

THEMATIC ABSTRACT REVIEW

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“All-on-Four”: Where Are We Now?

Advances in implant dentistry have allowed the shift from the early paradigms established by the pioneer work of Brånemark and coworkers. While initial healing of 6 months in the maxilla and 3 months in the mandible were recommended, progress in the understanding of biology and technical developments have allowed immediate loading of implants in specific clinical situations. One such situation is represented by the fully edentulous jaw.

Based on a national survey, edentulism rates have shown a tendency to drop from 1999 to 2008. However, with rates varying between 24% for Native Americans and 14% for Hispanics, as reported in 2008, a large proportion of the population still suffers from edentulism.¹ The alveolar atrophy in posterior sites in fully edentulous patients often hinders dental placement without prior technique-sensitive augmentation surgery with potential for increased patient morbidity and complications.

One suggested treatment option to avoid these unfavorable posterior areas is the use of tilted implants to allow for a better anterior-posterior spread of dental implants. This, in turn, favors a better load distribution. This concept, known as “All-on-Four,” was described by Maló and coworkers.² In brief, four (or more) implants are placed in the anterior part of the fully edentulous

jaw. The two most anterior implants are placed axially, and the posterior implants are placed in an angled position to maximize implant length and avoid anatomic structures (ie, mental nerve and anterior border of the maxillary sinus). These implants are loaded immediately with a provisional fixed dental prosthesis.

The present abstract review focuses on the findings of studies published in the course of last year, ie, January 2013 to January 2014.

From a functional standpoint, De Rossi et al (2013) compared the muscle surface electromyography (sEMG) of three different groups including a fully dentate group, a group rehabilitated with maxillary and mandibular All-on-Four, and a group rehabilitated with double complete dentures. The All-on-Four group presented similar contraction patterns of masticatory muscles (masseter and temporalis muscles) as compared to the fully dentate group. Conversely, the muscle activity significantly differed for the denture wearers as compared to the fully dentate and All-on-Four rehabilitated patients. The authors concluded that the All-on-Four may represent a better prosthetic rehabilitation to reestablish a more physiologic masticatory function in fully edentulous patients as compared to traditional removable prostheses.

Babbush et al (2014) retrospectively examined patient-centered outcomes including cost of treatment, length of treatment period, and comfort provided by the ad interim prosthesis in full-arch maxillary and mandibular rehabilitation cases. An All-on-Four group was compared to a historical control group, which encompassed full-arch fixed dental prostheses supported by natural teeth or implants and implant-supported overdentures. The financial analysis demonstrated that the costs were significantly lower using the All-on-Four concept as compared to "conventional" treatment modalities. Similarly, the length of treatment and the comfort provided by the temporary prostheses favored the All-on-Four treatment modality.

Balshi et al (2013) retrospectively analyzed the outcomes of 200 arches (800 implants) treated with the All-on-Four protocol. Implant cumulative and prosthetic survival rates amounted to 97.3% and 99.0%, respectively. Twenty percent (168 implants out of 800) of the implants analyzed had a follow-up of 3 years or more.

Along the same lines, a systematic review by Patzelt et al (2013), including 4,804 implants, demonstrated a mean cumulative implant and prosthesis survival rate at 3 years of $99.0 \pm 1.0\%$ and $99.9 \pm 0.3\%$, respectively. The mean bone loss at 3 years amounted to 1.3 ± 0.4 mm. While the results are very encouraging, the authors reported some limitations of the available evidence:

- Twelve studies out of the 13 included were considered as highly biased.
- Most of the studies included (69%) in the systematic review derived from a limited number of investigators in Italy and Portugal, which, in turn, may limit the generalizability of the findings.
- Measurement methods or marginal bone level changes were very heterogeneous.

- Only 31% of the studies reported a completed follow-up up to 36 months. The vast majority of the studies presented cumulative results with a high attrition rate of the patient population above the 3-year follow-up mark.

Browaeys et al (2014) in a 3-year prospective study reported a survival rate of 100% for both implants and prostheses using computer-guided flapless surgery and the All-on-Four immediate loading protocol. However, the mean bone loss experienced between years 1 and 3 amounted to 0.48 mm. At 3 years, 30% of the implants had lost more than 1.9 mm of bone. Ongoing bone loss was observed in 49.2% of the patients. The authors concluded that further scrutiny is warranted.

Taken together, the All-on-Four concept may be a valuable treatment modality in the treatment of fully edentulous jaws. It may decrease overall treatment time and reestablish adequate function in a cost-effective way. However, the relative paucity of long-term prospective data (5 years and more) and outcomes beyond (cumulative) survival rates should caution prudence, as the incidence of potential technical and biologic complications and their implication on the long term are undetermined.

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2. Maló P, Rangert B, Nobre M. "All-on-Four" immediate-function concept with Brånemark System implants for completely edentulous mandibles: A retrospective clinical study. *Clin Implant Dent Relat Res* 2003;5(suppl 1):2–9.

De Rossi M, Santos CM, Migliorança R, Regalo SC. All on Four® fixed implant support rehabilitation: A masticatory function study. *Clin Implant Dent Relat Res* 2013 Jan 10. [Epub ahead of print]

Fixed implant-supported prostheses according to All-on-Four (Nobel Biocare) principles have become an accepted treatment modality in totally edentulous patients, whereas the functional effect of this therapy is limited. The purpose of this study was to evaluate the muscular function of patients totally rehabilitated with All-on-Four. This study evaluated 63 patients. Twenty-one patients were successfully rehabilitated with maxillary and mandibular All-on-Four (no dropout implants, satisfactory esthetic and function demands prosthesis), 21 patients were dentate, and 21 were rehabilitated with double complete dentures. Electromyography was carried

out during clenching, nonhabitual and habitual chewing, and rest. All values were standardized as a percentage of a maximum voluntary contraction. Data were analyzed by ANOVA to compare groups, and paired *t* test was used for comparison between sides within each group. All groups presented symmetric muscular activity. The All-on-Four and dentate groups had a similar muscles surface electromyography (sEMG) contraction pattern, that is, a higher sEMG activity of masseter than temporalis muscles, differing ($P \leq .05$) from those of the denture group. Not one statistical difference was found between All-on-Four and dentate groups. The muscular function similarity of All-on-Four and dentate patients shows that this treatment concept may be considered as a good option for oral rehabilitation in edentulous patients.

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Babbush CA, Kanawati A, Kotsakis GA, Hinrichs JE. Patient-related and financial outcomes analysis of conventional full-arch rehabilitation versus the All-on-4 Concept: A cohort study. *Implant Dent* 2014 Jan 4. [Epub ahead of print]

Patient-related variables such as cost of treatment, length of the treatment period, and comfort provided by the interim prosthesis when treatment planning for full-arch rehabilitation are often neglected in dental publications. Two patient cohorts were followed up longitudinally in this study: the “All-on-4 treatment concept group” and the “historical group.” The number of implants, total treatment time, number of surgical procedures, number of sinus grafts, necessity for immediate provisional implants, adjusted cost associated for treatment in each group, and the quality of interim prosthesis were compared. The total adjusted cost for patients receiving the All-on-4 treatment concept averaged at \$42,422 ± 3,860 (€31,392 ± 2,856), whereas the mean total adjusted cost for the historical group was \$57,944 ± 20,198 (€42,879 ± 2,113) ($P = .01$). The difference in cost had a mean value of \$7,307 (€5,407) per jaw. Factors associated with complexity of treatment and patient comfort, such as the quality of interim prosthesis, number of surgeries, and duration of treatment time, all significantly favored the All-on-4 treatment concept group in comparison with conventional treatment modalities. When implant rehabilitation of the total jaw is sought, the All-on-4 treatment concept should be considered the least costly and least time-consuming treatment option.

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Balshi TJ, Wolfinger GJ, Slauch RW, Balshi SF. A retrospective analysis of 800 Brånemark System implants following the All-on-Four™ protocol. *J Prosthodont* 2014;23:83–88.

The purpose of this study was to retrospectively evaluate implant survival rates in patients treated with the All-on-Four protocol according to edentulous jaws, gender, and implant orientation (tilted vs axial). All Brånemark System implants placed in patients following the All-on-Four protocol in a single private practice were separated into multiple classifications (maxilla vs mandible; male vs female; tilted vs axial) by retrospective patient chart review. Inclusion criteria consisted of any Brånemark System implant placed with the All-on-Four protocol from the clinical inception (May 2005) until December 2011. Life tables were constructed to determine cumulative implant survival rates (CSR). The arches, genders, and implant orientations were statistically compared with ANOVA. One hundred fifty-two patients, comprising 200 arches (800 implants) from May 2005 until December 2011, were included in the study. Overall implant CSR was 97.3% (778 of 800). Two hundred eighty-nine of 300 maxillary implants and 489 of 500 mandibular implants survived,

for CSRs of 96.3% and 97.8%, respectively. In male patients, 251 of 256 implants (98.1%) remain in function, while 527 of 544 implants (96.9%) in female patients survived. Regarding implant orientation, 389 of 400 tilted implants and 389 of 400 axial implants osseointegrated, for identical CSRs of 97.3%. All comparisons were found to be statistically insignificant. The prosthesis survival rate was 99.0%. The results from this study suggest that edentulous jaws, gender, and implant orientation are not significant parameters when formulating an All-on-Four treatment plan. The high CSRs for each variable analyzed demonstrate the All-on-Four treatment as a viable alternative to more extensive protocols for rehabilitating the edentulous maxilla or mandible.

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Patzelt SB, Bahat O, Reynolds MA, Strub JR. The All-on-Four Treatment Concept: A Systematic Review. *Clin Implant Dent Relat Res* 2013 Apr 5. [Epub ahead of print]

The study aims to evaluate the All-on-Four treatment concept with regard to survival rates (SRs) of oral implants, applied fixed dental prostheses (FDPs), and temporal changes in proximal bone levels. A systematic review of publications in English and German was performed using the electronic bibliographic database MEDLINE, the Cochrane Library, and Google. Hand searches were conducted of the bibliographies of related journals and systematic reviews. The authors performed evaluations of articles independently, as well as data extraction and quality assessment. Data were submitted for the weighted least-squared analysis. Thirteen (487 initially identified) papers met inclusion criteria. A number of 4,804 implants were initially placed, of which 74 failed, with a majority of failures (74%) within the first 12 months. A total of 1,201 prostheses were incorporated within 48 hours after the surgery. The major prosthetic complication was the fracture of the all-acrylic FDP. The mean cumulative SR/SR±(standard deviation) (36 months) of implants and prostheses were 99.0±1.0% and 99.9±0.3%, respectively. The averaged bone loss was 1.3±0.4 mm (36 months). No statistically significant differences were found in outcome measures when comparing maxillary versus mandibular arches and axially versus tilted placed implants. The available data provide promising short-term results for the All-on-Four treatment approach; however, current evidence is limited by the quality of available studies and the paucity of data on long-term clinical outcomes of 5 years or greater. In terms of an evidence-based dentistry, the authors recommend further studies designed as randomized controlled clinical trials and reported according to the CONSORT statement.

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Browaeys H, Dierens M, Ruyffelaert C, Matthijs C, De Bruyn H, Vandeweghe S. Ongoing crestal bone loss around implants subjected to computer-guided flapless surgery and immediate loading using the All-on-4® Concept. Clin Implant Dent Relat Res 2014 Jan 8. [Epub ahead of print]

The All-on-4 concept is widely applied for full-arch rehabilitations, using two tilted and two axially loaded implants in order to overcome anatomical constraints. The aim of this study was to assess the survival and individual success of implants immediately loaded with an All-on-4 full-arch screw-retained prosthetic bridge in fully edentulous mandibles or maxillae over up to 3 years. In total, 20 patients with atrophic jaws (9 maxillae, 11 mandibles) were treated with computer-guided flapless surgery and immediately provided with a provisional bridge. The final prosthesis was delivered after 6 months. In total, 80 TiUnite Brånemark implants were placed. Radiographs were taken after surgery and 1 and 3 years later. A 3-year

survival rate of 100% was seen for all implants, both in lower and in upper jaw. None of the temporary or definite prostheses were lost over the follow-up period of 3 years. After 1 year, the mean bone loss was 1.13mm (SD 0.94; range -0.1 to 3.8), and after 3 years, it was 1.61mm (SD 1.40; range 0 to 5). The mean bone loss between the 1-year and 3-year follow-ups was 0.48mm (SD 0.66; range -1.2 to 3.6). This difference was statistically significant ($P < .001$), indicative of ongoing bone loss. Twenty-six percent of the implants had bone loss above 1.5mm after 1 year, but after 3 years, 30% of the implants had already lost more than 1.9mm. The implant and prosthetic survival was 100%, and patients benefited from the All-on-4 treatment. However, unacceptable ongoing bone loss was seen in 49.2% of the patients; this may be a warning sign for future problems and needs clinical attention. Overloading and surgery-related aspects need to be investigated as potential explanations.

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