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Methods for Occlusal Vertical Dimension Rehabilitation

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 “Methods for occlusal vertical dimension rehabilitation “ was prepared by the fifth-year student **Esraa Jawad Kadhim u**nder my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Signature

Lect. Yagthan Mohammd Haider

B.D.S., M.Sc Dental Material

Dedication

First of all, I would like to dedicate my graduation project to my parents for their love and constant support for me.

also to the one who was always the first to support and encourage me, to my best friend, **Aya Ibrahim..**

Finally, I would like to make a special dedication to the person who has the greatest credit in my life, to the person who taught me literally everything, to the one who was the greatest supporter of me, **Dr. Ali Abdel Karim** thanks for your hard work, patience and constant encouragement to me.

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List of Abbreviations

Abbreviation	Word
VDO	Vertical Dimension of Occlusion -
LFH	Lower Facial Height
MHI	Maximum Habitual Intercuspation
TMD	Temporomandibular Disorders
TMJ	Temporomandibular Joint
CR	Centric Relation
CAD/CAM	Computer-aided-design an Computer-aided manufacturing
ORPD	Overlay removable partial denture
T-RPD	telescopic retained RPD
RPD	Removal Partial Denture
OVD	Occlusal Vertical Dimension

INTRODUCTION:

Vertical dimension of occlusion (VDO) has been defined as the lower facial height measured between two points when the maxillary and mandibular teeth are intercuspated. Thus, it is the vertical position of the mandible in relation to maxilla when the occluding members are in contact (***The glossary of prosthodontic terms. J Prosthet Dent 2017).***

Vertical jaw relations are those established by the amount of separation of maxillae and mandible under specified conditions, classified as vertical dimension of rest and vertical dimension of occlusion. Physiologic rest position of the mandible is not determined by teeth it is established by muscles and gravity. Position of head is important; it must be held in an upright position by the patient and not supported by a headrest. Vertical dimension of occlusion is established by the natural teeth when they are present and in occlusion. In denture wearer, it is established by the vertical height of the two dentures when the teeth are in contact (***Glossary of Prosthodontic Terms. 4th ed. St Louis: CV Mosby co, 2017).***

The oral rehabilitation of edentulous patient can sometimes be impaired by the fact that all of the references used to determine the position, shape and size of the artificial teeth are essentially extra oral, such as the face contour and profile, the line between pupils, and the height of the lower facial third (***Mohindra NK and Bulman JS, 2002).*** Linear measurements, as the occlusal vertical dimension (OVD), and angular measurements, as the lower facial height (LFH), are defined based on these references.Due to this difficulty in establishing the correct OVD for edentulous patients, many researchers developed different techniques based on muscular posture

Positions, facial esthetic **,** oral function , craniometry , cephalometry **,**and electromyography (***Pound et al ,1978)*** **.** The most used techniques for the OVD determination are those recommended by Willis (***Mohindra and Bulman ,2002).***

The Willis technique is based on the fact that when the patient is at maximum habitual intercuspation (MHI) with the correct OVD, the distance between the corner of the eye and the labial commissure must be equal to the distance between the base of the mentum and the base of the nose (***Willis ,2016).***

It is the responsibility of the dentist to establish an appropriate lower facial height when lost, which should be within the range of patient's adaptability and acceptability. If VDO is registered too high or too low, it would end up deteriorating the existing patient's condition instead of improving it.

Although Prosthodontics as a whole has progressed leaps and bounds with variety of techniques being proposed and practiced for the evaluation of VDO, none of them is scientifically more accurate than other. Each method advocated has its own limitations. They are either tedious, time consuming, require special instrument/equipment, or expose patients to radiation (***Orthlieb et al,2000).*** The accuracy of recording vertical dimension at occlusion in edentulous patients is always a prime consideration for any dentist. Though there are many advances in techniques and materials employed in the field of prosthodontics for recording vertical dimension at occlusion; still, there is no accurate method of assessing vertical dimension of occlusion in edentulous patients available to dentist. In assessing this component for fabrication of complete denture, clinical judgment by dentist plays a major role (***Turrell ,2016).***

Aims of the Review:

This review attempt to:

1-Understand the etiology of the compromising OVD and how it is assessed.

2- Focus on the rehabilitation methods in patient that have lost or decreased their OVD.

Chapter One // Review of the Literature

1.1 / Occlusal Vertical Dimension

Vertical dimension is the length of the face as determined by the amount of separation of the jaws (***Glossary of Prosthodontic Terms. 4th ed,2017).*** There are two vertical dimensions, one is the length of the face when the teeth are in contact and the mandible is in centric relation (occlusal vertical dimension) and the other is the length of the face when the teeth are separated and the mandible is in a physiologic rest position (vertical dimension of rest). Both vertical dimensions are subject to change resulting from loss of teeth. Determination of the correct vertical dimension of occlusion for edentulous patients is one of the most important steps in making dentures with adequate esthetics and function (***Heartwell CM and Rahn AO.,1986)***. The physiologic rest position has been considered by some of remain constant throughout life regardless of presence or absence of the teeth (***Thompson ,1946).*** However, reported instability of the rest position and decrease in rest face height after removal of occlusal contact (***Atwood.1956). Thompson and Kendrick*** demonstrated a significant change in both vertical dimensions within 1 year in all of their 71 participants who were in the age range of 22 to 34 years . ***Sheppard*** reported that the rest position of the edentulous mandible tend to vary even over a short span of time following cephalometric examination***.*** ***Garnick and Ramfjord*** also demonstrated a variation in the rest position (an average of 1.5mm) in 13 of 20 subjects from of start to finish of the experimental period (45 minutes) .

Surgical crown lengthening procedure may appear to be helpful but unfortunately introduce other disadvantages. Tooth preparation and associated loss of coronal

tissue can risk further insult to the pulp and limit the options for future restoration replacement. An alternative approach is to create the necessary space by reorganizing the occlusion by means of an arbitrary increase of the vertical dimension of occlusion (***poyser et al.2005).***

No rigid rules available for determination of the occlusal vertical dimension when all of teeth have been lost ,because of the wide variations in the physical characteristic of the patients. Many techniques have been used for measurement of the vertical dimension of occlusion in dentulous and edentulous patients (***Wright WH.,1939).*** These range from using pre-extraction recommend to the use of swallowing (***Shanahan TEJ.,1956),*** functionally acquired jaw positions associated with phonetics (***Pound E.,1962)*** and cephalometric radiographs and evaluation of radiopaque paste in the vestibular fornix (***Ellinger CW,1968).***

There is no universally accepted or completely accurate method of determining the vertical dimension of occlusion in edentulous patients. There seem to be no significant advantages of one technique other than those of cost, time, and equipment requirements. It is the end result that matters. It should be satisfactory to the dentist and the patient from an esthetic point of view and not induce degenerative changes from a functional standpoint. Regardless of the technique, the vertical dimension of occlusion must be determined carefully by the dentist for a successful prosthesis.

1.2 Reasons of Loss of OVD

1.2.1 Teeth Loss

Loss of OVD can occur when enough number of teeth are lost due to caries or periodontal disease. The remaining teeth and supporting bone are unable to withstand even physiological occlusal forces and start to tip sideways and resulting in collapsed bite due to overclosure of the jaws ***(Moreno and Okeson ,2015).*** Fig 1.1

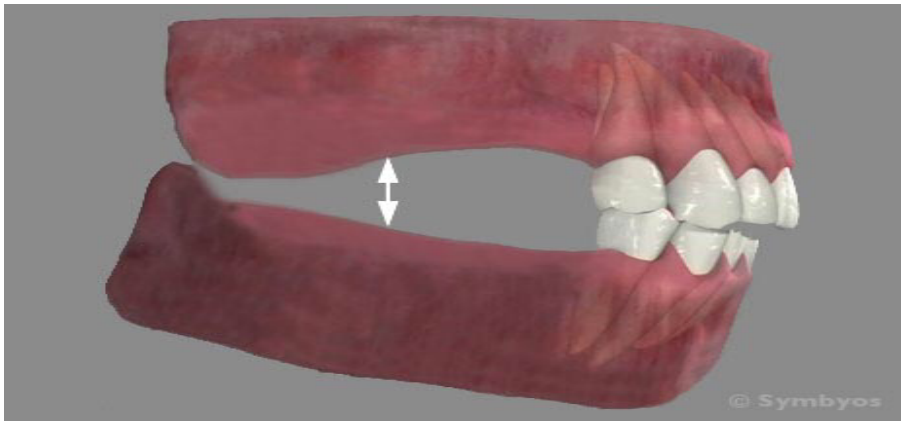


Fig 1.1: Loss of vertical dimension of occlusion/ Bite collapse *(Moreno and Okeson ,2015).*

1.2.2 Dental Erosion

Dental erosion, also known as tooth erosion, is the chemical loss of mineralized tooth substance caused by exposure to acids not derived from oral bacteria (***Schlueter N et al,2020).*** Erosive demineralization is a chemical process characterized by acid dissolution of dental hard tissue, and its etiology is multifactorial (***Imfeld T,1996).*** The primary etiologic factors of dental erosion are acids of intrinsic (often due to acid reflux) or extrinsic origin (diet, particularly

carbonated/soft drinks or acidic fruit-juice consumption; exposure to industrial or environmental chemicals) (***Zero DT,1996).*** Beyond aesthetic consequences and associated oral health issues, severe erosive activity can lead to exposed dentin, hypersensitivity, and eventual loss of affected teeth (***Twetman S,2015).*** Fig 1.2 .

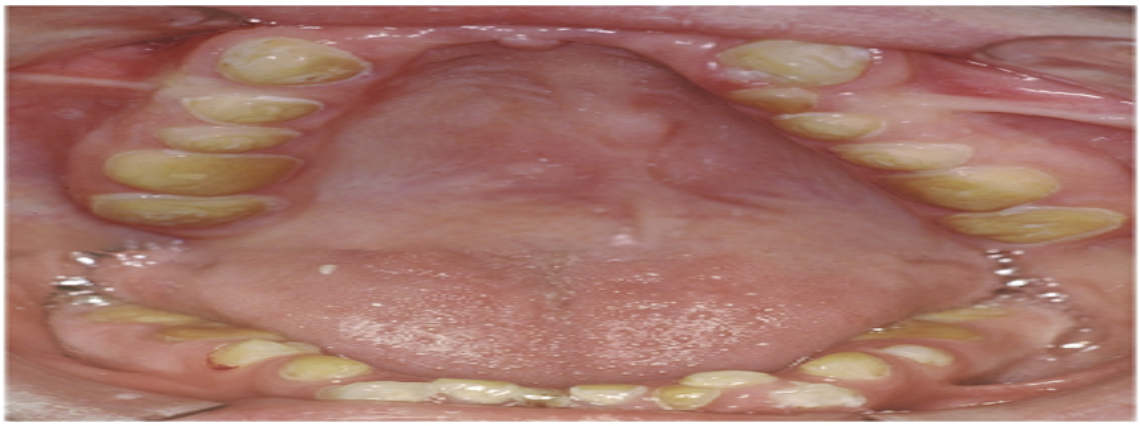


Fig 1.2: severe erosive damage in an intellectually disabled 17-year old boy with a habit of frequent rumination(*Schlueter N et al,2020).*

1.2.3 Bruxism

Bruxism is a common parafunctional habit, occurring both during sleep and wakefulness. Usually it causes few serious effects, but can do so in some patients. The etiology is multifactorial. There is no known treatment to stop bruxism, including prosthetic treatment. The role of bruxism in the process of tooth wear is unclear, but it is not considered a major cause. As informed by the present critical review, the relationship between bruxism and prosthetic treatment is one that relates mainly to the effect of the former on the latter (***Lobbezoo F et al,2010)***. Fig 1.3.

Fig 1.3: Patient with severe tooth wear and loss of vertical dimension particularly related to sleep bruxism and loss of posterior teeth (*Lobbezoo F et al,2010)*.

1.2.4 Complete Denture Wearing

The assessment and reestablishment of the OVD is considered an important factor in the treatment of complete dentures wearers ***(W. C. Rivera-Morales and N. D. Mohl,1991).***The decrease in occlusal vertical dimension is a characteristic of complete denture wearers, mainly due to a marked resorption of the lower ridge with a resulting upward rotation of the mandible and an increase in mandibular prognathism (***A. Tallgren et al,1980).*** Therefore, regular controls and early adjustments of the complete dentures are necessary in order to prevent marked changes in the jaw and occlusal relationships ***(A. Tallgren et al,1980).***

When controls and adjustments are not performed, changes of the OVD could interfere with the physiology of the masticatory system and the patient's ability to adapt ***(J. Abduo and K. Lyons,2012).(Matsuda et al,2014)*** conducted a study to identify how changes in the OVD can affect the sensory perception and activity of

the brain in complete denture wearers. The present study ***(Matsuda et al,2014)*** demonstrated that complete dentures with a lower vertical dimension decreased the masticatory force and a higher vertical dimension revealed an increase in psychological distress after gum chewing. Although it has been observed that complete denture wearers can tolerate an increase in OVD with new dentures ***(W. D. Owen and J. R. Douglas,1971), t***he consequences of an inadequate OVD such as hyperactivity of the masticatory muscles and elevation in masticatory forces and TMDs have been related ***(J. Abduo and K. Lyons, 2012).*** Therefore, it is prudent to evaluate the patient's OVD ***(K. A. Mays,2003)*** and the reestablishing of the OVD must be based on the masticatory system's capacity to accept change and must be determined prior to fabrication of a new denture (***K. A. Mays,2003)***. Figure 1.4.

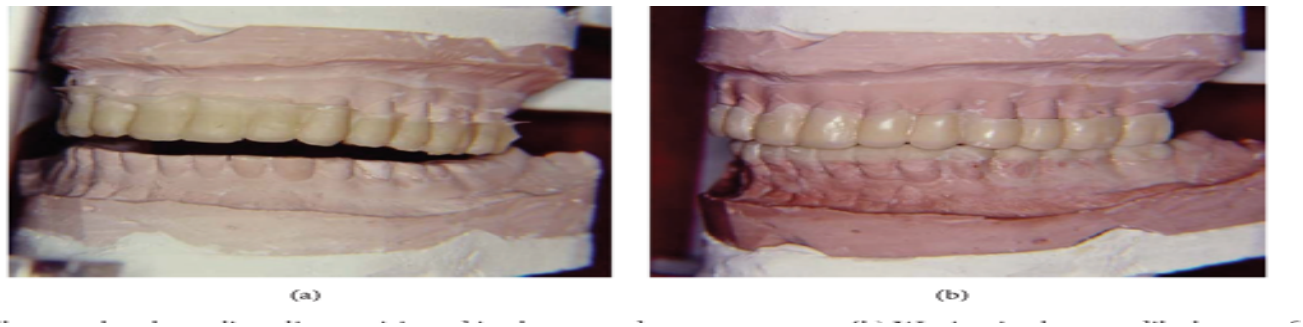


Fig 1.4: Reestablishment of OVD in complete denture wearing patient*(J. Abduo and K. Lyons,2012).*

1.2.5 Severe Cl II with deep bite

The characteristics of Class II division 2 malocclusion are often severe deep bites and lingually inclined upper incisors. The mandibular incisors are also retroclined and crowded. Skeletal and dentoalveolar characteristics include shortened anterior lower facial height, low mandibular plane angle, parallel upper and lower occlusal planes, and deep curve of Spee (***Uribe F et al, 2003).***The palatal gingiva of the

maxillary incisors can be subjected to trauma due to the deep overbite and the exaggerated curve of Spee (***Chen YJ et al, 2004).***Deep impinging overbites can harm the maxillary palatal mucosa and can lead to the loss of maxillary incisors in extreme condition (***Ghafari JG et al,2003).*** Figure 1.5

Fig 1.5: Patient with severe deep bite(*Uribe F et al, 2003).*

1.3- OVD Assessment

An accurate determination of OVD is very difficult procedure. Thorough extraoral and intraoral evaluations are mandatory to assess the suitability of increasing OVD. In the literature, multiple techniques have been proposed to quantify OVD loss **(Table 1.1).** However, the techniques lack consistency and reliability, which in turn affects the decision of whether to increase the OVD. Therefore, increasing OVD should be determined on the basis of the dental restorative needs and aesthetic demands. In general, a minimal increase in OVD should be applied, though a 5 mm maximum increase in OVD can be justified to provide adequate occlusal space for the restorative material and to improve anterior teeth aesthetics. The literature reflects the safety of increasing the OVD permanently, and although signs and symptoms may develop, these are usually of an interim nature. Whenever indicated,

the increase in OVD should be achieved with fixed restorations rather than a removable appliance, due to the predictable patient adaptation. The exception to this is for patients with TMD, where increasing the OVD should still be achieved using removable appliances to control TMD-associated symptoms before considering any form of irreversible procedure ***(Abduo and Lyons,2012).***

Table 1.1: Described clinical techniques for assessment of OVD loss (Abduo and Lyons,2012).

Technique	Description	Advantages	Disadvantages
Pre-treatment record	– Visual assessment of old diagnostic models – Previous photograph	– Approximates the loss of clinical crown height[78] – Formulates baseline record[8]	– Old models are rarely available before treatment[79]
Incisors height measurement	– The distance between the gingival margins of the maxillary and mandibular anterior teeth when they are in occlusion. A distance of less than 18 mm indicates loss of OVD	– Approximates the loss of clinical crown height – Applicable clinically – Aesthetically relevant – Measures the severity of tooth wear[80]	– Poorly represents the actual loss of OVD[5] – Affected by the original anterior tooth relationship
Phonetic evaluation	– S sound to measure the closest speaking space – F sound to locate the incisal edges of anterior maxillary teeth – M sound to locate the mandible in rest position	– Reproducible[81] – Applicable clinically – Indicates patient adaptation after loss of tooth tissues – Indicates incisal tooth relationship – Locates the incisal edges of maxillary anterior teeth in relation to lower lip[77]	– Variable outcome for patients with Class II and III occlusions[19] – Poorly represents the actual loss of OVD[82] – More useful for complete dentures construction[28,77]
Patient relaxation	– Mandible positioning at rest	– Applicable clinically – Visualizes the facial appearance at rest[83] – Ensures the lips are meeting	– Minor muscles tension will lead to inaccurate measurements[28,84]
Assessment of facial appearance	– Evaluation of facial tissues and musculature at rest	– Applicable clinically – Visualizes the facial appearance at rest[83] – Ensures the lips are meeting	– Arbitrary evaluation of the facial aesthetics[28,84]
Radiographic evaluation	– Cephalometric assessment of maxillomandibular relationship	– Highly accurate and reproducible[85,86] – Indicates incisal tooth relationship[87]	– Controlled setting is mandatory – Additional equipment and radiation[85]
Neuromuscular evaluation	– Recording EMG muscle activities where minimal muscle activity indicates the mandible is at rest position	– Useful clinical and research tool for OVD evaluation[88,89] – Accurate and reproducible[90,91]	– The devices are rarely available in t clinical setting – Great expertise is required – Rigorously controlled recording

1-5/ Methods for OVD Rehabilitation

1.5.1/ Bite Raising

Bite raising appliance (BRA)

You have been given a bite-raising appliance to help with your temporomandibular (Jaw) dysfunction (TMD). This is a group of conditions which affect the chewing system. **Bite raising appliance (BRA) //** The appliance is made from soft acrylic and usually fits over your lower teeth. It is designed to stop your upper and lower teeth from touching when you close your mouth ***(Mr A B Moody et al.2021).***

Indications of Bite raising

Increasing the occlusal vertical dimension for gaining sufficient restoration space in the management of severely worn dentition is being practiced and for temporarily relieving the symptoms of intra-capsular TMJ disorders (***Chander and Venkat,2011).***

Methods of Bite raising

The four basic modalities of bite raising are: occlusal overlay splints, temporary cover dentures, Dahl's modality and orthodontic bite raising appliances. Overlay splints can be used for a trial period, usually for 4 months to test the patient's response to new OVD. These splints are made in mutually protected occlusion antero-posteriorly and canine protected occlusion in lateral movements (***Ganddini et al,2004).***Cover dentures can be used for 6–7 weeks as a trial for testing patient acceptance to increased OVD. Aesthetics is restored

by this modality; hence it is more acceptable to the patient than the overlay splints. The original Dahl's appliance has been modified and can be helpful in management of deep overbite by opening posterior bite with anterior teeth contacting (***Mirzani,2006).***Different types of removable and fixed orthodontic appliances are used commonly for the correction of deep overbite situations, intrusion and extrusion of teeth.Appliances causing extrusion of posterior teeth are useful in the increasing OVD in situations with lack of space for restorations. Appliances causing intrusion of the anterior teeth are useful in maintaining OVD and correcting deep bite in patients (***Profift et al, 2011).*** **Figure 1.6 and figure 1.7**.

Fig 1.6 : A) Occlusal overlay splint (*Mirzani,2006).*
B) Labial view of Dahl appliance showing 2-3mm increasing in OVD.

Fig 1.7 : Orthodontic bite raising appliance (*Profift et al, 2011).*

1.5.2/ Transitional bonding using CAD/CAM

The author defines transitional bonding as the use of bonded interim prostheses or prototype restoration executed using either direct composites or indirectly fabricated Provisionals to reestablish esthetics, speech, functional stability (eg, eating, breathing), and occlusion that are sequentially transitioned into the definitive restorations. Not only do transitionally bonded prototypes/prostheses create a stable occlusion in CR with anterior coupling, but also they enable verification of the patient's desired outcomes, which can then be transitioned into the definitive restorations.Overall, the additive nature of transitional bonding for establishing CR and VDO presents several advantages for clinicians and patients (***Palmer KM ,2012).***These include easier and simpler procedures, more manageable and predictable results, and greater cost-effectiveness. Today's direct composites demonstrate significant improvements over previous products (ie, strength, handling characteristics, durability, lower polymerization shrinkage rates) and are considered among the most versatile restorative materials available (***Fortin D and Vargas MA, 2000).*** Additionally, their minimally invasive nature allows greater preservation of sound tooth structure (***Palmer KM ,2012).***Computer-aided-design and computer-aided-manufacturing (CAD/CAM) can make transitional bonding easier, more efficient, more manageable, and more predictable. Additionally, the technologies and the materials available in a digital restorative workflow facilitate stabilization of complex functional and esthetic issues. In fact, today's dental CAD/CAM systems (eg, CEREC AC Omnicam or CEREC Primescan AC, Sirona Dental Systems, Charlotte, NC) and millable composite blocks (eg, Lava Ultimate and Paradigm MZ100 by 3M ESPE; Telio and Tetric CAD by Ivoclar Vivadent; CeraSmart by GC; Enamic by VITA) enable dentists to

deliver predictable interim prostheses in one appointment. All blocks have the physical properties to meet the short term (3-12 months) requirements of CAD/CAM transitional bonding. These highly.esthetic and functional provisional/prototype restorations—which can withstand mastication forces—can help to establish ideal occlusion (***Fasbinder DJ, 2002).*** Highly accurate, efficient, and predictable for fabricating well-fitting frameworks in fewer steps than traditional laboratory processes (***Fasbinder DJ,2010),*** When definitive restorations are CAD/CAM fabricated, they have demonstrated survival rates comparable to traditional hand-fabricated restorations (***Wittneben JG et al,2009).***In recent years, the literature has increasingly cited the utility of CAD/CAM fabricated transitional bonding composite restorations for reconstructing or redefining VDO (***Edelhoff D et al, 2012).***CAD/CAM transitional bonding interim prototypes/prostheses are highly homogeneous compared to direct restorations, which increases long-term stability, biocompatibility, and wear resistance(***Edelhoff D et al, 2012).***Because these restorations can be milled extremely thin for placement on occlusal surfaces, little to no tooth preparation is required, contributing to a minimally invasive and additive rehabilitation approach(***Profift et al, 2011)..*** Fig 1.8

Fig1.8: A) Digital approach for full mouth rehabilitation
B) CAD/CAM Technology (*Edelhoff D et al, 2012).*

1.5.3/The Restorative approaches for patients with bruxism

After functional and esthetic analysis, composite resins direct restorations and metal-ceramic and ceramic crowns are options to repair tooth wear caused by bruxism (***Dietschi D and Argente A,2011).*** The choice to select a material for restoration of worn teeth is influenced by multiple factors. The development of adhesive techniques has provided conservative approaches to restore severely worn teeth through the use of direct resin composite and a silicone guides made over a waxed-up model. Some advantages of using direct procedures with resin composite include shortening procedure time, having immediate results, and providing good esthetics at a low cost. The advent of adhesion has changed the philosophy and treatment approach of restorative dentistry. Adhesive restorations have become the first choice among direct restorative techniques and have got important space also in indirect techniques, when associated with resin luting cements. After the enamel etching proposed by Buonocore (***Buonocore MG,1955),***dental substrate started to participate in the retention process of the restorations. Moreover, the development of bifunctional primers started to use the dentin as an available substrate as well, since the hybrid layer report by (***Nakabayashi et al, 1982) .***The evolution of dentin-bonding agents in the last decades provided adhesive systems with adequate bond strength, good marginal sealing, and satisfactory clinical performance. Basically, two types of adhesive systems are available: etch-and-rinse, which could be offered in three or two steps; or self-etching, which is divided in two steps or all-in-one ***(Van Meerbeek B et al, 2003).*** Indeed, both three-step etch-and-rinse and two-step self-etching adhesive systems have optimum mechanical behavior. However, the long-term degradation still seems to be the major problem related to the adhesion, and it is more relevant when associated with one bottle adhesive systems ***(Ozer and Blatz ,2013).***

Nevertheless, there is a lack of scientific information about the performance of the adhesive systems in bruxism-related patients. Regarding the choice for direct and indirect restorative options for oral rehabilitation of patients, there is no consensus in the literature about the best materials and techniques (***Katsoulis J et al,2011),***evaluated the rehabilitation of partially edentulous patients with severe tooth wear through fixed and removable prosthesis, and found 50% success these prosthetic treatments after 3-year follow-up. The same authors considered the rehabilitation of such patients as difficult procedures. ***Kukrer et al, 2004 i***n a prospective evaluation, performed the rehabilitation of 51 patients (with or without bruxism) with ceromer inlays and found 29% of the restorations with surface damages in only 28-month follow-up (***Kukrer et al, 2004).*** Hamburger et al,2011 conducted a retrospective clinical evaluation of 18 patients with severe tooth wear who were rehabilitated with direct composite restorations, and found good clinical performance of restorations after 4-year follow-up. In that survey, the patients were satisfied with the restorative treatment and there was only 6.9% of restoration failures. Fig 1.9.

Fig1.9: A) Patient with severe tooth wear and loss of vertical dimension particularly related to sleep bruxism and loss of posterior teeth.
B) Provisional overlay denture was confectioned with acrylic resin over the existent worn teeth to provide increase in the vertical dimension for adequate cosmetic restoration.C) The provisional overlay was completely substituted by anterior and posterior ceramic fixed prosthesis(*Kukrer et al, 2004).*

1.5.4/ Full mouth rehabilitation with implants

In contrast to the focus on achieving successful osseointegration of dental implants, nowadays obtaining the most natural-looking smiles through preserving the anatomy of the soft tissues or creating them either by tissue regeneration or prosthetic materials is the main concerns of the practitioners ***(M. Steigmann,2008).***

Elderly patients visit the dental clinics seeking for a good smile which was lost due to the loss of the teeth, supporting alveolar bone, and muscles. To restore these units, complete edentulous patients must be treated by dental implants (***J. Montero et al,2012)***. Treatment options may range from the use of removable implant supported dentures to the creation of fixed implant supported restorations. This treatment choice depends on the patient's anatomical limitations and personal preferences, including acceptance of extensive surgical procedures to restore the bone and/or soft tissue ***(M. Steigmann,2008).*** Implant supported overdentures and hybrid prosthesis often provide support for the soft tissues of the face when compared to the traditional fixed prosthesis. With the emergence of computer-aided designs and the development of prosthetic materials, soft tissue loss can be easily replaced and even pink interdental papilla can be artificially created ***(Gonzalez,2014).*** When adequate number of implants is present in an arch, a traditional fixed bridge is the prosthetic modality of choice. Often this is not an option in the maxilla due to combined vertical and horizontal resorption of bone and tilted positions of the implants. In this instance, a traditional fixed bridge would not meet the patient's requirements for hygiene maintenance, esthetics, phonetics, and comfort.

In addition to that, pink porcelain is less natural-looking and it usually requires more baking cycles that increase the risk of porcelain fracture ***(Montero et al,2012).***

These complications can be solved by fabricating hybrid prosthesis that can easily

replace the soft tissue, and, concerning their shock absorbing properties, it can reduce the mechanical and biological problems such as component fracture, screw loosening, and bone resorption ***(Kwon et al, 2014).*** With regard to the rapid wear of acrylic denture teeth as well as the stress generation of porcelain teeth within the framework leading up to marginal bone around dental implants, use of veneer materials has been widely accepted in implant dentistry for their stress absorption and less wear characteristics ***(Heintze et al,2012).*** Fig 1.10

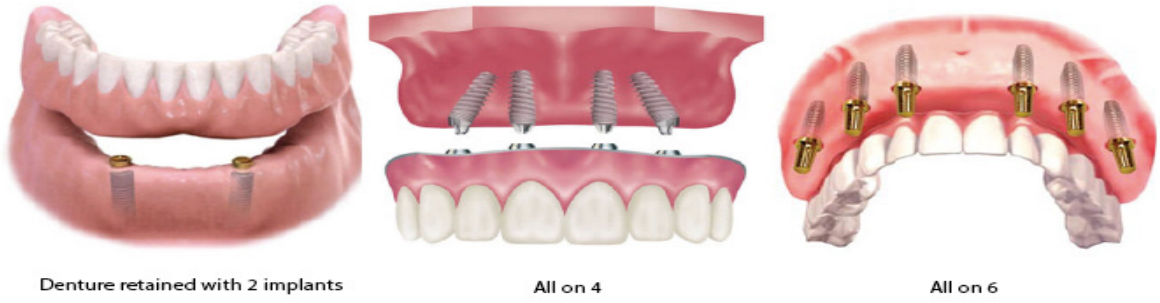


Fig 1.10/ Full mouth rehabilitation with implants*(Heintze et al,2012).*

1.5.5/ Telescope Denture

Telescopic prostheses are widely used in clinical situations. They are not limited to a single type or design as there are several possibilities and patterns of the double crown and the telescopic denture ***(Langer Y and Langer A,2000).***

The term (telescopic denture) refers to the type of prosthesis that includes double crowns as retainers or attachments. These retainers (or attachments) consist of 2 crowns; primary or inner crown which is cemented to the abutment and secondary or outer crown which is attached to the denture ***(Dabrowa T et al,2007).***

Telescopic crowns can be used as retainers for partial dentures instead of clasps and precision attachments. In this case, the prosthesis is called (telescopic partial denture) which is usually fabricated with metal framework (***Langer A,1981).*** Also, telescopic crowns are indicated as attachments for overdentures. Then the prosthesis is called (the telescopic overdenture) which is indicated generally where there are a few remaining teeth. These overdentures may be fabricated with acrylic base (***Schweitzer J.M. et al,1971).***In addition to using them with natural teeth, telescopic dentures may be supported by implants (***Krennmair G. et al,2006).*** Moreover, telescopic dentures may be a good choice to connect implants to natural teeth (***Chee W. and Jivraj S., 2006).*** Figure 1.11.

The main suspected benefits of such design of telescopic prosthesis over the standard overdenture are

(1) the minimized stress of the abutment teeth.

(2) no need for dowel or screw.

(3) avoiding the problem of labial undercuts.

(4) achieving periodontal health by avoiding the coverage of the gingival margin.

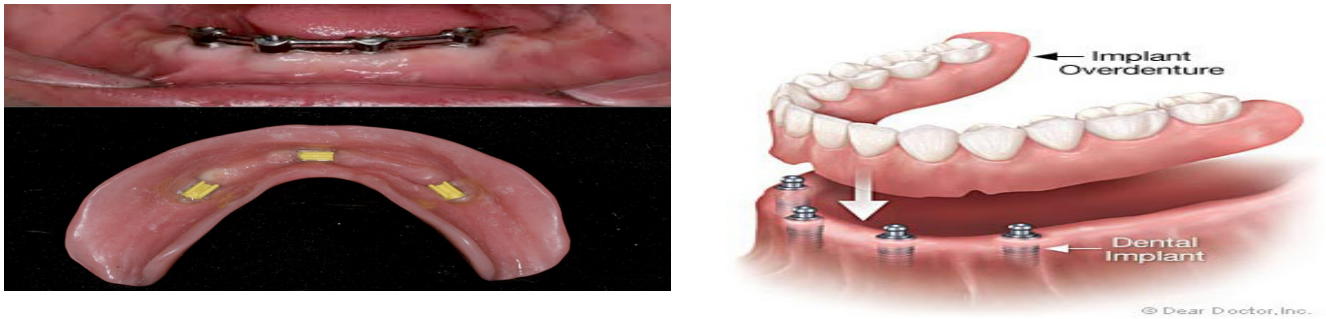


Fig 1.11/ A) Implant supported overdenture attachments.
B) Implant Overdenture (***Chee and Jivraj , 2006).***

1.5.6 Restorative treatment in dental erosion

Treatment options for dental erosion differ according to the extent of tooth structure damage. Hence, selecting restorative options required the analysis of remaining tooth structure, location of tooth loss, and occlusion. The treatment choice ranges from a conventional fixed and removable prosthesis to more conservative, less invasive adhesive restorations. The patients affected by severe erosive destruction need complex occlusal rehabilitation. The placement of extensive restorations like porcelain veneers only and full veneer crowns is utilized. Interceptive treatments are required for correction of esthetic impairments, functional difficulties, and pain or sensitivity of teeth. Treatment options depending on the loss of vertical dimension are described by Schuyler ***(Schuyler C. H,2001).*** Direct composite restorations are recommended for vertical dimension loss of less than 2 mm, while indirect ceramic veneer and overlays are recommended for more than 2 mm loss in vertical dimension. Indirect ceramic restorations are suggested for the rehabilitation of erosion with loss of vertical dimension more than 4 mm. Conventional crowns are effective in restoring extensively worn teeth, replacing missing teeth, and overcoming reduced crown height. They offer additional advantages like providing provisional restorations to evaluate the esthetics and function for both the dentist and the patient. The critical part of dental erosion management includes the prevention of further dental wear. Hence, the etiology of dental erosion should be determined to stop the disease and consequently the erosive process. Teamwork with medical professionals is mandatory along with restorative rehabilitation in treating structural damage from intrinsic erosions.Zirconia is less reactive to the acidic environment compared to the direct composite restorations and more esthetic than metal-ceramic restorations. The extensive palatal surface erosions in maxillary anterior teeth reduce the incisal height

and affect the horizontal overlap and the anterior guidance. Hence, it is strongly recommended to reestablish accurate incisal guidance during restorative procedures on anterior teeth (***Wang Y.-L. et al,2011)***.Inadequate anterior guidance induces posterior interferences in mandibular eccentric movements. The disclusion (**Akören A. C. and Karaağaçlioğlu L,1995)** of posterior teeth during mandibular eccentric movement reduces the posterior teeth contact time and precludes the consequent deleterious outcomes like attrition, fracture of posterior teeth, and periodontal diseases due to trauma from occlusion. Digital occlusal evaluation with T-Scan indicates the increased disclusion time in patients with deficient incisal guidance. Researchers also reported lesser masticatory muscle activity with canine guided occlusion with adequate incisal guidance (***Williamson E. H. and Lundquist D,1983)*** and help in relieving myofascial pain. The increased disclusion time, with balancing interferences, is reported to initiate temporomandibular disorders (***Morris J. B,2008).*** Fig 1.12.

Fig 1.12/A) Dental erosions on the palatal surface of the maxillary anterior teeth and premolars. B) Dental erosions on cusps of canines and premolars in the mandibular arch. C) Short, unesthetic maxillary anterior teeth*(Schuyler ,2001)*

The diagnostic mockup with composite temporization for a longer duration will provide the opportunity to elicit the opinion of the patient regarding the tooth form, shape, and inclination. It is a form of visual aid for the dentist to evaluate the esthetics and phonetics. Temporary restorations also help in assessing the response from the muscles of mastication and TMJ to the newly established occlusion (***Chana H. et al,2000).*** Patients with dental erosion require counseling to change the dietary and lifestyle issues. Postoperative follow-up care is important to evaluate, monitor, and reemphasize the behavioral changes, along with required modifications of the prosthesis. Figure 1.13.

Fig 1.13 :A) Composite build-up as long-term temporization.
B) Zirconia crown and bridges on restoring maxillary arch.
C) Final prosthesis with improved esthetics and anterior guidance (*Chana et al,2000).*

1.5.7 /Overlay removable partial denture

Treatment options for patients with severe attrition resulting in reduced occlusal vertical dimension are often limited to fixed prosthesis to reestablish proper occlusal vertical dimension and functional occlusion. In some cases such as when there are limited finances, minimal esthetic concerns, and medical considerations fixed prosthesis may not be the ideal treatment option. Overlay removable partial dentures (ORPDs) can be used as a provisional or interim prosthesis as well as permanent prosthesis in these cases. While ORPDs can provide a reversible and relatively inexpensive treatment for patients with a significantly compromised dental

status, there is not much scientific evidence in the literature on ORPDs. Most studies published on ORPDs to date are primarily reviews and clinical reports (***Mit B. Patel1 and Sompop Bencharit2,2009).*** Figure 1.14

Fig 1.14: A) Maxillary overlay removable partial denture; B) mandibular removable partial denture; C and D) intraoral view of the artificial teeth (*Mit B. Patel1 and Sompop Bencharit2,2009).*

There are perhaps three main indications for ORPDs:
First, as an interim prosthesis, an ORPD is most often pre- scribed for a patient with reduced occlusal vertical dimen- sion (VDO) due to moderate to severe worn dentition (***Turner KA, Missirlian DM,1984).***

Second, interim and permanent ORPDs are often pre- scribed to patients with severe dental and skeletal malocclu- sion. These malocclusions can be resulting from cleft palate ,class II or III skeletal malocclusion or open bite or open occlusal relationship (***Gitt I,1980).***

Third, the last common indication for ORPDs is medical or financial limitation for fixed prosthodontics .Some patients can have malocclusion or worn dentition that

can ideally be restored with fixed prostheses perhaps in con- junction with orthodontic, periodontal, and surgical treatment.However, financial concerns or general medical problem could prevent these treatments .

The major advantages of ORPDs are that they are relatively simpler and less expensive than the fixed prosthetic option ***(Windchy AM, Morris JC et al, 1998).***

Table 1.2: Advantages and disadvantages of ORPD

Advantages	**Disadvantages**
Cost effective	Possibility of caries if patient doesn't maintain proper oral hygiene
Short treatment time	Potential maintenance issues associated with acrylic resin fracture and discoloration
Minimally invasive	Future difficulty in restoring teeth under the framework while maintaining the fit of the framework

1.5.8/Rehabilitation in complete denture wearing

The establishment of appropriate occlusal vertical dimension (OVD) is a fundamental factor in the manufacture of new complete dentures in harmony with the patient's masticatory system (***K. A. Mays, 2003)***,However, the long-time use of

the same complete denture can result in jaw displacement due to abrasion of the artificial teeth and residual ridge resorption, causing a decrease of the OVD ***(J. Abduo and K. Lyons,2012).***The decrease of the OVD can compromise the esthetic and cause morphologic changes in the complete denture wearers, such as hyperactivity or hypoactivity of the masticatory muscles, increase or decrease in masticatory force, temporomandibular disorders, decreased facial height as a result of mandibular ridge resorption and a downward and forward rotation of the mandible], and increasing mandibular prognathism ***(A. Tallgren, and M. M. Ash Jr,1980).***These complications can significantly affect the function and comfort, as well as the phonetics and esthetic of the patient (***S. Yamashita and H. Katada,2015).*** The reestablishment of the OVD is considered one of the most challenging and complex procedures during oral rehabilitation of edentulous patients (***E. M. Dantas,2012).*** It is related to the head and cervical spine postures and anterior facial height ***(M. Fujimoto at al,2001),*** the esthetics of the entire face and mandibular position, and reestablishment of the masticatory function and phonetics (***B. Solow and A. Tallgren,1976***). For this reason, it is usually believed that changes in the OVD should be conservative and for a trial period, with an interim prosthesis if necessary, especially before the manufacture of a new complete denture set. One technique that has advocated for reestablishment of OVD includes the use of an acrylic splint in an appropriated OVD (***M. Fujimoto, I and I. Watanabe,2001).***This process allows assessing the patient's tolerance, esthetics, and phonetics at the proposed restored OVD before irreversible changes in the natural dentition or with a new partial denture (***L. Jahangiri and S. Jang, 2002)***.This technique has also been described for the edentulous patient with old complete dentures ***(C. A. Hansen,1985).***

The present case report describes a method of gradual reestablishment of an appropriate OVD using a diagnostic acrylic splint on artificial teeth in an old complete denture before manufacture of a new complete denture. (Figures 1.15 – 17).

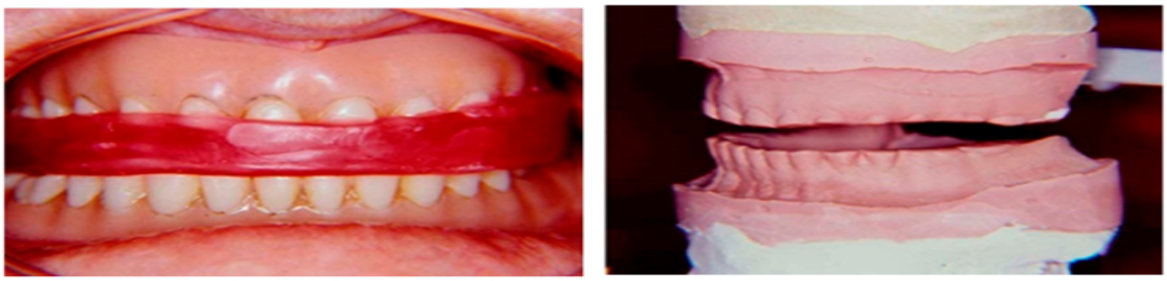


Fig 1.15/ Record for reestablishment of 7 mm in the OVD. (a) Record in wax with 7 mm; (b) first master cast set mounted in a semiadjustable articulator*(J. Abduo and K. Lyons,2012).*

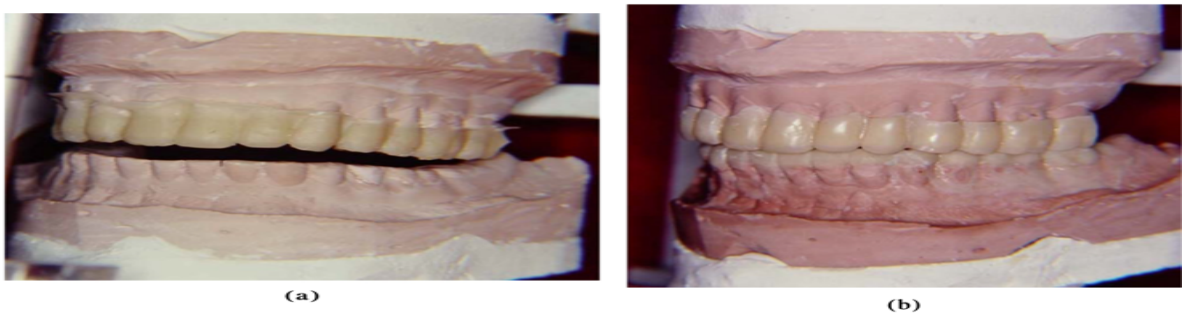


Fig 1.16/ (a) Maxillary occlusal acrylic splint positioned in the second master cast set. (b) Waxing in the mandibular cast for manufacturing the second occlusal acrylic splint *(J. Abduo and K. Lyons,2012).*

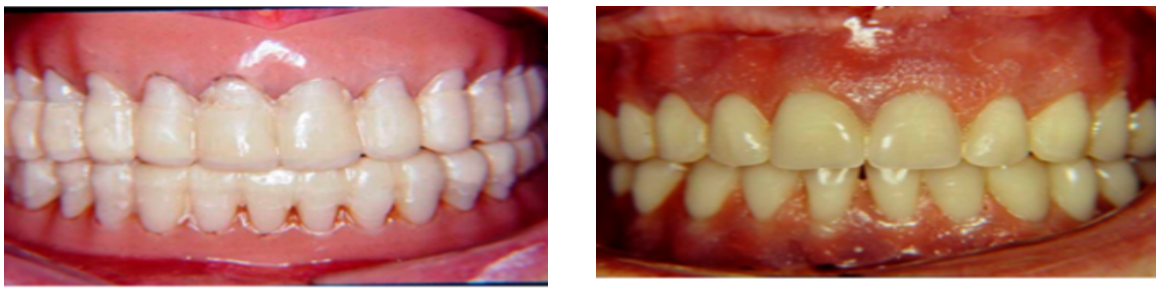
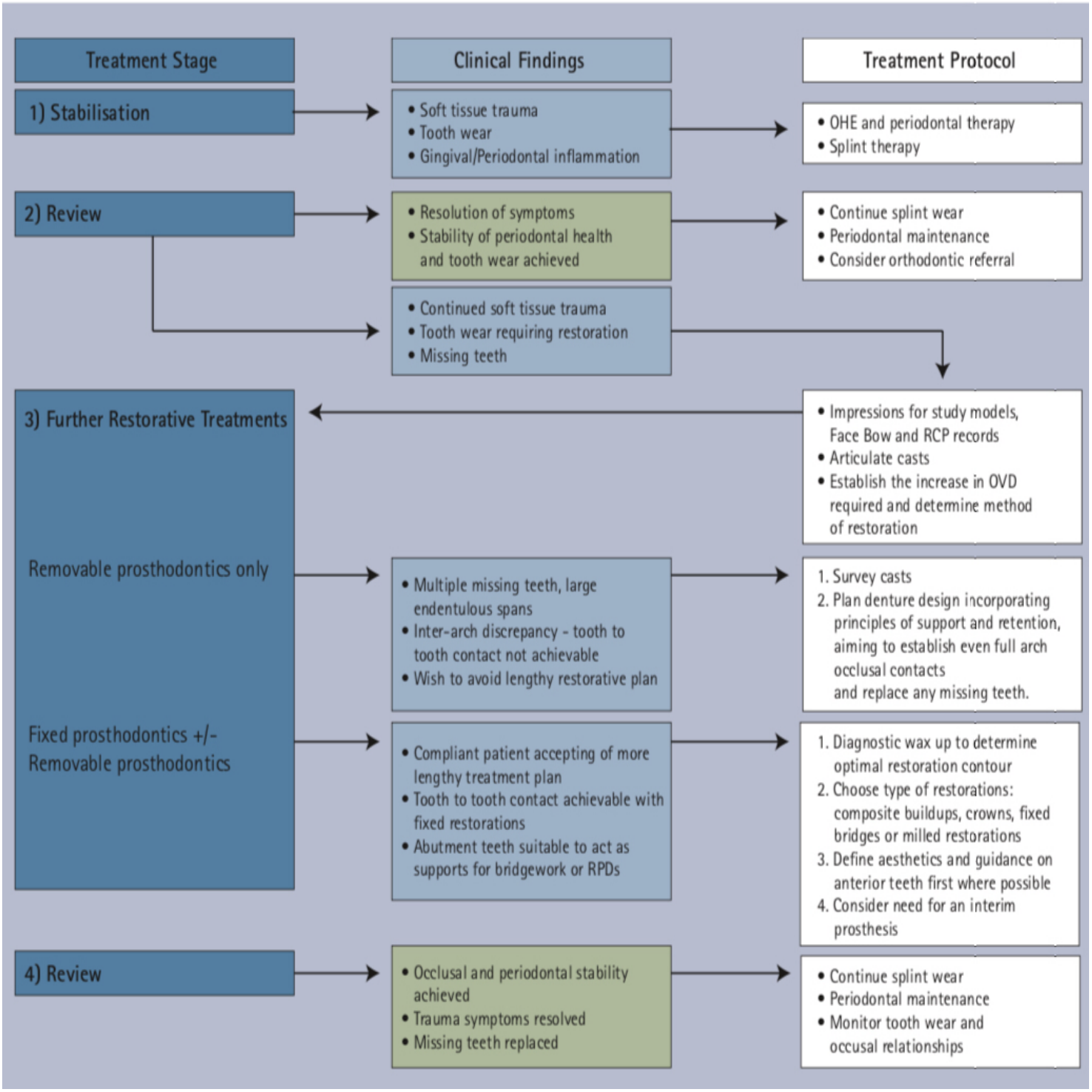


Fig 1.17/:A) Installation of the mandibular occlusal splint after a 30-day period of adaptation. B) Installation of the new complete denture set after the adaptation of OVD*(J. Abduo and K. Lyons,2012).*

1.5.9Rehabilitation in severe deep bite

To establish the desirable occlusion and articulation with proper inclination of teeth in deep-bite patients, orthodontic therapy alone is difficult and inefficient (***Bell WH et al, 1984).*** Therefore, orthognathic surgical procedures, which reconstruct occlusal plane by aligning teeth or correcting skeletal deformities, are preferred to obtain functional and marked esthetic results (***Finlay PM et al, 1995).***Since these procedures support the patient both physically and psychologically, they are constructive for the patient. In fact, these procedures could simplify the prosthodontics phase of treatment without damaging the tooth structure (***Basa S et al , 2008).*** Anterior segmental osteotomy is an important surgical procedure for the correction of maxillary and mandibular protrusion or retrusion to achieve improved occlusion and facial profiles (***Dai J et al, 2012).*** This osteotomy procedure is primarily for correction of bimaxillary dentoalveolar protrusion, anterior open bite, excessive inclination of anterior teeth, excessive vertical, or anteroposterior development of the maxillary dentoalveolar process and severe skeletal problems that cannot be corrected with orthodontic treatment (***Gunaseelan R et al, 2009).***It is difficult to achieve ideal facial proportions by increasing lower anterior facial height. In addition, the decreased vertical dimension of occlusion (VDO) in deep-bite patients can also cause unpleasant esthetic results, reduced masticatory capacity, muscle atrophy and pulpal sensitivity (***Guttal S et al,2005)***. A progressive approach should be followed to restore VDO (***Song MY et al,2010).***For such situations, occlusal splints, fixed or removable partial dentures are recommended as alternatives treatment (***Ergun G et al,1998).***

Table 1.3 Summarises the treatment protocol at each stage based on the possible clinical findings to aid decision making and the planning of treatment.



Chapter Two // Conclusion

2.1 /Conclusion

Compromised OVD can be managed with range of methods depending on the general orodental condition and other factors such as socioeconomic factors.Increase in OVD should be determined based on accomplishment of satisfactory and aesthetically pleasing restorations within the physiological limits.Due to a plenty of pathophysiological reasons, partially and completelyedentulous and even dentulous patients can complain of compromised OVD presenting its negative consequences. Increasing OVD is a safe procedure and any consequential signs and symptoms tend to be self-limiting (***Abduo, J. and Lyons, 2012).*** Functional complications were more frequent in cases of restorations supported completely by implants. A longer period of adaptive parafunctional activity wasreported with these prostheses due to the lack of sensory feedback from the periodontal ligament; consequently, more mechanical complications can occur on implant restorations after an increase in the OVD (***Hsieh et al, 2010).***

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