# Reduced dental arch: Concepts and updates — Literature review

Isis Carvalho **ENCARNAÇÃO***
Ivan Contreras **MOLINA****
Maria Del Piñal **LUNA*****
Antonio Carlos **CARDOSO******

**Abstract**

**Objective:** To highlight the advantages and disadvantages of the concept of shortened dental arch in the rehabilitation of a dentition with conventional and implant supported prosthesis, expanding treatment options to patients. **Literature review:** The traditional restorative concept makes the dentition a cycle of permanent repair, more than 50% of the restorative treatments consists on the repair of previous restorations. The shortened dental arch has been studied for some time and there is evidence that shows its predictability as an option in dental treatments. **Discussion:** The shortened dental arch is indicated to simplify the treatment plan, but it is important to consider their limitations in young patients that frequently have a high requirement for functionality, in patients with anterior open bite or with occlusal relationship type Class II and III, severe occlusal wear and in patients with bruxism. **Conclusion:** Dental treatment aims to maintain the natural function of the dentition during life, including social and biological functions, such as self-esteem, aesthetics, phonetics, chewing and oral comfort. The philosophy of the shortened dental arch meets all these requirements, expanding treatment options to patients.

**Keywords:** Dental occlusion. Dental implants. Dental arch.

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**Contact address:**

**Isis Carvalho Encarnação**
Universidade Federal De Santa Catarina
R. João Pio Duarte Silva, 180 – Apt 203, Bl A
CEP: 88.037-000 – Florianópolis/SC – Brazil
E-mail: isisencarnacao@hotmail.com

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* Specialist in Implantology, Brazilian Dentistry Association of São Paulo. MSc student in Implantology, Post-Graduate Program in Dentistry, Federal University of Santa Catarina.
** Specialist in Restorative Dentistry, Dental Research Center in Queretaro. MSc in Implantology, Federal University of Santa Catarina.
*** MSc student in Implantology, Federal University of Santa Catarina.
**** PhD in Prosthodontics. Full Professor of Occlusion and of Post-Graduation in Dentistry course, Federal University of Santa Catarina.

## Introduction

All subjects have 32 permanent teeth, except for developmental disorders, but this occlusal system is not stable throughout life and changes may result from both physiological processes and pathologies, such as occlusal wear, caries, periodontal disease and trauma. Despite the preventive and restorative interventions, these changes can accumulate causing a reduction in the number of teeth.[1]

A fundamental problem in the rehabilitation of missing teeth is the decision of how many teeth should be saved, or replaced, to ensure a satisfactory oral function. The preservation of complete dental arches is possible in many patients, but must also take into account the negative factors, such as costs and the actual need to rehabilitate these complete dental arches.[2] Reduced dental arch emerged as treatment option, and it is defined as the dentition with intact anterior region and reduction of the number of occlusal units on the posterior teeth.[3] Occlusal unit are pairs of antagonistic teeth to support occlusion, premolars and molars. A pre-molar occluding with another pre-molar adds 1 occlusal unit, while a molar occluding with another molar adds 2 occlusal units. In reduced dental arch there may be 3-4 occlusal units.

For the rehabilitation of patients with bilateral free extremity, include: Removable partial prostheses, fixed prostheses with cantilever, implant prosthesis and maintenance of dental arch condition which have been proposed 3 decades ago by Kayser. It is extremely important that clinical decisions be based on scientific evidence.

The dogma to replace all missing teeth should be questioned, therefore, the objective of this article is to evidence the advantages and disadvantages of the concept of reduced dental arch in rehabilitation of patients with conventional prosthesis and implant prosthesis, expanding treatment options to the patients.

## Literature review

The rehabilitation of the complete dental arch is a traditional concept and based on the publication in 1969, in which Henry Beyron defines a good occlusion, which will be determinant for dental health, requires a treatment planning which may create the maximum number of bilateral centric contacts.[4] In this philosophy, it was believed the absence of molars was responsible for several problems in the stomatognathic system. For example, as the periodontal collapse, diastema in anteroposterior region; displacement of the condyles, resulting in changes of the position of the mandible with deepening of the bite; overload in ATMs, causing structural changes.

Patients underwent treatment for the replacement of 28 teeth, the called "28-tooth syndrome".[4] This thought was confronted by Kayser in 1981, when the observation of 118 patients allowed him to propose there is sufficient adaptive capacity to maintain oral function in reduced dental arches when at least 4 occlusal units are present, this work was followed by many other experimental and epidemiological studies comparing the advantages, disadvantages and limitations of this philosophy of reduced dental arch.[5] A dentition and healthy occlusion should allow a satisfactory function related to esthetics and mastication; which means the number of teeth may vary and be less than 28; in addition, health of the dentition depends on the adaptive capacity of the patient regarding the individual functional demand.[6]

Traditional recuperative concept place the dentition into a permanent repair cycle, more than 50% of restorative works consist of repairing the previous restorations, especially in molars which are more susceptible to dental diseases.[7] The substitution of missing molar is a common cause of iatrogenic periodontal disease and should be avoided if the esthetic requirements and functional stability may remain satisfactory.[8]

Social impact of dental problems experienced by subjects and relationship of these problems with dental status has been investigated by Cushing, in 1986. He analyzed the function related to food and mastication; the social interaction related to communication and personal and social relationships, and; the self-image related to esthetics. This study questioned 414 subjects between 16 and 60 years of a population of northern England. Patients that had complaints with function had an average of 17 teeth and the group thatdid not report problems with function had an average of 21 teeth. The group with social communication problems had an average of 18 teeth and the group without problems an average of 20 teeth. Conversely, patients with self-image or esthetic problems had an average of 17 teeth and the group with no problems an average of 21 teeth, indicating that a dentition with at least 20 well-distributed teeth meets the functional and social demands of these patients.[9] However, it is important to remember the patient's adaptation to changes in the arch length is a critical point to the success of treatment with reduced dental arch.

In a 6-year longitudinal study on reduced dental arch, Witter showed there is sufficient adaptive capacity to a lasting oral function. The main conclusions of this study are that there is a sufficient oral function and comfort in terms of skill and masticatory and esthetic efficiency, mandibular stability, in other words, the absence of molars was not a risk factor for the development of dysfunctions.[10] In a randomized clinical study comparing two types of treatment, reduced dental arch (106 patients) and replacement of molars to removable partial prosthesis (109 patients), for a period of 3 years, it was found that tooth loss was more frequent than that expected at least in the reduced dental arch group, but the differences between treatments cannot be shown statistically because the 3-year observation period should have been short for these differences to be detected. In order to confirm the current observation if the tooth loss and other clinical parameters are or not related to the type of prosthetic treatment, long-term studies are still required. This enhances the importance of considering patients' preferences in decision making.[11]

One of the biggest criticisms to reduced dental arch is a reduction of masticatory performance. The masticatory ability is a subjective data, the assessment of this ability is measured by interviews asking the patients questions about their masticatory function and it is therefore a patient's subjective data. The masticatory performance is the objective assessment of masticatory function and involves studies which allow measuring the patient's ability in grinding food. The masticatory performance decreases linearly with the area of the masticatory platform, especially with hard foods; while the masticatory ability remains sufficient until the number of occlusal unit is between 3 and 5 units, dropping drastically when less than 3 occlusal units. Therefore, when 4 occlusal units are present and distributed in symmetrical positions on the reduced dental arch, there is adaptive capacity sufficient to supply the number of missing teeth.[12]

Given the concern about the reduction of masticatory performance, studies were conducted to determine whether patients with reduced dental arch were predisposed to digestive problems; Witter found no differences in the assessment for texture of food, preferences and consumption of 16 different foods selected for a group with reduced dental arch and a control group.[13] Another study showed patients increase the mastication time to compensate the absence of molars, in other words, the number of masticatory cycles before swallowing the food increases with the reduction in the number of occlusal units or they swallow large particles or prefer soft foods. The effect of reduced dental arch is quite controversial due to

its importance in food digestion. The modern diet is based mostly on soft foods, and it is accepted there is no need to chew these foods to be digested. Actually, there is a minimum masticatory need required for maximum absorption of food, even the foods most difficult to digest, such as proteins. A masticatory performance of 23% is sufficient for the maximum absorption of most of the food.[14] Furthermore, a study found that a lower masticatory efficiency does not affect the occurrence of gastrointestinal diseases,[15] others state the absence of teeth can cause diet restrictions which can compromise their nutritional status.[16]

In some situations it may occur migration of teeth, for example, tooth extrusion by the absence, for example, antagonistic molars, but we may restrain them by splinting teeth passive to be extruded to the neighboring tooth. This splinting may be performed through amalgam or resin restorations related to the use of steel wire. Another splinting way is through adhesive prosthesis, either in metal or composite resin.[17] Moreover, in the reduced dental arch, there is a higher number of occlusal contacts in anterior teeth. Usually, there are 10 teeth in contact, 6 anterior plus 4 occlusal units. This stability is determined by a number of factors, such as periodontal support, number of teeth in the dental arch and its distribution, interdental spaces, occlusal contacts.

In attempt to find these missing balance, the mobility and migration occur when a tooth or more teeth are missing. According to Witter, this occlusal stability can actually be reduced in the dental arches with up to 2 occlusal units, while the occlusal stability is reported to be optimal in arches with 3 to 4 occlusal units.[18] This suggests that reduced dental arches have  long-term occlusal stability.

Few studies report the prevalence of temporomandibular dysfunction in adults with reduced dental arch. A study of Witter, in 2003, reported no significant differences in the presence of pain, mouth opening, crepitation, when comparing to patients with reduced dental arch with a control group with all the present teeth.[19] There is no evidence the reduced dental arch causes dysfunction, but there is a high incidence of joint sounds when the support for posterior teeth is only unilateral or when no posterior teeth are found, in other words, when there is absence of total or unilateral posterior teeth.[20]

## Discussion

There is no indication the reduced dental arch can cause overload on the temporomandibular joint or teeth, suggesting the neuromuscular system acts efficiently controlling the maximum mastication forces according to occlusal conditions.[21] The traditional treatment of the bilateral posterior edentulous space is a free-end removable partial prosthesis, which often has poor long-term results, in Kennedy Class I patients the side effects of a removable partial prosthesis are highly negative. In those sites which the prosthesis is muco-supported, ridge resorption occurs increasing the mobility and instability of the prosthesis, and, in addition, the discomfort produced by these devices is too high so that many patients fail to use these prostheses, besides the overload to the support teeth. There is no indication that the oral function is improved with the use of removable partial prostheses in patients with reduced dental arch with 3 to 5 occlusal units.[3]

Some patients are able to adapt tothe use of removable prostheses and others will have major difficulty in accepting this treatment. Even the prosthesis meets all the requirements of adaptation, quality, esthetics, the patient may refuse the use of the prosthesis because they subjectively feel uncomfortable, unable to eat and have nausea, thus rejecting this removable prosthesis. It is very important that the surgeon-dentist

can evaluate this patient profile, which often has the case resolved with a choice of reduced dental arch or rehabilitation with implants if the patient does not get used to the reduced dental arch. When it is compared the oral comfort of patient with reduced dental arch versus patients with reduced dental arch and removable partial prosthesis versus patients with complete dental arch, no significant difference in pain or stress is observed, and only 8% of patients with reduced dental arch complained the masticatory ability, 20% of patients with reduced dental arch and removable partial prosthesis were not satisfied with the prosthesis and interrupt the use over the time.[13]

The loss of periodontal support is determined by increasing the probing depth, tooth mobility and the height loss of alveolar bone , in this case, radiographically measured on the distal surface of the premolars. When comparing patients treated with reduced dental arch and patients with removable partial prostheses, the results indicate both have higher mobility in more distal premolars in the arch, but with lower values of alveolar bone loss when they are compared to the control which has complete dental arch. The author credits this to occlusal overload and preexisting periodontal problems. Therefore, periodontal patients also constitute a risk group into the philosophy of the reduced dental arch.[22]

A study performed by dentists in Sweden have found it has affirmative opinions regarding the reduced dental arch concept.[23] The reduced dental arch concept is widely accepted by dentists; however, it is not practiced in the same proportion. Some of them occasionally indicate the treatment, especially in case of impaired patients or with financial restrictions, but only few of them often indicate reduced dental arch. This large discrepancy demonstrates the difficulty in accepting new concepts. There is the economic issue, in some countries the health system reimburses the treatment, so when the dentist leaves to treat a missing tooth no compensation is made.[24] However, based on the point of view of public health, the preservation of complete dental arch is not convenient and economically viable. In 1992, the World Health Organization adopted a goal in which patients with natural functional and esthetic dentition with more than 20 well-distributed teeth do not require rehabilitation treatments.

The treatment options for the rehabilitation of patients with free extremity include a removable partial prosthesis, fixed prosthesis with cantilever and implanto-supported fixed prostheses. In each option we have advantages and disadvantages, removable partial prostheses are known for their negative side effects; however, they can be neutralized with regular maintenance programs performed by the dentist.[25] Fixed partial prosthesis with cantilever are also among the treatment options, indications for the incorporation of cantilever can be due to the increased comfort in mastication and the patients with high esthetic demand.[26,27] In such cases the decision to replace teeth to fixed partial prostheses should be based on balance between benefits to patients and potential risks of treatment.[5,20] The implant prostheses , provided there is anatomic conditions for installation of them, are the most current and conservative treatment option, especially for preserving the complete dental structures (without the need of tooth wears). Furthermore, since the traditional treatment established by Brånemark, Implantology applies the philosophy of reduced dental arch in case of protocol prostheses to reduce the distal extension, reducing the lever arm.[28]

Reduced dental arch is indicated to simplify the treatment planning but it should be considered its limitations in young patients, because they have a high functional requirement, patients with anterior open bite, patients with Class II and III severe occlusal

relationship, severe occlusal wears, and bruxism patients. In these patients, more conservative treatments are the most indicated.[1]

## Conclusion

The objective of dental treatment is to maintain the natural function of the dentition throughout life, including social and biological functions, such as self-esteem, esthetics, phonetics, mastication and oral comfort. The philosophy of reduced dental arch meets all these requirements, expanding treatment options for patients. Certainly, by the advance of Implantology and the patient's requirement or request, the best alternative treatment for a reduced dental arch is the implant prosthesis.

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