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CASE REPORT

Shortened dental arch as a solution for maxillary sinus proximity in dental implant restoration

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Key Clinical Message

This case report demonstrates the benefit of using the shortened dental arch (SDA) design for a comprehensive implant-supported restoration and the avoidance of the complexities of implant placement near the maxillary sinus. The SDA concept as a treatment option is encouraging in terms of function, patient satisfaction, and cost-effectiveness.

Keywords

Dental implant, edentulous maxilla restoration, short dental arch.

Introduction

Historically, the goal of restorative dental treatment has been to replace all missing teeth, and failure to achieve this goal was believed to produce occlusal instability and temporomandibular joint (TMJ) disorders. This morphologically based approach has been called the "28-tooth syndrome" by Levin [1].

Arnd Käyser was the first to introduce the shortened dental arch (SDA) concept in 1981, and he defined it as a dentition that is missing the majority of the posterior teeth. Käyser drew attention to the lack of the necessity of a complete set of teeth, and the fact that despite missing teeth, patients could achieve satisfactory oral function without long-term complicating sequelae [2].

The 1982 World Health Organization (WHO) oral health goal for developing countries was set as the retention of 20 healthy, functional, aesthetically natural teeth without resorting to a prosthesis, and the findings of SDA research indicate that SDAs conform to this goal [3]. In modern prosthodontic decision-making, the old dogma that lost teeth must always be replaced has shifted to the notion of a minimal acceptable healthy, natural, functioning dentition [3, 4].

The SDA concept has become a favoured treatment option relative to other complex procedures. For example, the use of the SDA concept precludes the need to place implants in risky posterior bone sites adjacent to vital structures [5, 6].

Case Presentation

A 49-year-old male patient presented to our clinic with a chief concern of unsatisfactory dentures and a wish for a fixed restoration to replace his missing teeth, which were lost in a car accident several years previously. The patient was healthy apart from a history of recurrent sinus inflammation. An extraoral examination revealed a senile appearance, and muscle palpation, joint palpation, and range of motion examinations were all normal. An intraoral examination revealed an edentulous maxilla and a partially edentulous mandibular arch with the presence of restored teeth Nos. 35, 33, 44, and 45. Otherwise, the soft tissues were normal, and there was no tenderness on

buccal palpation, no tooth mobility, and no periodontal probing depths >3 mm.

The upper complete denture was poorly adapted to the supporting mucosa, and the lower partial denture exhibited poor retention. However, the dentures were aesthetically and phonetically acceptable with the aid of retention with a denture adhesive.

Preoperative dental panoramic tomography (DPT) revealed a root canal treatment, restorations of the remaining dentition, and a small apical radiolucency in tooth No. 45.

The DPT also revealed unfavorable vertical heights of the maxillary edentulous ridges due to insufficient alveolar bone quantity, particularly in the dorsal parts of the maxilla, with a radiographically enlarged inflamed maxillary sinus (Fig. 1). These findings compromised the possibility of inserting implants in the upper molar regions.

Explanations of all of the possible treatment options were offered to the patient in addition to explanations of the possible complications and financial aspects of the treatments. The patient desired a simple and low-cost approach, and opted for implants in the upper arch only and postponing implants in the lower arch.

Accordingly, the decision was made to utilize the SDA concept in the form of a fixed implant-supported prosthesis in the maxilla and a fixed prosthesis in the mandible.

The treatment plan included scaling, root surface debridement for the lower teeth, and endodontic retreatment of tooth No. 45. The patient was recalled for a primary impression using an irreversible hydrocolloid impression material. A diagnostic cast was fabricated and mounted on a semi-adjustable articulator using a face-bow transfer. The residual ridge relationship was recorded with a bite registration material. The existing upper denture was duplicated and used for the fabrication of a radiographic/surgical stent.

Informed consent was obtained for the surgical procedure. Following aseptic norms and surgical principles, the upper anterior region was anesthetized. A full-thickness mucoperiosteal flap was elevated, and an osteotomy was performed to place 5 XiVe, (Dentsply Implant GmbH, Mannheim, Germany) that were threaded with primary stabilities of >35 Ncm as follows:

The implant dimensions used were as follows:

- No. 14 region (11 × 4.5 mm)
- No. 12 region (15 × 4.5 mm)
- No. 22 region (13 × 4.5 mm)
- No. 23 region (13 × 3.8 mm)
- No. 24 region (8 × 3.8 mm)

Cover screws were tightened into place. A flap was approximated and sutured with 4-0 VICRYL RAPIDE™ (polyglactin 910) suture (Ethicon Inc., Johnson and Johnson Ltd, Somerville, N.J.). The patient was given routine postsurgical instructions and medication, and after 10 days, the patient returned for a follow-up.The implant was left buried without loading.

The patient was examined 4 months after the implant placements, and a DPT radiograph revealed successful osseointegration and stable crestal bone height (Fig. 2).

As advised in the classical Branemark two-stage protocol, the implants were uncovered. The covering screws were removed and replaced with gingival formers to ensure ideal emergence profiles around the future crown abutments. After 2 weeks, the gingival formers were replaced with the transfer copings to transfer the position of the implants exactly and reliably to the master model (Fig. 3).

Concomitantly, at this stage, the lower teeth were prepared to receive a fixed bridge, and upper and lower impressions were subsequently taken. Petroleum jelly was applied to the prepared teeth to fabricate provisional restorations using the indirect–direct technique. After the resin was polymerized, the provisional restorations were completed and cemented.

The impressions were poured to produce the final cast, which was mounted in a semi-adjustable articulator with the help of a face-bow and the interocclusal records, which were made using bite registration paste. The

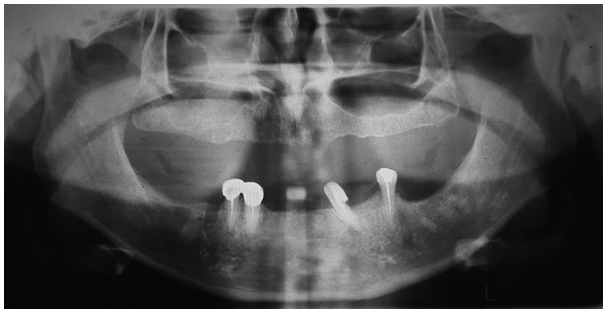

Figure 1. Preoperative DPT radiograph.

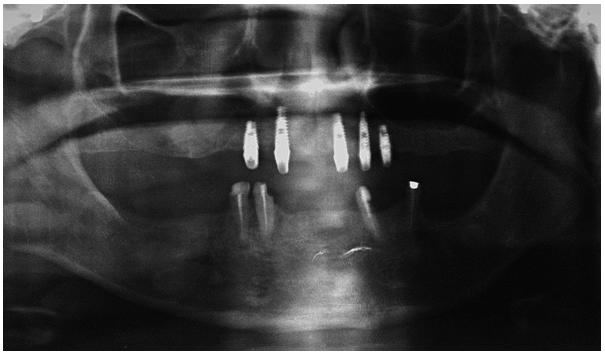

Figure 2. Postoperative 4 months DPT radiograph.

Figure 3. Gingival formers replacement with transfer copings.

implant abutments were attached to the fixtures and prepared to achieve parallelism to receive a porcelain-fused-to-metal (PFM) fixed bridge.

The laboratory-prepared abutments were placed on the implants, and the metal try-in was then performed with special considerations for the adaptation at the margins and the passivity of the fit (Fig. 4A and B).

Finally, the PFM fixed bridges were cemented onto the upper implants and the lower teeth to restore the anterior area to the left second premolar and the right first premolar regions (Fig. 5 A and B). Cement-retained restorations were chosen over the screw-retained because of their low expenses and less complex clinical and laboratory procedures. A post-treatment radiograph was taken for evaluation.

Figure 4. (A) Laboratory-prepared abutments were placed on the implants. (B) Metal try-in in place.

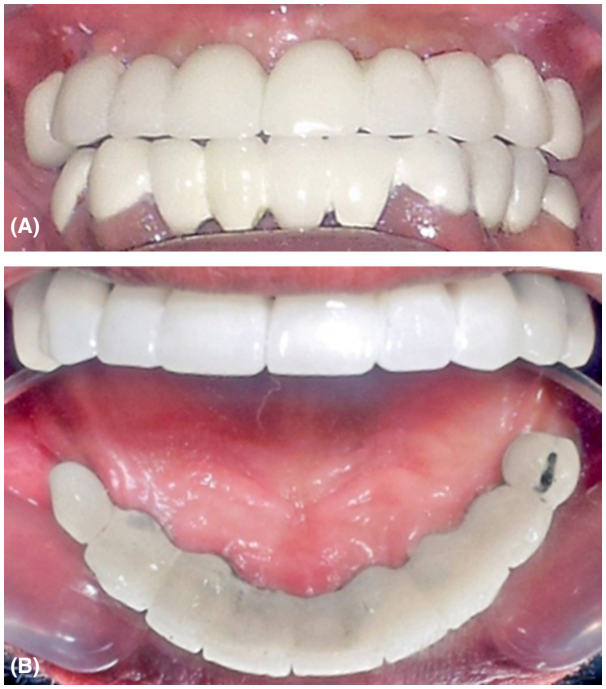

Figure 5. (A) Frontal view of the PFM fixed prosthesis. (B) Occlusal view of the upper PFM fixed implant-supported prosthesis.

The patient exhibited immediate satisfaction and comfort with the prosthesis. The occlusion, oral hygiene, and soft tissue were re-evaluated at 2 weeks and 2 months after delivery. The last recall visit for the patient occurred 3 years after the treatment, and at this time, he expressed complete satisfaction with the treatment outcome (Fig. 6).

Discussion

The shortened dental arch concept does not contradict current occlusion theories and appears to fit well with the problem-solving approach. In some situations, the restoration of the dental arches up to the second molars

Figure 6. Extraoral picture with the patient smile 3 years after.

is limited by either the patient's financial situation or surgical complications, difficulties, and complexities encountered by the clinician [7].

In the maxillary posterior, the proximity of the sinuses can create a problem for dental implants specially, if there is minimal residual crestal bone (<5 mm) for stability. Sinus complications often occurred when the Schneiderian membrane is perforated at time of sinus lifting surgery. Large perforation can cause sinusitis, graft infection, or graft displacement into the sinus, which could compromise new bone formation, implant survival, and the relatively uncommon migration of a dental implant into the maxillary sinus during the graft maturation period caused by masticatory forces [8].

In severely atrophic ridges, where the osteotomy of the sinus wall tends to be placed too far cranially, there is a high possibility of transecting the vessel leading to a bothersome bleeding [9]. Nonetheless, careful planning and precise surgery execution are essential to avoid such complications. The SDA concept is advantageous for plans that do not involve compensating for the loss of the posterior teeth and thus reduces the cost of treatment and the possible hazards of inserting implants in the area of the maxillary sinus [5].

Complex restorations of the molars should only be undertaken in the absence of limiting factors. These limiting factors include a history of poor dental health, particularly in the molars, and financial restrictions [7–10]. Witter suggests limiting the treatment goals to provide SDA when these limiting factors are present because such treatment goals provide suboptimal but acceptable oral function [10].

Käyser et al. suggested the adaptive capacities of patients with shortened dental arches are sufficient when at least four, preferably symmetrically positioned, occlusal units are left. Thus, in the SDA concept, the treatment is directed at preserving the anterior and premolar teeth [11]. Gotfredsen and Walls found that SDAs with a minimum of three occluding units exhibited no signs of occlusal instability, whereas such signs appeared with extremely shortened dental arches that involved fewer than two pairs of occluding premolars [12, 13]. Moreover, Witter et al. observed self-limiting occlusal changes in the SDA patients which resulted in no significant differences with respect to pain, distress, or interdental spacing. Additionally, these authors concluded that SDAs can provide long-term occlusal stability [13]. Although it seems that most people can tolerate and functionally accept a shortened dental arch, this may not be true for others. It has been found that some people with SDAs exhibit either reduced chewing ability or were forced to change their food preparation practices [14].

The SDA concept suggests that the minimum number of occluding pairs of teeth that are required to provide satisfactory levels of oral function may vary according to age and other factors [10]. Elderly people have functional needs that differ from those of younger people and may not require treatment that aims to maintain a complete dentition [15]. Missing teeth are often acceptable and tolerated by many adults. Jepson et al. demonstrated this notion in a study of 300 patients with partial dentures; 40% of these patients did not wear their dentures, and the remaining 60% wore their dentures due to the absence of their anterior teeth [16].

Some studies of SDA patients have revealed neither risks of dysfunction nor adverse effects on the TMJ [16, 17]. Indeed, Watanabe et al. concluded that the TMJ loads during maximum voluntary clenching were less in patients with SDAs than in those with complete dentitions, and the SDAs therefore never caused overloading of the TMJ [17]. Witter et al. conducted a six-year follow-up study related to cranio-mandibular dysfunction (CMD) and SDA and found that a reduction in the number of teeth (with a minimum retention of least three to five occlusal units) was not a risk factor for CMD [18]. According to Kreulen et al., only the complete absence of posterior occlusal support, unilaterally or bilaterally, increases the risk for the development of signs and symptoms associated with temporomandibular dysfunction [19].

Conclusion

The SDA concept represents a compromise between what is healthy/comfortable and pathological/uncomfortable for most middle-aged and elderly people. This concept is relevant for developing countries because it offers a reduced-cost functional approach that does not compromise the patient's oral health care. Moreover, SDA offers a new solution to evade the complexities of implant placement nearby vital structures, as in this case the maxillary sinus.

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Authorship

ASA: wrote the manuscript, analyzed the case, conducted literature review, performed the research, and conducted the patient's surgery and restoration. SBE: analyzed the

case and also corrected a large part of the manuscript (clinical arguments and English language).

Conflict of Interest

None declared.

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