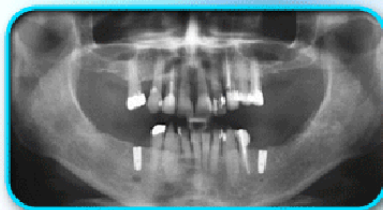


Implant-supported Crowns for a Shortened Dental Arch: A Case Report

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Abstract

Aim: The aim of this report is to highlight the efficiency of implant restoration of a shortened dental arch (SDA) for a partially edentulous patient.

Background: The SDA refers to a dentition with loss of posterior teeth. The goal of dental care is the maintenance of a natural dentition with regard to esthetics, speech, chewing, and oral comfort. In order to achieve this goal several issues were examined in a SDA clinical scenario including masticatory ability, occlusal factors, the effect of removable partial dentures, oral comfort, and periodontal support.

Report: A 62-year-old female with a SDA presented for treatment with concern about her compromised periodontal and restorative status. Following professional scaling and root planing and oral hygiene motivation, the bite was opened. Restorative treatment was rendered up to the second premolars with the issues associated with a SDA in mind.

Summary: A body of evidence in literature showed an arch extending to the second premolars is adequate for normal functional demands, oral hygiene, oral comfort, and possibly reduced costs on a dentition subjected to modern diet. The reported clinical outcomes of using implant supported crowns till the second premolar area using the concept of restoring only an existing SDA were highly satisfactory for the well-oriented patient.

Keywords: Shortened dental arch, SDA, dental implant, partial denture, restorative dentistry, periodontitis

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Background

The term 'shortened dental arches' (SDAs) was first used in 1981 by the Dutch prosthodontist Arnd Käyser to describe a dentition in which most posterior teeth are missing. This condition is frequently seen where posterior teeth are lost due to dental caries and periodontal disease, whereas anteriors and premolars tend to survive longer.^{1,2} The results of clinical studies by Käyser et al.^{1,3} showed there is sufficient adaptive capacity in people with a SDA when at least four occlusal units remain, and this capacity starts to diminish after having less than four occlusal units (one unit corresponds to a pair of occluding premolars). A SDA can also be defined as a dentition with an intact anterior region and a reduction of occluding posterior pairs, which starts posteriorly, as molars are more prone to be lost.¹

Edentulism was regarded as a normal characteristic of aging in the past, but the use of current disease prevention techniques along with advances in restorative dentistry have created the opportunity for the dentition to be maintained throughout old age which is a favorable trend since the percentage of elderly people is increasing.^{4,5}

For many patients and clinicians the preservation of complete dental arches (28 teeth) has been a traditional ideal primary goal, but for the majority of elderly patients, this is not possible, therefore, is no longer considered a goal in a contemporary approach to restorative dentistry.⁵

In 1992, the World Health Organization stated the aim of treatment to achieve oral health is the retention, throughout life, of a functional, esthetic, natural dentition of not less than 20 teeth and not requiring recourse to a prosthesis. The exact number of teeth needed to satisfy functional demands was not determined as these demands are different between individuals.⁶ However, failure to replace posterior teeth may result in adverse effects such as insufficient chewing ability, temporomandibular joint disorder (TMD), tooth migration, and over-eruption.^{7,8}

Furthermore, following tooth loss patients may experience discomfort, lack of a satisfying appearance, difficulty chewing, a loss of appetite, and stress. Keeping a natural, healthy, and

functional dentition for life has a positive effect on the quality of life.⁵ Therefore, the restoration or placement of prostheses should be able to meet the patient's needs in addition to being functionally sufficient.⁷ It appears the current goals of dental care is the maintenance of natural dentition with regard to social and biological factors such as esthetics, speech, chewing, and oral comfort.⁹

Alveolar bone resorption tends to affect the mandible more than the maxilla most probably due to the narrow denture bearing area with less favorable distribution of the occlusal load.¹⁰ A functionally oriented therapeutic approach has been introduced for patients with reduced dentition because bone loss is more extensive on the labial aspect of the anterior region of the ridge, more equal on the buccal and lingual aspects of the ridge in the premolar region, and the loss is greater on the lingual aspect of the ridge in the molar region.^{1,10,11}

A dental arch can be extended to obtain a functional level with one of the following options:⁵

- Removable partial denture (RPD)
- Cantilever bridges
- Overdentures

The traditional prosthodontic treatment of the partially edentulous jaw or SDA tended to be the removable partial denture (RPD) to substitute the missing teeth for optimum function and esthetics.¹ The RPD has been regarded as a predictable treatment option, but it can cause the breakdown of periodontal tissue supporting the remaining teeth and bone resorption underneath the denture base.³ Recent therapeutic options in the treatment of SDA have been suggested:¹

- Replacement with a fixed restoration to the second premolar
- The use of implants in combination with a fixed partial denture

Several factors in the restoration of a SDA clinical scenario were tested by Witter et al.^{12,13} including:

- Masticatory ability
- Occlusal factors
- Signs and symptoms of TMD
- The effect of RPDs in a SDA situation
- Degree of oral comfort
- Periodontal support

Based on their six year follow up study of patients with a SDA they reported the following:

- Minor changes occurred with respect to occlusal contact, overbite, interdental spacing, and alveolar bone support in both the SDA group and a SDA group with an RPD. The SDA clinical scenario provided durable occlusal stability even though they were left untreated.
- This study revealed SDA patients had sufficient mandibular stability to prevent signs and symptoms of TMD syndrome, so a SDA alone was not a risk factor for developing TMD.
- SDA provided sufficient oral comfort in terms of chewing ability and appearance compared with using RPD's.
- Oral function was not improved in the SDA scenario with the use of removable partial denture RPD.
- The patients experienced satisfaction regarding their oral function.
- It was also concluded the SDA clinical scenario has a useful effect on clinical practice and should be considered as a treatment option.

In a long-term nine year follow-up study the SDA clinical scenario did not result in occlusal collapse.¹⁴ The occlusal changes in a SDA were self-limiting and adaptive, leading to a new equilibrium and so extending the SDA by prosthetic devices was not necessary to prevent occlusal collapse. Also, no statistically significant differences were detected between restoration with an RPD or not to an SDA scenario in a randomized multi-center study.⁷ Within both treatment options, an improvement of Oral Health Quality of Life index was achieved.⁷

Out of these studies it was concluded SDA can maintain oral functions, prevent temporomandibular joint (TMJ) dysfunction, and provide long-term occlusal stability even when compared with complete dental arches.³ Although the restoration of a SDA has a sound biomechanical rationale it requires conditions such as healthy supporting tissues of the remaining teeth, and no parafunctional habits such as heavy bruxism.^{3,15}

There was, however, a discrepancy between the theoretical and practical acceptance of the restoration of a SDA among dentists in many countries in that the option was widely accepted

but not widely practiced.³ Dentists reported occasional restoration of a SDA in <10% of patients, and the outcome was generally satisfactory.¹¹

The short-term outcome of the restoration to a SDA concept in a periodontally compromised patient is presented in this report.

Case Report

A 62-year-old female presented to the Department of Oral Medicine and Periodontics at Tygerberg Oral Health Centre in Cape Town, South Africa, complaining of difficulty chewing food and her appearance due to the color of her teeth. The complaint of compromised mastication started after loss of her posterior teeth and she had to rely on only her anterior teeth to eat.

Medical History

The patient is a housewife with two sons. She reported a history of high blood pressure that was diagnosed four months earlier which is controlled with an antihypertensive. She had no allergies but is a light smoker and a social drinker.

Dental History

The patient had a history of several extractions and restorative treatment several years ago. Due to complicated extractions she had a negative view of dentists and refused to use any removable prosthesis suggested by them. After losing most of her posterior teeth, she used her anterior teeth to masticate her food and developed a deep overbite.

Extraoral Examination

No abnormalities were detected in the TMJ. There were neither palpable lymph nodes nor skin lesions. Her facial profile was straight, and she had an average smile line (Figure 1). An intraoral examination revealed the patient was partially edentulous and had a deep overbite (Figure 2).

A hard tissue examination showed over eruption of some maxillary and mandibular teeth as well as incisal attrition. Several teeth were missing, namely: #14-18, 26-28, 35-37, and 45-47 (FDI System). None of the remaining teeth were carious, but both tooth #38 and #48 were tilted and had drifted mesially. She had a fractured debonded crown on tooth #23 along with an ill-fitting temporary post and core.



Figure 1. Compromised smile.



Figure 2. Presence of a deep overbite.

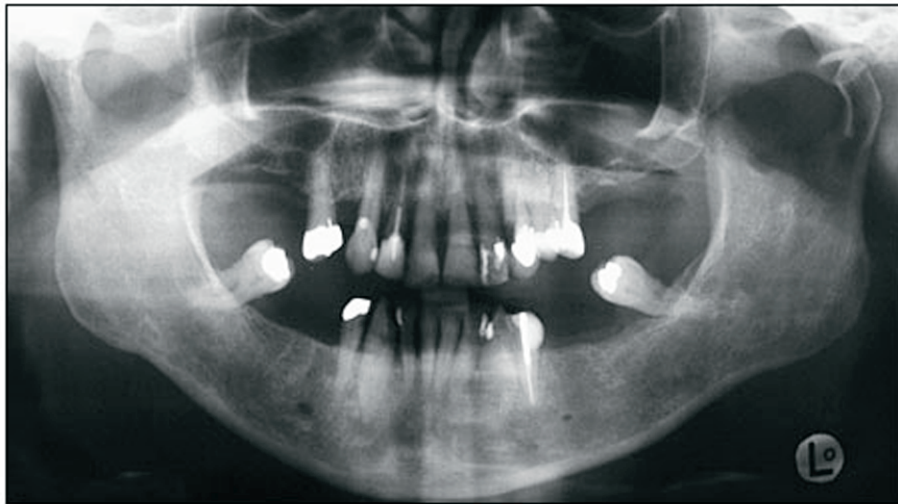


Figure 3. A panoramic radiograph showing horizontal bone loss and tilting of molars.

Teeth #12, 13, 21, 22, 24, 25, and 44 had composite restorations, #12 and 34 had post and cores, and #15 and 34 had amalgam restorations (MODs).

Radiographic Findings

A panoramic radiograph revealed periapical radiolucencies at tooth #33 and tooth #43, generalized horizontal alveolar bone loss, and pneumatization of the maxillary sinuses (Figure 3).

Treatment options including either the replacement of the posterior teeth with a RPD or the extraction of all teeth and replacement with partial or complete dentures had been refused previously by the patient. Other treatment options included:

- Restore up to the second premolars using cantilevered fixed restorations.
- Placement of implant-supported crowns in the lower second premolar regions.
- Placement of implant supported fixed bridges to the lower molars regions.

Treatment Plan

After discussing the options with the patient, she elected to receive two implants and to restore the dentition to a SDA clinical scenario. The treatment plan was as follows:

Phase 1: Professional scaling and root planing along with oral hygiene instructions on plaque control to ensure optimum oral health.

Phase 2: Increase the vertical dimension using maxillary and mandibular RPDs along with temporary crowns on lower first premolars and anterior teeth and/or composite build up of anterior teeth.

Phase 3: Restorative treatment up to the second premolars utilizing the SDA concept that included:

- a) Maxillary Restoration: Placement of porcelain-fused-to-metal (PFM) crowns on teeth #11, 12, 21, 22, 24, and 25. Fabrication of a cantilever three unit bridge using tooth #15 as abutment with an occlusal rest on tooth #13. Insertion of

a post and core, followed by placement of a PFM crown on tooth #23.

- b) Mandibular Restoration: Placement of dental implants in the regions of tooth #35 and #45 with PFM crowns in addition to PFM crowns on tooth #34 and #44 followed by the restoration of the lower anterior teeth with composite resin restorations.

Description of Treatment

The patient received oral hygiene instructions on plaque control, scaling and root planing as she had reduced alveolar bone support, and was informed the stabilization of periodontal disease was a prerequisite to proceed with the restorative phase (Figures 4 and 5).

Impressions were taken and both study and working models were made for use in the fabrication of a bite plane and a surgical stent. The patient experienced difficulties of a non-specific nature so the bite planes were fitted and adjusted continuously to help her tolerate them during this phase of treatment. However, they were later discarded.

At the time of surgery, the alveolar ridges were thin in the intended sites of implant placement, so the implants were placed distal to the intended sites in order to avoid possible fenestrations or ridge fractures. Single implants (A 9.5 Ankylos®, Friadent, Germany) were placed in the areas formerly occupied by teeth #35 and 45 using a submerged two-stage protocol (Figures 6 and 7).



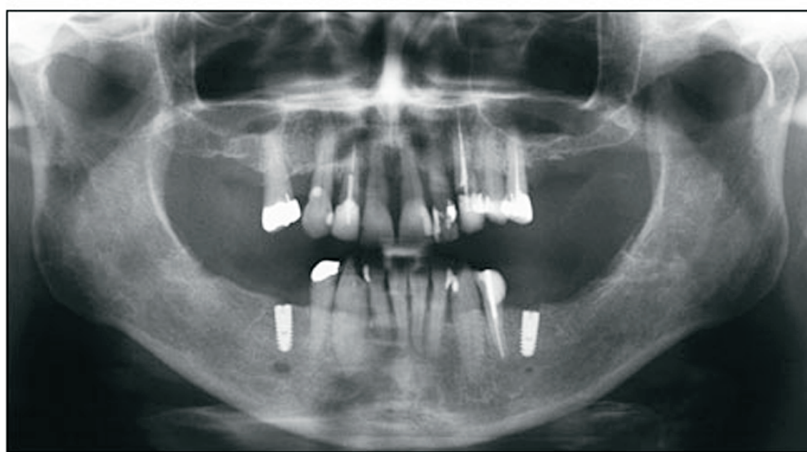
Figure 4. Occlusal view of the maxillary dentition after periodontal therapy.



Figure 5. Occlusal view of the mandibular dentition after periodontal therapy.



Figure 6. Surgical phase of implant placement.



Teeth #34 and 44 were prepared to receive PFM crowns using a labial shoulder and an axial chamfer. Temporary crowns were inserted to maintain the progress of opening the bite of the patient.

During the healing period, the root canal of tooth #23 was prepared to receive a post and core, then a labial shoulder and palatal chamfer was prepared along the cervical margins. An impression was taken with polyvinylsiloxane impression material (PRESIDENT®, Coltene\ Whaledent, Switzerland) and a temporary post was cemented in the canal. A polycarbonate crown was used as a temporary crown after being relined with self cure resin (SNAP®, Parkell Biomaterials, Farmingdale, NY, USA) and cemented on the temporary post.

During the second surgical stage the cover screws were removed and two sulcus formers (A3) were placed. Bone had grown over the implant platforms and bone ditching was necessary to remove the cover screws in order to fit the sulcus formers. Healing was uneventful (Figure 8).

Teeth #11, 12, 15, 21, 22, 24, and 25 were prepared to receive PFM crowns (labial shoulder and axial chamfer), and retraction cords were used for accurate impression taking. The temporary crown on tooth #23 was removed and the custom post and core was cemented with zinc-phosphate cement. The final impression for the upper arch was taken with polyvinylsiloxane impression material (PRESIDENT®, Coltene\ Whaledent, Switzerland) and the impression was sent to the dental laboratory for fabrication of the restorations.

After the healing period, the sulcus formers were removed and standard abutments (3.0 mm - 15°) were screwed in place using 35N of torque for both implants. Periapical radiographs were taken to verify full engagement of both abutments to implant surfaces.

Two transfer caps were positioned on top of the standard abutments, an impression was taken with polyether impression material (Impregum® Penta, 3M ESPE, St. Paul, MN, USA) using the closed tray technique, and the implant analogs were screwed to the impression. The shade was

selected, but the patient insisted on a 'very white' shade although it was not ideal in her case.

Crowns were tried-in for the upper and lower arches, upper teeth were then cemented with glass ionomer cement, and the implant-supported crowns were cemented with temporary cement (TempBond®, Kerr, Romulus, MI, USA). Treatment resulted in improved oral functionality, esthetics, and patient comfort (Figures 9-11).

Discussion

The "SDA" refers to a dentition with loss of posterior teeth.¹ Molars are more prone to be lost



Figure 8. At the second stage surgery, bone was found to have grown above the implants.

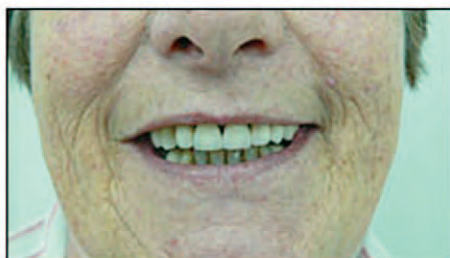


Figure 9. Final restorations were inserted and the bite was opened.



Figure 10. On a sixth month recall visit the patient reported comfort regarding chewing and appearance, and oral health was satisfactory.



Figure 11. A panoramic radiograph taken at the six month recall visit.

by both dental caries and periodontal disease and are considered being the most costly teeth to be preserved.⁵ Although restoration of the dental arches up to the second molars is desirable both by patients and clinicians, it is not always possible for all patients and can be limited by financial constraints or surgical complications.^{3,6} Furthermore, the current accepted level of oral health is the retention of a functional, esthetic, natural dentition of not less than 20 teeth and not requiring recourse to the use of prostheses. SDAs consisting of anterior and premolar teeth generally fulfill the requirements of a functional dentition as demonstrated by the studies done by Käyser et al.³

There is an increasing body of evidence to show restoration of a SDA meets the characteristics of current theories of an acceptable occlusion by terminating the occlusal platform at the second premolar region. It also provides a high standard of care and minimal cost by avoiding restorative treatment for the posterior regions of the mouth.^{3,6} This is beneficial for the potential implant patient since no posterior implants are needed which eliminates both the surgical implant and final restorative procedures, thus, reducing costs.^{3,6}

Research findings¹ indicate masticatory ability is related to the number of teeth, and there is sufficient adaptive capacity by patients to maintain adequate oral function in SDAs provided at least four symmetrically placed occlusal units remain. The masticatory ability starts to deteriorate when the patient has less than 20 well-distributed teeth.

The patient in this report complained about diminished chewing ability after the loss of her posterior teeth and occlusal wear of the remaining teeth making her avoid some types of food. After restoration of the dentition to an acceptable SDA clinical scenario that included the second premolar area, she reported a positive difference in chewing ability, especially on the right side.

Occlusal stability, the correct vertical dimension of occlusion, and the health of the soft and hard tissues including the temporomandibular joint, all are objectives to be met in treating patients with an SDA. In order to achieve these objectives a number of factors should be considered, including periodontal support, the number of teeth in the dental arches, interdental spacing, occlusal contacts, and tooth wear.

Occlusal stability could be achieved only after the stabilization of periodontal health. It has been suggested premolars, that are the most posteriorly located occluding teeth in the dental arch, tend to have a lower relative alveolar bone height than premolars in an intermediate location, and the combination of an existing severe periodontal involvement and a SDA is considered to be an unfavorable situation.¹⁵

Although the patient presented with a reduced alveolar bone level, the teeth showed normal physiologic mobility. Scaling and root planing was necessary in four quadrants. Patient compliance with oral hygiene instructions was satisfactory, and the periodontium was stabilized at the three month recall visit before placing the implants.

Removable dentures were initially inserted to open the bite and were ultimately discarded as the patient did not tolerate them. Temporary crowns were used later to open the bite until placement of the final restorations and to compensate for existing occlusal wear. At the three month and six month recall visits, the periodontal status was stable and no tooth mobility was found. The occlusion was stable and no drifting of teeth was recorded. No complaints of TMJ origin were noted and the tissues were in healthy status. Moreover, the patient reported satisfaction with the treatment in terms of oral comfort, absence of pain or distress, masticatory ability, appearance of the teeth, and the ease of performing daily oral hygiene procedures.

The option of restoration of a SDA is accepted by a great majority of dentists but is not widely practiced. Dentists reported occasional use of the option in <10% of patients, and the outcome

was generally satisfactory.¹¹ Patient needs and demands vary considerably and should be assessed individually. Recognizing ongoing global changes in needs and demand, especially in dental health and economy, and continuing research on the restoration of a SDA will be required to meet these demands.

Summary

A body of evidence in literature showed an arch extending to the second premolars is adequate for normal functional demands, oral hygiene, oral comfort, and possibly reduced costs on a dentition subjected to modern diet.

The reported clinical outcomes of using implant supported crowns till the second premolar area using the concept of restoring only an existing SDA were highly satisfactory for the well-oriented patient.

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