be defined as:

1. Osseous integration (1993) the apparent direct attachment or connection of osseous tissue to an inert alloplastic without intervening connective tissue.

2. The process and resultant apparent direct connection of the endogenous material surface and the host bone tissues without intervening connective tissue.

3. The interface between alloplastic material and bone**(Veerauyan *et al* 2003).**

Weiss theory states that there is a fibro-osseous ligament formed between the implant and the bone and this ligament can be considered as the equivalent of the periodontal ligament found in the gomophosis, He defends the presence of collagen fibers at the bone-implant interface. He advocates the early loading of the implant **(Veeraiyzn, 2003 ;,Bhat *et al*.,2003).**

1.2 Implant supported overdenture

In the treatment of fully edentulous patients, the practitioner fasces the problem of greatly resorbed residual ridges, excess salivary flow, reduced muscle tone, and

other factors, which mean that the patients require greater retention of their prostheses for psycho logic reasons as well as for the efficiency of their masticatory system.

Implant-retained overdentures make are considered an attractive option in comparison to conventional complete denture. Patients find their prosthesis more stable and retentive and have improved oral function. The treatment has a high success rate with minimal reported morbidity. The long-term reliability of implant overdentures is well documented, particularly when they are placed in the mandible. The provision of these restorations is thought to be one of the more economical forms of implant treatment, and hence more affordable to patients. The surgery is relatively simple because fewer implants are generally required to support an overdenture, as the; occlusal load generated is shared between the alveolar ridge and the implants **(Waston *et al.*, 2001).**

The most important advantages of overdenture compared with complete dentures are:

1-Greater functional stability due to preservation of residual ridge contours near the abutment teeth (whether or not attachments are used).

2-Better retention, especially when retentive attachments au as used in mandibular prostheses.

3- Greater chewing efficiency because of better stability and retention.

4- Less pressure on the mucosa.

5- Reduced extension of the denture base in the maxilla. The palate need only be partially covered when retentive elements are utilized. This is often very important psychologically for the patient.

6- Adaptation and incorporation of the denture is facilitated by the factors listed above.

7- Training effect for complete dentures that may become necessary later, by preparing the neural pathways for appropriate reflex patterns. This takes. Place while the occlusion and denture bases are similar to those of complete dentures, but while stability and retention of the removed dentures are maintained by the supporting teeth and retentive attachments **(Charles and Martin, 1993).**

1.4 Impression techniques used in implant

Impression technique that been used in implants were classified as a direct impression technique which use an open tray with pickup technique for transferring the impression coping, and indirect Impression technique which use a closed tray with transfer technique for transferring the impression coping.

1.4.1 Direct Impression techniques

It need a custom or stock open tray with proper access to the impression coping screws **(figure1.1)**, which exposes the coronal part of the impression coping. And it use pickup technique in which the impression coping is stayremain with the impression As it removed from the patient mouth **(figure 1.2)**. In direct technique, impression material applied around the impression coping and the tray is filled with impression material and inserted into the patient mouth, a guide pin which is a pin that contact the impression coping and it stay through the tray and from the holes of the open tray impressions, so ensuring that the guide pin can get through the hole of the open tray is significant important. Before removing the tray, impression copings are unscrewed and removed from the mouth with the set

impression. The implant analogues are connected to the copings using the same screw been used before removing the tray, for confirmed seating
of impression coping to the implant in the tray, radiographic x-ray can bring a lot of value **(Gayathridevi *et al.*, 2016)**.

Indication: It's used for single tooth restorations, and also for multi-unit restorations and denture supported by implant.

Advantages: the desired healing and soft tissue contour can achieved because the laboratory preparation and contour of the provisional prosthesis can be conformed before final crown fabrication.

The direct technique can be further subdivided into splinted and non- splinted techniques.

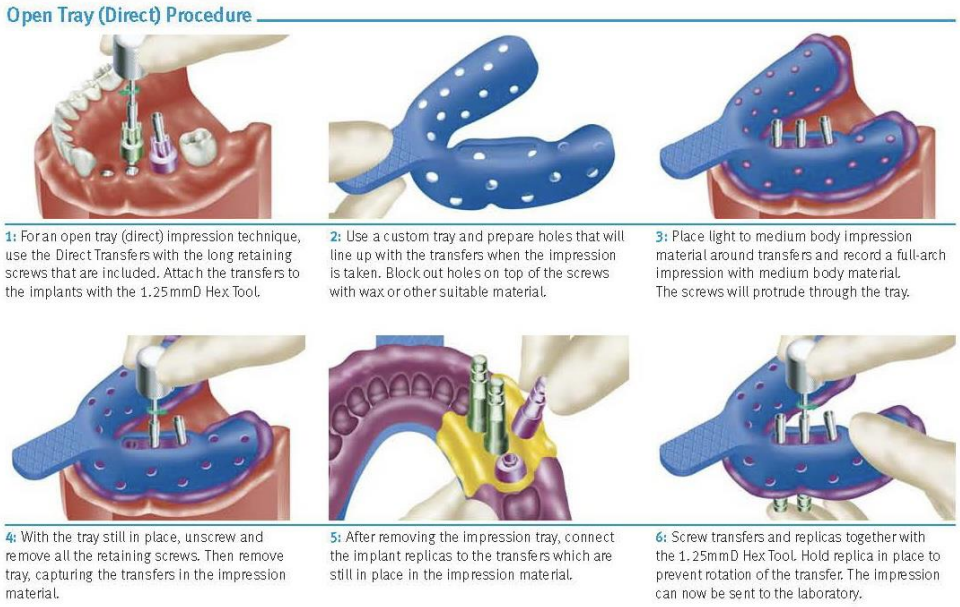


Figure (1.1); open tray impression techniques (direct).

Splinting vs. non splinting impression

Splinting mean using material to splint the impression and the materials include light-curing composite resin, impression plaster, thermoforming material, acrylic resin, and autopolymerizing acrylic resin In vitro, twenty two studies was made for comparing the effect of splinting and non-splinting technique On the accuracy of impression, more than the half of studies show that using splinting have positive effect on The accuracy of the impression also three clinical studies was made to demonstrate the effect of Using splintering or non-splinting on the accuracy of the impression, the result of all the clinical studies shows totally positive effect for using splinting over the non-splinting **(Papspyridakos *et al* 2014).**

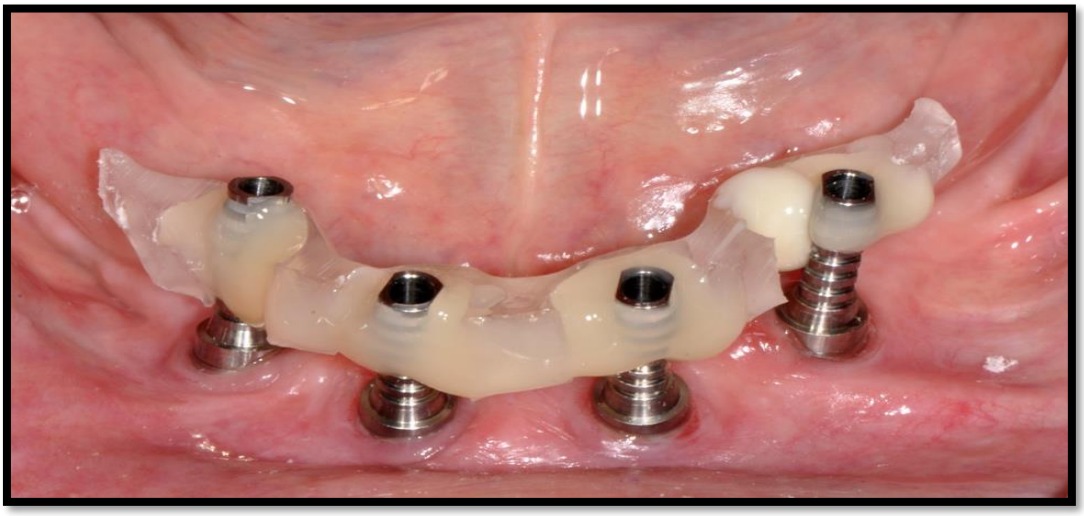


Figure (1.2) ; Splinting using flowable composite or acrylic

Figure (1.3) ; Concurrently light-body impression material is expressed around the copings to capture the morphology of the soft tissue

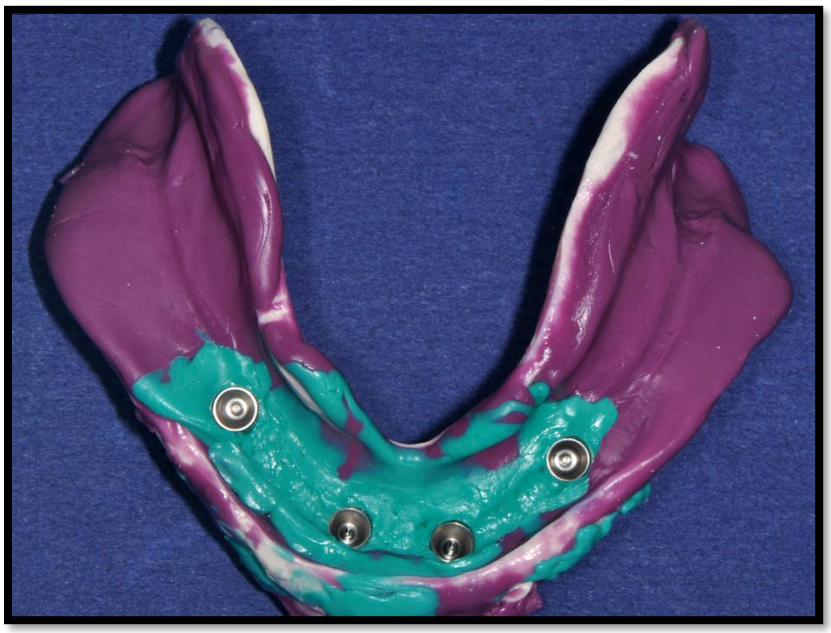


Figure (1.4) ; Afterthe impression material polymerizes, the screws in the temporary copings are loosened and the impression removed.

1.4.2 The indirect technique

Indirect technique (closed tray): An indirect technique used closed tray without any holes it's also use a transfer technique in which the impression coping aren't removed when the tray is removed (**Gayathridevi *et. al*,2016)**, these copings are then removed and connected to the implant analogues and reinserted in the impression tray .

Indication: the indirect technique is indicated for posterior teeth because of difficulty of access in that region and also in patients with limited mouth opening. material is expressed around the copings to capture the morphology of the soft tissue.

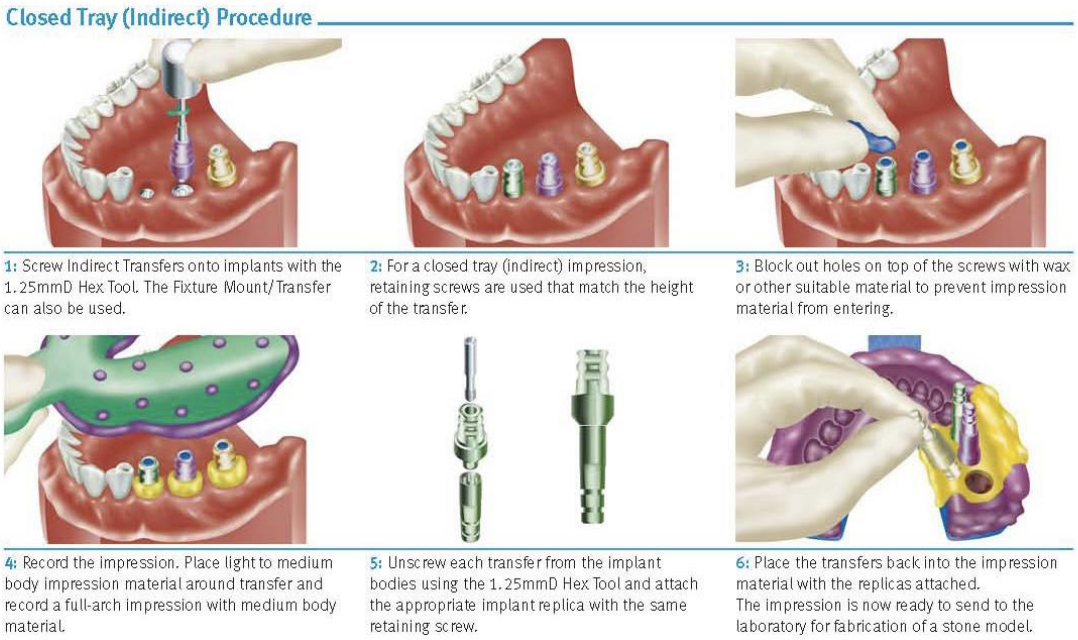


Figure (1.5): closed tray impression techniques (indirect).

1.3 All-on-four and all-on-six implants prosthesis

The “all-on-four” treatment concept was developed to maximize the use of available remnant bone in atrophic jaws, allowing immediate function and avoiding regenerative procedures that increase the treatment costs and patient morbidity, as well as the complications inherent to these procedures **(Malo *et al.*, 2000).** In full-arch dental prosthesis, the prosthetic framework can generate more complications when long-span prostheses are used instead of short-span one **(Chee *et al*., 2006)**.

Although the all-on-six concept appears to induce lower stress compared to the all-on-four concept (**Almeida *et al*., 2015)**, factors related to the prostheses have not yet been evaluated. The prosthetic framework material plays an important role in stress transmission to the implant-support system and the peri-implant bone region **(Bacchi *et al*., 2013).**

Titanium and a cobalt-chromium alloy are widely used as prosthetic framework materials due to their biocompatibility, low cost, low density and favorable mechanical properties (**Hulterstrom *et al*., 1991; Watanabe *et al*., 1997).**

Zirconia, which improves the esthetic results, has emerged as a prosthetic framework material (**Abduo and Lyons, 2012)**. The edentulous maxilla's anatomic characteristics make rehabilitation of atrophic jaws with dental implants challenging. Its complex three-dimensional reabsorption process involves vertical and/or horizontal reabsorption of the alveolar ridge and sinus pneumatisation (**Chiapasco and Zanibon, 2009).**

In addition, stretched nasal cavities (**Penarrocha-Oltra *et al*., 2013)** resorption of the posterior regions (**Malo *et al*.,2011)**and low bone quality and quantity are often observed (**Lekholm *et al*., 1985)** according to the effects of the number of implants, different angles of implants, cantilever length and stress levels on cortical and trabecular bone.

1.5.1 Number of implants

Stress location and distribution in both models with 4 and 6 implants are similar and increasing the number of implants decreases the highest Von Mises stress (**Silva *et al.*, 2010)**. Japanese research team had examined the effect of implant number on distribution of stress in cortical bone of the mandible in the All-on-Four method. The results showed that by placing 4 implants, stress in the cortical bone around the implants increases compared to 6 implants (**Takahashi *et al.*, 2010).**

1.5.2 Implant angles

The provided stress due to different angles of implant placement was studied. Implants were placed with angles of zero or 15 degrees facing the mesial and distal aspects. This study showed that under horizontal and vertical forces, the highest compressive stresses were located in the cortical bone around the implant neck and the results suggested that not all of the tilted implants restored with splinted crowns displayed concentration of stress **(Lan *et al*., 2008).**

Tilted instead of straight implants can be used to avoid anatomic structures, reducing patient discomfort and financial costs and shortening overall treatment time. In the maxilla, tilted implants can be placed mesially or distally to the maxillary sinus; in the mandible they can be inserted in intertoforaminal regions (**Buser *et al.*, 1990;Agliardi *et al*., 2010).**

The rationale for using tilted implants is that the vertical forces applied during function are supposed to cause more bone resorption than horizontal forces acting around tilted implants. The angulation of distal implants divides the occlusal forces in vertical and horizontal vector components, effectively reducing the distribution of load in the surrounding bone tissue.

Furthermore, placing tilting implants in a reduced bone volume allows the surgeon to use longer implants engaging a greater quantity of residual bone, thus increasing implant stability **(Vico *et al.*, 2011; Agnini *et al*., 2014; Asawa *et al*., 2015).** Concerning marginal bone loss, finite element analysis suggests that single tilted implants undergo a greater stress than straight implants, a condition that might increase the surrounding bone resorption **(Vico *et al.*, 2011;Pen˜arrocha-Oltra *et al* 2012;Asawav *et al.*, 2015).** However, full arch prostheses create a physical connection between straight and tilted implants that changes the distribution of loading forces, reducing crestal bone remodeling **(Bellini *et al.*2009; Corbella *et al* 2011;Vico *et al.*, 2011;Chrcanovic *et al* 2015;Asawa *et al* 2015).**

1.5.3 Angled Abutments

In general, the magnitude of stress and strain for angled abutments was within or slightly above the physiologic limits. The use of angled abutments on two tilted implants placed in a curved arch and with cross-arch splinting might help decrease the stresses around the distal implants . In order to avoiding bone grafting surgery and maximize the utility of the existing jawbone volume, a tilted (or angled) implant seems a suitable alternative option **(Begg, *et al* 2009).**

1.6 Immediate extraction socket placement

The connection of implants may provide a safer transfer of load on each implant and so the placement in healed or fresh extraction bone sites may not influence implant survival when rehabilitating totally edentulous mandibles **(Tommaso *et al.*, 2012).**

From a surgical perspective, the most notable are careful implant site preparation, use of relatively low – torque producing implants , the preparation of an osseous

shelf to level the alveolar ridge and establish optimum implant sites and the provision of adequate interocclusal space.

From a prosthetic perspective, the high success rate obtained with this protocol , including minimal bone loss even with multiple extractions and bone reduction followed by immediate function is believed to be as a result of :

• Stable splinting of all four implants with the provisional immediately after surgery,

• careful occulsal adjustment to provide bilateral occulsion in the canine and first premolar areas,

• Avoid occlusal contact toward the distal of the prosthesis and maximizing the anteroposterior spread .

An Anteroposterior spread that minimizes the distal cantilevers and establishes well distributed four-point stability was probably contributary to both implant and prosthetic success. The immediate implant loading and function in the dental extraction setting sites can be performed with a high degree of confidence (**Daniel *et al*., 2012).** In order to avoiding bone grafting surgery and maximize the utility of the existing jawbone volume, a tilted (or angled) implant seems a suitable alternative option (**Maló *et al*., 2003).**

Anteroposterior spread is the distance from the center of the most anterior implant to a line joining the distal aspect of the two most distal implants on each side is called the anteroposterior (A-P) distance or the A-P spread

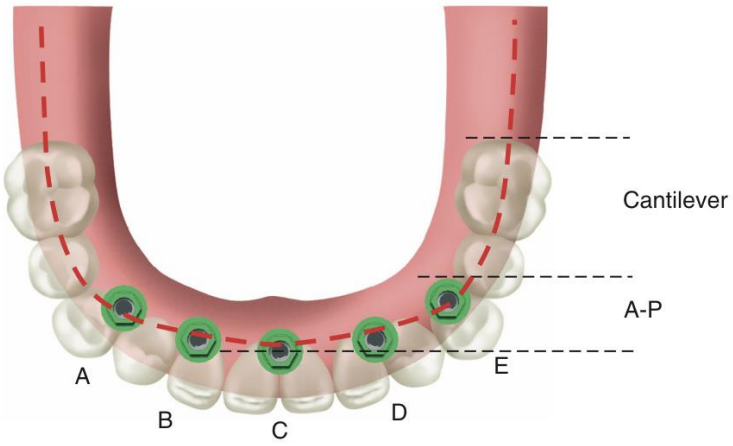
The A-P distance is affected by the arch form. The types of arch forms may be separated into square, ovoid, and tapering. A square arch form in the anterior mandible has a 0- to 6-mm A-P spread between the most distal and most anterior implants **(Figure 1.7)**. An ovoid arch form has an A-P distance of 7 to 9 mm and is

the most common type **(Figure 1.8)**. A tapering arch form has an A-P distance greater than 9 mm **(Figure 1.9).**Hence, whereas a tapering arch form may support a 20 mm cantilever, a square arch form requires the cantilever to bereduced to 12 mm or less.

The position of the mental foramen can affect the A-P spread The mental foramen is most often found between the root apices of the premolars. However, it may be located as far anterior as just distal to the canine (more common in white women) and as far distal as the mesial of the first molar apex (more oftenin black men). The farther forward the foramen, the shorter the cantilever length because the A-P spread is reduced. The A-P spread is only one of the force factors to be considered for the extent of the distal cantilever.

If the stress factors are high (e.g., parafunction, crown height, masticatory musculature dynamics, opposing arch), the cantilever length of a prosthesis should be reduced and may even be contraindicated The density of bone is also an important criterion **(Cutright *et al*., 2003).**

Figure (1.6): A mandibular square arch form has an anteroposterior (A-P) distance of O to 6 mm.As a result, a cantilever is limited.



Figure(1.7): mandibular ovoid arch form has an anteroposterior (A-P) distance of 7 to 9 mm and is the most common type. A cantilever may extend to 18 mm with the ovoid-type arch

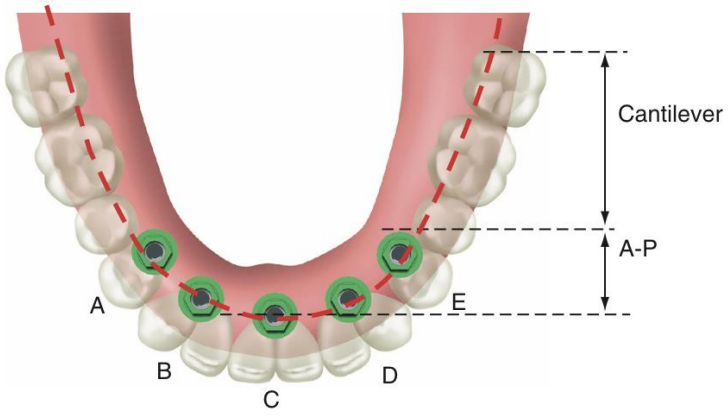
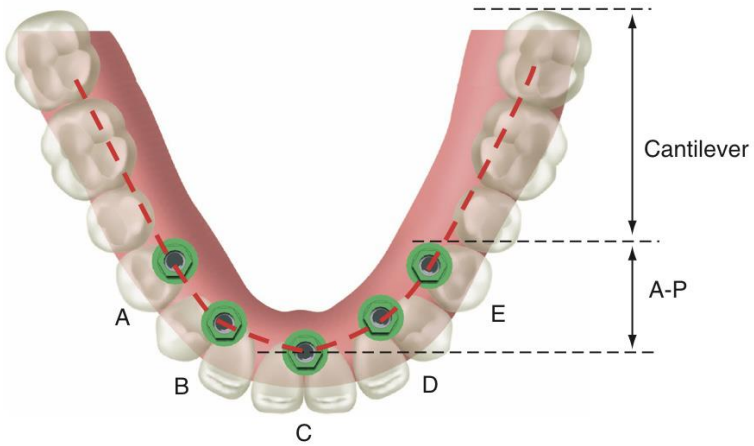


Figure (1.8): A mandibular tapered arch form has an anteroposterior (A-P) distance of greater than 9 mm, and is the type least observed. A cantilever is least at risk for this arch form.



1.7 Mandibular and Maxillary Implant Overdenture

To increase implant and prosthesis survival rates, treatment for maxillary overdentures with division A bone is To increase implant and prosthesis survival rates, treatment for maxillary overdentures with division A bone is To increase implant and prosthesis survival rates, treatment for maxillary overdentures with division A bone is planned similarly to treatment for mandibles with C minus height (C-h) bone and greater factors of forces. In addition, subantral augmentation often is performed to place more distal implants and dramatically improve the A-P distance when the anterior and posterior implants are splinted with a bar. This treatment approach has proved successful in yielding success rates similar to those for mandibular overdentures From a biomechanical perspective, the implant-restored anterior maxilla is often the weakest section compared with other regions of the mouth. In the majority of patients with available bone, the bone is less dense in the anterior maxilla than in the anterior mandible. In the mandible, a dense cortical layer is coupled with coarse trabecular bone strength and permits implants to be supported by a denser bone quality(**Misch, 1991).**

In the premaxilla, esthetics and phonetics dictate that the replacement teeth be placed at or near their original position, often cantilevered off the residual ridge, which usually is resorbed palatally and superiorly.

The accelerated bone volume loss in the incisor region, often resulting in the inability to place central and lateral incisor implants without substantial augmentation procedures To resist mandibular excursions, implants should be splinted, and as a result in an edentulous premaxilla, implants usually should be placed in both canines and at least one additional incisor positioned in the anterior regions of the arch. Only two treatment options are available for the maxillary IODs, but five treatment options are available for the mandibular IODs. The difference is primarily because of the biomechanical disadvantages of the maxilla

compared with the mandible including the fact the opposing arch is most always natural teeth or an implant prosthesis. Independent implants are not an option because bone quality and force**(Figure1.9)** (**Jemt, 1993).**
direction are severely compromised. Cantilever bars usually are not recommended for the same reasons. As such, the two treatment options provide a RP-5 restoration with some posterior soft tissue support or a RP-4 restoration, which is completely supported, retained, and stabilized by implants **(Misch, 2015)**

1.7.1 Treatment options of maxilla

The CHS is important for maxillary overdentures, and more often a lack of space may compromise tooth position compared with the mandibular situation. At least 12 mm of posterior CHS is required and 15 mm of anterior space because the central incisor tooth is greater in height. the fewest number of implants for a RP-5 maxillary overdenture should be four with as wide an A-P spread as possible.

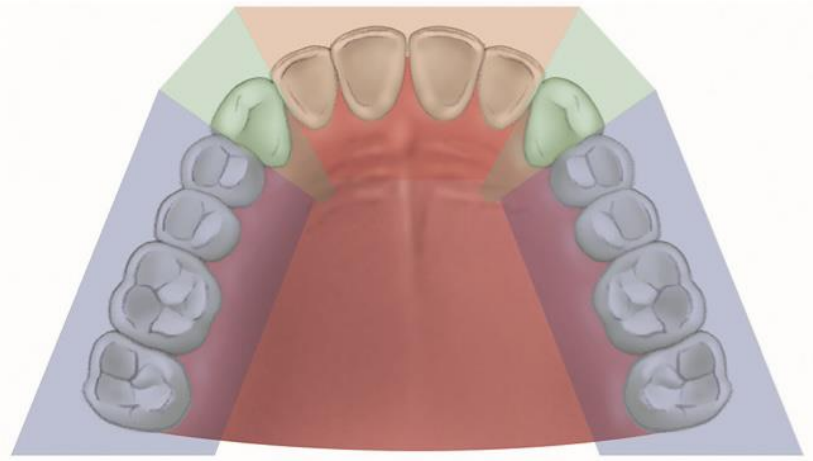


Figure (1.9): The maxillary arch may be considered a five sided arch consisting of the incisors, the bilateral canines, and the posterior regions. Splinting three or more adjacent sides together results in a rigid structure.

1.7.1.1 Treatment option 1

The first treatment option for a completely edentulous maxilla has 4-6 implants, of which at least three are positioned in the premaxilla.

Implant number and location are more important than implant size, but the implant should be at least 9 mm in length and 3.5 mm in body diameter. The key implants are positioned in the bilateral canine regions. When possible, at least one central incisor position is suggested. Other secondary implants may be placed in the first premolar region. When an implant cannot be placed in at least one central incisal position, the incisive foramen may be considered for implant insertion. Another alternative is the use of bilateral lateral incisor implants. In this option, because of the reduced A-P spread, two implants are planned in the anterior region. In these conditions, the dentate arch form should be square to ovoid. When the lateral incisor is the anterior most implant site and force factors are greater,

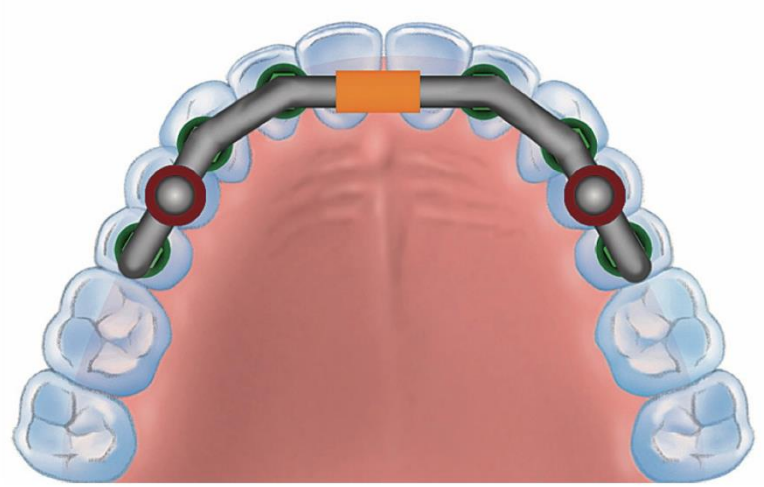


Figure (1.10): Four implants in the premaxilla usually are the minimum for a RP-5 maxillary overdenture.

1.7.1.2 Treatment option 2

In the second option for a maxillary IOD, 7-10 implants support a RP-restoration, which is rigid during function. This option is the most common treatment because it maintains greater bone volume and provides improved security and confidence to

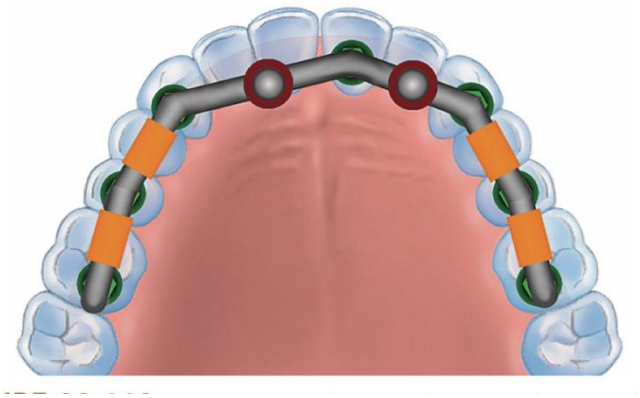


Figure (1.11) : A RP-4 maxillary implant overdenture should have seven key implant positions, similar to a maxillary fixed prosthesis.

1.7.2Treatment options of mandible

There are five treatment options in mandible implant supported Overdenture,the first three options are out of our scope because they have less than 3 supporting implants.therefore we are going to consider the 4 th and 5th options only in this review

1.7.2.1 Overdenture option 4

4 implants are placed in the A, B, D, and E positions. This is often the minimum number of implants when the patient has opposing maxillary teeth, or C–h anterior bone volume with CHS greater than 15 mm. These implants usually provide sufficient support to include a distal cantilever up to 10 mm on each side if the stress factors are intermediate to low.

The cantilevered superstructure is a feature of the four or more implant treatment options in a completely edentulous arch for three reasons:

• increase in implant support compared with OD-1 to OD-3.

• The biomechanical position of the splinted implants is improved in an ovoid or tapering arch form compared with OD-1 or OD-2.

• The additional retention provided by the fourth implant for the superstructure bar, which limits the risk of prosthetic screw loosening and other related complications of cantilevered restorations.

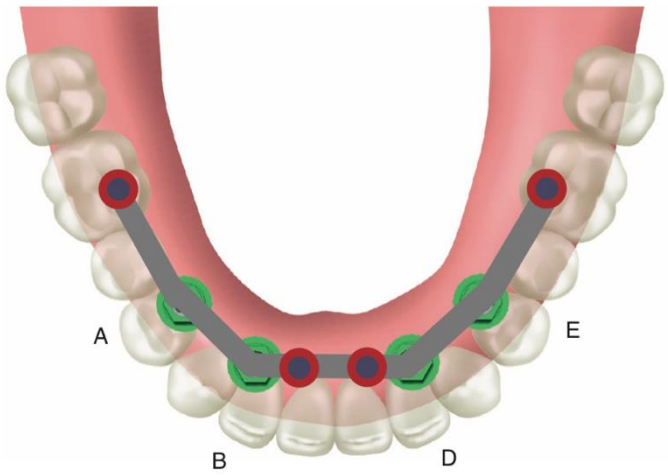


Figure (1.12): In overdenture option 4, four implants are placed in the A, B, D, and E positions. The implants usually provide sufficient support for a distal cantilever up to 10 mm..

1.7.2.2 Overdenture option 5

In the OD-5 treatment option, five implants are inserted in the A, B, C, D, and E positions. The superstructure is usually cantilevered distally up to two times the A-P spread (if almost all of the stress factors are low) and averages 15 mm, which places it under the first molar area.

The amount of the distal bar cantilever is related to the A-P distance. The forces exerted on cantilevered bar designs and implants have been studied by several authors. A constant finding is that the most distal implants receive stresses two to

three times greater than the other implants. The highest concentration of stresses is at the level of the crest distal to the most distal implant **(McAlarney1995).** Figure (1.6-1.7-1.8).

1.8 Prosthetic framework material influence

The prosthetic framework material was influential on the stress and displacement of the implant-support system. In general, stiffer materials (i.e., Zr and CoCr) showed higher stress values in the prosthetic framework than did soft materials (i.e., Ti). However, all stress values were within the tensile strength limit for all materials evaluated: CoCr **(Sevimay, (2005)** Ti (**Niinomi (1998))** and Zr **(Christel *et al.*, 1989).**

This indicates that fractures or mechanical complications would not occur under such conditions. Materials with high elastic moduli are more resistant to bending and deformation and, therefore, have high stress values **(Bacchi *et al.*, 2013 ;Sertgoz, 1997).**

Despite of the higher stress concentration in the prosthetic framework, stiffer materials transmitted lower stress for the other system components. According to **(Sertgoz *et al.*,1997)**,the use of more rigid materials for the prosthetic framework may be recommended to prevent failure of implant-support system. This correlates with the lower stress observed in the cortical bone, implants, abutments and screws and the lower displacement level of the implant-support system when using frameworks made of Zr and CoCr. also more rigid materials result in lower stress values on the bone **(Abreu *et al.*, 2010); Bacchi *et al.*, 2013)**implants and retaining screws **(Sertgoz., 1997).**

Therefore, the second hypothesis, which was that the elasticity modulus of the prosthetic framework material influences the stress on the peri-implant region, was

accepted.Regarding the stress distribution pattern in the prosthetic framework, the stress concentration in the abutment seat base most likely occurred because of the contact interface between the framework and the abutment and the preload applied to the retaining screws. The concentrations in the bar connectors (between the teeth) and in the middle line are associated with changes in the framework geometry in this region. The reduction in material thickness makes such regions more susceptible to a greater stress concentration. Fractures in the anterior region have been described as a common complication in some clinical studies and have been attributed to the absence of a metallic framework in provisional prosthesis. However, the outcome of this study indicates that the stress concentration in the anterior region also occurs when either a metal or ceramic framework is used. The bending and torsion of the framework in the middle line may explain these results.

The Ti framework with the F concept was the least successful model tested. The low elasticity modulus of Ti and the absence of a distal support for the framework in the F groups support this outcome. These findings support those of Benzing et al. that the material properties (elasticity modulus), number of implants, implant distribution in the jaw, and distal support are determining factors for displacement and stress levels in the implant-support system. (**Abreu *et al.*,2010).**

1.8 Stress patterns on implants in prosthesis supported by four or six implants

An extensive term study found no significant differences in implant survival in a comparison of complete maxillary prosthesis supported by four or six implants. The stress location and distribution patterns were very similar in both four and six implant models. Th**e** cantilever should be minimized as its presence greatly

increases stress on the distal implant, regardless of whether or not the prosthesis is supported by four or six implants .(**Guilherme *et al*., 2010).**

1.9 Treatment concept

Malò first proposed the all-on-4 concept. This involved inserting 2 implants parallel to the facial midline and 2 distal implants with a 35° to 40° angle. In the maxilla, the same authors suggested placing 6 instead of 4 implants because of the lower bone density and volume (**Malo *et al*., 2015)**. Treatment concept of "all on-four," involves placing two implants vertically in the anterior zone of the jaw, and another two implants in the posterior zone in tilted positions, with the dentures supported by only four implants. This concept has been implemented to successfully avoid damage to the inferior alveolar nerves and reduce the lengths of the denture cantilevers. Moreover, tilted implants increase the length of the implant embedded in the bone, which allows iIm plants of standard length (>10 mm) to be used, thereby substantially increasing the bone-to-implant contact area gGood success rates of this treatment concept after 3 and 7 years have been verified. **(Malo *et al*., 2012; Baggi *et al*., 2013;Malo´*et al*., 2015).**

The cantilever loading had a large effect on the bone stress and strain around dental implants in all-on-four treatment. Higher bone stress and strain might increase the risk of bone overloading loss **(Isidor, 2006; Kan *et al*.,2014).**
Few studies have investigated full-arch dentures, especially the effects of the biomechanics of implant design on four implants supporting mandibular full-arch fixed dentures. In 20113 ‹Baggi et al used an FEA method to compare the biomechanical performance of two kinds of implant systems: the SynCone system with four Ankylos implants (Dentsply Friadent) and all-on-four treatment with four NobelSpeedy implants (Nobel Biocare AB). They concluded that all-on four

treatment with four NobelSpeedy implants resulted in better transmission of applied loads to the bone compared to the SynCone system with four vertical Ankylos implants in the distal molar region. However, because that conclusion involved two combinations of analyzed parameters idimplants design and tilted angle of implants is still difficult to know whether the benefit of this “better transmission of applied loads” was due to the implant design or the tilting of the implant (**Baggi *et al*., 2013).**

Two kinds of implant designs were chosen for the analyses (Fig. 1): NobelSpeedy (Nobel Biocare AB, Go¨teborg, Sweden) and NobelActive (Nobel Biocare AB).

Figure (1.13): Nobelspeedy (left)and noble active (right)

Both of these Implant design has been considered as another factor influencing the forces transmitted to the surrounding bone, the mechanical behavior of two alternative treatments (the F and S concepts) to a bone grafting procedure for the rehabilitation of moderate atrophic maxilla with dental implants.

The first hypothesis tested, which proposed that short implants in the posterior maxillary (S concept) would result in lower stress to the implants and bone tissue than would long, angled implants (F concept), was partially accepted.

-The S treatment showed lower stresses values on the implants and cortical bone, respectively. These findings corroborate with previous studies that compared these alternative treatment concepts for the mandible (**Dogan *et al*., 2014)** and maxilla

(Almeida *et al.*, 2015).

-The presence of a greater number of implants in the S concept allows better transmission of force to the implants and supporting tissues, which may explain our results. The same behavior was noted for trabecular bone, which showed a slight decrease in the stress value in the S group. The stress reduction caused by the addition of implants in the posterior region (**Benzing *et al*., 1995).**

However, considering the stresses in the cortical bone, the Six concept showed higher values than the Four concept.

-The smaller displacement values observed in the Six groups may be the driving force toward such result. The prosthetic framework loading created energy on the system that resulted in framework deformation and bending, which were distributed over the entire framework length and displaced the implants **(Benzing *et al.*, 1995).**

1.10.1 Indication for all on four implant

1- the implant made with a good oral hygiene to prevent the present of systemic disease(**Malo *et al.*, 2007).**

2- In the region of interforaminal bone length is at least 10 mm of cases**(Menini *et al.*, 2012).**

3- Interforaminal bone width is at least 5 mm of cases**(Malo *et al*., 2003).**

4-Maxillary anterior region, bone length is at least 10 mm in cases**(Boyacı, 2015).**

5-Anterior maxillary sinus bone length is at least 10 mm in cases (**Boyacı, 2015).**

6-Maxillary region of bone width at least 5 mm in cases(**Boyacı, 2015).**

7-Conditions provided in the primary stability(**Menini *et al.*, 2012).**

8-Cases in which the implant is placed immobile for immediate loading(Menini et al., 2012).

9-Arches distance at least 20 mm in cases(**Menini *et al* ., 2012).**

1.10.2 Contraindications

1-Cases with contraindications to conventional implant placement(**Menini *et al.*, 2012).**

2- patients with systemic conditions which do not allow to the surgical implant placement(**Menini *et al.*, 2012;Boyacı, 2015).**

3-Bone reduction needed due to a high smile line in the maxilla(**Menini *et al.*, 2012).**

4-Irregular bone crest, or thin bone crest(**Menini *et al.*, 2012).**

5-Insufficient bone volume(**Menini *et al.*, 2012).**

6-Remaining teeth or root that interfere with the planning for implant placement(**Menini *et al.*, 2012).**

7-Insufficient mouth opening to accommodate surgical instrumentation of at least 50 mm (**Menini *et al.*, 2012).**

1.10.3 Advantages

1- The low cost(**Babbush *et al*., 2013).**

2-In particular achieving higher of posterior primary stability(**Menini *et al*.,2012).**

3-Temporary acrylic prosthesis make functions to start immediately (immediate loading)(**Krekmanov *et al*., 2016).**

4-The decrease in the sinus lifting surgery, grafting, and does not need mandibular nerve repositioning and minimally invasive surgery (**Spinelli *et al.*, 2013).**

5-To ensure a natural aesthetic and be sufficient masticatory forces(**Spinelli *et al.*, 2013).**

6-The use of longer implants for posterior (≥13 mm) and an increase in bone anchorage and consequently provide high primary stability with the right to be placed of biomechanical position (**Menini *et al*., 2012;Spinelli *et al.*, 2013).**

7-Planning and implant surgery computer-assisted method and computer assisted surgery are used, surgical planning and guidance to increase the success rate of implants made of digital plates Being regular occlusal forces distribution (**Spinelli *et al.*, 2013).**

8- Cantilever in the maxilla is less of 9.3 mm and 6.6 m extension to be mandible (**Spinelli *et al.*, 2013).**

9-Post-surgical period is comfortable for the patient and the less complications (**Spinelli *et al.*, 2013).**

10-The implementation of atrophic edentulous jaw (**Spinelli *et al.*, 2013).**

11-Jaw type, gender and place of implant does not affect the treatment plan (**Balshi,2014).**

12-Quickly and effective treatment option (**Ferreira *et al.*, 2010).**

Chapter two

Conclusions

Conclusions

It can be concluded that all on 4 and all on 6 are successful prosthodontic strategical treatment modalities for the completely edentulous patients. It need a thorough analysis for the patient status and highly professional dental teams that integrating together to achieve such modern treatment option for a wide range of elderly people, who are complaining of the drawbacks of the conventional treatment options.

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